

**TERMS OF REFERENCE**

**Special Committee SC-159**  
**Navigation Equipment Using the Global Navigation Satellite System (GNSS)**  
**(Version 17)**

**ORIGINAL REQUESTOR:**

Organization	Person

**SC LEADERSHIP:**

Position	Name	Affiliation	Telephone	Email	Change
Co-Chair	Christopher Hegarty	The MITRE Corporation	781-271-2127	chegarty@mitre.org	
Co-Chair	George Ligler	GTL Associates	(919) 346-1807	ligler1@earthlink.net	
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Secretary	Wes Googe	American Airlines	336-830-4120	<a href="mailto:wes.googe@aa.com">wes.googe@aa.com</a>	TBD

**BACKGROUND:**

Since it was established in 1985, RTCA SC-159 has produced and maintained a suite of minimum operational performance standards (MOPS) and minimum aviation system performance standards (MASPS) for aviation equipment using the Global Positioning System (GPS) and its augmentations, specifically aircraft-based (ABAS), ground-based (GBAS), and satellite-based (SBAS) augmentation systems, using a single GPS signal, the GPS coarse/acquisition (C/A) code that is modulated on the link 1 (L1) carrier frequency of 1575.42 MHz. Similarly, the International Civil Aviation Organization (ICAO) has produced various aviation and equipment standards for GPS and its augmentations. All of these standards are in global use today.

The world is entering a new era of the Global Navigation Satellite System (GNSS) with new constellations and a variety of new, civil, safety-of-life signals. Consideration for use requires that the carrier frequencies be at 1575.42 MHz and at 1176.45 MHz with a usable signal bandwidth of no more than +/-12MHz around the carrier frequency. Other conditions may apply, such the signal being open and being supported by the service provider for safety-of-life use.

The current GNSS status is that GPS is presently being modernized, and the constellation is being populated with three new civil signals (L5, L2C, and L1C) on multiple frequencies with three of

the four end-state civil signals (L1 C/A, L5, and L1C) being located within bands allocated for aeronautical radio navigation services (ARNS). SBASs, such as the Wide Area Augmentation System (WAAS) in North America, are evolving to support dual-frequency user equipment. Additionally, other GNSS core constellations have been deployed (Russia’s GLONASS) or are being deployed (Europe’s Galileo and China’s BeiDou).

ICAO’s Navigation System Panel (NSP) is updating Standards and Recommended Practices (SARPs) contained within Annex 10 to the International Convention on Civil Aviation to incorporate GPS and GLONASS modernization as well as the new core constellations. Aviation equipment standards are/will be required for safety-of-life use. A GPS/GLONASS L1 MOPS was produced and adopted in 2017 as a first step towards standardization of multi-constellation equipment.

**DELIVERABLES:**

Product	Description	FRAC Completion Due Date*	Change
DO-235C	Updated L1 interference environment report	October 2020	
DO-292A	Updated L5 interference environment report	March 2021	
GNSS-Aided Inertial Systems MOPS	New MOPS for GNSS-aided inertial navigation systems.	October 2020	
GNSS(SBAS) L1/L5 MOPS **, ***	GPS/Galileo/SBAS MOPS developed jointly with EUROCAE WG-62 that are intended to be usable for ETSO/ TSO production and certification of the receivers for aviation use  Update to GPS/Galileo/SBAS MOPS for dual-frequency equipment ***, *****	December 2020  December 2022	
GNSS(GBAS) L1/L5 MOPS and ICD**	Initial MOPS and ICD for Verification and Validation  Validated GPS/Galileo/GBAS MOPS	2023  2025	

	and ICD for dual-frequency equipment.		
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\*Note: Final Review and Comment (FRAC) Completion Due Date refers to the date that the committee plenary approves the document after completing the FRAC Process. SCs should submit the final document at least 45 days before the PMC meeting where it will be considered for approval.

\*\* Requirements for core constellations in addition to GPS and Galileo will be dependent upon multiple prerequisites as discussed in the Specific Guidance Section below. Additionally, in the case of the GNSS (SBAS or GBAS) L1/L5 MOPS, constellation providers will be advised to provide final needed technical information at least two-years prior to the completion of the Updated MOPS in order to have their constellations included in the MOPS. This includes the official set of user interface definition, technical and performance information for the core constellations, technical service provisions for H-ARAIM, interference environment (RTCA DO-235C, DO-292A) and multi-constellation SBAS.

\*\*\*Operations targeted for this MOPS include, but are not limited to, LPV 200 autoland (Cat I with VMC below 200 ft), LPV 200 in equatorial regions, ADS-B out requirements and improved availability of Low RNP operations. The MOPS will include integrated DO-229E requirements for class Beta, Delta and Gamma receiver classes, DFMC SBAS E1/L1/E5a/L5 requirements and may include H-ARAIM requirements.

\*\*\*\* Jointly developed with EUROCAE WG-62, based on initial return from experience and may potentially include new requirements such as Cat II autoland (with VMC below 100 ft), SBAS authentication, Service Area Message, L5 SBAS-Ranging, Non-GEO SBAS pending ICAO SARPS completion, and complete H-ARAIM requirements, if deemed necessary.

**SCOPE:**

RTCA SC-159 shall develop equipment standards for GNSS augmented by ABAS, GBAS, and SBAS, as well as associated interference environment reports and interface control documents (ICDs).

**ENVISIONED USE OF DELIVERABLE(S)**

The guidance developed by this special committee is envisioned to be referenced by the Federal Aviation Administration (FAA) and other State Authorities as appropriate in certification guidance material including Technical Standard Orders (TSOs) or other national documents.

**SPECIFIC GUIDANCE:**

1. The following core constellations should be addressed:
  - a. The U.S. Global Positioning System (GPS)
  - b. The Russian Federation Global Orbiting Navigation Satellite System (GLONASS).
  - c. Europe’s Galileo
  - d. China’s BeiDou

2. The incorporation of the foreign core constellations listed above within equipment standards shall be contingent upon multiple prerequisites being satisfied for operational use.
3. The following augmentations should be addressed:
  - a. Aircraft-based augmentation system – as defined by ICAO, this includes receiver autonomous integrity monitoring (RAIM), which uses GNSS information exclusively, and aircraft autonomous integrity monitoring (AAIM), which uses information from additional on-board sensors (e.g., barometric altimeter, clock and inertial navigation systems). Consideration should be given to advanced RAIM (ARAIM) methods currently under development.
  - b. SBAS.
  - c. GBAS.
4. Particular attention should be given to meeting integrity and availability requirements especially for all phases of flight.
5. New MOPS will address, to the extent practicable, the threats of intentional interference and spoofing.
6. New MOPS should address, to the extent practicable, the possibility of higher levels of adjacent-band interference in the future operational environment.
7. The work of the committee should be coordinated with the European Organization for Civil Aviation Equipment (EUROCAE) Working Groups 28 and 62, as well as with ICAO's Navigation System Panel (NSP). The GNSS (SBAS) L1/L5 MOPS (both versions) will be developed jointly with EUROCAE WG-62.

**INITIAL DOCUMENTATION** - the following documents should be made available to this committee.

<b>Documents</b>	<b>Intended Use</b>
DO-229F	Basis for updated GPS/SBAS MOPS.
EUROCAE ED-259	Basis for updated GPS/Galileo/SBAS MOPS
U.S.-EU WG-C ARAIM Airborne ADD	Basis for updated GPS/Galileo/SBAS MOPS to incorporate ARAIM requirements
DO-245, -246E with Change 1, -253D with Change 1	Basis for updated GPS/GBAS MOPS and ICD.
DO-316	Basis for updated GPS/ABAS MOPS.
DO-235B, -292, -327	Basis for updated interference environment assessments.

**TERMINATION:**

When the scope of this Terms of Reference is complete, the committee will recommend to the PMC that the committee Sunset, go into Active Monitoring Mode, or spend a period of time in Hiatus. Any change/extension in the committee's work program requires prior PMC approval.