U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

Subject: DISPLAYING GEOMETRIC ALTITUDE RELATIVE TO MEAN SEA LEVEL

Date: 07/09/2009 **AC No:** 20-163
Initiated by: AIR-100

1. Purpose of this AC.

a. This advisory circular (AC) shows you how to gain a type certificate (TC), supplemental TC (STC), amended TC (ATC), amended supplemental TC (ASTC), or technical standard order (TSO) authorization for systems incorporating the presentation of geometric altitude relative to mean sea level (MSL) on electronic displays.

b. This AC is not mandatory and does not constitute a regulation. In it, we describe an acceptable means, though it is not the only means, to gain approval. If you use the means described, you must follow it in all important respects.

2. To Whom this AC Applies. We wrote this AC for aircraft and avionics manufacturers and designers of electronic displays on any type of aircraft (that is, Title 14 of the Code of Federal Regulations (14 CFR) parts 23, 25, 27, and 29).

3. Definitions.

a. We define *geometric altitude relative to MSL* in this AC as the height above MSL, derived *primarily* from geometric sources. Those sources are systems (like global positioning systems [GPS]) not affected by local barometric pressure. Geometric altitude relative to MSL is therefore distinct from barometrically-derived altitude, and from height above reference surfaces other than MSL. Geometric altitude relative to MSL may include a barometric component, but the primary derivation source is geometric.

b. We will not use formal geodetic terminology in this AC. Rather, we refer to the term "geoid" (the undisturbed MSL extended continuously through the continents) as "MSL." Likewise, we refer to "orthometric height" (height of a point relative to the geoid) here as "geometric altitude relative to MSL."

4. Vertical Separation and Displaying Geometric Altitude Relative to MSL.

a. Barometrically derived altitudes are required for pilot compliance with published and air traffic controller-issued altitudes within the National Airspace System. The coexistence of

barometric and geometric altitudes in the flight deck may confuse pilots, due to their similarity. For example, corrected barometric altitude and geometric altitude relative to MSL represent height above MSL, even though they differ by how they're derived.

b. Pilots reading geometric altitude relative to MSL could reduce their vertical separation from other aircraft, because geometric altitude sometimes differs from the barometrically derived altitudes that other aircraft are using.

c. It's important, therefore, to make geometric altitude relative to MSL clearly identifiable and distinguishable from barometric altitude, so pilots won't confuse them and risk a reduction in vertical aircraft separation.

5. TSO Deviations. Displaying geometric altitude relative to MSL is currently not required by 14 CFR, but covered in FAA TSO-C151b, *Terrain Awareness and Warning System (TAWS)* regarding alerts for Class C systems. If you're a Class C TAWS applicant using TSO-C151b, request a TSO deviation to Appendix 4, paragraph 2.0, "1.2. Altitude Accuracy" until we revise the TSO.

6. Exclusions. This AC does not:

a. Apply to hybrid altimeters that comply with TSO-C10b, *Altimeter, Pressure Actuated, Sensitive Type,* and other performance requirements for static pressure altimeters.

b. Cover the intended functions that we will accept. You are responsible for proposing an acceptable intended function for the display of geometric altitude relative to MSL.

c. Cover ellipsoidal height referenced to the WGS-84 (World Geodetic System — 1984) geodetic reference datum and other GPS-derived altitudes not referenced to MSL. We expect, however, that if you display ellipsoidal height/altitude, you'll distinguish it from barometric altitude.

7. Labeling Geometric Altitude Relative to MSL Value. Altitude labels give pilots key information, like the height measurement reference (as with MSL, above ground level, or flight level.) Another key piece of information is the derivation source, like barometry, GPS, or radar. Consider the following when selecting the geometric altitude relative to MSL label.

a. Display the geometric altitude relative to MSL in accordance with 14 CFR 23.1301, 25.1301, 27.1301, or 29.1301. We recommend that the label:

(1) Be intuitive to pilots,

(2) Be compatible with aviation language,

(3) Specify that the derivation source is not entirely barometric, and

(4) Specify that the measurement reference is mean sea level.

b. Previous labels for geometric altitude relative to MSL have included "MSL" to convey the height measurement reference. However, due to the historical association between MSL and barometry, using "MSL" in the label can be misleading and potentially unsafe. Therefore, we don't recommend "MSL" as all, or part, of the geometric altitude relative to MSL label.

c. We recommend limiting the label to no more than three characters. The character limit minimizes the cost of modifying existing displays, some of which can accept no more than three characters.

d. We recommend "GSL" as a label for geometric altitude relative to MSL because it satisfies the above guidance. As an acronym, "GSL" might represent the key words "geometric" and "sea level."

8. Your Statement Of Intended Function.

a. Your statement of intended function must be sufficiently specific and detailed for us to decide if the system is appropriate for the intended function, in accordance with 14 CFR 23.1301, 25.1301, 27.1301, or 29.1301.

b. Use the following sample questions to help you decide whether your statement of intended function and associated tasks are descriptive enough:

(1) What should the flight crew assess, decide, or do, based on the display of geometric altitude relative to MSL?

(2) What other information will be used in combination with the display?

(3) What is the assumed operational environment in which the display will be used?

(4) What are your design assumptions about the pilot population, characteristics, and expectations, and

(5) What should the flight crew assess, decide, or do, if geometric altitude relative to MSL is unavailable for display?

9. Explanatory Text. Insert explanatory text and cautionary notes in the airplane or rotorcraft flight manual (AFM or RFM), AFM/RFM supplement, pilot operating guide, or equivalent pilot reference. As a minimum:

a. Describe how geometric altitude relative to MSL is derived.

b. Describe the proper operational use of geometric altitude relative to MSL.

c. Caution that pilots should **not** use geometric altitude relative to MSL to comply with published or air traffic controller-issued altitudes, and

d. Explain why they should not use it to comply with published or air traffic controller-issued altitudes.

10. Effect Of Policy.

a. As stated in paragraph 1, this AC is not a new regulation. However, if you're an applicant, you should expect that certificating officials may rely on this information when making findings of compliance during the certification process.

b. If your proposed method for showing compliance falls outside the guidance in this AC, you may expect your FAA aircraft certification office (ACO) to coordinate with FAA Aircraft Certification Service, Technical Programs and Continued Airworthiness Branch, AIR-120.

c. If you have questions regarding this AC or need more information, call AIR-120 at (202) 385-6330.

11. Related References. 14 CFR 23.1301, 25.1301, 27.1301, or 29.1301. You can order copies online at www.access.gpo.gov . Select "GPO Access," then "Online Bookstore." Browse to "Aviation," then scroll to "Code of Federal Regulations." You can also directly access regulations online at http://www.faa.gov/regulations_policies/faa_regulations/ .

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