NATO STANDARD

AEtP-12.3

NATO IFF TEST REQUIREMENTS – TRANSPONDER PLATFORM INTEGRATION MARK XIIA AND MODE S

Edition A Version 1
SEPTEMBER 2019

NORTH ATLANTIC TREATY ORGANIZATION

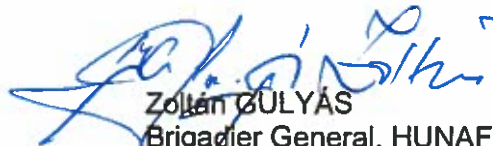**ALLIED ELECTRONIC PUBLICATION**

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NORTH ATLANTIC TREATY ORGANIZATION (NATO)

NATO STANDARDIZATION OFFICE (NSO)

NATO LETTER OF PROMULGATION

26 September 2019

1.	The enclosed Allied Electronic Publication AEtP-12.3, Edition A, Version 1, NATO IFF TEST REQUIREMENTS – TRANSPONDER PLATFORM INTEGRATION MARK XIIA AND MODE S, which has been approved by the nations in the Consultation Command and Control (C3) Board, is promulgated herewith. The recommendation of nations to use this publication is recorded in STANREC 5647.

2.	AEtP-12.3, Edition A, Version 1, is effective upon receipt.

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4.	This publication shall be handled in accordance with C-M(2002)60.

Zoltán GULYÁS
Brigadier General, HUNAF
Director, NATO Standardization Office

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RECORD OF RESERVATIONS

CHAPTER	RECORD OF RESERVATION BY NATIONS

Note: The reservations listed on this page include only those that were recorded at time of promulgation and may not be complete. Refer to the NATO Standardization Document Database for the complete list of existing reservations.

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RECORD OF SPECIFIC RESERVATIONS

[nation]	[detail of reservation]
Note: The reservations listed on this page include only those that were recorded at time of promulgation and may not be complete. Refer to the NATO Standardization Document Database for the complete list of existing reservations.	

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1. GENERAL

1.1. Safety

Coordinate with the local Air Traffic Control (ATC) before performing any testing. Ensure no radiation of false altitudes, Mode 3/A Codes, or emergency. Frequency Authorization must be obtained for all transponders and Identification Friend or Foe (IFF) test equipment.

1.2. Introduction

These test requirements have been prepared by the North Atlantic Treaty Organization (NATO) Identification Friend or Foe (IFF) Capability Team (CaT). The requirements were developed in order to perform installed-level qualification testing for transponders in accordance with STANAG 4193 Edition 3.

1.3. Objective

The purpose of these test requirements is to provide a minimum set of tests to evaluate the installed transponder compliance with the STANAG 4193 Edition 3 specification. Successful completion of these tests provides an acceptable confidence level that this Mark XIIA transponder installation is ready for the operational testing contained within AEtP-12.4, the NATO IFF Test Requirements – Transponder Flight Mark XIIA and Mode S.

1.4. Scope

These test requirements define the system checks required to demonstrate compliance to STANAG 4193 Edition 3 for transponder installations on air and sea-based platforms. The tests are not intended to replace Electromagnetic Environmental Effects (E3) and TEMPEST compliance testing, which are outside the scope of this document. AEtP-12.1, the NATO IFF Test Requirements – Transponder Box Mark XIIA and Mode S, shall be completed prior to platform installation.

1.5. General Guidance

- Unless otherwise directed, Standard Interrogation Signals (SIS) and Standard Sidelobe Interrogation Signals (SSIS) as defined in STANAG 4193 Edition 3 Part I Annex K should be used for all testing.
- Unless otherwise directed, all testing should be conducted with all modes enabled; however, squitters may need to be disabled in order to take accurate measurements.
- Unless otherwise directed, testing may be conducted on either channel.
- When testing using a direct connection, the channel not under test must be connected to a dummy load.
- Flight Line test equipment is allowed for all measurements of power, sensitivity and frequency in this document. The tolerances of the measurement can be adjusted in accordance with the tolerance of the test equipment. Example: If a tolerance is ± 2 dB in the document and the measurement equipment has an accuracy tolerance of ± 2 dB, the tolerance of the measurement for that test can be adjusted to ± 4 dB.

1.6. Equipment List

The tester(s) must provide the information requested in Section 2.

1.7. Information Needed

STANAG 4193 Ed 3: Part I Annex F 2.5.2.4.1; Part I Annex F 2.5.2.5; Part III Annex A 3.2.2.2; Part III Annex A 3.2.2.3. ADS-B and TCAS are not required by STANAG 4193 Edition 3.

Complete the following checklist:

☐ Frequency Authorization for platform

☐ Frequency Authorization for test set(s)

☐ Platform IFF specification (if there are any platform specific IFF requirements)

☐ Dry run data sheets

☐ Software Description Document (SDD) / Version Description Document (VDD) for platform controlling software

☐ IFF system interconnection diagram(s)

☐ Schematic diagram of suppression bus

☐ Platform silhouette with antenna locations

☐ Pictures / diagrams of the IFF control pages

☐ Electromagnetic Environmental Effects (E3) Test Report (The following should be evaluated with the platform on the ground: random replies, sensitivity level, reply percentage)

☐ Schematic diagram of IFF emergency bus (if applicable)

☐ Description of how keys are protected in the event of aircraft loss (if applicable)

☐ If applicable, Traffic Alert and Collision Avoidance System (TCAS) compatibility report. May be satisfied by (1) Performing the tests called out in AC 20-151B section 2-15 paragraphs a and c, OR (2) Performing the tests called out in AC 20-151B section 2-15 paragraphs b and c

☐ If applicable, position latency analysis of Automatic Dependent Surveillance-Broadcast (ADS-B) data (may use AC 20-165B Appendix C as a guide)

☐ If applicable, Mode 5 Figure of Merit (FOM) accuracy analysis. Include how FOM is affected by the velocity of the platform (up to the maximum rated velocity), the turn rate of the platform (up to the maximum rated rate), and degraded GPS reception.

☐ If applicable, ADS-B position source qualification (may use AC 20-165B Appendix B as a guide)

☐ USA Specific Requirement - Type 1 NSA certification/approval of the control link (Mark XIIA Unmanned Aircraft Systems (UAS) transponders only)

☐ If applicable, verification that the source providing the vertical rate has been qualified to have an accuracy as specified in the appropriate TSO (refer to AC 20-165B 3-9) European TSO (ETSO).

☐ If applicable, SDA analysis of any intermediary devices that process/pass ADS-B data including verification that the SDA as transmitted in ADS-B accounts for these intermediary devices

☐ Built-In-Test (BIT) failure codes (if applicable)

☐ Certification test plans / procedures derived from this document (if applicable)

1.8.   List of Acronyms

ADC	Air Data Computer
ADS-B	Automatic Dependent Surveillance-Broadcast
AIMS	ATCRBS IFF Mark XIIA Systems
ATC	Air Traffic Control
ATCRBS	Air Traffic Control Radar Beacon System
DF	Downlink Format
DoD	Department of Defense
E3	Electromagnetic Environmental Effects
EHS	Enhanced Surveillance
ELS	Elementary Surveillance
FOM	Figure of Merit
GPS	Global Positioning System
IBIT	Initiated BIT
ID	Identification
IFF	Identification Friend or Foe
I/P	Identification of Position (sometimes referred to as IDENT)
NO	National Origin
PIN	Platform Identification Number
PO	Program Office
RA	Resolution Advisory
RF	Radio Frequency
SDD	Software Description Document
SIF	Selective Identification Feature
TA	Traffic Advisory
TCAS	Traffic Alert and Collision Avoidance System
TOD	Time of Day
TSO	Technical Standard Order
UA	Unmanned Aircraft
UAS	Unmanned Aircraft System
UF	Uplink Format
UTC	Coordinated Universal Time
VDD	Version Description Document
VSWR	Voltage Standing Wave Ratio

1.9.   References

1) STANAG 4193 Edition 3
    Technical Characteristics of the IFF Mk XIIA System

2) AEtP-12.4
    NATO IFF Test Requirements – Transponder Flight Mark XIIA and Mode S

3) AEtP-12.1
    NATO IFF Tests Requirements - Transponder Box Mark XIIA and Mode S

4) RTCA/DO-181E, EUROCAE/ED 37E
    Minimum Operational Performance Standards for Air Traffic Control Radar Beacon
    System/Mode Select (ATCRBS/MODE S) Airborne Equipment, Minimum Operational
    Performance Specification for Secondary Surveillance Radar Mode S Transponders

5) US FAA Advisory Circular (AC) 20-151B (or equivalent European document)
Airworthiness Approval of Traffic Alert and Collision Avoidance Systems (TCAS II),
Versions 7.0 & 7.1 and Associated Mode S Transponders

6) US FAA Advisory Circular (AC) 20-165B (or equivalent European document)
Airworthiness Approval of Automatic Dependent Surveillance - Broadcast (ADS-B) Out
Systems

7) RTCA/DO-144A (or equivalent European document)
Minimum Operational Performance Standards for Air Traffic Control Radar Beacon System
(ATCRBS) Airborne Equipment

8) ICAO Annex 10 Volume IV
International Standards and Recommended Practices for Aeronautical Telecommunications,
Surveillance and Collision Avoidance Systems

9) Commission Implementing Regulation (EU) No 1207/2011
laying down requirements for the performance and the interoperability of surveillance for the
single European sky (this document is necessary because of some tests related to ELS and
EHS)

1.10. USA Specific Information - Unmanned Aircraft System Transponders

Transponders installed in UAS are not required to operate in all modes.

1.10.1. Civil-Only

Civil-Only UAS transponders do not include Modes 1, 2, 4, or 5 and may not include Modes S and/or ADS-B.
All tests involving modes which are not included in the transponder are not applicable and may be skipped.
Civil-only UAS transponders may be tested using the MOPS included in DO-144( ) or DO-181 ( ) rather than
this document, with the exception of tests included in sections 6.5 and 19 which apply to all civil-only UAS.

1.10.2. Non-Secure Military

Non-secure military UAS transponders do not include Modes 4 or 5, but must include all other modes. All tests
involving modes which are not included in the transponder are not applicable and may be skipped.

2. PLATFORM INFORMATION

2.1. General

Engineer(s) witnessing test _____

Date _____

Platform Type (i.e. DDG, F-15, Eurofighter…) _____

Tail number or other Platform Identifier _____

2.2. Transponder

System nomenclature _____

Model _____

Part number   _____

Serial number   _____

Software version   _____

How many transponders?   _____

How is the switching between transponders controlled?

                                                       _____

2.2.1. Other Transponder(s)

If not the same complete the following information:

System nomenclature   _____

Model   _____

Part number   _____

Serial number   _____

Software version   _____

2.3. Transponder Mount

Part number   _____

Serial number   _____

2.4. Cryptographic Computer

System nomenclature   _____

Part number   _____

Serial number   _____

Version   _____

2.5. Test Set(s)

System nomenclature   _____   _____   _____

Model   _____   _____   _____

Part number   _____   _____   _____

Serial number   _____   _____   _____

Software version   _____   _____   _____

Calibration date   _____   _____   _____

2.6. Mode S

Assigned Mode S Address   _____

Verify that the default address matches the address assigned.   PASS / FAIL

Default Aircraft Identification (ID) (if applicable)   _____

Capability Elementary Surveillance (ELS)   YES / NO

Capability Enhanced Surveillance (EHS)   YES / NO

Automatic Dependent Surveillance-Broadcast (ADS-B)   YES / NO

2.7. Mode 5

Capability   Level 1 / Level 2

Time Source System nomenclature   _____

Model   _____

Part number   _____

Software version   _____

Update rate   _____

Verify that the time source is provided by a secure source   PASS / FAIL

2.8. Position Source(s)

2.8.1. Mode 5 Level 2

System nomenclature   _____

Model   _____

Part number   _____

Software version   _____

Update rate   _____

Uses WGS 84 Earth model   PASS / FAIL

2.8.2. ADS-B (if different and applicable)

System nomenclature   _____

Model   _____

Part number   _____

Software version   _____

Update rate   _____

Uses WGS 84 Earth model   PASS / FAIL

2.9. Antennas

	Top	**Bottom**
Type	_____	_____
Model	_____	_____
Part Number	_____	_____
Cable type used	_____	_____
List any equipment which shares the antenna	_____	_____

2.10. IFF Control Unit

System nomenclature   _____

Model   _____

Part number   _____

Software Version   _____

Bus Control Type   _____

2.11. TCAS (If Applicable)

System nomenclature   _____

Model   _____

Part number   _____

Software Version   _____

2.12. Frequency Assignment

1030 Radio Frequency Assignment Number _____

1090 Radio Frequency Assignment Number _____

3. PRE-TEST INSPECTION

3.1. Display

Ensure there is an unobstructed view of the display(s) from the normal seated position.   PASS / FAIL

Ensure controls for in-flight operation are readily accessible from the normal seated position.

PASS / FAIL

3.2. IFF Control Unit

Check to see that the applicable control panel is mounted securely.   PASS / FAIL

Faceplate and light indicators are not broken or cracked.   PASS / FAIL / NA

Knobs and dials, if any, are free from backlash, binding, and scraping.   PASS / FAIL / NA

Connectors and pins are free of damage.   PASS / FAIL / NA

3.3. Mounting Base

Inspect seating and attachment.   PASS / FAIL

Check for loose or missing hardware.   PASS / FAIL

Transponder hold down nut and bolt assemblies not stripped or damaged.   PASS / FAIL

3.4. Transponder

Transponder fits in mount securely.   PASS / FAIL

Antenna cables have required length to reach the transponder without stress.   PASS / FAIL

Connectors properly installed on coax cables.   PASS / FAIL

Connectors and pins are free of damage.   PASS / FAIL

Hold down brackets not broken or missing on the transponder.   PASS / FAIL

3.5. Antennas and Associated Cables

Check for dents or chips.   PASS / FAIL

Mounting to platform is tight.   PASS / FAIL

List all antennas within 3 ft of the IFF antenna that may cause E3 issues

_____

Check for broken wires.   PASS / FAIL

Check for loose connectors.   PASS / FAIL

Harness is securely clamped to platform frame as required.   PASS / FAIL

Check for binding and scraping.   PASS / FAIL

3.6. USA Specific Requirement - Link 16 Compatibility

Verify that Link 16 emissions received by the transponder are no greater than −90 dBm. (Conducted by analysis).

PASS / FAIL / NA

3.7. Antenna

3.7.1. Antenna Characteristics

STANAG 4193 Ed 3: Part III Annex A 3.2.1.2; Part III Annex A 3.2.1.3; Part III Annex A 3.2.1.8

Using information from the antenna manufacturer:

Verify that the antennas are vertically polarized.   PASS / FAIL

Verify that the antennas are capable of radiating 15 W average power.   PASS / FAIL

Verify that the antennas have a bandwidth of at least 20 MHz at 1030 MHz and 1090 MHz.

PASS / FAIL

3.7.2. Antenna VSWR

STANAG 4193 Ed 3: Part III Annex A 3.2.1.9

Antenna VSWR measurements conducted over the 1000 to 1100 MHz frequency range.

Antenna	Frequency (MHz)	VSWR ($\leq 1.5{:}1$)[1]	Result	Comments
Top	1020		PASS / FAIL	
Top	1030		PASS / FAIL	
Top	1040		PASS / FAIL	
Top	1080		PASS / FAIL	
Top	1090		PASS / FAIL	
Top	1100		PASS / FAIL	
Bottom	1020		PASS / FAIL	
Bottom	1030		PASS / FAIL	
Bottom	1040		PASS / FAIL	
Bottom	1080		PASS / FAIL	
Bottom	1090		PASS / FAIL	
Bottom	1100		PASS / FAIL	

(1) VSWR is allowed to exceed 1.5:1 if precluded by installation limitations. USA allows a VSWR of 2:1.

3.7.3. Antenna Pattern

STANAG 4193 Ed 3: Part III Annex A 3.3.1; Part III Annex A 3.4.1

Inspect the antenna patterns to ensure:

It is essentially omni-directional in the horizontal plane and has a vertical beam width of at least ± 30 degrees from the horizontal plane. PASS / FAIL

Over 360° azimuth within the elevation range ±30°, the total antenna system gain, including system losses, at the receiver input is greater than −4 dBi for 50%, −6 dBi for 80%, and −8.5 dBi for 95% of the coverage volume.
PASS / FAIL

3.7.4. Isolation

STANAG 4193 Ed 3: Part III Annex A 3.2.1.7

Measure the isolation between the antenna transmission lines: _____ ($\geq$ 40 dB)

This can be evaluated by calculating the isolation of each antenna cable along with the closest proximity of the cables. The analysis should be provided via a white paper.

3.8. Differential Delay

STANAG 4193 Ed 3: Part III Annex A 3.2.1.6; Part I Annex A 4.6.1

Note that the following test will need to be verified by analysis / white paper:
White paper/analysis provided YES / NO

This test is NA for non-diversity platforms (note that the USA requires all platforms other than UAS and surface maritime platforms to operate in diversity). Calculate the total two-way transmission difference using the following:

(a)   Top / Bottom box level differential reply delay (from AEtP-12.1): _____ µs

(b)   Transmission time from transponder to top antenna: _____ µs

(c)   Transmission time from transponder to bottom antenna: _____ µs

(d)   Horizontal distance between top and bottom antennas: _____ ft

(a) + 2($|$ [(c) − (b)] $|$) + 2((d) * 0.00102): _____ µs

Verify the total using the equation above is $\leq$ 0.130 µs. PASS / FAIL / NA

3.9. USA Specific Requirement - Radio Frequency Transmission Line Loss

Radio Frequency (RF) transmission insertion line loss measurements at 1030 and 1090 MHz.

Antenna	Frequency (MHz)	Loss ($\leq$ 3 dB)[1]	Result	Comments
Top	1030		PASS / FAIL / NA	
Top	1090		PASS / FAIL / NA	
Bottom	1030		PASS / FAIL / NA	
Bottom	1090		PASS / FAIL / NA	

(1) The loss for UAS may be any value so long as the power into the antenna is at least 52 dBm.

4. ELECTRICAL POWER

4.1. Aircraft

STANAG 4193 Ed 3: Part I Annex A 4.8.1.6; Part I Annex C 4.8.6.1; Part I Annex E 4.8.6.3

Ensure aircraft is safe to apply electrical power. Apply electrical power to aircraft. Ensure the following circuit breakers are engaged:
>Transponder
>IFF Control Unit
>Barometric Altimeter
>Radar Altimeter (TCAS installations) if applicable
>Secure Positioning Navigation and Timing (PNT) source input

Ensure the barometric altimeter and controller are on and operating. Load time of day (if not done automatically). Load Mode 4 and Mode 5 cryptographic keys and codes. Set the transponder to Normal.

On the transponder, run the Initiated Built-In-Test (IBIT)/active test and verify no failures are present.
<div align="right">PASS / FAIL / NA</div>

On the IFF controller, run IBIT/active test and verify no failures are present.   PASS / FAIL

NOTE: Due to the radiation of replies from the transponder, IBIT/active test shall only be initiated once per test.

Verify that IBIT/active test cannot be continuously selected.   PASS / FAIL

If the platform has a requirement for the transponder and/or controller to operate under emergency power, transition aircraft power to emergency power and ensure all applicable systems remain operating.

Asset	State	Pass / Fail
IFF Controller	On / Off	PASS / FAIL / NA
Transponder	On / Off	PASS / FAIL / NA

Transition power from emergency power and ensure all systems are operating.

Asset	State	Pass / Fail
IFF Controller	On / Off	PASS / FAIL / NA
Transponder	On / Off	PASS / FAIL / NA

4.2. Surface Platform

STANAG 4193 Ed 3: Part I Annex A 4.8.1.6; Part I Annex C 4.8.6.1; Part I Annex E 4.8.6.3

Apply applicable electrical power. Ensure the following circuit breakers are engaged:
>Transponder
>IFF Controller
>Secure PNT source: GPS or equivalent navigational input (Mode 5 Level 2 installations)

Load time of day (if not done automatically). Load Mode 4 and Mode 5 cryptographic keys and codes. Set the transponder to Normal.

On the transponder, run IBIT/active test and verify no failures are present.   PASS / FAIL

On the IFF controller, run IBIT/active test and verify no failures are present.   PASS / FAIL

NOTE: Due to the radiation of replies from the transponder, IBIT/active test shall only be initiated once per test.

Verify that IBIT/active test cannot be continuously selected.   PASS / FAIL

5. TRANSPONDER CONTROL VERIFICATION DIRECT CONNECT

5.1. Master Control

STANAG 4193 Ed 3: Part I Annex A, B, C, D, E, F 4.2.2; Part I Annex A 4.8.1.1

Verify that controls are present to put the transponder in the following operational modes: Off, Standby, and Normal. Note that Off might only be controlled via a circuit breaker.

PASS / FAIL

Verify that when the transponder is in the Off condition, it is not powered and does not reply to any interrogations (including lethal).

PASS / FAIL

USA Specific Requirement - Verify that the Off control requires a confirmation or that another means to prevent inadvertent selection is used which has been approved by the AIMS PO.

PASS / FAIL / NA

Interrogate the transponder in Mode 2 with the transponder in Standby. Verify that when the transponder is switched to Normal, it begins replying without a noticeable delay (taking into account that some test sets have a delay before displaying data to the user).

PASS / FAIL

USA Specific Requirement - Ensure the platform is in the ground state. Remove power to the platform for at least 3 minutes. Verify that the transponder starts up in Standby (unless the transponder control is a physical switch or the platform opts to start up in an alternate mode).

Transponder State before Power Loss	Transponder State on Start Up	Expected Transponder State on Start Up	Result
Off			PASS / FAIL / NA
Standby			PASS / FAIL / NA
Normal			PASS / FAIL / NA

5.1.1. USA Specific Requirements - TCAS

The following tests only apply to platforms with a TCAS capability:

Simulate an airborne state, place the transponder in Normal and disable all modes. Select TA. Verify that Modes 3/A, C, and S are automatically enabled.

PASS / FAIL / NA

Simulate an airborne state, place the transponder in Normal and disable all modes. Select TA/RA. Verify that Modes 3/A, C, and S are automatically enabled.

PASS / FAIL / NA

5.2. Mode Status

STANAG 4193 Ed 3: Part I Annex B, C, D, E, F 4.8.2.1; Part I Annex D 4.8.2.4; Part I Annex F 4.8.2.6; Part I Annex F 4.8.2.7

Verify that each mode can be enabled or disabled individually or in any combination (with some exceptions – see below). Note that civil-only UAS transponders are not required to provide mode enables.

Mode	Result
1	PASS / FAIL
2	PASS / FAIL
3/A	PASS / FAIL
S	PASS / FAIL
4	PASS / FAIL
5	PASS / FAIL
ADS-B	PASS / FAIL

(1)ADS-B might not be capable of being enabled without Mode S being enabled (this is the suggested implementation)
(2) ADS-B is not required by STANAG 4193 Edition 3

USA Specific Requirement - Verify that Mode 4 and 5 are defaulted to the enable condition (on the ground only) after a power loss of at least 3 minutes.
    Note: NA only applies if the platform has an operational reason to default to the disabled condition.

PASS / FAIL / NA

USA Specific Requirement - Verify that enabling Mode 3/A also enables Mode C framing brackets.

PASS / FAIL / NA

USA Specific Requirement - Verify that if Mode 3/A is disabled, Mode C framing brackets cannot be enabled.

PASS / FAIL / NA

If the Mode C framing brackets are not tied to the Mode 3/A control, verify that Mode C can be enabled and disabled individually.

PASS / FAIL / NA

Disable Mode 3/A, enable Mode 5, and enable the barometric altitude (may be labelled "Mode C"). Interrogate in Mode 5 Format 2 and verify that barometric altitude is received.

PASS / FAIL

Disable Mode 3/A, enable Mode 5, and disable the barometric altitude (may be labelled "Mode C"). Interrogate in Mode 5 Format 2 and verify that barometric altitude is not received.

PASS / FAIL

USA Specific Requirement - Verify that the Mode 4 control requires a confirmation in order to disable Mode 4 or that another means to prevent inadvertent disabling is used which has been approved by the AIMS PO.

PASS / FAIL / NA

USA Specific Requirement - Verify that the Mode 5 control requires a confirmation in order to disable Mode 5 or that another means to prevent inadvertent disabling is used which has been approved by the AIMS PO.

PASS / FAIL / NA

USA Specific Requirement - Verify that Mode S is enabled automatically when ADS-B is enabled.

PASS / FAIL / NA

USA Specific Requirement - Verify that ADS-B is enabled automatically when Mode S is enabled.

PASS / FAIL / NA

If applicable, enable Mode S and disable ADS-B. Verify that no ADS-B squitters are transmitted. PASS / FAIL

Verify that there is a control to disable Mode 5 Level 2. When configured for Level 1 only operation, verify that Level 2 interrogations result in Level 1 replies and that Level 2 squitters are not transmitted.
   Note: NA only applies to Mode 5 Level 1 only integrations.

PASS / FAIL / NA

USA Specific Requirement - For Mode S EHS platforms, verify that there is a control to disable Mode S EHS.

PASS / FAIL / NA

If there is a control to disable Mode 5 Level 2 squittered reports, verify that the control operates as follows:

Mode 5 Level Control Setting	Mode 5 Squitter Control Setting	Mode 5 Squitters Transmitted?	Expected Mode 5 Squitter Transmissions	Result
1	Disabled		No	PASS / FAIL / NA
1	Enabled		No	PASS / FAIL / NA
2	Disabled		No	PASS / FAIL / NA
2	Enabled		Yes	PASS / FAIL / NA

USA Specific Requirement - Simulate an airborne state and disable all modes. Cycle power on the transponder and verify that all modes are still disabled.

PASS / FAIL / NA

USA Specific Requirement - Ensure the platform is in the ground state. Verify that when Mode S is enabled, Mode 3/A replies are inhibited.

PASS / FAIL / NA

USA Specific Requirement - Disable Mode S. Verify that Mode 3/A can be enabled and disabled.

PASS / FAIL / NA

USA Specific Requirement - Enable Mode S and simulate an airborne state. Verify that Mode 3/A is automatically enabled and properly replies to interrogations.

PASS / FAIL / NA

USA Specific Requirement - Ensure that Mode 5 keys are loaded. Place the transponder in standby and disable all modes. Place the transponder in Normal. Verify that Mode 5 is automatically enabled and all other modes remain disabled.

PASS / FAIL / NA

If there is a control to disable acquisition squitters, enable Mode S and ADS-B (if applicable), and disable acquisition squitters. Verify that no acquisition squitters are transmitted. (Note that an acquisition squitter control is prohibited by USA requirements).

PASS / FAIL / NA

5.3. Codes

5.3.1. Legal and Illegal Entries

STANAG 4193 Ed 3: Part I Annex B 4.8.2.2; Part I Annex E 4.8.2.3; Part I Annex E 4.8.2.4; Part I Annex D 4.8.2.6

On the system make data entries and verify that the expected system code/message is displayed. Note that civil-only and non-secure military UAS transponders are not required to allow the operator to change the Mode S address.

Field	Data Entry / Code	Expected System Code / Message Displayed	Result
Mode 1	2345	2345	PASS / FAIL
Mode 1	7800	Illegal entry or similar	PASS / FAIL
Mode 2	3200	3200	PASS / FAIL
Mode 2	8000	Illegal entry or similar	PASS / FAIL
Mode 3/A	2525	2525	PASS / FAIL
Mode 3/A	8800	Illegal entry or similar	PASS / FAIL
Mode S Address	Default	Default	PASS / FAIL
Mode S Address[1]	00000000	Illegal entry or similar	PASS / FAIL / NA
Mode S Address[1]	77777777	Illegal entry or similar	PASS / FAIL / NA
Mode S Aircraft Identification	Default or ABCDEFG	Default or ABCDEFG	PASS / FAIL
Mode S Aircraft Identification[2]	H3----MX	Illegal entry or similar	PASS / FAIL
Mode S Aircraft Identification[2]	-H3----MX	Illegal entry or similar	PASS / FAIL
Mode 5 Platform Identification Number (PIN)	37777	37777	PASS / FAIL
Mode 5 PIN	40000	Illegal entry or similar	PASS / FAIL
Mode 5 National Origin (NO)	3777	3777	PASS / FAIL
Mode 5 NO	4000	Illegal entry or similar	PASS / FAIL

(1) The requirement to be able to change the Mode S Address is USA Specific.

(2) All alpha/numeric entries are valid. Aircraft Identification may contain 7 or 8 symbols. Spaces are considered symbols, but valid Mode S Aircraft Identifications cannot contain leading or intervening spaces. (-) are representing spaces in the table.

5.3.2. USA Specific Requirements - Codes after Power Loss

Ensure the platform is in the ground state. Remove power to the transponder and transponder control subsystem for at least 3 minutes. Note that turning the transponder off most likely does not remove the power (either pull the transponder circuit breaker or power off the entire platform). Power up the transponder and verify that the Mode 1, Mode 2, Mode 3/A, NO, and PIN codes are retained or revert to a default value. If a default value is used, document the operational reason for the choice.

Code	Code Set Before Power Loss	Code Set After Power Loss	Result
1	1111		PASS / FAIL / NA
2	2222		PASS / FAIL / NA

Code	Code Set Before Power Loss	Code Set After Power Loss	Result
3/A	3333		PASS / FAIL / NA
PIN	12345		PASS / FAIL / NA
NO	3210		PASS / FAIL / NA

Simulate an airborne state. Remove power to the transponder and transponder control subsystem for at least 3 minutes. Power up the transponder and verify that the Mode 1, Mode 2, Mode 3/A, NO, and PIN codes are retained or are easily restored via an onboard system.

Code	Code Set Before Power Loss	Code Set After Power Loss	Result
1	1111		PASS / FAIL / NA
2	2222		PASS / FAIL / NA
3/A	3333		PASS / FAIL / NA
PIN	12345		PASS / FAIL / NA
NO	3210		PASS / FAIL / NA

5.3.3. Partially Updated Data

STANAG 4193 Ed 3: Part I Annex A 4.8

Change the data in each field listed in the table below. Verify that the platform does not transmit a different value until either the entire field has been entered or the operator has confirmed entry in some way.

Field	Result
Mode 1	PASS / FAIL
Mode 2	PASS / FAIL
Mode 3/A	PASS / FAIL
Mode S Address	PASS / FAIL
Mode S Aircraft Identification	PASS / FAIL
Mode 5 PIN	PASS / FAIL
Mode 5 NO	PASS / FAIL

5.3.4. USA Specific Requirements - Default PIN and NO

Verify that the default PIN is stored on the platform.   PASS / FAIL / NA

Verify that the default NO is stored on the platform.   PASS / FAIL / NA

Note: The default PIN and NO may be resident in a piece of hardware (e.g. personality module), non-volatile software code (e.g. lookup table), a fixed cable wiring technique, or some other design. It is also acceptable for the default PIN and NO to be recorded in a permanently resident aircraft log book or via other means that will allow for the manual entry of the default value.

5.4. Time of Day

STANAG 4193 Ed 3: Part I Annex J 2.2

Verify that time is maintained to an accuracy of at least 4 seconds over any designated mission period. Note: If the platform passes all of the USA Specific Requirements in 5.4.1, this test can be marked as passed.

PASS / FAIL

5.4.1. USA Specific Requirements

Verify that Time of Day (TOD) is displayed or an indicator shows that TOD is or is not within tolerance.

<div align="right">PASS / FAIL / NA</div>

If the TOD is controlled by means other than a manual entry override, document the TOD update process.

Verify that there is a way for the operator to manage or control the update of TOD in use by the transponder.

<div align="right">PASS / FAIL / NA</div>

Note that the following tests will likely need to be verified by analysis / white paper:

Verify that when TOD is entered, the time provided is within 2 seconds of Coordinated Universal Time (UTC).

<div align="right">PASS / FAIL / NA</div>

If a maximum initial error other than 2 seconds is assumed, record the value used: _____

Verify that the value sent to the transponder for the initial time error is greater than or equal to the actual time error.

<div align="right">PASS / FAIL / NA</div>

Verify that there is a stale time annunciator.   PASS / FAIL

Describe the type of annunciator used to indicate stale time whenever the system is within 12 hours of the time at which it is no longer guaranteed to achieve 4 second accuracy to UTC.

_____

5.5. USA Specific Requirements - ATC Off (If Applicable)

Enable all modes. Simulate an airborne state. Enable ATC Off and verify the following responses.

Interrogation Mode	Reply when in ATC Off	Result
Mode 3/A	No Reply	PASS / FAIL / NA
Mode C	No Reply	PASS / FAIL / NA
Mode S UF = 0 (Short Air-Air Surveillance)	DF = 0 / DF = 16	PASS / FAIL / NA
Mode S UF = 4 (Surveillance, Alt. Request)	No Reply	PASS / FAIL / NA
Mode S UF = 5 (Surveillance, Identity Request)	No Reply[1]	PASS / FAIL / NA
Mode S UF = 11 (Mode S-Only All-Call)	No Reply	PASS / FAIL / NA
Mode S UF = 16 (Long Air-Air Surveillance)[2]	DF = 0 / DF = 16	PASS / FAIL / NA
Mode S UF = 19 (Military)	Based on 03-1000B paragraph 4.7.18	PASS / FAIL / NA
Mode S UF = 20 (Comm-A, Altitude Request)	No Reply	PASS / FAIL / NA
Mode S UF = 21 (Comm-A, Identity Request)	No Reply[1]	PASS / FAIL / NA
ATCRBS-Only All-Call	No Reply	PASS / FAIL / NA
ATCRBS/Mode S All-Call	No Reply	PASS / FAIL / NA

(1) DF = 5 / DF = 21 replies may be considered on a case by case basis.

(2) UF = 16 is supported by transponders connected to an on-board operational TCAS.

Verify that Mode S Acquisition Squitters are transmitted when in ATC Off.　　　PASS / FAIL / NA

Verify that Mode S Extended Squitters are not transmitted when in ATC Off.　　　PASS / FAIL / NA

5.6. Flight Status

STANAG 4193 Ed 3: Part I Annex A 4.8.1.9; Part I Annex D, E, F 4.8.5.3

Verify that the flight status ("On the Ground" or "Airborne") is determined automatically or that there is a control to select the flight status of the platform.

　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　PASS / FAIL

6. SELECTIVE IDENTIFICATION FEATURE (SIF) DIRECT CONNECT

6.1. Power, Sensitivity, and Frequency

STANAG 4193 Ed 3: Part I Annex B 2.3.1; Part I Annex B 4.2.2; Part I Annex B 4.3.1.1; Part I Annex A 4.5.2.1

Set the transponder to each of the codes in the table. Interrogate the transponder with the test equipment, and record the displayed code, power, sensitivity, and frequency. Dummy load the bottom antenna as required.

Top Antenna					
Mode 1 Code	**Received Code**	**Power 57 ± 2 dBm[1]**	**Sensitivity −77 ± 3 dBm[2]**	**Frequency 1090 ± 0.5 MHz[3]**	
0000					PASS/FAIL
7777					PASS/FAIL

(1) USA allows the power out of a UAS transponder may be as low as 52 dBm.

(2) USA requires the sensitivity to be -76 ± 2 dBm.

(3) USA requires the frequency to be 1090 ± 0.1 MHz.

Repeat for the bottom antenna. Dummy load the top antenna as required.

Bottom Antenna				
Mode 3/A Code	**Received Code**	**Power 57 ± 2 dBm[1]**	**Sensitivity −77 ± 3 dBm[2]**	**Frequency 1090 ± 0.5 MHz[3]**	
1234					PASS/FAIL

(1) USA allows the power out of a UAS transponder may be as low as 52 dBm.

(2) USA requires the sensitivity to be -76 ± 2 dBm.

(3) USA requires the frequency to be 1090 ± 0.1 MHz.

6.2. Identification of Position (I/P)

STANAG 4193 Ed 3: Part I Annex B 4.2.2; Part I Annex A 4.8.1.2; Part I Annex A 4.8.5.4

Note that non-USA surface (maritime) platforms are not required to support I/P.

6.2.1. Method 1

Enable the Identification of Position (I/P) function (generally available on the transponder controller). Interrogate the transponder with the test equipment and record the results in the table.

Mode	Code Set	Code Received	Time 15 -30 seconds[1]	Power 57 ± 2 dBm[2]	I/P Received
1	1111				PASS / FAIL / NA
2	2222				PASS / FAIL / NA
3/A	3333				PASS / FAIL / NA

(1)USA requires the time to be 18 ± 1 seconds.

(2) USA allows the power out of a UAS transponder may be as low as 52 dBm.

Enable I/P again. After 10 seconds, re-enable I/P. Verify that the I/P condition persists for 25 − 40 seconds (28 ± 1 seconds for USA requirements).

PASS / FAIL / NA

USA Specific Requirement - Verify that the I/P control is a momentary activation.   PASS / FAIL / NA

Verify that means are provided to prevent continuous selection of the I/P control.   PASS / FAIL / NA

6.2.2.   Method 2

Complete this section if there is a secondary method for enabling I/P (generally via keying the operator's microphone). Enable the alternate Identification of Position (I/P) function. Interrogate the transponder with the test equipment and record the results in the table.

Mode	Code Set	Code Received	Time 15 -30 seconds[1]	Power 57 ± 2 dBm[2]	I/P Received
1	1111				PASS / FAIL / NA
2	2222				PASS / FAIL / NA
3/A	3333				PASS / FAIL / NA

(1)USA requires the time to be 18 ± 1 seconds.

(2) USA allows the the power out of a UAS transponder may be as low as 52 dBm.

Enable I/P again. After 10 seconds, re-enable I/P. Verify that the I/P condition persists for 25 − 40 seconds (28 ± 1 seconds for USA requirements).

PASS / FAIL / NA

USA Specific Requirement - Verify that the I/P control is a momentary activation.   PASS / FAIL / NA

Verify that means are provided to prevent continuous selection of the I/P control.   PASS / FAIL / NA

6.3. USA Specific Requirements - Diversity

This section is NA for non-diversity UAS transponders and for platforms without a diversity control. Connect test set to top antenna port and connect dummy load to bottom port. Set the platform for bottom antenna only. Immediately interrogate the transponder in Mode 3/A.

Verify no response is received by the test set.   PASS / FAIL / NA

Verify that the transponder returns to diversity operation within 1 minute.   PASS / FAIL / NA

Set the platform for top antenna only. Immediately interrogate the transponder in Mode 3/A.

Verify response is received by the test set.   PASS / FAIL / NA

Connect test set to bottom antenna port and connect dummy load to top port. Set the platform for top antenna only. Immediately interrogate the transponder in Mode C.

Verify no response is received by the test set.   PASS / FAIL / NA

Verify that the transponder returns to diversity operation within 1 minute. PASS / FAIL / NA

Simulate an airborne state. Verify that the antenna selection control requires a confirmation in order to make a selection or that another means to prevent inadvertent selection is used which has been approved by the AIMS PO. Note that preventing antenna selection while airborne is acceptable and is the preferred implementation.

<div align="right">PASS / FAIL / NA</div>

6.4. Mode C Altitude Source

STANAG 4193 Ed 3: Part I Annex A, B 4.8.1.3

Disable the altitude source. Verify that the transponder replies in Mode C with framing pulses only.

<div align="right">PASS / FAIL</div>

Enable the altitude source. Place the altitude control in the "Off" position (Control is often labelled "Mode C"). Verify that the transponder replies in Mode C with framing pulses only.

<div align="right">PASS / FAIL</div>

6.5. X Bit

STANAG 4193 Ed 3: Part I Annex A 4.8.5.5

Verify that either an X bit control is provided or that the X bit is pre-configured to the desired state.

<div align="right">PASS / FAIL</div>

6.5.1. USA Specific Requirements

Ensure the transponder does not radiate an X bit if installed on a non-UAS. PASS / FAIL / NA

UAS only:

Ensure the platform is in the on the ground state. Interrogate the transponder with the X bit enabled and disabled per the following table.

X Bit Control	Mode 1 X Bit Present?	Expected Mode 1 X Bit State	Mode 2 X Bit Present?	Expected Mode 2 X Bit State	Mode 3/A X Bit Present?	Expected Mode 3/A X Bit State	Result
Enabled		Present		Present		Present	PASS / FAIL / NA
Disabled		Present		Present		Not Present	PASS / FAIL / NA

Simulate an airborne state. Interrogate the transponder with the X bit enabled and disabled per the following table.

X Bit Control	Mode 1 X Bit Present?	Expected Mode 1 X Bit State	Mode 2 X Bit Present?	Expected Mode 2 X Bit State	Mode 3/A X Bit Present?	Expected Mode 3/A X Bit State	Result
Enabled		Present		Present		Present	PASS / FAIL / NA
Disabled		Present		Present		Not Present	PASS / FAIL / NA

6.6. No Reply Verification

STANAG 4193 Ed 3: Part I Annex B 4.2.2

On the transponder, verify that all modes are enabled and the transponder is set to standby. Interrogate the transponder with the test set in each mode (1, 2, 3/A, C). Verify that no replies are received for each mode.

Interrogation Mode	No Reply
1	PASS / FAIL
2	PASS / FAIL
3/A	PASS / FAIL
C	PASS / FAIL

USA specific requirement (DoD AIMS 03-1000C 4.9.16.13): run IBIT/active test while running through all modes of interrogation again and verify that no replies are received.

Interrogation Mode	No Reply with IBIT/active test
1	PASS / FAIL / NA
2	PASS / FAIL / NA
3/A	PASS / FAIL / NA
C	PASS / FAIL / NA

7. MODE 4 DIRECT CONNECT

7.1. Mode 4 Power, Frequency, and Sensitivity

STANAG 4193 Ed 3: Part I Annex C 2.3.1; Part I Annex C 4.3.1.1; Part I Annex A 4.5.2.1

Load the test equipment with two Mode 4 keys. Interrogate the transponder with the test equipment and record the displayed power, sensitivity, and frequency.

Antenna	Power 57 ± 2 dBm[1]	Sensitivity −77 ± 3 dBm[2]	Frequency 1090 ± 0.5 MHz[3]
Top			
Bottom			

(1) USA allows the power out of a UAS transponder may be as low as 52 dBm.

(2) USA requires the sensitivity to be -76 ± 2 dBm.

(3) USA requires the frequency to be 1090 ± 0.1 MHz.

7.2. No Reply Verification

STANAG 4193 Ed 3: Part I Annex C 4.2.2

On the transponder, verify that all modes are enabled and the transponder is set to standby. Interrogate the transponder with the test set in Mode 4. Verify that no replies are received.

No Reply	No Reply)
PASS / FAIL	PASS / FAIL

USA specific requirement: run IBIT/active test while interrogating again and verify that no replies are received.

No Reply	No Reply with IBIT/active test
PASS / FAIL	PASS / FAIL

7.3. Reply Indication

STANAG 4193 Ed 3: Part I Annex A 4.8; Part I Annex C 4.8.1.4; Part I Annex A 4.8.3.3

Verify that the Mode 4 reply indicator is enabled. Interrogate the transponder in Mode 4. Verify that the reply indicator is activated.

PASS / FAIL

If there is a Mode 4 reply indicator control, disable the Mode 4 reply indicator. Interrogate the transponder in Mode 4. Verify that the reply indicator is not activated.

PASS / FAIL / NA

Verify that the reply indicator stays on as long as the interrogations continue.   PASS / FAIL

Verify that the Mode 4 reply indication is not combined with a reply indication for any non-secure modes (1, 2, 3/A, C, or S).

PASS / FAIL

USA Specific Requirement - Record how long the reply indicator stays active after interrogations cease:

_____ (3 – 10 seconds)

7.4. Caution and Audio

STANAG 4193 Ed 3: Part I Annex A 4.8; Part I Annex C 4.8.1.4; Part I Annex C 4.8.4.3; Part I Annex C 4.8.4.4

Interrogate the transponder as indicated and record the results in the table below. When interrogating with the incorrect code, use Code B. Note that audio may be provided as an indicator in UAS.

Interrogating Code	Transponder State	Mode 4 State	Audio State	Observed Caution Indicator State	Expected Caution Indicator State	Observed Audio State	Expected Audio State
Correct	Standby	Off	Enabled		On / Off[1]		On / Off[2]
Correct	Standby	On	Enabled		On / Off[3]		On / Off[2]
Correct	Normal	Off	Enabled		On / Off[3]		On / Off[2]
Correct	Normal	On	Enabled		Off		Off
Incorrect	Standby	On	Enabled		Off		On
Incorrect	Standby	On	Disabled[4, 5]		Off		On / Off
Incorrect	Standby	Off	Enabled		Off		On
Incorrect	Normal	On	Enabled		Off		On
Incorrect	Normal	On	Disabled[4, 5]		Off		On / Off
Incorrect	Normal	Off	Enabled		Off		On
Incorrect	Normal	Off	Disabled[4, 5]		Off		On / Off

(1) USA permits the caution indicator to be off in this condition only if the transponder is in Standby, Mode 5 is disabled, and a lethal non-reply indicator is provided.

(2) USA requires the audio to be off in this condition.

(3) STANAG 4193 permits the caution to be Off in this condition, while USA requires it to be on.

(4) USA requires the capability to disable audio, but STANAG 4193 does not.

(5) USA does not require UAS to be able to disable the audio.

Verify that the Mode 4 caution indication cannot be disabled.   PASS / FAIL

Describe the caution indicator including wording, colouring, and location. (If different caution conditions give different indicators, note that as well):

_____
___

_____
___

_____
___

Verify that the caution indication remains on for the duration of the interrogations. It is suggested to test this with the transponder in standby with Mode 4 enabled and interrogate using the correct code (if this condition results in a Caution).

                                                                PASS / FAIL / NA

USA Specific Requirement - Record how long the caution indicator stays active after interrogations cease:

_____ (3 – 10 seconds or until acknowledged by an operator)

USA Specific Requirement - If the platform displays the caution until acknowledged by the operator, interrogate to cause the caution indication to be active and then cease interrogations. Clear the caution indication. Interrogate again and verify that the caution indication is active.

PASS / FAIL / NA

Enable Mode 4. Zeroise the crypto computer. Verify that the Mode 4 caution indicator is enabled.

PASS / FAIL

USA Specific Requirement - Disable Mode 4 with the crypto computer zeroised. Verify that the Mode 4 caution indicator is not enabled.

PASS / FAIL / NA

USA Specific Requirement - Turn off the transponder. Disconnect the crypto computer. Turn on the transponder. Enable Mode 4 if necessary. Verify that the Mode 4 caution indicator is enabled. *(Notes: NA for embedded crypto. NA for installations which do not allow Mode 4 to be enabled with the crypto computer disconnected.*).

PASS / FAIL / NA

7.5. Interrogation Indication

STANAG 4193 Ed 3: Part I Annex A 4.8.3.2

If there is a Mode 4 interrogation indication, verify that it is not combined with an interrogation indication for any non-secure modes (1, 2, 3/A, C, or S). (Note that a Mode 4 interrogation indication is not allowed in USA integrations).

PASS / FAIL / NA

8. MODE 5 DIRECT CONNECT

8.1. Mode 5 Power and Sensitivity

STANAG 4193 Ed 3: Part I Annex A 4.5.2.1; Part I Annex E 4.3.1.1; Part I Annex E 4.3.1.2

Load the test equipment with Mode 5 keys. Interrogate the transponder with the test equipment in Format 2 and record the displayed power and sensitivity.

Antenna	Power 57 ± 2 dBm[1]	Sensitivity −80 to −88 dBm
Top		
Bottom		

(1) USA allows the the power out of a UAS transponder may be as low as 52 dBm.

8.2. Squittered Reports and Figure of Merit

STANAG 4193 Ed 3: Part I Annex F 4.4.3; Part I Annex F 4.5.4.2; Part I Annex F 4.6.2

Do not interrogate the transponder. Record the displayed format and timing of the squitters. Record the FOM. Return the platform to the ground state and record the timing.

Platform State	Antenna	Format	FOM	Time Between Reports	Expected Time Between Reports
Airborne	Top	Hi-Res PIN (0100)			0.9 – 1.1 seconds[1]
Airborne	Bottom	Hi-Res PIN (0100)			0.9 – 1.1 seconds[1]
On Ground	Top	Hi-Res PIN (0100)			0.45 – 0.55 seconds
On Ground	Bottom	NA			No squitters

(1) Time is doubled from the requirement due to squitters being transmitted from both channels.

8.3. I/P

Note that non-USA surface (maritime) platforms are not required to support I/P.

STANAG 4193 Ed 3: Part I Annex A, E, F 4.8.1.2

On the transponder controller, enable the I/P function. Interrogate the transponder with the test equipment and record the results in the table.

Mode 5 Interrogation Format	I/P Bit Set
4	PASS / FAIL / NA
20	PASS / FAIL / NA

8.4. USA Specific Requirements - X Bit

Ensure the transponder does not radiate an X bit if installed on a non-UAS.   PASS / FAIL

UAS ONLY:

Verify that the X bit is present for Modes 5 Level 1 and Level 2 regardless of the setting of the X Bit control.

Mode 5 Interrogation Format	X Bit Control	X Bit Set
1	Enabled	PASS / FAIL
18	Enabled	PASS / FAIL
1	Disabled	PASS / FAIL
18	Disabled	PASS / FAIL

8.5. Altitude Reporting

STANAG 4193 Ed 3: Part I Annex A 4.8.1.3

Place the altitude control in the "Off" position (Control is often labelled "Mode C"). Interrogate with a Format 2. Verify that the barometric altitude is all zeros.

<div align="right">PASS / FAIL</div>

8.6. No Reply Verification

STANAG 4193 Ed 3: Part I Annex E, F 4.2.2

Set the transponder to standby. Interrogate the transponder with the test set in Mode 5. Verify that no replies are received for each format..

Transponder Status	Interrogation Format	No Reply
Mode 5 off; all other modes on	2	PASS / FAIL
	19 (Lethal)	PASS / FAIL
All modes on	1	PASS / FAIL
	17	PASS / FAIL

USA specific requirement (DoD AIMS 03-1000C, 4.9.16.13): run IBIT/active test while running through all modes of interrogation again and verify that no replies are received. Enable squitters while conducting the test

Transponder Status	Interrogation Format	No Reply (with IBIT/active test)
Mode 5 off; all other modes on	2	PASS / FAIL
	19 (Lethal)	PASS / FAIL
All modes on	1	PASS / FAIL

8.7. Lethal Reply Verification

STANAG 4193 Ed 3: Part I Annex E, F 4.2.2

Set the transponder to standby with only Mode 5 enabled. Interrogate the transponder with the test set in Mode 5. Verify that replies are received to lethal interrogations and record the data.

Interrogation Format	Reply
3	PASS / FAIL
19	PASS / FAIL

8.8. Mode 5 Reply Verification Tests

STANAG 4193 Ed 3: Part I Annex F 2.5.2.1; Part I Annex F 2.5.2.2; Part I Annex F 2.5.2.3.1; Part I Annex F 2.5.2.3.2; Part I Annex E 2.5.3.1; Part I Annex E 2.5.3.2; Part I Annex E 2.5.3.3; Part I Annex F 4.2.2; Part I Annex E, F 4.8.2.2

Connect the test equipment to the top antenna port. Ensure that the bottom antenna port is properly loaded. Load the test equipment with Mode 5 keys. Disable all modes except Mode 5. Make sure the altitude is enabled (may be labeled "Mode C"). Interrogate the transponder with the test equipment.

Mode / Data	Input Values
Mode 1	
Mode 2	
Mode 3/A	
Current Mode C	
PIN	
National Origin	
Latitude	
Longitude	
GNSS Altitude	

Interrogation Format	Response Type	Data	Result
1	Data	Mode 1 Code: Mode 2 Code:	PASS / FAIL
2	Data	Mode 3/A Code: Mode C Altitude:	PASS / FAIL
4	Data	PIN: National Origin:	PASS / FAIL
16[1]	PIN Report (0000)	Latitude: Longitude: Altitude: PIN: National Origin:	PASS / FAIL
17[1]	Mode 1/Mode 2 Report (0001)	Latitude: Longitude: Altitude: Mode 1 Code: Mode 2 Code:	PASS / FAIL
18[1]	Mode 3/Altitude Report (0010)	Latitude: Longitude: Altitude: Mode 3/A Code: Baro Altitude:	PASS / FAIL
20[1]	High-Resolution PIN Report (0100)	Latitude: Longitude: Altitude: PIN: FOM:	PASS / FAIL

(1) If the platform is not Mode 5 Level 2 capable it must reply with the corresponding Mode 5 level 1 reply.

8.9. Reply Indication

STANAG 4193 Ed 3: Part I Annex A 4.8; Part I Annex E, F 4.8.1.4; Part I Annex E 4.8.3.2; Part I Annex A 4.8.3.3

Verify that the Mode 5 reply indicator is enabled. Interrogate the transponder in Mode 5 Format 1. Verify that the reply indicator is activated.

PASS / FAIL

Place the transponder in Standby and interrogate in Mode 5 Format 3. Verify that the reply indicator is activated.

PASS / FAIL

If there is a Mode 5 reply indicator control, disable the Mode 5 reply indicator. Interrogate the transponder in Mode 5. Verify that the reply indicator is not activated.

PASS / FAIL / NA

Enable the reply indicator. Verify that the reply indicator stays on as long as the interrogations continue.

PASS / FAIL

Verify that the Mode 5 reply indication is not combined with a reply indication for any non-secure modes (1, 2, 3/A, C, or S).

PASS / FAIL

USA Specific Requirement - Record how long the reply indicator stays active after interrogations cease:

_____ (3 – 10 seconds)

8.10. Caution and Audio

STANAG 4193 Ed 3: Part I Annex A 4.8; Part I Annex E 4.8.1.4; Part I Annex E 4.8.4.4; Part I Annex E 4.8.4.7

Interrogate the transponder with Mode 5 as indicated and record results in table below.

Interrogation Format	Transponder State	Mode 5 State	Observed Caution Indicator State	Expected Caution Indicator State
1	Standby	Off		On / Off[1]
1	Standby	On		On / Off[2]
3	Standby	On		Off
1	Normal	Off		On / Off[3]
3	Normal	Off		On / Off[3]
1	Normal	On		Off

(1) USA permits the caution light to be off in this condition only if a lethal non-reply indicator is provided.

(2) USA requires the caution indicator to be off in this condition.

(3) USA requires the caution indicator to be on in this condition.

USA Specific Requirement - Set the transponder to Normal with Mode 5 disabled and interrogate in Format 1. Verify that the caution indication remains on for the duration of the interrogations.

PASS / FAIL

USA Specific Requirement - Record how long the caution indicator stays active after interrogations cease:

_____ (3 to 10 seconds or until acknowledged by an operator)

USA Specific Requirement - If the platform displays the caution until acknowledged by the operator, interrogate to cause the caution indication to be active and then cease interrogations. Clear the caution indication. Interrogate again and verify that the caution indication is active.

PASS / FAIL / NA

Describe the caution indicator including wording, colouring, and location. (If different caution conditions give different indicators, note that as well):

_____
___

_____
___

Verify that if Mode 5 audio is implemented, its use is limited to indicating the reception of invalid Mode 5 interrogations. (Note that Mode 5 audio is not allowed in USA integrations).

PASS / FAIL / NA

Enable Mode 5. Zeroise the crypto computer. Verify that the Mode 5 caution indicator is enabled.

PASS / FAIL

USA Specific Requirement - Disable Mode 5 with the crypto computer zeroised. Verify that the Mode 5 caution indicator is not enabled.

PASS / FAIL / NA

USA Specific Requirement - Turn off the transponder. Disconnect the crypto computer. Turn on the transponder. Enable Mode 5 if necessary. Verify that the Mode 5 caution indicator is enabled. (_Notes: NA for embedded crypto. NA for installations which do not allow Mode 5 to be enabled with the crypto computer disconnected._).

PASS / FAIL / NA

8.11. USA Specific Requirements - Lethal Indications

8.11.1. Lethal Received

Place the transponder in Normal with all modes enabled. Interrogate with Mode 5 Format 3. Does the platform display an indication when an authenticated lethal interrogation is received?

YES / NO

If present, record the duration of the indication after interrogations cease: _____ ($3 – 10$ seconds)

If present, verify that the indication is not combined with any other indictor. PASS / FAIL / NA

If present, verify that the indication is not displayed as a caution or failure. PASS / FAIL / NA

8.11.2. Lethal Failure to Respond

Place the transponder in Standby with Mode 5 disabled. Interrogate with Mode 5 Format 3. Does the platform display an indication when failing to respond to lethal interrogations?

YES / NO

If present, verify that the indicator cannot be disabled.   PASS / FAIL / NA

8.12. Flight Line Test / Mode 4 Verification Bit 1

STANAG 4193 Ed 3: Part I Annex A 4.9.2; Part I Annex J 3.5; Part I Annex J 4.1.5; Part I Annex J 4.11.3

Note that flight line test is not required, but if it is present, it must be verified. Load the test equipment with Mode 4 and Mode 5 keys. Enable Flight Line Test on the transponder. Set the test set to interrogate with Mode 5 Flight Line Test followed by Mode 4 Verify Bit 1.

	Reply Present
Mode 5 Flight Line Test	PASS / FAIL / NA
Mode 4 Verify Bit 1	PASS / FAIL / NA

Verify that enabling Flight Line Test also enables Mode 4 Verify Bit 1.   PASS / FAIL / NA

Verify that the flight line test control cannot be continuously selected.   PASS / FAIL / NA

8.12.1. USA Specific Requirements

Verify that the platform operates in one of the following ways:

8.12.1.1. Option A

Verify that the transponder operates in Flight Line Test only when the control is manually activated.

PASS / FAIL / NA

Verify that upon release of the Flight Line Test control, the transponder immediately reverts to normal operation.

PASS / FAIL / NA

8.12.1.2. Option B

Ensure the platform is in the ground state. Verify that Flight Line Test is automatically terminated within 5 minutes.

PASS / FAIL / NA

Activate Flight Line Test. Simulate an airborne state. Verify that Flight Line Test is automatically terminated as soon as the platform is in the airborne state.

PASS / FAIL / NA

Simulate an airborne state. Verify that Flight Line Test cannot be enabled.   PASS / FAIL / NA

8.13. Position and Time Data

Note that the following tests will likely need to be verified by analysis / white paper:

Analysis / white paper provided   YES / NO
Verify that the time is provided from a secure source.   PASS / FAIL

If time is provided from a source which can be operated in a secure or a non-secure mode, verify that there are operational procedures in place to ensure that it is operated in a secure mode.

Verify that the Level 2 position data is provided from a secure source.   PASS / FAIL / NA

USA specific requirements:

Verify that if the position data coming to the transponder is no longer secure, the transponder ceases to function in Mode 5 Level 2.   PASS / FAIL / NA

Verify the transponder resumes Mode 5 Level 2 operation automatically if secure position data is available again.   PASS / FAIL / NA

Note: NA applies in case the platforms are not Mode 5 Leve l2 capable

8.14. Interrogation Indication

STANAG 4193 Ed 3: Part I Annex A 4.8.3.2

If there is a Mode 5 interrogation indication, verify that it is not combined with an interrogation indication for any non-secure modes (1, 2, 3/A, C, or S). (Note that a Mode 5 interrogation indication is not allowed in USA integrations, other than for lethal interrogations).

PASS / FAIL / NA

9. MODE S DIRECT CONNECT

9.1. Power, Sensitivity, and Frequency Performance Requirements.

STANAG 4193 Ed 3: Part I Annex A 4.5.2.1; Part I Annex D 4.2.2; Part I Annex D 4.3.1.1; Part I Annex D 4.8.2.1; ICAO Annex 10 Volume IV: 3.1.2.2.1

Interrogate the transponder with the test equipment and record the displayed power, sensitivity, and frequency.

Antenna	UF	Power 57 ± 2 dBm[1]	Sensitivity −77 ± 3 dBm[2]	Frequency 1090 ± 1 MHz	Result
Top	4				PASS / FAIL
Bottom	5				PASS / FAIL

(1) USA allows the power out of a UAS transponder to be as low as 52 dBm.

(2) USA requires the sensitivity to be -76 ± 2 dBm.

9.2. Acquisition Squitter

STANAG 4193 Ed 3: Part I Annex D 4.8.2.1; ICAO Annex 10 Volume IV: 3.1.2.8.5.1, 3.1.2.8.5.2

Verify the acquisition squitter rates under the following conditions.

Platform State	ADS-B State	Antenna	DF=11 Squitter Interval	Expected DF=11 Squitter Interval	Result
Ground	Disabled	Top		0.8 – 1.2 seconds	PASS / FAIL
Ground	Disabled	Bottom		No squitters[1]	PASS / FAIL
Airborne	Disabled	Top		1.6 – 2.4 seconds	PASS / FAIL
Airborne	Disabled	Bottom		1.6 – 2.4 seconds	PASS / FAIL
Ground	Enabled	Top		No squitters	PASS / FAIL
Ground	Enabled	Bottom		No squitters	PASS / FAIL
Airborne	Enabled	Top		1.6 – 2.4 seconds	PASS / FAIL
Airborne	Enabled	Bottom		1.6 – 2.4 seconds	PASS / FAIL

(1) Some squitters may be detected on the bottom antenna at a lower power level due to the transmit isolation.

Enable Mode 3/A and disable Mode S. Verify that there are no DF=11 squitters transmitted.

PASS / FAIL

9.3. USA Specific Requirement - Mode 3/A Off

If Mode 3/A has to be enabled for Mode S to operate, the results are NA for the test. Turn off Mode 3/A and make sure Mode S data is still available in DF=5 and DF=21.

PASS / FAIL / NA

9.4. On Ground / Airborne Verification

STANAG 4193 Ed 3: Part I Annex D 4.3.10.3; Part I Annex D 4.8.2.1; ICAO Annex 10: 3.1.2.4.1.2.2.2, 3.1.2.10.3.10

Simulate an airborne state and the mode enables as instructed in the table. Interrogate the transponder using the top antenna port. Note that replies must be from the indicated mode. No other modes are permitted to reply.

Airborne State	Modes Enabled	Interrogation	Expected Condition	Result
On Ground	S	UF=4	Reply (Mode S)	PASS / FAIL
On Ground	S	UF=11	No Reply	PASS / FAIL
On Ground	S	Mode A/S All-Call	No Reply	PASS / FAIL
On Ground	S	Mode A-Only All-Call	No Reply	PASS / FAIL
Airborne	3/A, S	Mode A/S All-Call	Reply (Mode S)	PASS / FAIL
Airborne	3/A	Mode A/S All-Call	Reply (Mode 3/A)	PASS / FAIL
Airborne	3/A, S	Mode A-Only All-Call	No Reply	PASS / FAIL
Airborne	3/A	Mode A-Only All-Call	Reply (Mode 3/A)	PASS / FAIL
Airborne	3/A	UF=4	No Reply	PASS / FAIL
Airborne	3/A	UF=11	No Reply	PASS / FAIL

9.5. Altitude Control

STANAG 4193 Ed 3: Part I Annex D 2.5.3.4; Part I Annex A, D 4.8.1.3

Place the altitude control in the "Off" position (Control is often labelled "Mode C"). Interrogate with a UF=4. Verify that the AC field is all zeros in both DF=4 and DF=20.

PASS / FAIL

Interrogate with a UF=0. Verify that the AC field is all zeros in DF=0.   PASS / FAIL

9.6. USA Specific Requirements - Default Address and Power Interrupt Test

While the platform is in the ground state, change the Mode S address. Using the test set, confirm the Mode S address has been changed and record the address.

Mode S Address: _____   PASS / FAIL / NA

Cycle power to the aircraft, waiting at least 3 minutes before powering back up. Check the Mode S address to ensure the correct default address has returned and record the address.

Mode S Address: _____   PASS / FAIL / NA

While the platform is in the ground state, change the Mode S address. Using the test set, confirm the Mode S address has been changed and record the address.

Mode S Address: _____   PASS / FAIL / NA

Simulate an airborne state. Cycle power to the transponder and confirm the changed address has been maintained and record the address.

Mode S Address: _____   PASS / FAIL / NA

9.7. No Reply Verification

STANAG 4193 Ed 3: Part I Annex D 4.2.2

On the transponder, verify that all modes are enabled and the transponder is set to standby. Interrogate the transponder with the test set in Mode S UF=4. Verify that no replies are received..

No Reply
PASS / FAIL

USA specific requirement (DoD AIMS 03-1200C, 4.9.16.13): run IBIT while interrogating again and verify that no replies are received

No Reply (with IBIT)
PASS / FAIL

9.8. Reply Data Tests

9.8.1. DF=0 Reply Data

ICAO Annex 10 Volume IV: 3.1.2.8.2

Simulate an airborne state. Interrogate with UF=0, RL=0, AQ=1 using the test set. Record the data in tables below. Note: The RI field value depends on aircraft configuration.

Parameter	Expected	Actual	Result
DF	0		PASS / FAIL
VS	0		PASS / FAIL
RI	(See Below)		PASS / FAIL
Address			PASS / FAIL
AC			PASS / FAIL

If maximum airspeed values are selectable, generate the following RI Codes, then return RI code to the original value recorded.

RI_{16}	RI_{10}	Value	Result
8	8	No maximum airspeed available	PASS / FAIL / NA
9	9	Airspeed ≤ 75 knots	PASS / FAIL / NA
A	10	75 < Airspeed ≤ 150 knots	PASS / FAIL / NA
B	11	150 < Airspeed ≤ 300 knots	PASS / FAIL / NA
C	12	300 < Airspeed ≤ 600 knots	PASS / FAIL / NA
D	13	600 < Airspeed ≤ 1200 knots	PASS / FAIL / NA
E	14	Airspeed > 1200 knots	PASS / FAIL / NA

9.8.2. DF=4 Reply Data

STANAG 4193 Ed 3: Part I Annex A, D 4.8.1.2; ICAO Annex 10 Volume IV: 3.1.2.6.5

Interrogate using UF=4. Record the data in the following table:

Parameter	Expected	Actual	Result
DF	4		PASS / FAIL
DR	00		PASS / FAIL
DR (Flt ID change)	4/5		PASS / FAIL
UM	00		PASS / FAIL
Address			PASS / FAIL
AC			PASS / FAIL

Ensure the platform is in the ground state. Verify FS=1.   PASS / FAIL

Change the Mode 3/A code. Verify FS=3.   PASS / FAIL

Simulate an airborne state. Verify FS=0.   PASS / FAIL

Change the Mode 3/A code. Verify FS=2.   PASS / FAIL

Initiate I/P. Verify FS=5.   PASS / FAIL

Initiate I/P again and immediately change the Mode 3/A code. Verify FS=4.   PASS / FAIL

Change the Aircraft Identification. Verify DR=4 or 5.   PASS / FAIL

9.8.3.   DF=5 Reply Data

ICAO Annex 10 Volume IV: 3.1.2.6.7

Interrogate using UF=5. Record the data in the following table:

Parameter	Expected	Actual	Result
DF	5		PASS / FAIL
DR	00		PASS / FAIL
UM	00		PASS / FAIL
Address			PASS / FAIL
ID (3/A code)			PASS / FAIL

9.8.4.   DF=11 Reply Data

ICAO Annex 10 Volume IV: 3.1.2.5.2.2

Simulate an airborne state. Interrogate using UF=11. Record the data in the following table:

Parameter	Expected	Actual	Result
DF	11		PASS / FAIL
CA	5		PASS / FAIL
Address			PASS / FAIL

9.8.5.   DF=16 Reply Data

ICAO Annex 10 Volume IV: 3.1.2.8.3. If the transponder and/or platform is not TCAS, this test can be skipped.

Simulate an airborne state. Enable TCAS if the aircraft is equipped with it. Interrogate using UF=16. Record the data in the following table:

Parameter	Expected	Actual	Result
DF	16		PASS / FAIL
VS	0		PASS / FAIL
SL			PASS / FAIL
RI			PASS / FAIL
Address			PASS / FAIL
AC			PASS / FAIL

Verify that SL and RI are > 0 for TCAS equipped aircraft.   PASS / FAIL / NA

9.8.6.   DF=20 Reply Data

ICAO Annex 10 Volume IV: 3.1.2.6.6

Simulate an airborne state. Enable TCAS if the aircraft is equipped with it (in order to set the corresponding bits in BDS 1,0). Interrogate using UF=20, requesting BDS 1,0 (use RR=17). Record the data in the following table:

Parameter	Expected	Actual	Result
DF	20		PASS / FAIL
FS	0		PASS / FAIL

Parameter	Expected	Actual	Result
DR	00		PASS / FAIL
UM	00		PASS / FAIL
Address			PASS / FAIL
AC			PASS / FAIL
MB	BDS 1,0		PASS / FAIL

9.8.7. DF=21 Reply Data

ICAO Annex 10 Volume IV: 3.1.2.6.8

Simulate an airborne state. Enable TCAS if the aircraft is equipped with it (in order to set the corresponding bits in BDS 1,0). Interrogate using UF=21, requesting BDS 1,0 (use RR=17). Record the data in the following table:

Parameter	Expected	Actual	Result
DF	21		PASS / FAIL
FS	0		PASS / FAIL
DR	00		PASS / FAIL
UM	00		PASS / FAIL
Address			PASS / FAIL
ID (3/A code)			PASS / FAIL
MB	BDS 1,0		PASS / FAIL

9.9. Mode S Register Tests

STANAG 4193 Ed 3: Part I Annex D 4.8.6.5; Part I Annex D 4.8.6.6

9.9.1. ELS Registers

Record the contents of the following registers. Verify the data contents are in line with the expected values for the platform. (Refer to reference (3) in paragraph 1.9 for data data register definitions). Register 30_{16} is only required for TCAS equipped platforms.

Register	Data noted	Result
10_{16}		PASS / FAIL
17_{16}		PASS / FAIL
18_{16}		PASS / FAIL
19_{16}		PASS / FAIL
$1A_{16}$		PASS / FAIL
$1B_{16}$		PASS / FAIL
$1C_{16}$		PASS / FAIL
20_{16}		PASS / FAIL

Register	Data noted	Result
30_{16}		PASS / FAIL / NA

Parameter	Value	Expected Value	Result
Aircraft Identification			PASS / FAIL

Simulate an airborne state followed by the ground state. Verify that the Aircraft Identification does not change.

PASS / FAIL

9.9.2. EHS Registers

Record the contents of the following registers. Verify the data contents are in line with the expected values for the platform. Note that EHS platforms must also support all ELS registers.

Register	Data noted	Result
40_{16}		PASS / FAIL / NA
50_{16}		PASS / FAIL / NA
60_{16}		PASS / FAIL / NA

Parameter	Value	Expected Value	Result
MCP / FCU Selected Altitude			PASS / FAIL / NA
FMS Selected Altitude[1]			PASS / FAIL / NA
Barometric Pressure Setting			PASS / FAIL / NA
Magnetic Heading			PASS / FAIL / NA

(1) Not required as indicated in Reference (9) in paragraph 1.9 (but if implemented must be evaluated)

9.9.3. Optional Registers

Record the data present in all of the following registers. If any data is present, verify that the data contents are in line with the expected values for the platform. If the BDS is not supported by the platform, the content of this BDS shall be all zeros.

Register	Data noted	Result
07_{16}		PASS / FAIL
$0B_{16}$		PASS / FAIL
$0C_{16}$		PASS / FAIL
$1D_{16}$		PASS / FAIL
$1E_{16}$		PASS / FAIL
$1F_{16}$		PASS / FAIL

Register	Data noted	Result
21_{16}		PASS / FAIL
22_{16}		PASS / FAIL
25_{16}		PASS / FAIL
41_{16}		PASS / FAIL
42_{16}		PASS / FAIL
43_{16}		PASS / FAIL
48_{16}		PASS / FAIL
51_{16}		PASS / FAIL
52_{16}		PASS / FAIL
53_{16}		PASS / FAIL
54_{16}		PASS / FAIL
55_{16}		PASS / FAIL
56_{16}		PASS / FAIL
$5F_{16}$		PASS / FAIL
$E3_{16}$		PASS / FAIL
$E4_{16}$		PASS / FAIL
$E5_{16}$		PASS / FAIL
$E6_{16}$		PASS / FAIL
$E7_{16}$		PASS / FAIL
EA_{16}		PASS / FAIL
$F1_{16}$		PASS / FAIL

Register	Data noted	Result
F2$_{16}$		PASS / FAIL

9.9.4.   USA Specific Requirements - EHS Disabled

Switch the transponder to ELS only mode (also disable ADS-B if applicable). Verify that the following registers are filled with all 0s.

Register	Result
40$_{16}$	PASS / FAIL / NA
50$_{16}$	PASS / FAIL / NA
5F$_{16}$	PASS / FAIL / NA
60$_{16}$	PASS / FAIL / NA

Record the values of the following registers:

Register	Data noted
10$_{16}$	
17$_{16}$	
19$_{16}$	

Record the values of the following bits:

Register	Bit	Recorded Value	Expected Value	Result
10$_{16}$	25		0	PASS / FAIL / NA
17$_{16}$	9		0	PASS / FAIL / NA
17$_{16}$	16		0	PASS / FAIL / NA
17$_{16}$	23		0	PASS / FAIL / NA
17$_{16}$	24		0	PASS / FAIL / NA
19$_{16}$	17		Either	
19$_{16}$	18		Either	
19$_{16}$	33		Either	
19$_{16}$	49		Either	

Re-enable EHS. Record the values of the following registers:

Register	Data noted
10$_{16}$	
17$_{16}$	
19$_{16}$	

Record the values of the following bits:

Register	Bit	Recorded Value	Expected Value	Result
10_{16}	25		1	PASS / FAIL / NA
17_{16}	9		1	PASS / FAIL / NA
17_{16}	16		1	PASS / FAIL / NA
17_{16}	23		1 (if $5F_{16}$ is serviced) 0 (if $5F_{16}$ is not serviced)	PASS / FAIL / NA
17_{16}	24		1	PASS / FAIL / NA
19_{16}	17		1	PASS / FAIL / NA
19_{16}	18		1 (if $5F_{16}$ is serviced) 0 (if $5F_{16}$ is not serviced)	PASS / FAIL / NA
19_{16}	33		1	PASS / FAIL / NA
19_{16}	49		1	PASS / FAIL / NA

9.10. USA Specific Requirements - TCAS Testing (if applicable)

The following guidelines are provided to inform the Test Set operator of typical TCAS testing setup requirements, and may be different dependent on the specific platform. Refer to platform equipment manuals for specific testing requirements.

Simulate an airborne state. Place dummy loads on both antennas. Set radar altimeter to read above 5,000 feet or disable radar altimeter in accordance with platform technical manual (SIF targets will not be correctly displayed if the radar altimeter tells the TCAS the platform is in the ground state). Set the barometric altitude to 20,000 ft with a pitot-static test set. Select "TA/RA" mode on the TCAS control. Enable cockpit audio (to allow TCAS advisories to be heard). Set surveillance range to 20 nmi. Set surveillance altitude to, "Above" (typically a small button on TCAS display unit labeled "A/B"). Select a Resolution Advisory (RA) scenario and ensure the cockpit audio calls out a Traffic Advisory (TA) ("Traffic, Traffic") followed by an RA. The test set providing the scenario must be directly connected to or pointed at the TCAS antenna of the platform.

TCAS Test Results (TA/RA)	
TA Audio Present	PASS / FAIL / NA
RA Audio Present	PASS / FAIL / NA
BDS Register 30_{16} is Correctly Populated and Transmitted	PASS / FAIL / NA
BDS Register 61_{16} (Subtype 2) is Correctly Populated and Transmitted	PASS / FAIL / NA
TCAS RA bit set within ADS-B (Register 65_{16})	PASS / FAIL / NA

Record the values of the following registers:

Register	Data noted
30_{16}	
61_{16} (Subtype 2)	

Repeat the above test in TA mode.

TCAS Test Results (TA)	
TA Audio Present	PASS / FAIL / NA
RA Audio Not Present	PASS / FAIL / NA

TCAS Test Results (TA)	
BDS Register 30_{16} does not report any active RAs	PASS / FAIL / NA
TCAS RA bit not set within ADS-B (Register 65_{16})	PASS / FAIL / NA
TCAS Operational bit not set within ADS-B (Register 65_{16})	PASS / FAIL / NA

10. USA SPECIFIC REQUIREMENTS - ADS-B DIRECT CONNECT

10.1. Accuracy and Integrity

Record the values present for the following items and ensure that they are as expected. If the platform supports any ADS-B registers (ex. 08_{16}), the register contents must be verified using this section even if the data is not squittered.

Performance Parameter	Value	Expected Value	Result
NIC			PASS / FAIL / NA
NAC_p			PASS / FAIL / NA
NAC_v			PASS / FAIL / NA
SIL		3	PASS / FAIL / NA
SDA			PASS / FAIL / NA

Verify that the SDA is ≥ 2.   PASS / FAIL / NA

10.2. Minimum Message Set

10.2.1. Ground

Verify the following data is contained within the ADS-B messages while on the ground. Ground track angle or heading is required. Latitude, longitude, ground track angle, and heading are intended to be qualitative checks (make sure the values are reasonable).

Parameter	BDS Register	Value	Expected Value	Result
Mode S Address	All			PASS / FAIL / NA
Latitude	06_{16}			PASS / FAIL / NA
Longitude	06_{16}			PASS / FAIL / NA
Ground Speed (Movement)	06_{16}			PASS / FAIL / NA
Status for Heading / Ground Track	06_{16}			PASS / FAIL
Heading / Ground Track	06_{16}			PASS / FAIL
Time Synchronization	06_{16}			PASS / FAIL / NA
Emitter Category[1]	08			PASS / FAIL / NA
Call Sign / Flight ID	08			PASS / FAIL / NA

Parameter	BDS Register	Value	Expected Value	Result
Mode A Code	61 (Subtype 1)			PASS / FAIL / NA
Aircraft Length	65_{16} (Subtype 1)			PASS / FAIL / NA
Aircraft Width	65_{16} (Subtype 1)			PASS / FAIL / NA
TCAS Resolution Advisory Active	65_{16} (Subtype 1)			PASS / FAIL / NA
1090 ADS-B In Capability	65_{16} (Subtype 1)			PASS / FAIL / NA
UAT ADS-B In Capability	65_{16} (Subtype 1)			PASS / FAIL / NA
Single Antenna Flag	65_{16} (Subtype 1)			PASS / FAIL / NA
Track Angle / Heading	65_{16} (Subtype 1)			PASS / FAIL
Horizontal Reference Direction	65_{16} (Subtype 1)			PASS / FAIL

(1) Requires knowledge of the Emitter Category Set within the Format Type Code to properly decode. UAS must use the Unmanned Aerial Vehicle emitter category.

Initiate I/P. Verify that the IDENT switch active is set to 1 in register 65_{16} (Subtype 1).　　　　PASS / FAIL

10.2.2.　Airborne

Simulate an airborne state with the TCAS in TA/RA (if applicable) and verify the following data contained within the ADS-B messages. Latitude, longitude, ground track angle, and heading are intended to be qualitative checks (make sure the values are reasonable).

Parameter	BDS Register	Value	Expected Value	Result
Mode S Address	All			PASS / FAIL / NA
Latitude	05_{16}			PASS / FAIL / NA
Longitude	05_{16}			PASS / FAIL / NA
Barometric Altitude	05_{16}			PASS / FAIL / NA
Time Synchronization	05_{16}			PASS / FAIL / NA
Emitter Category[1]	08_{16}			PASS / FAIL / NA
Call Sign / Aircraft Identification	08_{16}			PASS / FAIL / NA
Geometric / Barometric Difference	09_{16}			PASS / FAIL / NA
East–West Velocity	09_{16} (Subtype 1&2)			PASS / FAIL / NA
North–South Velocity	09_{16} (Subtype 1&2)			PASS / FAIL / NA
Mode 3/A Code	61_{16} (Subtype 1)			PASS / FAIL / NA

Parameter	BDS Register	Value	Expected Value	Result
SIL$_{SUPP}$	62$_{16}$ or 65$_{16}$ (Subtype 0)			PASS / FAIL / NA
NIC$_{BARO}$	62$_{16}$ or 65$_{16}$ (Subtype 0)			PASS / FAIL / NA
Version Number	65$_{16}$			PASS / FAIL / NA
TCAS Installed and Operational	62$_{16}$ or 65$_{16}$ (Subtype 0)			PASS / FAIL / NA
TCAS Resolution Advisory Active	65$_{16}$ (Subtype 0)			PASS / FAIL / NA
1090 ADS-B In Capability	65$_{16}$ (Subtype 0)			PASS / FAIL / NA
UAT ADS-B In Capability	65$_{16}$ (Subtype 0)			PASS / FAIL / NA
Single Antenna Flag	65$_{16}$ (Subtype 0)			PASS / FAIL / NA

(1) Requires knowledge of the Emitter Category Set within the Format Type Code to properly decode. UAS must use the Unmanned Aerial Vehicle emitter category.

Initiate I/P. Verify that the IDENT switch active is set to 1 in register 65$_{16}$ (Subtype 0).   PASS / FAIL

10.3. Additional Data

The following data is included within ADS-B, but is not required to be transmitted within the USA. However, the accuracy of any data that is transmitted must be verified.

Parameter	BDS Register	Value	Expected Value	Result
Vertical Rate[1]	09$_{16}$ (Subtype 1&2)			PASS / FAIL / NA
Vertical Rate Source[1]	09$_{16}$ (Subtype 1&2)			PASS / FAIL / NA
Airspeed	09$_{16}$ (Subtype 3&4)			PASS / FAIL / NA
Airborne Heading	09$_{16}$ (Subtype 3&4)			PASS / FAIL / NA
Selected Heading[1]	62$_{16}$			PASS / FAIL / NA
Selected Altitude Type[1]	62$_{16}$			PASS / FAIL / NA
Selected Altitude[1]	62$_{16}$			PASS / FAIL / NA
Barometric Pressure Setting[1]	62$_{16}$			PASS / FAIL / NA
Geometric Vertical Accuracy[1]	65$_{16}$ (Subtype 0)			PASS / FAIL / NA
GNSS Antenna Offset[1]	65$_{16}$ (Subtype 1)			PASS / FAIL / NA

(1) Required for European compliance (see Commission Implementing Regulation (EU) No 1207/2011).

10.4. Altitude Disabled / Failed

Simulate an airborne state. Place the altitude reporting control in the "Off" position (Control is often labeled "Mode C"). Verify that the altitude field is set to all 0s in BDS Register 05$_{16}$.

                                                                              PASS / FAIL

Verify that the NIC level reported is unchanged.   PASS / FAIL

10.5. Latency

Verify the following using the position latency analysis of ADS-B data provided (see paragraph 1.7):

Using information provided by the platform, verify that the total latency for the broadcast of geometric position is less than 2.0 seconds.

PASS / FAIL / NA

Using information provided by the platform, verify that the total uncompensated latency for the broadcast of geometric position is less than 0.6 seconds.

PASS / FAIL / NA

10.6. ADS-B Disabled

Disable ADS-B. Also disable EHS if applicable. Verify that the following registers are filled with all 0s.

Register	Result
05_{16}	PASS / FAIL / NA
06_{16}	PASS / FAIL / NA
07_{16}	PASS / FAIL / NA
08_{16}	PASS / FAIL / NA
09_{16}	PASS / FAIL / NA
$0A_{16}$	PASS / FAIL / NA
61_{16}	PASS / FAIL / NA
62_{16}	PASS / FAIL / NA
65_{16}	PASS / FAIL / NA

Record the values of the following registers:

Register	Data noted
10_{16}	
17_{16}	
18_{16}	
19_{16}	

Record the values of the following bits:

Register	Bits	Recorded Value	Expected Value	Result
10_{16}	25		0	PASS / FAIL / NA
10_{16}	34		0	PASS / FAIL / NA
17_{16}	1-6		All 0s	PASS / FAIL / NA
18_{16}	47-52		Any	
19_{16}	2-16		Any	

Re-enable ADS-B. Record the values of the following registers:

Register	Data noted
10_{16}	
17_{16}	
18_{16}	
19_{16}	

Record the values of the following bits:

Register	Bits	Recorded Value	Expected Value	Result
10_{16}	25		1	PASS / FAIL / NA
10_{16}	34		1	PASS / FAIL / NA
17_{16}	1-6		Not All 0s	PASS / FAIL / NA
18_{16}	47-52		Not All 0s	PASS / FAIL / NA
19_{16}	2-16		Not All 0s	PASS / FAIL / NA

11. ALTITUDE DIRECT CONNECT

11.1. Altitude Accuracy

STANAG 4193 Ed 3: Part I Annex F 2.5.2.4.2; Part I Annex D 2.5.3.4; Part I Annex A 4.8.5.1; ICAO Annex 10 Volume IV: 3.1.1.7.12.2.4, 3.1.2.6.5.4

Use the pitot-static test set to simulate the following altitudes. Aircraft do not need to be tested beyond their maximum operational altitude. Record the results.

Caution: Do not transmit altitudes over the air at any time when testing.

Altitude (ft)	Air Data Test Set Altitude (ft)	Mode C (± 125 ft of Air Data Test Set)	Mode S DF=4 (±125 ft of Air Data Test Set)	ADS-B (±125 ft of Air Data Test Set)	Mode 3/Altitude Report (Use Mode 5 Format 18 Interrogation) (±125 ft of Air Data Test Set)
−1000					
−900					
2300					
2500					
3800					
4300					
4800					
6800					
14800					
19800					
30800					
31000					
62800					

Provide the quantization of the altitude source: _____ ft

Record the Mode S, ADS-B (if applicable), and Mode 5 Level 2 (if applicable) altitude increment size for altitudes below 50,175 ft: _____ ft

Verify that the Mode S, ADS-B (if applicable), and Mode 5 altitude is reported in 25 ft increments if the quantization of the source is 25 ft or less and is reported in 100 ft increments if the quantization of the source is greater than 25 ft.

PASS / FAIL

Change the barometric pressure setting on the pilot's and copilot's altimeters and ensure that the reported altitude does not change.

PASS / FAIL

11.2. Air Data Computer (ADC) Altitude Test (If ADC is present)

STANAG 4193 Ed 3: Part I Annex D 4.1

Set platform to the ground state. Directly connect the test set to transponder antenna port and dummy load the unused antenna port. Run BIT on the Air Data Computer (ADC), disable Mode S, and interrogate the transponder with the test set in Mode C. Record the altitude. Enable Mode S and interrogate transponder with a UF=4 (expected reply DF=4). Ensure altitude is not reported greater than actual altitude, and record the results in the following table.

Mode	Reported Altitude	Result
C		PASS / FAIL / NA
S		PASS / FAIL / NA

12. EMERGENCY DIRECT CONNECT

12.1. Air Traffic Control Emergency Signal (Aircraft Only)

STANAG 4193 Ed 3: Part I Annex B 2.4.2.1.3; Part I Annex B 2.5.2.3; Part I Annex B, D, E, F 4.2.2; Part I Annex A 4.8.1.1; Part I Annex B, C, D, E 4.8.2.1

While testing the transponder emergency function, ensure the transponder emergency signal is not radiated. Interrogate the top antenna and ensure the bottom antenna is properly loaded. Set the Mode 1 code to 7300, the Mode 2 code to 7777, and the Mode 3/A code to 0000. Enable all modes. Enable both military and civil emergency responses. Enable emergency and interrogate the transponder with the test equipment to elicit the replies listed in the following table and record the results. Civil-only UAS transponders may be tested by entering a Mode 3/A code of 7700.

Mode	Expected Response	Result
1	Code 7300 with emergency pulses	PASS / FAIL
2	Code 7777 with emergency pulses	PASS / FAIL
3/A	Code 7700 with emergency pulses	PASS / FAIL
C	Normal	PASS / FAIL
4	Normal	PASS / FAIL
S (UF=5)	DF=5; FS=2 or 3; ID (3/A code)=7700	PASS / FAIL
5 Format 1	Emergency bit set	PASS / FAIL
5 (Squitters) if applicacable	Emergency bit set	PASS / FAIL / NA
ADS-B if applicable	Emergency State field=1; ID (3/A code)=7700 [BDS Register 61_{16} (Subtype 1)]	PASS / FAIL / NA

Disable all modes and set the transponder to Normal. Enable emergency and verify that no responses are received.

Mode	Result
1	PASS / FAIL
2	PASS / FAIL
3/A	PASS / FAIL
C	PASS / FAIL
4	PASS / FAIL
S (UF=5)	PASS / FAIL
5 Level 1	PASS / FAIL
5 (Squitters) if applicable	PASS / FAIL
ADS-B if applicable	PASS / FAIL

Verify that each mode can be enabled and disabled while in emergency. Each mode should respond with the correct response once enabled.

Mode	Expected Response	Result
1	Code 7300 with emergency pulses	PASS / FAIL
2	Code 7777 with emergency pulses	PASS / FAIL
3/A	Code 7700 with emergency pulses	PASS / FAIL
C	Normal	PASS / FAIL
4	Normal	PASS / FAIL
S (UF=5)	DF=5; FS=2 or 3; ID (3/A code)=7700	PASS / FAIL
5 Format 1	Emergency bit set	PASS / FAIL

Mode	Expected Response	Result
5 (Squitters) if applicable	Emergency bit set	PASS / FAIL / NA
ADS-B if applicable	Emergency State field=1; ID (3/A code)=7700 [BDS Register 61_{16} (Subtype 1)]	PASS / FAIL / NA

Disable emergency. Enable all modes and set the Mode 3/A code to 7700. Verify that each mode responds with the correct response. Note that USA platforms do not comply with this requirement.

Mode	Expected Response	Result
1	Code 7300 with emergency pulses	PASS / FAIL
2	Code 7777 with emergency pulses	PASS / FAIL
3/A	Code 7700 with emergency pulses	PASS / FAIL
C	Normal	PASS / FAIL
4	Normal	PASS / FAIL
S (UF=5)	DF=5; FS=2 or 3; ID (3/A code)=7700	PASS / FAIL
5 Format 1	Emergency bit set	PASS / FAIL
5 (Squitters) if applicable	Emergency bit set	PASS / FAIL / NA
ADS-B if applicable	Emergency State field=1; ID (3/A code)=7700 [BDS Register 61_{16} (Subtype 1)]	PASS / FAIL / NA

Verify that the emergency control cannot be inadvertently enabled.   PASS / FAIL

Disable emergency and place the transponder in Normal with all modes enabled. Interrogate the transponder in the modes listed below and verify the transponder does not reply with an emergency condition.

Mode	Expected Response	Result
1	Code 7300	PASS / FAIL
2	Code 7777	PASS / FAIL
3/A	Code 0000	PASS / FAIL
S (UF=5)	DF=5; FS=0 or 1; ID (3/A code)=0000	PASS / FAIL
5 Format 1	Emergency bit not set	PASS / FAIL
5 (Squitters) if applicable	Emergency bit not set	PASS / FAIL / NA
ADS-B if applicable	Emergency State field=0; ID (3/A code)=0000 [BDS Register 61_{16} (Subtype 1)]	PASS / FAIL / NA

USA Specific Requirement – Set the transponder to Off (if applicable). Enable emergency and verify that the transponder turns on.

PASS / FAIL / NA

Disable all modes. Place the transponder in emergency. Enable all modes. Disable emergency. Verify that all modes are enabled.

PASS / FAIL

Enable emergency. Disable all modes. Disable emergency. Verify that all modes are disabled.

PASS / FAIL

12.1.1. Military-Only Emergency (if applicable)

STANAG 4193 Ed 3 Part I Annex A, 4.8.1.10

If the platform has the capability, configure the emergency state for military only. Set the Mode 1 code to 7300, the Mode 2 code to 7777, and the Mode 3/A code to 0000. Enable all modes and set the transponder to Normal. Enable emergency and interrogate the transponder with the test equipment to elicit the replies listed in the following table and record the results.

Mode	Expected Response	Result
1	Code 7300 with emergency pulses	PASS / FAIL / NA
2	Code 7777 with emergency pulses	PASS / FAIL / NA
3/A	Code 0000 with emergency pulses	PASS / FAIL / NA
C	Normal	PASS / FAIL / NA
4	Normal	PASS / FAIL / NA
S (UF=5)	DF=5; FS=0 or 1; ID (3/A code)=0000	PASS / FAIL / NA
5 Level 1	Emergency bit set	PASS / FAIL / NA
5 (Squitters)	Emergency bit set	PASS / FAIL / NA
ADS-B	Emergency State field=0; ID (3/A code)=0000 [BDS Register 61_{16} (Subtype 1)]	PASS / FAIL / NA

12.1.2. Civil -Only Emergency (if applicable)

13. STANAG 4193 Ed 3 Part I Annex A, 4.8.1.10

If the platform has the capability, configure the emergency state for civil only. Set the Mode 1 code to 7300, the Mode 2 code to 7777, and the Mode 3/A code to 0000. Enable all modes and set the transponder to Normal. Enable emergency and interrogate the transponder with the test equipment to elicit the replies listed in the following table and record the results.

Mode	Expected Response	Result
1	Code 7300	PASS / FAIL / NA
2	Code 7777	PASS / FAIL / NA
3/A	Code 7700	PASS / FAIL / NA
C	Normal	PASS / FAIL / NA
4	Normal	PASS / FAIL / NA
S (UF=5)	DF=5; FS=2 or 3; ID (3/A code)=7700	PASS / FAIL / NA
5 Level 1	Emergency bit not set	PASS / FAIL / NA
5 (Squitters)	Emergency bit not set	PASS / FAIL / NA
ADS-B	Emergency State field=1; ID (3/A code)=7700 [BDS Register 61 (Subtype 1)]	PASS / FAIL / NA

12.2 Ejection Seat (if applicable)

STANAG 4193 Ed 3: Part I Annex A 4.2.2, 4.8.5.9

If the platform has the requirement to do so, verify that emergency is automatically enabled if a pilot ejection occurs with the transponder in normal.   PASS / FAIL / NA

If the platform has the requirement to do so, verify that Mode 4 and Mode 5 keys are zeroised upon an ejection.   PASS / FAIL / NA

13. CRYPTO DIRECT CONNECT

13.1. USA Specific Requirements - Key Retention during Power Loss in Air

Simulate an airborne state. Remove power to the platform for at least 3 minutes. Turn the transponder back on and set it to Normal.

Mode 4 and Mode 5 cautions are displayed.   PASS / FAIL / NA

Interrogate the transponder with the test set.

No replies are received in Mode 4 and Mode 5.   PASS / FAIL / NA

If the platform does not drop keys after three minutes, verify that a method of automatic key zeroization is present in the event of aircraft loss.

PASS / FAIL / NA

13.2. Code Hold (Key Hold / Refuel Hold) / Key Retention during Power Loss on Ground

STANAG 4193 Ed 3: Part I Annex A 4.8.1.8

If Code Hold is implemented, verify that the control cannot be continuously selected. Note that USA does not have this requirement.

PASS / FAIL / NA

13.2.1. USA Specific Requirements - Key Hold Implemented

Set the platform to the ground state. Load Mode 4 and Mode 5 keys. Remove power to the platform for at least 3 minutes. Turn the transponder back on and set it to Normal. Interrogate the transponder with the test set.

Mode 4 and Mode 5 replies are received.   PASS / FAIL / NA

Simulate an airborne state. Return the platform to the ground state. Activate Key Hold. Remove power to the transponder for at least 3 minutes. Turn the transponder back on and set it to Normal. Interrogate the transponder with the test set.

Mode 4 and Mode 5 replies are received.   PASS / FAIL / NA

Simulate an airborne state. Return the platform to the ground state. Do not activate Key Hold. Remove power to the transponder for at least 3 minutes. Turn the transponder back on and set it to Normal. Interrogate the transponder with the test set.

Mode 4 and Mode 5 cautions are displayed.   PASS / FAIL / NA

No Mode 4 or Mode 5 replies are received.   PASS / FAIL / NA

13.2.2. USA Specific Requirements - Key Hold Not Implemented

Load Mode 4 and Mode 5 keys. Simulate an airborne state followed by the ground state. Remove power to the transponder for at least 3 minutes. Turn the transponder back on and set it to Normal. Interrogate the transponder with the test set.

Mode 4 and Mode 5 replies are received.   PASS / FAIL / NA

13.3. Code A/B Control

STANAG 4193 Ed 3: Part I Annex J 3.2

Verify that there is a way to initiate Mode 4 key variable changeover at the beginning of each new crypto period. This may be accomplished automatically (preferred) or via a Code A/B control.

PASS / FAIL

13.3.1.   USA Specific Requirements - Code A/B Control Provided

Disable TOD in the transponder. Verify that Code A is selected and interrogate the transponder with Code A from the test set. *(Note: May need to be done by analysis.)*

Verify that Mode 4 replies are received.   PASS / FAIL / NA

Switch both the platform and the test set to Code B.

Verify that Mode 4 replies are received.   PASS / FAIL / NA

13.3.2.   USA Specific Requirement - Code A/B Control Not Provided

Disable TOD in the transponder. Verify that all Mode 4 and Mode 5 TEKs are zeroised. *(Note: May need to be done by analysis).*

PASS / FAIL / NA

13.4. Zeroise

STANAG 4193 Ed 3: Part I Annex A 4.8.1.7

Verify that when the crypto control zeroise function is selected, the cryptocomputer erases at least all red keys.

PASS / FAIL

Verify that the zeroise function cannot be inadvertently selected.   PASS / FAIL

USA Specific Requirement - Verify that the zeroise function is accessible by the operator.

PASS / FAIL / NA

13.5. Non-Secure Mode Only Operation

Zeroise the transponder and remove the crypto (if external). Verify that the transponder continues to operate in the following modes.

Mode	Result
1	PASS / FAIL
2	PASS / FAIL
3/A	PASS / FAIL
C	PASS / FAIL
S	PASS / FAIL
ADS-B	PASS / FAIL

14. SUPPRESSION

STANAG 4193 Ed 3: Part I Annex A 4.8.5.8

For transponders using legacy high voltage interfaces (and all USA platforms), record the impedance to the suppression output of the transponder.

_____ ($\geq$ 300 ohms) (USA allows has a maximum allowance of 2200 ohms)

USA Specific Requirement - Verify that the only systems able to send suppressions to the transponder are the IFF Interrogator, TCAS, Electronic Warfare Systems, and Tactical Air Navigation systems. (Any other system sending suppressions to the transponder must be coordinated with the AIMS (ATCRBS IFF Mark XIIA Systems) PO). Provide a diagram of the suppression bus.

PASS / FAIL

15. BIT / ANTENNA FAILURE

STANAG 4193 Ed 3: Part I Annex B, C, D, E 4.8.1.4; Part I Annex A 4.8.3.7; Part I Annex A 4.9.4

Enable all modes. Disconnect the bottom RF cable from the transponder receiver-transmitter, bottom antenna connector. Leave the bottom antenna disconnected from the transponder receiver-transmitter. Verify a failure indication on the transponder control panel/control display unit. (An IBIT/active test may or may not need to be initiated). (USA requires the failure to specifically call out an antenna failure).

PASS / FAIL

Connect the bottom antenna, then disconnect the top antenna and perform the test above. Verify a failure indication on the transponder control panel/control display unit. (An IBIT/active test may or may not need to be initiated). (USA requires the failure to specifically call out an antenna failure).

PASS / FAIL

Verify that any BIT indicator cannot be disabled.　　　　　　　　　　　　　　PASS / FAIL

NOTE: Due to the possible radiation of replies from the transponder, IBIT/active test shall only be initiated once per test.

USA Specific Requirement - Verify that the platform does not run IBIT/active test without operator initiation (other than potentially at start up).

PASS / FAIL / NA

16. OPERATIONAL STATE CHANGE

STANAG 4193 Ed 3: Part I Annex A 4.9.3

Pull the transponder circuit breaker. Verify that the operator is informed that the transponder is unavailable.

PASS / FAIL

17. SURFACE (MARITIME) PLATFORM DIRECT CONNECT

STANAG 4193 Ed 3: Part I Annex A 2.3.3

Interrogate the transponder in Mode C. Verify that the transponder replies with an altitude of −1000 ft or does not reply (option only applies to non-USA platforms).

PASS / FAIL

Interrogate the transponder in Mode 5 Format 2. Verify that the transponder replies with an altitude of −1000 ft.

PASS / FAIL

USA Specific Requirement - Interrogate the transponder with a Mode S all-call. Verify that the transponder does not reply.

PASS / FAIL / NA

USA Specific Requirement - Verify that there are no Mode S squitters present.   PASS / FAIL / NA

USA Specific Requirement - Interrogate the transponder with TCAS II UF=0 interrogations. Verify that no replies are sent.

PASS / FAIL / NA

18. RADIATED TESTING

18.1. Mode 2

STANAG 4193 Ed 3: Part I Annex B 2.3.1; Part I Annex B 4.3.1.1

Enable Mode 2 only. Interrogate the top and bottom antennas in Mode 2.

Antenna	Power 51 to 59 dBm[1]	Sensitivity −70 to −80 dBm[2]	Frequency 1090 ± 0.5 MHz[3]	Percent Reply ≥ 99%	Result
Top					PASS / FAIL
Bottom					PASS / FAIL

(1) Calculation based on the required transponder power along with the recommendation to limit signal path loss to 4 dB. USA requires the power to be 52 to 59 dBm.

(2) Calculation based on the required transponder sensitivity along with the recommendation to limit signal path loss to 4 dB. USA requires the sensitivity to be −71 to −78 dBm.

(3) USA requires the frequency to be 1090 ± 0.1 MHz.

18.2. Mode 5

STANAG 4193 Ed 3: Part I Annex E 4.3.1.1; Part I Annex E 4.3.1.2

Enable Mode 5 only. Interrogate the top antenna with the test equipment. (If the test set cannot properly measure power and sensitivity using Level 2 reports, disable Level 2 on the platform to force Level 1 responses to the Format 18 interrogations).

Antenna	Format	Power 51 to 59 dBm[1]	Sensitivity −76 to −88 dBm[2]	Percent Reply ≥ 99%	Result
Top	4				PASS / FAIL
Bottom	18				PASS / FAIL

(1) Calculation based on the required transponder power along with the recommendation to limit signal path loss to 4 dB. USA requires the power to be 52 to 59 dBm.

(2) Calculation based on the required transponder sensitivity along with the recommendation to limit signal path loss to 4 dB. USA requires the sensitivity to be −77 to −88 dBm.

19. USA SPECIFIC REQUIREMENTS - UAS DIRECT CONNECT

19.1. Control Link Failure

Enable all modes. Simulate a control link failure. Interrogate the transponder and record the Mode 3/A code:

_____

Verify that the reported Mode 3/A code matches the preset lost link code.   PASS / FAIL / NA

Verify that all modes are enabled.   PASS / FAIL / NA

Disable all modes. Simulate a control link failure. Verify that all modes remain disabled. (Note that civil-only UAS do not require the ability to disable modes).

PASS / FAIL / NA

Verify that the IFF crypto is zeroised upon or prior to a landing when a control link failure condition exists. (If the platform zeroises the crypto prior to a landing, provide documentation on how this is accomplished).

PASS / FAIL / NA

19.2. Loss of Controlled Flight

Set the Mode 1 code to 7300, the Mode 2 code to 7777, and the Mode 3/A code to 0000. Enable all modes. Simulate a condition where the Unmanned Aircraft (UA) has detected a failure or condition that prevents safe and controlled flight. Verify that the transponder has been automatically set to the emergency state using the following table.

Mode	Expected Response	Result
1	Code 7300 with emergency pulses	PASS / FAIL / NA
2	Code 7777 with emergency pulses	PASS / FAIL / NA
3/A	Code 7700 with emergency pulses	PASS / FAIL / NA
C	Normal	PASS / FAIL / NA
4	Normal	PASS / FAIL / NA
S (UF=5)	DF=5; FS=2 or 3; ID (3/A code)=7700	PASS / FAIL / NA
5 Format 1	Emergency bit set	PASS / FAIL / NA
5 (Squitters)	Emergency bit set	PASS / FAIL / NA
ADS-B	Emergency State field=1; ID (3/A code)=7700 [BDS Register 61_{16} (Subtype 1)]	PASS / FAIL / NA

If the UA automatically enables or disables reply and report modes based on the mission and/or mission phase, include documentation detailing those functions and conditions.

Verify that the IFF crypto is zeroised when engine power is lost and/or upon uncontrolled flight into the ground. Include documentation detailing those functions and conditions.

PASS / FAIL / NA

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