Federal Aviation Administration

Memorandum

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To: National Flight Procedures Group, AJW-32

From: Flight Technologies and Procedures Division, AFS-400

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Subject: Area Navigation (RNAV) Terminal Instrument Procedures (TERPS) Geospatial Standards for Procedure Development Automation

In 1986, the Office of National Geodetic Survey (NGS), redefined and readjusted the North American Datum of 1927 (NAD 27), creating the North American Datum of 1983 (NAD 83). The World Geodetic System of 1984 (WGS 84) was defined by the Defense Mapping Agency (DMA). Both NAD 83 and WGS 84 were originally defined (in words) to be geocentric and oriented as the Bureau International de l'Heure (BIH) Terrestrial System. In principle, the three-dimensional coordinates of a single physical point should therefore be the same in both NAD 83 and WGS 84 systems; in practice, however, small differences are sometimes found. The original intent was that both systems would use the Geodetic Reference System of 1980 (GRS 80) as a reference ellipsoid. As it happened, the WGS 84 ellipsoid differs very slightly from GRS 80. The difference is 0.0001 meters in the semi-minor axis. In January 2, 1994, the WGS 84 reference system was realigned to be compatible with the International Earth Rotation Service's Terrestrial Reference Frame of 1992 (ITRF) and renamed WGS 84 (G730). The reference system underwent subsequent improvements in 1996, referenced as WGS 84 (G873) closely aligned with ITRF94, to the current realization adopted by the National Geospatial-Intelligence Agency (NGA) in 2001, referenced as WGS 84 (G1150) and considered equivalent systems to ITRF 2000.

The North American Vertical Datum of 1988 (NAVD 88) is the vertical control datum established in 1991 by NGS by the minimum-constraint adjustment of the Canadian-Mexican-U.S. leveling observations. It held fixed the height of the primary tidal bench mark, referenced to the new International Great Lakes Datum of 1985 local mean sea level height value, at Father Point/Rimouski, Quebec, Canada. Additional tidal bench mark elevations were not used due to the demonstrated variations in sea surface topography, (i.e., the fact that mean sea level is not the same equipotential surface at all tidal bench marks).

NOTE: *NGS indicates that, in the not too distant future, the current NAD 83, WGS 84, and ITRF models will all evolve into a single model.*

RNAV Geospatial Standards:

The following standards apply to evaluation area (OEA) construction and the evaluation of obstacle and terrain position and elevation data relative to RNAV OEAs and obstacle clearance surfaces (OCSs).

Fix Position and Track Determination:

The semi-major and semi-minor axes of the WGS 84 and NAD 83 ellipsoids are essentially equivalent. Calculations based upon the WGS 84 ellipsoid applied to NAD 83 positions effectively result in NAD 83 positions; therefore, the standard reference-ellipsoid for calculation of track and fix position is the "WGS-84 (G1150)" ellipsoid. Construct straight-line courses as a calculated geodesic path based on the reference-ellipsoid. Construct parallel and trapezoidal boundary lines as a locus of points measured perpendicular to the geodesic path. *(The resulting primary and/or secondary boundary line/lines do not display a "middle bulge" due to curvature of the ellipsoid's surface, since they are not geodesic paths.)* Determine the elevations of obstacle clearance surfaces (OCS) spherically *(using the FAA approved spherical earth radius that is equal to the geometric mean of the WGS 84 semi-major and semi-minor axes)* relative to their origin MSL elevation.

NOTE 1: *WGS 84 ellipsoid standard values:*
semi-major axis = 6378137 meters,
semi-minor axis = 6356752.314245 meters
Flattening ratio 1/f = 298.257223563

NOTE 2: *Spherical earth radius = 6367435.67964 meters*

Terrain and Obstacle Elevation

Terrain and obstacle data are reported in NAD 83 latitude, longitude, and elevation relative to mean sea level (MSL) in NGVD29 or NAVD88 vertical datum. Evaluate obstacles using their NAD 83 horizontal position and NAVD88 elevation value compared to the WGS 84 referenced course centerline (along-track and cross-track), OEA boundaries, and OCS elevations as appropriate.