CHAIRMAN OF THE JOINT CHIEFS OF STAFF INSTRUCTION

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POSITION (POINT AND AREA) REFERENCE PROCEDURES

Reference: DODD 5105.60, 11 October 1996, "National Imagery and Mapping Agency" (now known as the National Geospatial-Intelligence Agency).

1. Purpose. This instruction establishes policy in the use of position reference procedures for unilateral and joint operations of the US Armed Forces and for multinational operations with the military forces of allied nations.

2. Cancellation. CJCSI 3900.01B, 16 July 2004, "Position Reference Procedures," is canceled.

3. Applicability. This instruction applies to the combatant commands, Services, Defense agencies, and Joint Staff.

4. Policy

a. World Geodetic System 1984 (WGS 84) is the official DOD positional reference system. In unilateral and joint operations, the US military force of the commander involved will use the WGS 84 horizontal coordinates and height (Height Above Ellipsoid) unless the commander determines that the use of other position reference systems (i.e., horizontal and/or vertical datum) is mission critical. Universal use of the WGS 84 positional reference system (datum) will eliminate confusion regarding which system is being used in reporting positions. The two coordinate reference systems to be used for reporting and referencing positions (referenced to WGS 84) shall be:

(1) Geographic coordinates using the sexagesimal system, expressed (represented) in degrees, minutes, and decimal minutes (DDMM.mmmm).

(2) The Military Grid Reference System (MGRS). Ground units and ground combat operations shall be serviced with MGRS coordinates. To support homeland security and homeland defense, the federal Geographic Data Committee (FGDC) US National Grid (USNG) standard when referenced to North American Datum 1983 (NAD83) is operationally equivalent to and is an accepted substitute for MGRS coordinates referenced to WGS 84. Note that at mapping scales of 1:5000 and smaller, NAD83 and WGS 84 are considered equivalent.

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 unless the combatant commander determines that the use of another area reference system is mission critical. It provides the two-dimensional (2-D) construction from which control and coordination measures can be constructed. It is not used to describe exact geographic locations or to express precise positions for guided weapon employment, or to describe areas smaller than 5 minutes by 5 minutes. Joint Pub 2-03, Geospatial Intelligence for Joint Operations, provides more detailed guidance.

c. Coordinate reference systems (point and area) used will be specified in Annex M (Geospatial Information and Services) of OPLANS and CONPLANS.

d. Due to the WGS 84 global three-dimensional (3-D) datum characteristics and because several vertical models are defined within WGS 84, users will report the vertical model referenced in respect to WGS 84 (i.e., Earth Gravitational Model (EGM) 96, EGM 84, etc.) whenever a deviation of the policy stated in subparagraph 4a becomes necessary.

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 from approved sources will be used to support precision targeting with coordinate seeking weapons.

f. For any operation, several local and/or regional horizontal and vertical datums may exist throughout an area of interest and, under special circumstances, may be used in lieu of WGS 84. Combatant commanders will determine the appropriate local and/or regional horizontal and/or vertical reference system (datum) for use, and coordinate 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 M of applicable plans and orders. Furthermore, due to the existence of several vertical datums worldwide from which to derive heights – with each height modeling a different surface (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 the Enclosure to this instruction. This does not preclude the use of other coordinate formats to support intelligence databases, target materials and intelligence, surveillance and reconnaissance (ISR) 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 4a and 4b above.

h. All graphical 2-D and 3-D positional (point and area) data software shall simultaneously display geographic and grid coordinates in accordance with subparagraph 4a above - except where miniaturization of system displays renders this impractical.

5. Definitions. See Glossary.

6. Responsibilities

a. The Director of NGA (D/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 combatant commanders in determining an appropriate alternative positional reference system. NGA will provide standard algorithms and parameters to perform datum transformation and coordinate conversion (i.e., Geographic Translator (GEOTRANS)). For existing products (e.g., maps/charts, software, aircraft systems, etc.) not in compliance with this instruction, NGA will coordinate with the affected combatant commander, 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, Services, and DOD agencies in making all future products used for position (point and area) reference in compliance with this instruction.

b. Combatant commanders will develop procedures for coordinating the use of the WGS 84 positional reference system (datum) in all joint operations involving US military forces. Combatant commanders 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, combatant commanders 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 M (Geospatial Information and Services) of all deliberate and crisis plans.

7. Summary of Changes

a. Includes “area” reference system terminology along side “point” reference system terminology within the text.

b. Introduces the GARS as the “area-centric” counterpart to the “point-centric” MGRS.

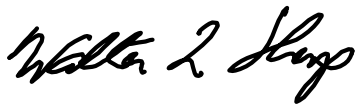
c. Establishes the NGA as the functional manager (FM) for position (point and area) reference system development.

d. Clarifies guidance concerning authorized coordinate systems and their use.

8. Releasability. This instruction is approved for public release; distribution is unlimited. DOD components (to include the combatant commands), other Federal agencies, and the public may obtain copies of this instruction through the Internet from the CJCS Directives Home Page--
http://www.dtic.mil/cjcs_directives.

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

For the Chairman of the Joint Chiefs of Staff:



WALTER L. SHARP
Lieutenant General, USA
Director, Joint Staff

Enclosure:
A -- Reporting Process

ENCLOSURE

REPORTING PROCESS

1. When reporting 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), etc.).

b. Type of Grid. Identify the grid reference system of the source (e.g. MGRS, GARS, Universal Transverse Mercator (UTM), Universal Polar Stereographic (UPS), etc.). Unless otherwise directed by the respective combatant commander, the UTM or UPS grid systems 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, etc.).

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 etc.).

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, etc.).

f. 2-D Grid Coordinate Reporting Examples. 38SMB2649083145 (MGRS) – (center of city, using map series, WGS 84) or 150LV43 (GARS) – (center on 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. 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 shall 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 prime 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 shall be expressed as DDDMM.mmmm"E" or DDDMM.mmmm"W".

e. Feature Description. See subparagraph 1c above.

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

g. Horizontal Datum. See subparagraph 1e 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 information using a grid coordinate, provide the following information:

a. Grid Coordinate. See subparagraph 1a above.

b. Type of Grid. See subparagraph 1b 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, etc.). 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. Examples: meters, feet, etc.

e. Feature Description. See subparagraph 1c above.

f. Horizontal Source System. See subparagraph 1d 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, etc.).

h. Horizontal Datum. See subparagraph 1e 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, etc.

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 2a above.

b. Latitude Format. See subparagraph 2b above.

c. Longitude Coordinate. See subparagraph 2c above.

d. Longitude Format. See subparagraph 2d above.

e. Vertical Coordinate. See subparagraph 3c above.

f. Height Units. See subparagraph 3d above.

g. Feature Description. See subparagraph 1c above.

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

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

j. Horizontal Datum. See subparagraph 1e above.

k. Vertical Datum. See subparagraph 3i above.

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

GLOSSARY

PART I - ACRONYMS

2-D	two-dimensional
3-D	three-dimensional
DPPDB	Digital Point Positioning Database
EGM	Earth Gravitational Model
FGDC	Federal Geographic Data Committee
GEOTRANS	Geographic Translator
GPS	Global Positioning System
GARS	Global Area Reference System
GEOINT	geospatial intelligence
GEOREF	World Geographic Reference System
JSIPS	Joint Services Imagery Processing System
MGRS	Military Grid Reference System
MSL	mean sea level
NGA	National Geospatial-Intelligence Agency
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 - NGA produced the GEOTRANS software to provide standard transformations/conversions between WGS 84 and the major local datums. The Joint Interoperability Test Center has certified GEOTRANS. For technical advice on coordinate system conversions contact the NGA Coordinate Systems Analysis Team (Comm:314-263-4171 or 301-227-3340) or NGA Office of Military Support (Comm: 703-264-3003 or DSN 570-3003).

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 WGS 84 ellipsoid provides a single standard of reference within the Department of Defense.

geodetic datum - 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. WGS 84 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, reference JP 2-03 (Geospatial Intelligence Support to Joint Operations – 22 Mar 07).

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 UPS 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 MGRS, reference JP2-03 (Geospatial Intelligence Support to Joint Operations – 22 Mar 07).

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 MGRS/UTM when referenced to earth-centric datum WGS 84/NAD 83. See MGRS 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. NGA developed the system as the standard geographic reference system for use within the Department of Defense. NGA uses World Geodetic System 1984 in its production of maps and charts. In principle, NATO and the allied nations approved the use of the World Geodetic System 1984 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 World Geodetic System 1984. 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."