Memorandum

U.S. Department
of Transportation
Volpe National
Transportation
Systems Center

Subject: <u>INFORMATION:</u>
**Volpe Aircraft Noise Certification DGPS Validation/Audit General
Information, Data Submittal Guidelines, and Process Details**;
Letter Report V324-FB48B3-LR5

Date: 09JAN2018

From: Chris Cutler, Physical Scientist
Environmental Measurement and Modeling Division

Reply to
Attn. of: V324

To: Joseph DiPardo, Acting Manager, Noise Division, FAA/AEE-100
and U.S. Aircraft Noise Certification Applicants

As required by Federal Aviation Administration (FAA) Order 8110.4C: "*Type Certification
Process*" (most recently revised as "Change 5", 20 December, 2011), the Volpe Center
Acoustics Facility (Volpe), in support of the FAA Office of Environment and Energy (AEE),
performs audits of aircraft noise certification applicants' software and methodologies to
ensure conformance with the requirements and specifications of the Code of Federal
Regulation (CFR) Title 14 part 36 (Part 36). These audits are executed as "validations" of
applicants' software, instrumentation and procedures.

In addition to the **primary software & methodology validation**, separate validations are
performed for **noise measurement and analysis instrumentation systems**, and for **DGPS
(DGNSS) tracking systems**. Applicants should note that validation of particular
instrumentation for one applicant does not universally apply – each applicant must submit to
validation of their instrumentation system, including evaluation of formalized
documentation such as an individualized operator manual or procedures report for setup
and operation of the instrumentation by the applicant. This may sometimes result in
individual validation reports for instrumentation components and for applicant procedures
related to those components.

As a result of recent issues related to unexpected results from applicants using validated
and approved DGPS systems and in coordination with FAA's Transport Directorate Noise
Certification Specialist (TDNCS), Bruce Conze, Volpe is instituting some changes to the data
submittal requirements and procedures for the audit/validation of DGPS tracking systems
used in

aircraft noise certification flight-tests. In addition to the existing data requirements, Volpe requests that the following submission requirements be implemented:

1. Coordinate transformation code used to convert GPS coordinates to local, site-specific TXYZ data must now include ID and Version control, and applicants must include a statement in any test plans that they will use the validated code;
2. Formal documentation of the applicant's individual setup and operation protocols for use of the DGPS system in the field, and the applicant must include a statement in any test plans that these procedures will be followed, and specifically include a daily "validity check", as follows:
    a. Prior to each takeoff, the aircraft must be taxied over a known and previously verified survey location in the ramp area;
    b. A check of the on-board system location against the surveyed location.
3. Latitude/Longitude coordinates must be input to 6 significant digits when using Decimal Degrees format (45.123456° N), and to 2 significant digits when using Degrees/ Minutes/Decimal Seconds format (45° 12' 34.56" N). Calculations performed on such coordinates must maintain (at minimum) this level of precision throughout all processing until converted to local XYZ data.

Volpe will be re-validating applicants who have previously been validated and approved, as certification projects become available. Applicants should allow additional time for such validation to be completed prior to flight-testing.

Applicants should note that Volpe has established a set of detailed requirements for the data sets to be supplied, which in some cases exceed the reporting requirements for certification. This is necessary in order for Volpe to most accurately duplicate the applicant's procedures and to obtain meaningful results for evaluation.

If you have any comments or questions, please do not hesitate to contact me.

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Attachments:

1. DGPS Validation Submittal Instructions;
2. DGPS Validation Submittal Checklist;

cc:
 M. Marsan, FAA, AEE-100
 S. Liu, FAA, AEE-100
 R. Cointin, FAA, AEE-100
 B. Conze, FAA, AIR-672

D. Read, Volpe, V324
C. Roof, Volpe, V322
C. Lee, Volpe, V324
C. Reherman, Volpe, V320
G. Fleming, Volpe, V320

![U.S. Department of Transportation Volpe National Transportation Systems Center logo]

Aircraft Noise Certification
DGPS Validation/Audit
Data Submittal Instructions

The applicant should provide the following data:

1. **General information**:
    a. Formal name of applicant organization
    b. Applicant address
    c. Technical Point-Of-Contact (POC) name
    d. POC Title
    e. POC Organization
    f. POC email
    g. POC phone
    h. Source of validation dataset
    i. DGPS Software Version ID

The applicant should prepare and submit documentation which includes:

2. **Documentation**
    a. System description. This should include information on the following topics:
        i. Selection of processing method (real-time vs. post-test)
        ii. Selection of solution method (carrier vs. code)
        iii. Use of geodetic or waypoint coordinates
        iv. Selection of GPS receiver and antenna
        v. Selection of data link equipment (if real-time system)
    b. Hardware description. Model and version number of all system components, including DGPS receivers, antennas, transceivers and computer.
    c. Software description. Software functionality and capabilities, data file formats, hardware required and operating system.
    d. System setup and operation protocols. Ground and aircraft installation of the system including antennas, operating procedures, site survey procedures, power requirements and system limitations.
    e. Daily system "validity check" protocol. This is a new requirement for use and approval of DGPS systems in aircraft noise certification in the US. A method often used is to taxi the aircraft at a known, surveyed location and to read its position from the DGPS system. The installation can be verified from a comparison of the DGPS and surveyed positions. As a minimum this process should be performed at the start and end of each measurement program and preferably at the beginning of each measurement day.

3. **Accuracy verification test**
   a. The applicant should perform a one-time verification of the system accuracy, based on a minimum of six aircraft flight-test runs which encompass the conditions (i.e. speed, altitude, range and maneuvers) for which the system will be later used as a reference.
   b. The accuracy verification test should involve a comparison of the DGPS-based TSPI system's position data with those from an accepted reference, such as another approved DGPS system.
   c. This test should be performed on the complete DGPS-based TSPI system developed by the applicant. It is not adequate for an applicant to simply cite prior approval of another applicant's system designed around the same GPS receiver.

4. **Software verification (ID and Version control)**
   a. Prior to using the system during a noise measurement program, any applicant-developed software for data logging and processing used to obtain TSPI data should be submitted to the FAA for approval. The approved software should include ID & version control.
   b. Coordinate transformation code used to convert GPS coordinates to local, site-specific TXYZ data must now also include ID and Version control, and applicants must include a statement in any test plans that they will use the validated code;

Note: Microsoft-Windows-compatible **ASCII text file versions of all data sets are required**. *Please provide as* **comma-separated value (.csv)** *format files, or alternatively as Microsoft* **Excel worksheet files**.

Please direct any questions to:

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617-494-2817, Christopher.Cutler@dot.gov

Differential Global Positioning System Validation Report & Checklist

Applicant:	
Latest Update: *Date Initiated:* *Date Completed:*	STATUS NOTES:
Points-of-contact:	

Address:	Telephone:
	FAX:
	Email:

Subject Aircraft for Validation:
Aircraft to be Certified:
DGPS Revalidation? ☐ Yes   ☐ No

*Notes:

GPS-Related Instrumentation:
Equipment setup and data collection procedure documentation?   ☐ Yes   ☐ No

	GPS Base Station Receiver Manufacturer and Model:
	GPS Base Station Antenna Manufacturer and Model:
	Choke Ring: ☐ Yes ☐ No
	GPS Rover Receiver Manufacturer and Model:
	GPS Rover Antenna Manufacturer and Model:
	Notes:

Type of Solution:
☐ Dual Frequency (L1/L2)
☐ Single Frequency (L1)

	Multipath Test Performed:	☐ Yes	☐ No
	Notes (e.g., angular cutoff implemented, multipath in accordance with?):		

Processing Method:

Raw, uncorrected data saved separately?	☐ Yes	☐ No
GPS coordinates maintain minimum significant digits? • Decimal Degrees: 6 decimal places • Deg, Min, Sec: 2 decimal places	☐ Yes	☐ No

☐ Real Time (Local base station)	Notes (e.g., real-time guidance implemented):
☐ Real Time (Regional base station)	
☐ Post Test (Local base station)	
☐ Post Test (Regional base station)	
☐ Other:	

Dynamic System Test:

☐ FAA Technical Center	Notes:
☐ Laser	
☐ Ground Radar	
☐ Theodolite	
☐ Differential GPS	
☐ Differential GPS & Radar Altimeter	
☐ Microwave	
☐ APOP@ (Photographic Overhead Positioning)	
☐ Video	
☐ Other:	

☐ Documentation of pre-test DGPS check. (*Process in place to confirm accuracy of DGPS system before actual testing begins?*):

Differential Solution Quality:		
	Notes (e.g., applicant checks and verifies acceptable solution quality limits):	
Coordinate Transformation:		
	☐ WGS-84 Coordinate System	
	☐ GPS Manufacturer's Transformation Software	
	☐ Applicant's Transformation Software	
		Version Identifier/Date:
		Version:
		Notes (e.g., simplified or exact equations used):
Differences, Special Corrections, Exemptions, Unique Methods, Limitations, etc. (e.g. site specific validation, system used for test site survey):		