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Form 442 Experimentation Description

VHF Experimentation:

Emitter - One device design - Transceiver

VHF Aviation Radio designed to meet FAA TSO-C169a VHF Transceiver and RTCA DO-186B VHF Radio Communications Transceiver Equipment Operating Within Radio Frequency Range 117.975 To 137.000 Megahertz VHF Experiments (in flight test aircraft station and in ground fixed station) in support of flight test include:

Emissions Tests -

Dynamic Response - eqpt not adversely affected by aircraft operations on ground and in flight

Interference Effects - eqpt not source of harmful conducted or radiated interference and shall not be adversely affected by conducted or radiated interference from other equipment or systems installed in the aircraft. **Cover low, high and one mid-band frequencies. (2 frequencies added to license)**

Listed are EMC, Harmonics, Spurious Emissions.

Reception - eqpt monitoring a local communication frequency to verify that the receiver produces a clearly audible and understandable output.

Transmission - eqpt establishing contact with another VHF communication station and receiving a report of reliable communications.

Flight Tests -

Interference Effects - in flight, **cover low, high and one mid-band frequencies. (2 frequencies added to license)**

Communication System Performance - omni coverage in flight.

Equipment Functional Test - Air to Ground and Ground to air radio check

UHF Experimentation:

Emitter - One device design - Transponder

UHF Aviation Radio designed to meet FAA Standards -

TSO-C74d - Air Traffic Control Radar Beacon System (ATCRBS) Airborne Equipment

TSO-C112e - Air Traffic Control Radar Beacon System/Mode Select (ATCRBS - MODE S) Airborne Equipment

TSO-C166b - Extended Squitter Automatic Dependent Surveillance - Broadcast (ADS-B) and Traffic Information Service - Broadcast (TIS-B) Equipment Operating on the Radio Frequency of 1090 Megahertz (MHz)

AC 20-151B - Airworthiness Approval of Traffic Alert and Collision Avoidance Systems (TCAS II), Versions 7.0 & 7.1 and Associated Mode S Transponders

AC 20-165A - Airworthiness Approval of Automatic Dependent Surveillance - Broadcast (ADS-B) Out Systems

and RTCA Minimum Operational Performance Standards -

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- DO-144A - MOPS for Air Traffic Control Radar Beacon System (ATCRBS) Airborne Equipment
- DO-181E - MOPS for Air Traffic Control Radar Beacon System I Mode Select (ATCRBS Mode S) Airborne Equipment
- DO-260B - MOPS for 1090 MHz Extended Squitter Automatic Dependent Surveillance-Broadcast (ADS-B)& Traffic Information Services- Broadcast (TIS-B)

UHF Experiments (cumulative) include:

ATCRBS

Installed - Interference Effects

Flight Test Procedures

- Ground Pre-Flight Tests - Random triggering, R/T Characteristics, Automatic Altitude Reporting,
- Operational Flight Tests - Maneuvering
 - Perform the flight test using an ATC facility and procedures.
 - Altitude Reporting - While performing flight test, request ATC to monitor the altitude being reported & compare.
 - Request ATC to verify proper performance while operating.

ATCRBS-S

On Ground - Installed - MOPS

- Interference Effects
- Pressure Altitude Transmissions - digitizer off
- Report "on-the-ground" condition

Flight Test Procedures - MOPS

- Altitude Reporting Test - ascending & descending
- Airpeed Fixed Field - confirm max. airspeed report
- Flight demonstration of installed performance -
 - Schedule arranged with the area air traffic control facility
 - Line-of-sight signal propagation.
 - Test maneuvers include standard rate turns through 360 degrees, climbs and descents so that ATC can confirm valid returns.

Transponder Ground Tests & Evaluations - Installed - A/C

- Conduct ground testing in coordination with ATC and [or] use antenna shielding (that is, transmission absorption covers or caps) to prevent test data that could generate false intruder information from being transmitted.
- Mode Test - Interrogations made in Modes A, C, and S, replies
- Reply Delay - Interrogates with valid modes and verifies Reply delay
- Reply Jitter - Interrogates with valid modes and verifies Jitter
- ATCRBS Reply - Interrogations made in Modes A, C, verifies pulses
- SLS Level - SLS Suppression (Omni - Control Transmission)
- Verify that the ICAO 24-bit aircraft address and maximum airspeed are correct.
(ICAO 24-bit address is a function of the aircraft registration number)
- ATCRBS-Only All-Call. Interrogates with an ATCRBS-only All-Call and verifies.

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Mode S All-Call. Interrogates with the ATCRBS (mode A) Mode S All-Call.
Invalid ICAO 24-bit aircraft address - verify no reply.
SPR On/Off, Mode S UF0, UF4, UF5, UF11, UF16, UF20, UF21 Interrogations.
Acquisition Squitter - verify
Frequency - Verifies frequency
Diversity. Verifies diversity isolation
MTL Difference. Verifies Receiver Sensitivity (Minimum Trigger Level)
Altitude Reporting - Verifies the reported altitude from the on-board source

Basic Flight Tests - A/C

All phases of flight, determine any mutual interference with other A/C systems

Mode S Transponder Tests -

- Climb and Distance Coverage - flight plan provided
- Long Range Reception - maneuvering described
- High Angle Reception - maneuvering described
- High Altitude Cruise - flight plan provided
- Surveillance Approach - flight plan provided
- Holding and Orbiting Patterns - maneuvering described
- Altitude Reporting - functional test of the altitude
encoder by comparison with ATC displayed altitudes

ADS-B

Per AC 20-165A - Airworthiness Approval ADS-B Out

On Ground Tests

Coordinate with local ATC before broadcasting over the air to prevent being a source of interference to ATC or ADS-B IN equipped aircraft in the area. For example, transmitting airborne position reports with simulated airborne altitudes while on the surface will produce false targets for the ATC surveillance systems or airborne ADS-B IN equipped aircraft.

Flight Tests

In-Flight Test with FAA Ground System.

Perform a flight test to show that the installed system performs properly with the FAA ground system. The test will verify that the FAA ground system properly receives the aircraft's ADS-B broadcast messages, there are no drop outs and the information transmitted is complete and correct.

Currently the only method available to accomplish the flight test is to fly within ADS-B service coverage and accomplish a post flight analysis of the data received from the FAA. This test is intended to evaluate the design interface for the position source and the ADS-B equipment. If you have flight test data from a previous STC or TC which established this compatibility, you do not need to re-accomplish the flight test.

Note: 1: This flight test is intended to complete a design approval under an STC or TC application; it is not intended for the alteration of individual aircraft.

Note: 2: Follow your standard process for requesting flight test authorization, there

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are no unique flight test authorization requirements for ADS-B flight tests.

a. Preflight coordination.

(1) Data retrieval. At least 48 hours prior to the flight, notify the FAA by e-mailing 9-avs-air-130flttst@FAA.gov that you require data from the flight test to support post flight analysis. Include contact information for your ACO point of contact, aircraft registration number or applicable call sign, 24-bit address, expected date, location and approximate time of the flight.

(2) ATC coordination. There is no ADS-B specific requirement to coordinate the flight test in advance with ATC. Follow normal flight test procedures for coordinating with ATC.

b. Flight Test Profile - flown on all ADS-B system approvals - specifies:

Location of flight - for ground station coverage

Distance from ground station - any profile

Altitude - multiple

Turns - ADS-B system performs properly during turning maneuvers – Table of Turns

Per DO-260B

On Ground Tests

Transmitting Subsystem -

Interference Effects, same as for VHF, Installed Equipment

Flight Tests

Surveillance Testing -

Verify that installed ADS-B system is capable of transmitting and/or receiving ADS-B squitter messages from other aircraft.

Shorter range (to 20 NM) operational requirements may be demonstrated using a ground based Target system. (Sandel Fixed base)

Longer range operation might require an airborne Target system (aircraft)

Fly A/C straight and level at the minimum operational range and verify that data from A/C received reliably by the Target system.

If the A/C has receive capability, verify that A/C reliably reports information about the Target.

Transmitting Subsystem -

Pre-Flight, fixed data verification

Taxi Out, ADS-B "On" surface mode, operation limits may preclude transmissions

Beginning of Flight Plan

Take off / Departure, ADS-B function detects take off, air mode selected

En Route, continues transmitting in air mode

Approach, air mode continued, appropriate messages support on-condition reports

Landing/Taxi, surface mode entered when ADS-B function detects an on-ground condition.