CHAIRMAN OF THE JOINT CHIEFS OF STAFF INSTRUCTION

J-3 CJCSI 3900.01E
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POSITION (POINT AND AREA) REFERENCE PROCEDURES

References:
a. DoDD 5105.60, 29 July 2009, "National Geospatial-Intelligence Agency (NGA)"
b. NGA STND.0036, Department of Defense World Geodetic System 1984
c. JP 2-03, 26 May 2022, "Geospatial Intelligence for Joint Operations"

1. Purpose. This instruction establishes policy in the use of verbal or written and the storage and/or display of position reference procedures for unilateral and joint operations of the U.S. Armed Forces and for multinational operations with the military forces of allied nations.

2. Superseded/Cancellation. CJCSI 3900.01D, 14 May 2015, "Position (Point and Area) Reference," is hereby superseded.

3. Applicability. This instruction applies to the Combatant Commands (CCMDs), Services, Defense agencies, and Joint Staff.

4. Policy

a. World Geodetic System 1984 (WGS 84), which incorporates an ellipsoidal Earth model, is the official Department of Defense (DoD) positional coordinate reference system. In unilateral and joint operations, the U.S. military will use the WGS 84 geodetic three-dimensional (3-D) coordinate reference system (including Height Above Ellipsoid) unless the commander determines that the use of other position reference systems (i.e., datum) is mission critical. Universal use of the WGS 84 (datum) provides the common, global, accurate reference system necessary for modern military operations and precision weapons. The two coordinate systems to be used for reporting positions (referenced to WGS 84) will be:

(1) Geodetic coordinates—latitude, longitude, and ellipsoid height—will be computed using the WGS 84 ellipsoid, latitude, and longitude, and will be expressed in degrees, minutes, and decimal minutes (DDMM.mmmm).

(2) The Military Grid Reference System (MGRS) is based on the WGS 84 universal (Universal Transverse Mercator/Universal Polar Stereographic) projected coordinate reference systems. Ground units and ground combat operations will be serviced with MGRS coordinates. To support homeland security and homeland defense, the Federal Geographic Data Committee (FGDC) U.S. National Grid (USNG) standard is operationally equivalent to MGRS.

b. The standard reference system authorized for reporting and referencing areas (referenced to WGS 84) is the Global Area Reference System (GARS). The GARS provides a common language to describe 30x30, 15x15, and 5x5 minute areas. The Combatant Commander (CCDR) may, however, determine that the use of another area reference system is mission critical. GARS defined areas are used in battlespace coordination and large area search and rescue. GARS is not used to express precise positions for guided weapon employment, or to describe areas smaller than 5 minutes by 5 minutes. Reference c provides more detailed guidance.

c. Coordinate and area reference systems used will be specified in Annex B, Appendix 7 (Geospatial Intelligence) of operation plans and contingency plans.

d. The preferred reference for height is the WGS 84 Ellipsoid. Whenever a deviation of the policy stated in subparagraph 4.a. becomes necessary, such as a reference to the WGS 84 Geoid, as in the case for elevation or gravity-related height, the associated Earth Gravity Model (EGM) (e.g., EGM2008, EGM96, EGM84) will be reported. Identification of the EGM is necessary because the older models, which vary in resolution and accuracy, are still in use.

e. Forces navigating and operating off hard copy and digital maps based upon mean sea level (MSL) will continue to use MSL for elevations unless ellipsoidal height (based on WGS 84) is available. Only ellipsoidal heights (in meters) from approved sources will be used to support precision targeting with coordinate seeking weapons.

f. North America Datum 1983 (NAD 83) may be used in the United States for homeland security and homeland defense, as it is considered equivalent to WGS 84 for mapping and charting purposes. Local datums should not be used. If there is a need to use a local datum because of special circumstances, CCDRs will consult with the National Geospatial-Intelligence Agency (NGA) /Coordinate Systems Analysis Office or Office of Military Support for technical advice. The conditions for use of local datums and any limitations or restrictions will be published in Annex B, Appendix 7 (Geospatial Intelligence)

of applicable plans and orders. Because heights can be based on several types of surfaces (e.g., ellipsoid, geoid, and topographic), extreme care must be exercised when reporting the vertical coordinate of a 3-D position. As a result, users will report the height source and vertical datum in accordance with the procedures contained in Enclosure A to this instruction. This does not preclude the use of other coordinate formats to support intelligence databases, target materials, and intelligence, surveillance, and reconnaissance applications.

g. Express the vertical component as either a positive (+) or negative (-) to indicate that the position is above or below the vertical datum. The horizontal components of 3-D positional (point and area) information shall be represented in accordance with subparagraphs 4.a. and 4.b. above.

h. All geospatial display software shall simultaneously display geographic and MGRS coordinates in accordance with subparagraph 4.a. above—except where display size renders this impractical.

i. "Web Mercator" may be used for general planning, illustrative purposes, or non-positioning and non-targeting analysis. "Web Mercator" is a non-conformal map projection and will not be used for Mission Planning, positioning, navigation, or targeting purposes. Many popular commercial visualization applications use reference system settings and/or data that appear to be WGS 84 in name but, in fact, do not comply with NGA's recommended mathematical and parameter implementations of WGS 84 and, therefore, can cause confusion. Some examples of nomenclature with the same meaning as "Web Mercator" are "Pseudo-Mercator," "Spherical Mercator," "WGS 84 Web Mercator," "WGS 1984 Web Mercator (Auxiliary Sphere)," and "EPSG 3857." NGA recommends the use of conformal map projections: Mercator, transverse Mercator (TM), Lambert Conformal Conic (LCC), and Universal Polar Stereographic (UPS) employing the WGS 1984 ellipsoid, parameters, and mathematics.

5. Definitions. See Glossary.

6. Responsibilities

a. The Director of NGA will establish specifications and procedures for applying position (point and area) reference systems to geospatial intelligence. NGA will assist its allied co-producers in using this system. When WGS 84 cannot be used, NGA will assist the CCDRs in determining an appropriate alternative positional reference system. NGA will provide standard algorithms and parameters to perform datum transformation and coordinate operations

(i.e., Mensuration Services Program Geographic Translator (MSP GEOTRANS)). For existing products (e.g., maps/charts, software, aircraft systems) not in compliance with this instruction, NGA will coordinate with the affected CCDR, Service, or agency on the feasibility to convert these products with regard to time, cost, and scheduling. NGA will coordinate with the Joint Staff, Combatant Commands (CCMDs), Services, and DoD agencies in making all future products used for position (point and area) reference in compliance with this instruction.

b. CCDRs will develop procedures for coordinating the use of the WGS 84 positional reference system in all joint operations involving U.S. military forces. CCDRs will coordinate with allied commands on position (point and area) reference procedures to be followed within areas of multi-national interest. In cases where conditions preclude the use of WGS 84, CCDRs will coordinate on the use of alternative positional reference system procedures. Designated datums, coordinate systems, accuracy requirements, and other relevant geospatial information will be incorporated into Annex B, Appendix 7 (Geospatial Intelligence) of all deliberate and crisis plans.

7. Summary of Changes

a. Removes NGA Standardization Document, 9 December 2013, "Implementation Practice Web Mercator Map Projection," as reference c. This document has been "Retired" and, as such, is no longer a valid reference.

b. Adds Joint Publication 2-03, 26 May 2022, "Geospatial Intelligence for Joint Operations," as reference c.

c. Updates guidance for the use of "Web Mercator" in paragraph 4.i.

8. Releasability. UNRESTRICTED. This directive is approved for public release; distribution is unlimited on the non-secure internet protocol router network. DoD Components (to include the CCMDs), other Federal agencies, and the public may obtain copies of this directive through the Internet from the CJCS Directives Electronic Library at: <https://www.jcs.mil/library>. Joint Staff activities may also obtain access via the secure internet protocol router network Directives Electronic Library web sites.

9. Effective Date. This INSTRUCTION is effective upon receipt.

For the Chairman of the Joint Chiefs of Staff:

GEORGE M. WIKOFF, RADM, USN
Vice Director, Joint Staff

Enclosures:
A – Reporting Process
GL – Glossary

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ENCLOSURE A

REPORTING PROCESS

1. When reporting two-dimensional (2-D) positional (point and area) information using a grid coordinate, provide the following information:

a. Grid Coordinate. Coordinates of a grid coordinate system to which numbers and/or letters are assigned for use in designating a point or area on a grid map, photograph, or chart (e.g., 32UNA123456 (MGRS) or 150LV43 (GARS)).

b. Type of Grid. Identify the grid reference system of the source (e.g. MGRS, GARS, Universal Transverse Mercator (UTM), UPS). Unless otherwise directed by the respective CCDR, the UTM or UPS projected coordinates will be the basis and expressed in the grid reference alphanumeric point position reporting system (MGRS) and/or the grid reference alphanumeric cell/tile/ surface position reporting system (GARS).

c. Feature Description. Narrative characterization of the geospatial feature by the coordinate represented (e.g., the top center of the Washington Monument, the base of the flagpole located on the north side of the Capital Building).

d. Horizontal Source System. System identifier used to calculate or derive coordinates of the geospatial feature representation (e.g., Joint Services Imagery Processing System (JSIPS), Global Positioning System (GPS), Digital Point Positioning Database (DPPDB), map/chart series).

e. Horizontal Datum. The base reference for a coordinate system. Includes point of origin, ellipsoidal model used, and orientation of the reference system with respect to the initial point. It is a datum identifier that denotes the numerical or geometrical quantity that uniquely serves as a reference for the production of the geospatial coordinate position (e.g., WGS 84, NAD 27). A horizontal datum is used with three-dimensional 3-D or 2-D coordinate systems. It specifies how a particular coordinate system relates to the Earth, or a portion of the Earth. A datum, coupled with a coordinate system, becomes a coordinate reference system.

f. 2-D Grid Coordinate Reporting Examples. 38SMB2649083145 (MGRS) – (center of city, using map series, WGS 84) or 150LV43 (GARS) – (center of stadium/via chart series/WGS 84).

2. When reporting 2-D positional information (point and area) using a geographic coordinate, provide the following information:

a. Latitude Coordinate. The geographic coordinate identifying the position of a point with the ability to indicate precision to 1/10,000 of an arc minute, north or south of the equator. An angular measure from the equatorial plane to a line normal to the ellipsoid, passing through the point. Example: DDMM.mmmm only (followed by "N" for north of the equator or "S" for south of the equator).

b. Latitude Format. Latitude format identifier denotes the numerical representation of latitude. For example, "DDMM.mmmmH" where DD is degrees, MM is minutes, .mmmm is decimal minutes, and H is the hemisphere, which will be "N" for north or "S" for south of the equator. The coordinate will be expressed as DDMM.mmmm"N" or DDMM.mmmm"S".

c. Longitude Coordinate. The geographic coordinate identifying the position of a point with the ability to indicate precision to 1/10,000 of an arc minute, 0 to 180 degrees east or west of the international reference meridian. Example: DDDMM.mmmm only (followed by "E" for east of the zero meridian or "W" for west of the zero meridian).

d. Longitude Format. Longitude format identifier denotes the numerical representation of longitude. For example, "DDDMM.mmmmH" where DDD is degrees, MM is minutes, .mmmm is decimal minutes, and H is the hemisphere, which will be "E" for east of Greenwich or "W" for west of Greenwich. The coordinate will be expressed as DDDMM.mmmm"E" or DDDMM.mmmm"W".

e. Feature Description. See subparagraph 1.c. above.

f. Horizontal Source System. See subparagraph 1.d. above.

g. Horizontal Datum. See subparagraph 1.e. above.

h. 2-D Geographic Coordinate Reporting Example. 3317.0921N 04412.6332E (center of city/via GPS/WGS 84).

3. When reporting 3-D positional (compound) information using a grid coordinate and a separate vertical reference system, provide the following information:

a. Grid Coordinate. See subparagraph 1.a. above.

b. Type of Grid. See subparagraph 1.b. above.

c. Vertical Coordinate. Vertical distance of a point above or below a reference datum. Points may be plus (+) or minus (-) according to whether the point is above or below the vertical datum (e.g., 1,234, -12.34). With respect to GARS, the vertical coordinate refers to the height associated with the cell/tile/ surface above or below the vertical datum.

d. Height Units. Linear unit of measure in which height information is reported (e.g., meters, feet).

e. Feature Description. See subparagraph 1.c. above.

f. Horizontal Source System. See subparagraph 1.d. above.

g. Vertical Source System. The system identifier used to calculate or derive the height of the geospatial feature representation (e.g., JSIPS, GPS, map/chart series, DPPDB, survey data).

h. Horizontal Datum. See subparagraph 1.e. above.

i. Vertical Datum. Any level surface (e.g., mean sea level) taken as a surface of reference from which to determine heights. Examples: WGS 84 Ellipsoid, North American Vertical Datum of 1988 (NAVD 88), Tokyo Bay Mean Sea Level, WGS 84-EGM96, WGS 84-EGM84.

j. 3-D Grid Coordinate Reporting Examples. 38SMB2649083145 (MGRS) +135 meters (center of city/via map series/WGS 84 - EGM96) or 150LV43 (GARS) Surface-10,000ft (centered on stadium/via chart series/WGS 84 - EGM 96).

4. When reporting 3-D positional information (point and area) using a geographic coordinate, the following information will be provided:

a. Latitude Coordinate. See subparagraph 2.a. above.

b. Latitude Format. See subparagraph 2.b. above.

c. Longitude Coordinate. See subparagraph 2.c. above.

d. Longitude Format. See subparagraph 2.d. above.

e. Vertical Coordinate. See subparagraph 3.c. above.

f. Height Units. See subparagraph 3.d. above.

g. Feature Description. See subparagraph 1.c. above.

h. Horizontal Source System. See subparagraph 1.d. above.

i. Vertical Source System. See subparagraph 3.g. above.

j. Horizontal Datum. See subparagraph 1.e. above.

k. Vertical Datum. See subparagraph 3.i. above.

l. 3-D Geographic Coordinate Reporting Example. 3317.0921N 04412.6332E +135m (center of city/via GPS/WGS 84 Ellipsoid).

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GLOSSARY

PART I – ABBREVIATIONS AND ACRONYMS

2-D	two-dimensional
3-D	three-dimensional
CCDR	Combatant Commander
CCMD	Combatant Command
DoD	Department of Defense
DPPDB	Digital Point Positioning Database
EGM	Earth Gravitational Model
FGDC	Federal Geographic Data Committee
GPS	Global Positioning System
GARS	Global Area Reference System
GEOINT	geospatial intelligence
GEOREF	World Geographic Reference System
JSIPS	Joint Services Imagery Processing System
LCC	Lambert Conformal Conic
MGRS	Military Grid Reference System
MSL	mean sea level
MSP GEOTRANS	Mensuration Services Program Geographic Translator
NAD	North America Datum
NGA	National Geospatial-Intelligence Agency
TM	transverse Mercator
UPS	Universal Polar Stereographic
UTM	Universal Transverse Mercator
USNG	United States National Grid
WGS	World Geodetic System

PART II – TERMS AND DEFINITIONS

datum transformation and coordinate conversion – The National Geospatial-Intelligence Agency (NGA) produced the Mensuration Services Program Geographic Translator (MSP GEOTRANS) software to provide standard transformations/conversions between World Geodetic System 1984 and the major local datums. The Joint Interoperability Test Center has certified MSP GEOTRANS. For technical advice on coordinate system conversions contact the NGA Coordinate Systems Analysis Team or the NGA Office of Military Support.

ellipsoid – A mathematical figure generated by the revolution of an ellipse about one of its axes. The ellipsoid that approximates the geoid is an ellipse rotated about its minor axis. An ellipsoid serves as the mathematical model from which maps and charts are produced. However, numerous ellipsoids have been developed to support local datums. The use of the World Geodetic System 1984 ellipsoid provides a single standard of reference within the Department of Defense.

geodetic datum – Describes the relationship of a coordinate system to the Earth by defining an origin, scale, and orientation of the coordinate system. Contains a reference surface consisting of the following parameters: the latitude and longitude of an initial point (origin), the orientation of the network, and the two parameters of a reference ellipsoid. Coordinates for a particular ground location will vary based on the datum used to produce a particular map or chart. Therefore, it is essential that the datum used to derive the coordinates be included when reporting positions. World Geodetic System 1984 now provides the single standard reference datum, or geographic reference system, within the Department of Defense.

geoid – The equipotential surface in the gravity field of the Earth that coincides with the undisturbed mean sea level extended continuously through the continents. The direction of gravity is perpendicular to the geoid at every point. The geoid is the reference surface for geodetic leveling (surveying) and some inertial navigation systems.

Global Area Reference System – Normally created by superimposing a latitudinal-/longitudinal–based grid on pre-existing projections. The global grid overlay may be printed on military maps to include air and naval charts. This area reference system provides a common method by which to define worldwide geographic areas in an extremely brief yet succinct manner for purposes of deconfliction, synchronization, and command and control. It is designed for battlespace management and is not intended for precise targeting

or navigation operations. Also called "GARS." Note: For additional details regarding the proper use of GARS, see reference c.

grid – Two sets of parallel lines intersecting at right angles and forming squares. A grid is superimposed on maps, charts, and other similar representations of the Earth's surface in an accurate and consistent manner to permit identification of ground locations with respect to other locations and the computation of direction and distance to other points.

height above ellipsoid – The distance above or below the ellipsoid (plus or minus). Ellipsoid height is also called geodetic height or HAE.

map projection – A set of mathematical algorithms and associated parameters that establish a systematic, one-to-one correspondence between points on the surface of an ellipsoid and points on a plane while controlling the resulting geometric distortions.

Military Grid Reference System – Normally created by superimposing a metric, square grid overlay on a UTM or Universal Polar Stereographic projection. The grid is printed on military maps and certain air and naval charts that include land areas. This point position reference system provides a common system for the positioning of points on land or coastal areas and for the rapid computation of direction and distances between points. Also called "MGRS." There are other geographic, square military grid reference systems similar to the military grid reference system. However these systems cover some areas of the world that have not been converted to the UTM grid. Note: For additional details regarding the proper use of Military Grid Reference System, see reference c.

reference systems (general) – Any method of position (point and area) referencing and reporting (coordinate system) is dependent upon the ellipsoid and datum used to model the Earth. Any distortions or inaccuracies in the sources of the coordinates, whether from topographic map, aeronautical or hydrographic chart, digital data product, or other source can be compounded if different coordinates based on different datums are mixed when reporting positional information. Note: For this reason, it is important to state the reference datum when using any of the grid or geographic systems defined above. To avoid confusion, the procedures established in the Enclosure of this instruction will be followed when passing or transmitting coordinates.

reference systems (other) – Some reference systems involve the use of a grid or use polar coordinates expressed in bearing (azimuth) and distance. The grid or polar coordinates may be permanently superimposed on maps and charts. They may be temporarily established in relation to some fixed or moving point

of reference. There are other geographic, square military grid reference systems covering some areas that have not been converted to the UTM grid.

survey data – Any measurement (horizontal and vertical) that has been collected for determining the relative positions of points on, above, or beneath the Earth's surface.

United States National Grid – The U.S. civil standard, FGDC-STD-011-2001, that is functionally equivalent to Military Grid Reference System/Universal Transverse Mercator when referenced to earth-centric datum WGS 84/NAD 83. See Military Grid Reference System above and www.fgdc.gov/USNG.

vertical datum – A surface that approximates the size and shape of all or part of the Earth's surface and is designated a height of zero. The height of any point that does not lie on this surface is measured along a line perpendicular to the reference surface and passing through the point.

World Geodetic System 1984 – An Earth-centered, Earth-fixed worldwide geodetic datum and reference system based on a determination of the Earth's parameters and gravity field. The National Geospatial-Intelligence Agency (NGA) developed the system as the standard geographic reference system for use within the Department of Defense. NGA uses World Geodetic System 1984 (WGS 84) in its production of maps and charts. In principle, NATO and the allied nations approved the use of the WGS 84 for geospatial information purposes. It provides uniform datum and reference system information for use in joint and multinational operations. In addition, GPS—which is a navigation tool for air, land, sea, and space operations within the Department of Defense—is designed to work in WGS 84. Also called "WGS 84."

World Geographic Reference System – A worldwide position reference system that may be applied to any map or chart graduated in latitude and longitude—regardless of projection. This method expresses latitude and longitude in a form suitable for rapid reporting and plotting. Also called "GEOREF."