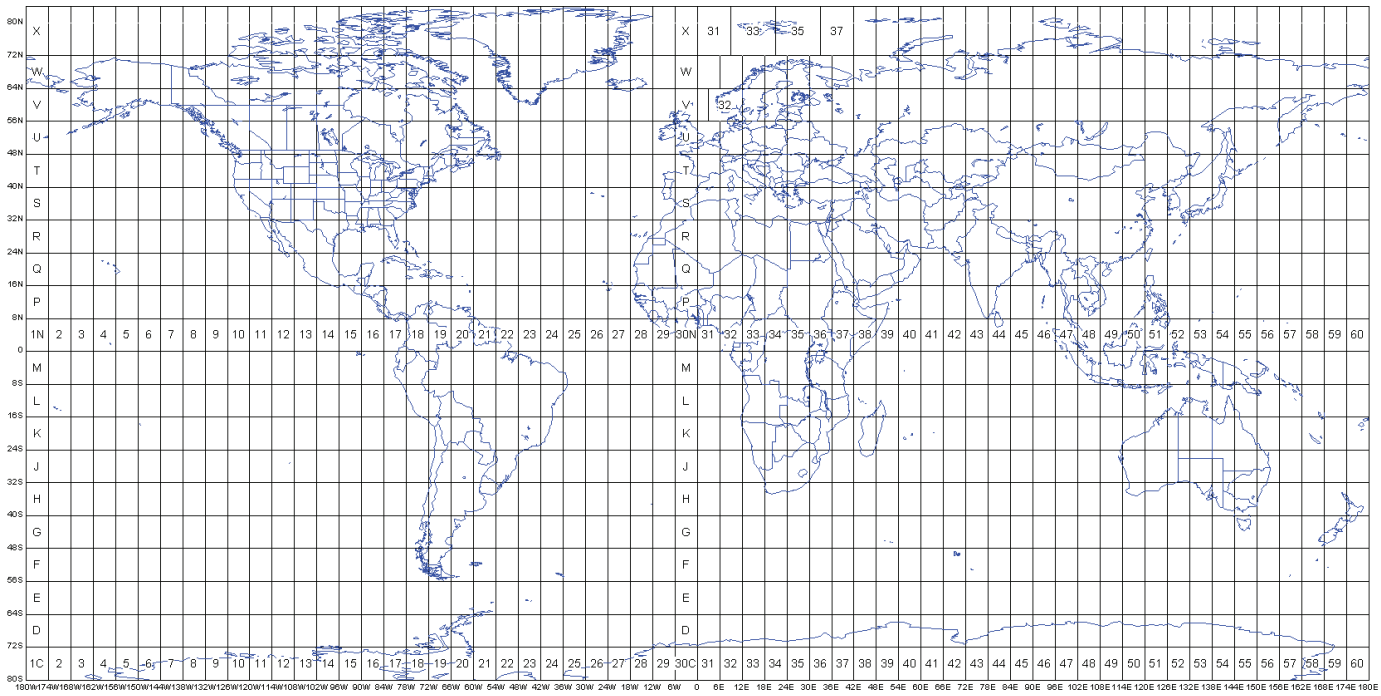
UTM, MGRS and the US National Grid

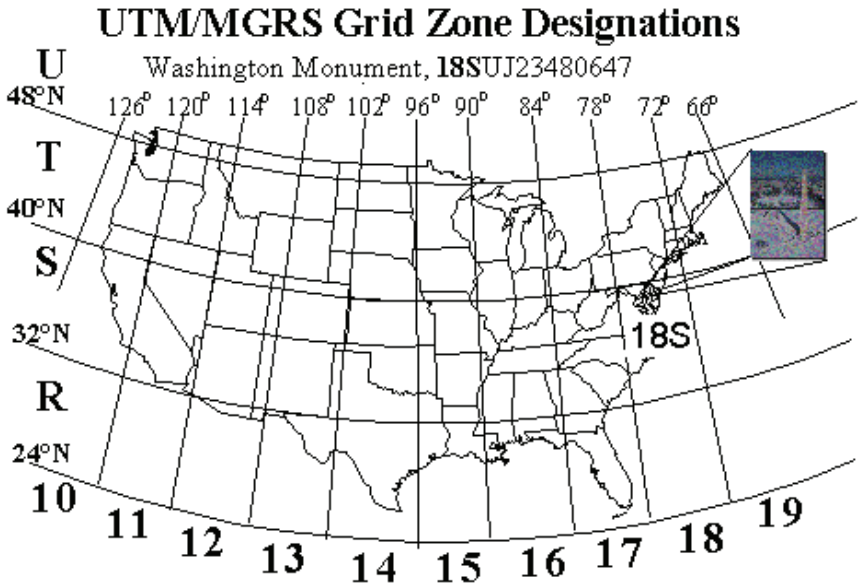
The Military Grid Referencing System (MGRS) has been around since World War II and continues to be the military standard. MGRS and the USNG (US National Grid) use the long-standing Universal Transverse Mercator (UTM) projection and coordinate systems, with a different notation to make it easier and more consistent to use and communicate.

UTM divides the surface of the earth into “rectangular” zones of 6 degrees of longitude (from pole to pole) and 8 degrees of latitude. Each of these zones is then given a unique alphanumeric identifier. We are currently in **zone 15S.**

S does NOT mean south. It’s just a letter. North of us is 15T, west is 14S.

UTM refers to locations as a distance in meters from the lower-left corner of the zone. However, this is a lot of digits, requires full-resolution (1 meter accuracy) and there are usually more digits one way than the other.





MGRS simplfies this, first by dividing zones into 100,000-meter “squares,” each given a two-character designation formed by rows and columns of single characters. We are currently in square **UD**.

Then, this makes your life really easy by having only five digits each direction to specify anywhere within the grid to 1 meter precision. By convention, and because you always know how many digits, it’s also possible to use fewer. Conventional “grid reference” means you are designating a location with 1000 meter precision, and that only takes 4 digits. Anywhere in the world can be refereced with just a few letters and numbers:

Right here we’re at 15S UD 31204 87833

Taking the Easting:

3 10,000 m precision

1 1,000

2 100

0 10

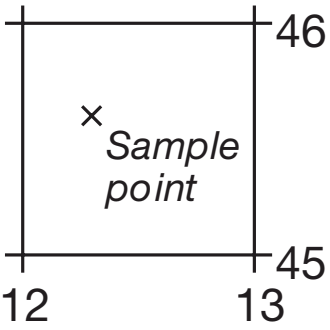
4 1

Note that you don’t need the zone or square for most communications. If you are working with others inside your square, or with people who know approximately where you are, you can just use the numbers (4063) alone.

(I like to give a little pause between the Easting and Northing, and write them down with a gap but that’s just me, and is not convention per se.)

You do need to pay attention to this, however. You might be operating right next to people, but on the edge of a zone. But when possible, eliminate extra information. Especially when communicating on the radio, this is good policy, good security, and much faster.

SAMPLE 1000 METER GRID SQUARE



100,000 M SQUAREIDENTIFICATION

UD

GRID ZONE DESIGNATION

15S

100 METER REFERENCE

1. Read large numbers labeling the VERTICAL grid line left of the point and estimate tenths (100 meters) from gridline to point. 123
2. Read large numbers labeling the HORIZONTAL grid line below the point and estimate tenths (100 meters) from gridline to point. 456

Example: 123456

WHEN REPORTING OUTSIDE THE 100,000 METER SQUARE AREA IN WHICH THE POINT LIES, PREFIX THE 100,000 METER SQUARE IDENTIFICATION.

Example: WD123456

WHEN REPORTING OUTSIDE THE GRID ZONE DESIGNATION AREA IN WHICH THE POINT LIES, PREFIX THE GRID ZONE DESIGNATION.

Example: 15SWE123456

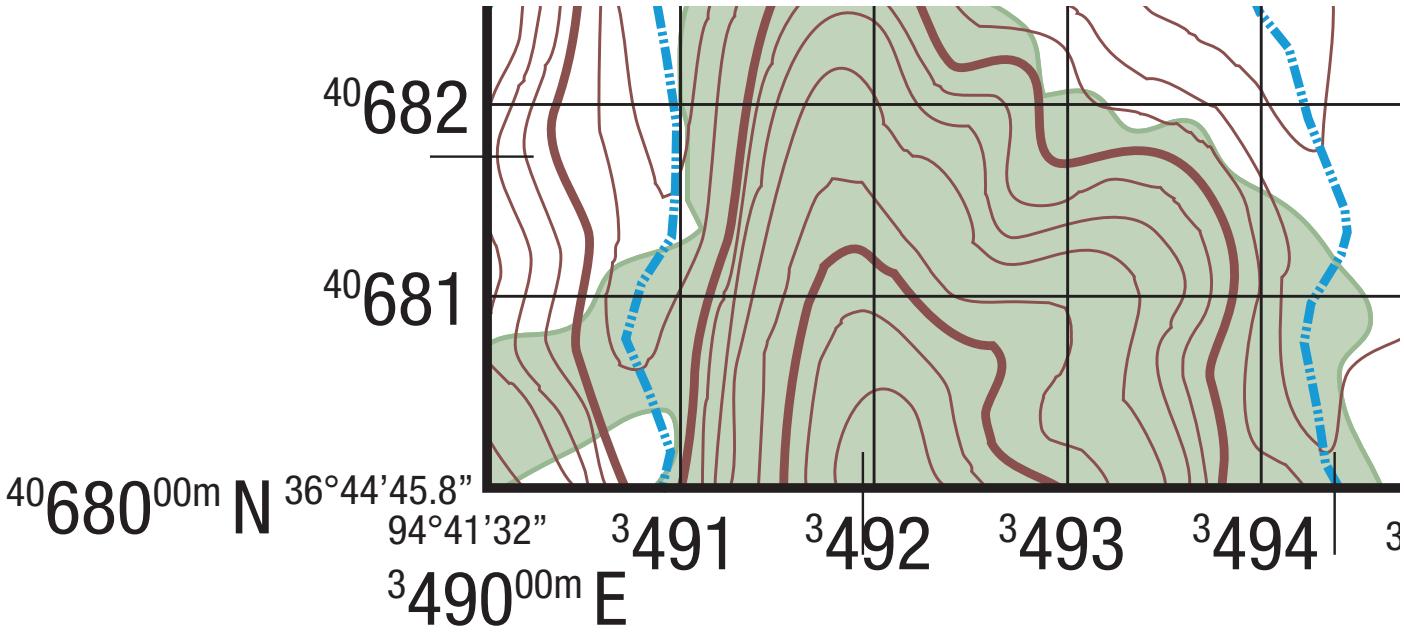
Reading Grids off Maps

Grids on military issue maps are drawn every 1000 m, and each line is labeled. Every tenth line is heavier, and the numbers are repeated inside the map as well, to make it easier to read on large sheets.

Our maps have some extra numbers, to support UTM, and because our grids are at 100 meter intervals (because we operate on smaller land, and do everything on foot).

To read grids, look across first (left to right) then up. *Demonstrate. Everyone does this themselves.*

Lat/long, in the manner used by the Air Force (but not the Navy... they use a different notation style), is also listed on the maps. The corners, and small ticks along the edge, note that coordinate system. If you work in or with the Air Force, you will need to draw in these grid lines, and learn how that system works. But we won't as it's very different.



Precision Level 1 – Reference points

Grid squares are pretty big. You usually need more precision than this. One easy way to note it is to find something unique and unambiguous inside the grid. For this example, "the trail intersection shown on the map at 510732" is pretty clear. This of course will only work for some cases. It's hard to drop GPS-guided bomb on those coordinates. But it's good for talking quickly to your immediate higher, or the next squad over.

Precision Level 2 – 100, 10, 1 m Coordinates

Grid squares can be subdivided, using guesswork, straightedges, measuring tools or better yet, your issued "roamer" or "protractor."

See the example chart on the previous page, discussing subdividing a grid square. v

Declination

Declination is a complexity induced upon you because our north-seeking device doesn't work off Grid north, the lines where our MGRS GRID is aligned, but off magnetic north.

The magnetic north pole wanders about, and as a result of the geometry of trying to represent the round earth on flat maps.

Luckily, you don't have to do the math, and every military map (and many others) has a declination chart in the corner, giving you the numbers. There are several kinds: USGS and U.S. military maps are to (angular) scale and aligned with a grid line, others (e.g. Russian) are not. The sample here is a U.S. Military one.

To adjust, put the compass on the map, aligned with GN. Twist the capsule (or declination adjustment) so the capsule aligns with MN.

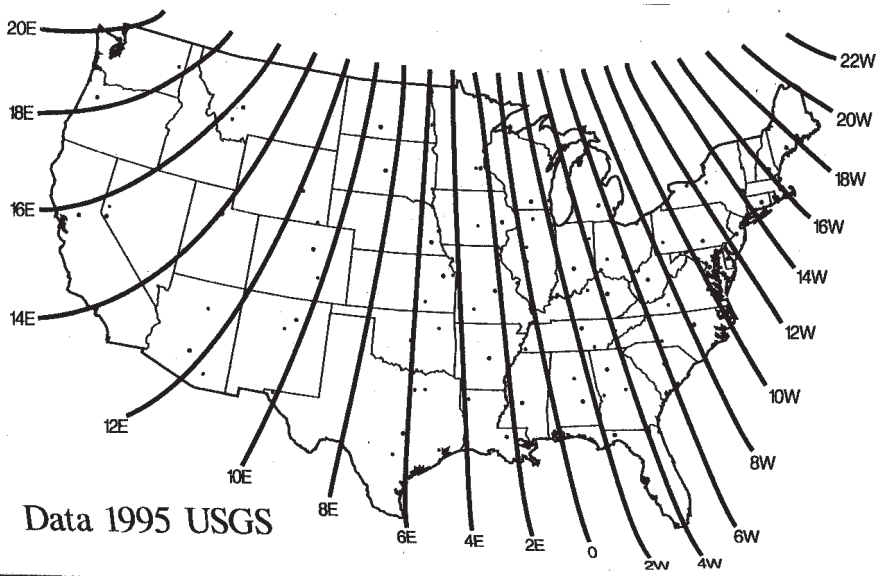
GN is Grid North, or the north/south axis against which all the lines in the UTM Zone grid are aligned. These are different for each Zone or map sheet, so read your map each time.

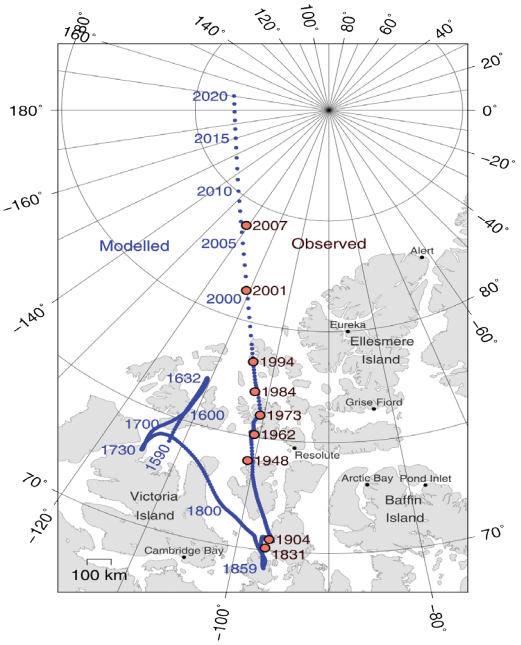
TN is True North. This is often marked with a star, and points to the location where all the longitude lines converge at the North Pole (which is more or less the axis about which the earth spins). This is the "grid" upon which lat/long measurements are taken. If using lat/long – like if you are working with the USAF – you will need to adjust directions to True North, not Grid North. *But we do not care about True North*.

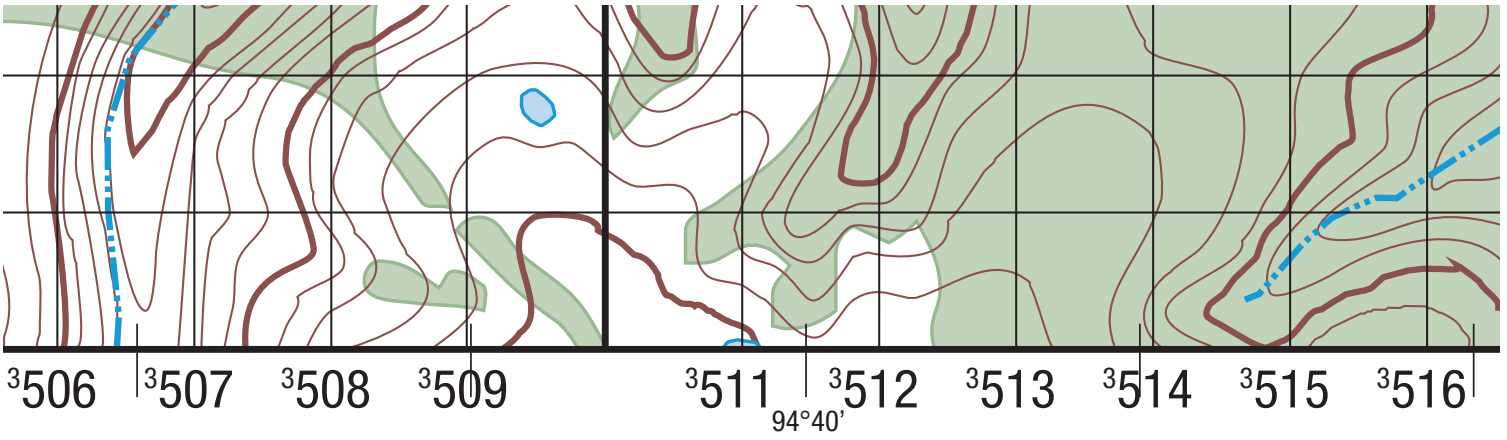
MN is Magnetic North, (often marked with an arrow) and corresponds to where your compass points. The declination chart is accurate ONLY at one point. Sometimes this is the center of the Zone, but for military charts it tends to be at the center of the sheet, or the actual piece of paper you are issued. This often will not matter a lot, but if you are working somewhere with 80° declination, it will change by several degrees as you move across sheets; driving for an hour can change declination a great deal.

Magnetic north moves about all the time. You need to look for the date the map was published; sometimes the date is immediately adjacent to the declination scale for this exact reason. In high declination areas, it can put you off by miles, even when traveling by foot, after just a few years.

In general, it's good to remember that Zones simulate being flat, 2D sheets so the grids are all square. But this is a cheat so there is some inaccuracy, and projection inaccuracy gets more severe as you approach the poles. If you will be operating in arctic areas, try to get familiar with the navigation methods needed in such environments.







3510^00m E

als 24.36 m
d increments

400 500 Meters
400 500 Yards
1/4 Statute Mile

) FEET

. . . . . .CLARKE 1866
. . . . . .100 M UTM ZONE 15
. . . . . TRANSVERSE MERCATOR
ODETIC VERTICAL DATUM OF 1929
WORLD GEODETIC SYSTEM 84
. . . . . .USGS, USC&GS & DMA
. . . . . KCAA GIS AUTH
NCY TOPOGRAPHIC CENTER 7 84

METER REFERENCE

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GN

GRID NORTH

TRUE NORTH

MAGNETIC NORTH

2008
G-M ANGLE
1°1'
(18 MILS)

GRID CONVERGENCE
2°39' (47 MILS)
FOR CENTER OF
SHEET

TO CONVERT A
MAGNETIC
AZIMUTH TO A
GRID AZIMUTH
SUBTRACT G-M
ANGLE

TO CONVERT A
GRID AZIMUTH TO
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