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THE UNIVERSAL GRID SYSTEM

- **Universal Transverse Mercator (UTM)**
- **Military Grid Reference System (MGRS)**
- **Universal Polar Stereographic (UPS)**
- **United States National Grid (USNG)**

A simplified definition and explanation of UTM and related systems

THE UTM SYSTEM

UTM coordinates are based on a family of 120 Transverse Mercator map projections (two for each UTM zone, with one for each N/S hemisphere).

- The earth is divided into 60 zones, each 6° wide in longitude (with the exception of a few non-standard-width zones for Svalbard and southwest Norway). See Figure 1.

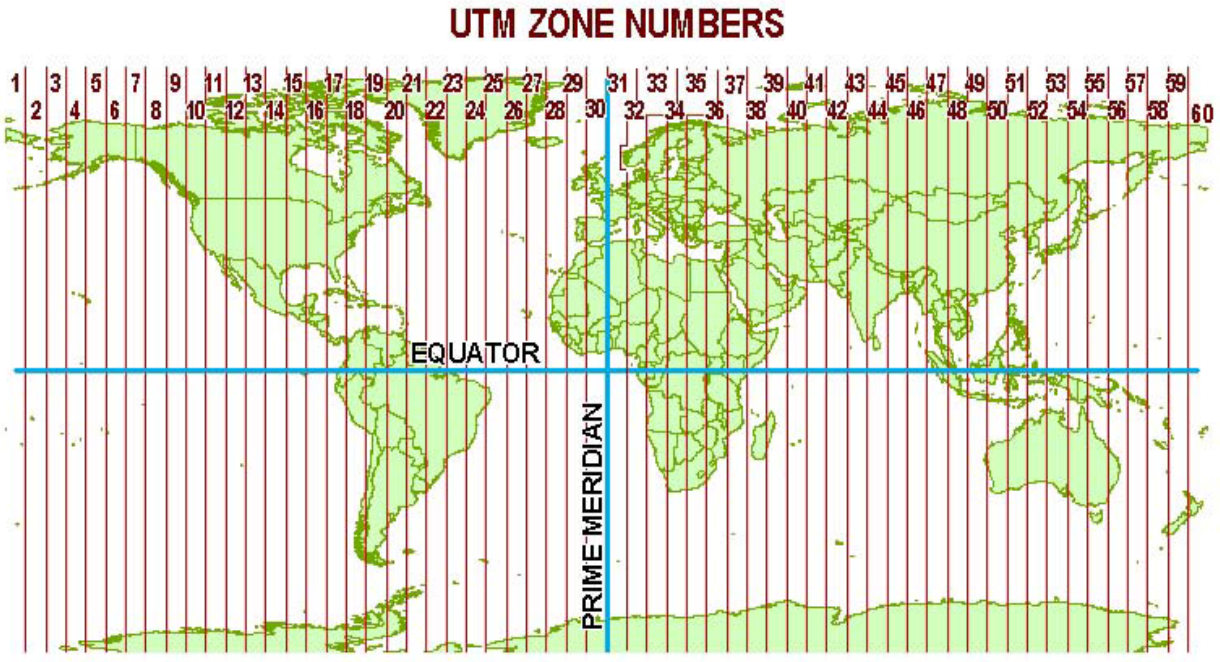


Figure 1.

- Numbering of zones begins at 180° and proceeds eastward.
    - Zone 1 is from 180°W to 174°W,
    - Zone 2 is from 174°W to 168°W, and so on.
- Each zone has a central meridian.
    - Zone 1 central meridian is 177°W,
    - Zone 2 central meridian is 171°W, and so on.
- The X value, called the Easting, has a value of 500,000m at the central meridian of each zone (Figure 2).
- The Y value, called the Northing, has a value of 0m at the equator for the northern hemisphere (Figure 3), 10,000,000m at the equator for the southern hemisphere.

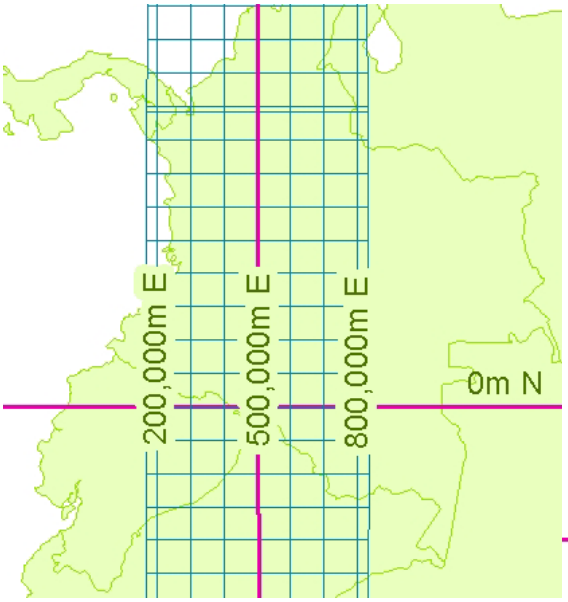


Figure 2. Easting values.

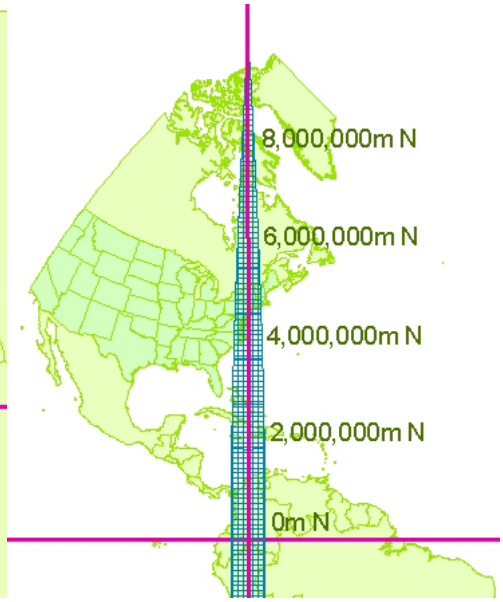


Figure 3. Northing values.

- UTM is limited to the area between 84°N and 80°S. Beyond that, Universal Polar Stereographic (UPS) coordinates are used. See section on UPS.

REFERENCING / EXPRESSING A POSITION IN UTM COORDINATES

- In the UTM system, positions are expressed as Easting / Northing, e.g. “580817mE, 4251205mN”. In some cases, the letters are left off, e.g. “580817 4251205”.
- If positions occur near UTM zone junctions, the UTM zone may also be specified, e.g. “580817mE, 4251205mN, Zone 15”.
- Since the above expresses two possible positions on the earth, the hemisphere may also be specified, e.g. “580817mE, 4251205mN, Zone 15, Northern Hemisphere” (Figure 4).

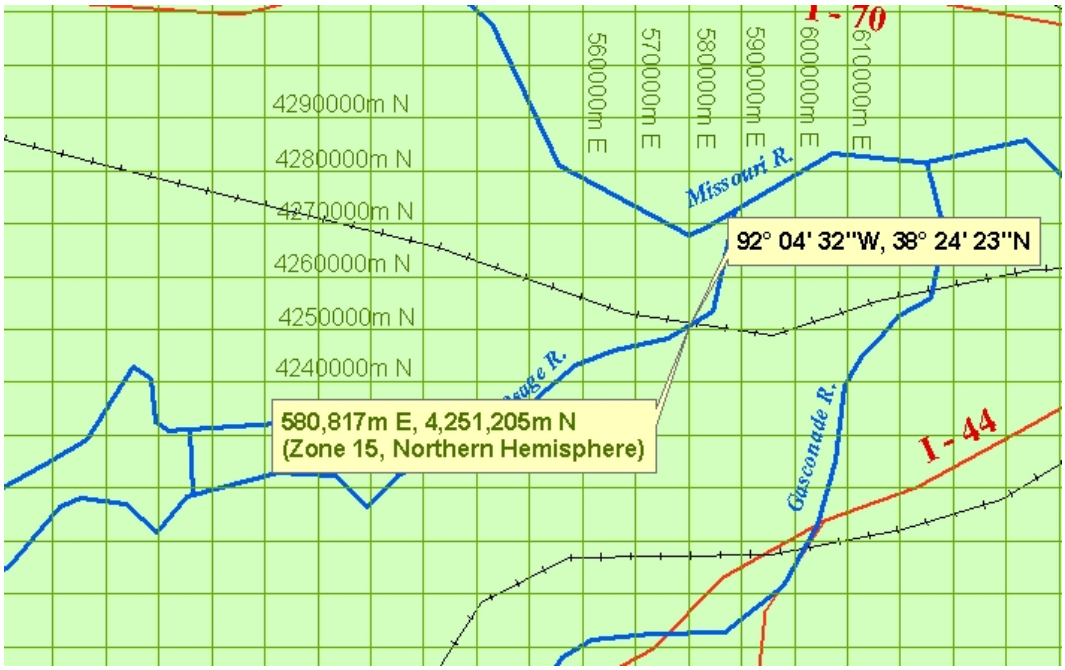


Figure 4. Example of position expressed in both Lat/Long and UTM coordinates.

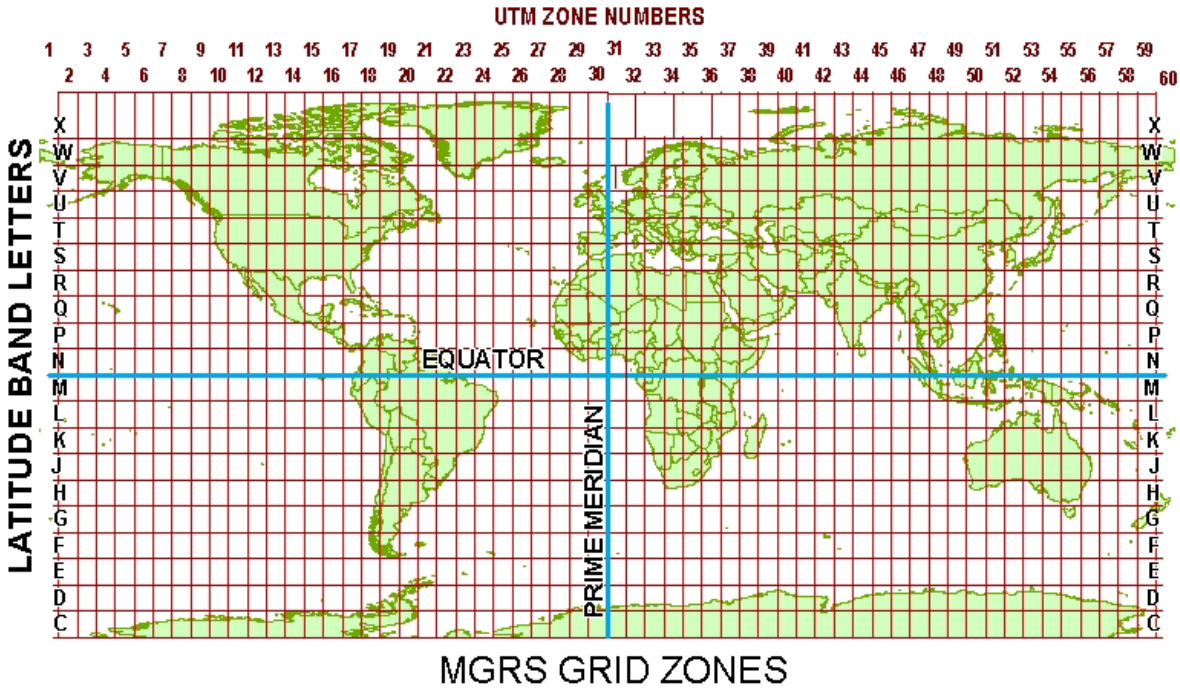
- Many systems abbreviate the above, representing the hemisphere as a single letter, “N” for northern hemisphere, and “S” for southern hemisphere, e.g. “15N 580817 4251205”.
- **CAUTION**: IN MANY SYSTEMS, THE LETTER AFTER THE ZONE NUMBER DESIGNATES A LATITUDINAL BAND, **NOT** A HEMISPHERE. MORE ON THIS BELOW.

MGRS

The Military Grid Reference System (MGRS) is an alpha-numeric system for expressing UTM / UPS coordinates. A single alpha-numeric value references a position that is unique for the entire earth. The components of MGRS values are as follows:

(Example: 15SWC8081751205)

- The first two characters represent the 6° wide UTM zone.
  - Leading zeroes are included so that Zone 9 is “09”.
  - For polar areas outside the UTM area, these characters are omitted.
- The third character is a letter designating a band of latitude.
  - Beginning at 80°S and preceding northward, the 20 bands are lettered C through X, omitting I and O.
  - The bands are all 8° high except band X, which is 12° high.
  - Outside the UTM area, A and B are used near the South Pole, Y and Z near the North Pole.



- The vertical UTM boundaries and horizontal latitudinal band boundaries form (generally) 6° X 8° ***Grid Zones***. Hence, the first

three letters of the MGRS value, e.g. “15S”, are referred to as the ***Grid Zone Designator (GZD)***.

- The fourth and fifth characters are a pair of letters identifying one of the 100,000-meter grid squares within the grid zone (or UPS area). See Figure 6.

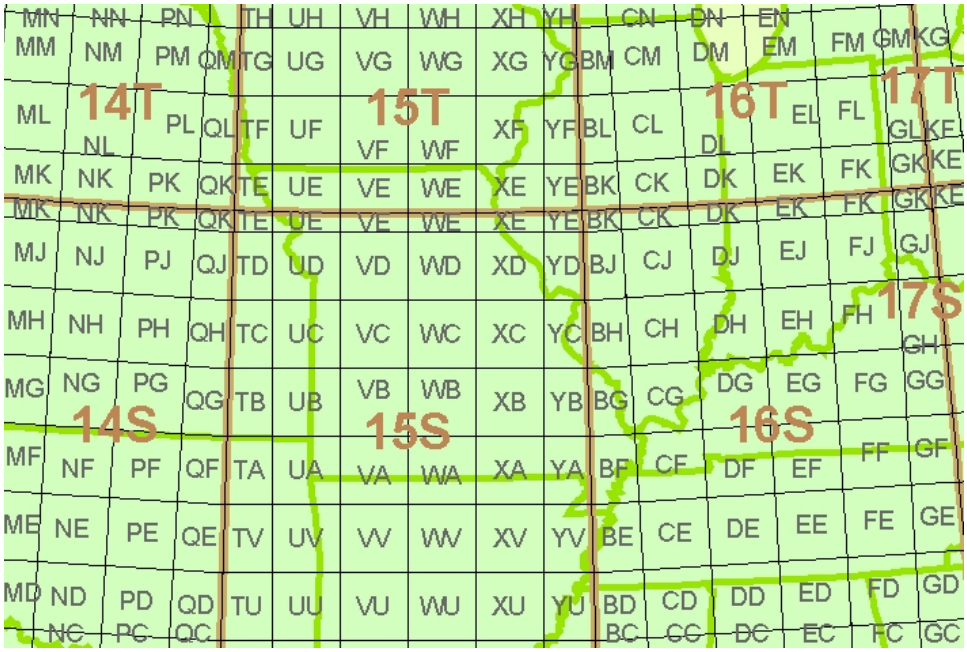


Figure 6.
In this sample area, the Grid Zone Designators are shown in brown. The smaller gray letters are the100,000-meter grid square identifiers. The example point “15SWC8081751205” is located in square “WC” near the center of the figure.

- The remaining characters consist of the numeric Easting and Northing values within the 100,000-meter grid square (Figure 7).

- MGRS coordinates may be rounded to reflect lesser refinement. For example:

15SWC8081751205 is at one-meter refinement.
15SWC80825121 is at 10-meter refinement.
15SWC808512 is at 100-meter refinement.
15SWC8151 is at 1000-meter refinement.

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