
NGA.STND.0037_2.0.0_GRIDS

# NATIONAL GEOSPATIAL-INTELLIGENCE AGENCY (NGA) STANDARDIZATION DOCUMENT

## UNIVERSAL GRIDS
## AND
## GRID REFERENCE SYSTEMS

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**OFFICE OF GEOMATICS**

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# CHAPTER 1
# GENERAL

## 1-1 INTRODUCTION

Earth features are commonly referenced using geographic coordinates. However, because it is a non-rectangular system of angular rather than linear units, the geographic coordinate system is often unsuitable for land-based operations that require distance calculations and location references. Grids provide a rectangular coordinate system of linear units (e.g. meters) which simplifies distance measurements and other calculations using, for example, the Universal Transverse Mercator (UTM) and Universal Polar Stereographic (UPS) grids. These grid locations are reported using the Military Grid Reference System (MGRS).

## 1-2 PURPOSE AND SCOPE

a. This manual provides guidance to Department of Defense (DoD) mapping and charting production elements, product users, system developers, and geospatial intelligence (GEOINT) analysts on the application of grids and grid reference systems. It describes the standard methods for selecting and portraying grids on maps, charts and graphics at scales of 1:1,000,000 and larger. Descriptions are based on the following categories:

   1) Topographic Maps
   2) Hydrographic Charts
   3) Aeronautical Charts

b. The Universal Transverse Mercator (UTM) grid, the Universal Polar Stereographic (UPS) grid and the Military Grid Reference System (MGRS) are described.

c. For standard topographic, hydrographic, and aeronautical products, additional detailed instructions and formats for grid depictions and labeling, grid margin data, declination data, font sizes, etc. are contained in NGA product specifications.

## 1-3 UTILIZATION

NGA.STND.0037_2.0_GRIDS is to be used by DoD mapping and charting production elements, product users, DoD system developers and GEOINT analysts in the application of grids and grid reference systems. Users are cautioned that the information contained herein applies to current and future production, and does not necessarily apply to products that are currently available through the DoD supply system.

## 1-4 SUPERCESSION

This document supersedes DMA 8358.1, Edition 1, September 1990.

## 1-5 STANDARD GRIDS

a. Between 84° N and 80° S, the standard grid is the UTM grid.

b. For polar areas north of 84° N and south of 80° S, the standard grid is the UPS grid.

c. The UTM and UPS grids are described in Chapter 2.

## 1-6 REFERENCE SYSTEMS

DoD and its mission partners mainly employ two types of coordinate reference systems: grid coordinates and geographic coordinates [IAW CJCSI 3900.01C Position (Point and Reference) Reference Procedures].

### 1-6-1 GRID REFERENCES

MGRS is an grid reference system based upon UTM and UPS grid coordinates. MGRS is described in Chapter 3. UTM and UPS grids are usually shown on maps and charts at scales of 1:1,000,000 and larger and are discussed further in Chapter 2. For a more detailed description and guidance on MGRS, UTM, and UPS, consult NGA INFORMATION GUIDANCE, The Universal Grids Based on the Transverse Mercator and Polar Stereographic Map-Projections, Version 2.0 (NGA.SIG.0012_2.0.0_UTMUPS).

### 1-6-2 GEOGRAPHIC REFERENCES

a. The use of geographic coordinates as a system of reference is based on the expression of position by latitude and longitude in terms of arc (degrees, minutes, and seconds) referred to the equator (north and south) and a prime meridian (east and west). Geographic coordinate references are described in Chapter 5.

b. On maps, charts and graphics, latitude and longitude are represented by the graticule, a network of lines or ticks representing parallels of latitude and meridians of longitude. Maps and charts at all scales show the graticule.

## 1-7 MULTIPLE GRIDS

Multiple grids are depicted at junction areas, as with a junction between UTM grid zones, or the junction of UTM and UPS grids. These occurrences present complex conditions but lend themselves to a uniform graphical treatment with differences in grid orientation and grid color, labels and values. The rules for the portrayal of multiple grids are given in later chapters.

## 1-8 OVERLAPPING GRIDS

Maps at scales of 1:100,000 and larger falling within approximately 40 kilometers of a grid zone junction portray the adjacent (overlapping) grid by ticks and values around the neatline. The rules for the portrayal of overlapping grids are given in Chapters 2, 6, and 9.

## 1-9 EXTENDED GRIDS

a. An extended grid is portrayed on certain NGA standard products such as Image City Maps. The extended grid provides total coverage of a map on a single grid when a portion of the map falls on an adjacent grid. The major grid is extended beyond the grid zone junction to cover the adjacent area and is shown by complete lines.

b. If extended grids are not specifically prescribed in NGA standard product specifications, multiple grids should be depicted. The rules for the portrayal of extended grids are given in Chapters 7, 8, and 11.

## 1-10 NON-UTM/UPS GRIDS

For guidance concerning non-UTM/UPS grids (also known as “nonstandard grids”), including but not limited to the British National Grid, please refer to Defence Geographic Centre Technical Manual GSGS 5191, produced by Defence Geographic Centre, Ministry of Defence, United Kingdom.

## 1-11 MARGIN NOTES

Margin notes on maps and charts (marginalia) should include projection, ellipsoid, grid zone, horizontal datum, and magnetic declination data. Treatment of marginalia on each NGA standard product is covered in the specific product specifications.

# CHAPTER 2
# HORIZONTAL DATUMS, ELLIPSOIDS, MAP PROJECTIONS AND GRIDS

## 2-1 HORIZONTAL DATUMS

a. A horizontal datum is a set of geodetic quantities which attaches a coordinate system to the earth's features.

b. A horizontal datum is necessary for large-scale mapping, charting, and geospatial applications requiring precision. Without a horizontal datum, coordinates remain imprecise or ambiguous.

c. The World Geodetic System 1984 (WGS 84) is the standard horizontal datum for the Department of Defense (DoD), as set forth in MIL-STD-2401 Department of Defense World Geodetic System (WGS).

d. It is not necessary to specify a horizontal datum for maps or charts at scales 1:1,000,000 or smaller.

## 2-2 ELLIPSOIDS

a. An ellipsoid called the reference ellipsoid is a mathematical model of the size and shape of the earth. It is formed by rotating an ellipse about its minor axis. The parameters of the ellipsoid occur in the formulas for a map projection (Section 2-3).

b. The WGS 84 ellipsoid is the standard reference ellipsoid for all DoD mapping, charting, and geospatial applications.

c. The ellipsoid is one element of a horizontal datum. Normally, the WGS 84 ellipsoid is specified when the horizontal datum is WGS 84.

## 2-3 MAP PROJECTIONS

a. A map projection is an orderly system for portraying the meridians and parallels of the reference ellipsoid upon a geometric plane called the map projection plane. The map projection consists of formulas for computing grid coordinates of a point given its geographic coordinates, and vice versa. The position of the grid in relation to the graticule is dependent on the parameters of the map projection.

b. Maps, charts and graphics that portray the Universal Transverse Mercator (UTM) or Universal Polar Stereographic (UPS) grids are normally projected using the corresponding UTM or UPS map projection parameters. This ensures accurate positioning and correct portrayal of grids. For exceptions see paragraph 2-3-3.

c. UTM parameters are selected according to hemisphere (northern or southern) and grid zone.

d. UPS parameters are selected according to hemisphere (northern or southern).

### 2-3-1 UNIVERSAL TRANSVERSE MERCATOR (UTM) SYSTEM

a. The UTM system of map projections is comprised of 120 separate Transverse Mercator projections, each with its own set of parameters. The world is divided into 60 longitudinal zones. Each zone is further divided into two separate hemisphere dependent coordinate systems, due to the assigning of different false northing values to the Origin Latitude.

The following Tables (1 and 2) are the map projection parameters of the UTM system and Table 3 shows the central meridians of the UTM zones:

1) Northern hemisphere:

| **Transverse Mercator parameter:** | **Specification for northern hemisphere UTM:** |
|---|---|
| Central meridian | See Table 3 |
| Central meridian scale (scale factor) | 0.9996 |
| False easting | 500,000 m |
| False northing | 0 m |
| Origin Longitude | Same as the central meridian |
| Origin Latitude | 0°N |

*Table 1.* Universal Transverse Mercator (UTM) Northern Hemisphere Map Projection Parameters

2) Southern hemisphere:

| **Transverse Mercator parameter:** | **Specification for southern hemisphere UTM:** |
|---|---|
| Central meridian | See Table 3 |
| Central meridian scale (scale factor) | 0.9996 |
| False easting | 500,000 m |
| False northing | 10,000,000 m |
| Origin Longitude | Same as the central meridian |
| Origin Latitude | 0°N |

*Table 2.* Universal Transverse Mercator (UTM) Southern Hemisphere Map Projection Parameters

3) Central Meridians:

| UTM Zone | Central Meridian |
|---|---|
| 1 | 177°W |
| 2 | 171°W |
| 3 | 165°W |
| 4 | 159°W |
| 5 | 153°W |
| 6 | 147°W |
| 7 | 141°W |
| 8 | 135°W |
| 9 | 129°W |
| 10 | 123°W |
| 11 | 117°W |
| 12 | 111°W |
| 13 | 105°W |
| 14 | 99°W |
| 15 | 93°W |
| 16 | 87°W |
| 17 | 81°W |
| 18 | 75°W |
| 19 | 69°W |
| 20 | 63°W |
| 21 | 57°W |
| 22 | 51°W |
| 23 | 45°W |
| 24 | 39°W |
| 25 | 33°W |
| 26 | 27°W |
| 27 | 21°W |
| 28 | 15°W |
| 29 | 9°W |
| 30 | 3°W |

| UTM Zone | Central Meridian |
|---|---|
| 31 | 3°E |
| 32 | 9°E |
| 33 | 15°E |
| 34 | 21°E |
| 35 | 27°E |
| 36 | 33°E |
| 37 | 39°E |
| 38 | 45°E |
| 39 | 51°E |
| 40 | 57°E |
| 41 | 63°E |
| 42 | 69°E |
| 43 | 75°E |
| 44 | 81°E |
| 45 | 87°E |
| 46 | 93°E |
| 47 | 99°E |
| 48 | 105°E |
| 49 | 111°E |
| 50 | 117°E |
| 51 | 123°E |
| 52 | 129°E |
| 53 | 135°E |
| 54 | 141°E |
| 55 | 147°E |
| 56 | 153°E |
| 57 | 159°E |
| 58 | 165°E |
| 59 | 171°E |
| 60 | 177°E |

*Table 3.* Central Meridians of the UTM Zones (See Tables 7 and 8 for exceptions)

### 2-3-2 UNIVERSAL POLAR STEREOGRAPHIC (UPS) SYSTEM

a. The UPS system consists of two separate Polar Stereographic projections: one each for the northern hemisphere and southern hemisphere.

The following Tables (4 and 5) are the map projection parameters of the UPS system:

1) Northern hemisphere:

| Polar Stereographic parameter: | Specification for northern UPS: |
|---|---|
| Scale at the Pole (scale factor) | 0.994000000 |
| Standard parallel | 81.11451787° N |
| Central meridian (longitude **down** from the Pole) | 0°E |
| False Easting | 2,000,000 m |
| False Northing | 2,000,000 m |
| Origin Longitude | 0°E (moot) |
| Origin Latitude | 90°N |

*Table 4.* Universal Polar Stereographic (UPS) System Northern Hemisphere Map Projection Parameters

2) Southern hemisphere:

| Polar Stereographic parameter: | Specification for southern UPS: |
|---|---|
| Scale at the Pole (scale factor) | 0.994000000 |
| Standard parallel | 81.11451787° S |
| Central meridian (longitude **up** from the Pole) | 0°E |
| False Easting | 2,000,000 m |
| False Northing | 2,000,000 m |
| Origin Longitude | 0°E (moot) |
| Origin Latitude | 90°S |

*Table 5.* Universal Polar Stereographic (UPS) System Southern Hemisphere Map Projection Parameters

b. In Tables 4 and 5, the scale at the Pole is an exact number, set by convention. The standard parallel (where the scale factor is unity), is computed from the scale at the Pole and the parameters of the WGS 84 ellipsoid.

### 2-3-3 OTHER MAP PROJECTIONS

Normally, maps and charts that portray UTM or UPS grids are projected using the corresponding UTM or UPS map projection parameters, but there are exceptions for some NGA standard products. Harbor, Approach and Coastal Charts portray UTM grids but use the Mercator projection. Tactical Pilotage Charts (TPCs) and Operational Navigation Charts (ONCs) portray UTM grids but use the Lambert Conformal Conic projection. Consult product specifications for individual NGA standard products to determine correct application of map projection parameters.

## 2-4 GRIDS

a. A grid is a pattern of horizontal and vertical lines forming squares, and superimposed on the map projection plane. The grid represents a rectangular (X,Y) coordinate system. The X and Y coordinates are called Eastings and Northings.

b. Vertical grid lines represent Eastings and horizontal lines represent Northings. In contrast to longitude and latitude, Eastings and Northings represent distances on the map or chart projection plane in agreement with the scale bar. Because of the unavoidable distortions in map projections, including the map projection chosen for the specification of a system of grid coordinates, the Eastings

and Northings do not exactly represent ground distances, i.e. distances on the ellipsoid. Within a UTM zone (6 degrees wide longitudinally), the variation from ground distance may be as much as 1 part in 1,000.

c. UTM and UPS grids are derived from the UTM and UPS systems of map projections.

### 2-4-1 UTM GRIDS

a. UTM grids are portrayed between 84°N and 80°S.

b. UTM grids are portrayed on maps, charts and graphics according to grid zones.

c. UTM grid zones extend 3° in longitude in each direction from the central meridian to form 60 UTM grid zones, each 6° wide. The numbering of zones starts at 180°W and proceeds eastward. Zone 1 extends from 180°W to 174°W; Zone 2 extends from 174°W to 168°W and so forth until reaching Zone 60 which extends from 174°E to 180°E (the notations 180°E and 180°W refer to the same meridian). Table 6 shows the extent of each UTM grid zone.

| UTM Grid Zone | Westernmost Extent | Easternmost Extent | UTM Grid Zone | Westernmost Extent | Easternmost Extent |
|---|---|---|---|---|---|
| 1 | 180°W | 174°W | 31 | 0°E | 6°E |
| 2 | 174°W | 168°W | 32 | 6°E | 12°E |
| 3 | 168°W | 162°W | 33 | 12°E | 18°E |
| 4 | 162°W | 156°W | 34 | 18°E | 24°E |
| 5 | 156°W | 150°W | 35 | 24°E | 30°E |
| 6 | 150°W | 144°W | 36 | 30°E | 36°E |
| 7 | 144°W | 138°W | 37 | 36°E | 42°E |
| 8 | 138°W | 132°W | 38 | 42°E | 48°E |
| 9 | 132°W | 126°W | 39 | 48°E | 54°E |
| 10 | 126°W | 120°W | 40 | 54°E | 60°E |
| 11 | 120°W | 114°W | 41 | 60°E | 66°E |
| 12 | 114°W | 108°W | 42 | 66°E | 72°E |
| 13 | 108°W | 102°W | 43 | 72°E | 78°E |
| 14 | 102°W | 96°W | 44 | 78°E | 84°E |
| 15 | 96°W | 90°W | 45 | 84°E | 90°E |
| 16 | 90°W | 84°W | 46 | 90°E | 96°E |
| 17 | 84°W | 78°W | 47 | 96°E | 102°E |
| 18 | 78°W | 72°W | 48 | 102°E | 108°E |
| 19 | 72°W | 66°W | 49 | 108°E | 114°E |
| 20 | 66°W | 60°W | 50 | 114°E | 120°E |
| 21 | 60°W | 54°W | 51 | 120°E | 126°E |
| 22 | 54°W | 48°W | 52 | 126°E | 132°E |
| 23 | 48°W | 42°W | 53 | 132°E | 138°E |
| 24 | 42°W | 36°W | 54 | 138°E | 144°E |
| 25 | 36°W | 30°W | 55 | 144°E | 150°E |
| 26 | 30°W | 24°W | 56 | 150°E | 156°E |
| 27 | 24°W | 18°W | 57 | 156°E | 162°E |
| 28 | 18°W | 12°W | 58 | 162°E | 168°E |
| 29 | 12°W | 6°W | 59 | 168°E | 174°E |
| 30 | 6°W | 0°E | 60 | 174°E | 180°E |

*Table 6.* Eastern and Western Extents of Each UTM Grid Zone

d. Tables 7 and 8 show the exceptions to the above limits which occur near southern Norway and Svalbard:

1) Between 56° N and 64° N, UTM grid zones 31 and 32 adhere to the following limits:

| UTM Grid Zone | Westernmost Extent | Easternmost Extent |
|---|---|---|
| 31 | 0°E | 3°E |
| 32 | 3°E | 12°E |

*Table 7.* UTM Grid Zone Extent Exceptions for Southern Norway

2) Between 72° N and 84° N, UTM grid zones 32, 34, and 36 do not exist. Zones 31, 33, 35, and 37 adhere to the following limits:

| UTM Grid Zone | Westernmost Extent | Easternmost Extent |
|---|---|---|
| 31 | 0°E | 9°E |
| 33 | 9°E | 21°E |
| 35 | 21°E | 33°E |
| 37 | 33°E | 42°E |

*Table 8.* UTM Grid Zone Extent Exceptions Near Svalbard

e. Each of the 60 UTM grid zones is further divided into its northern and southern hemisphere parts.

### 2-4-2 UPS GRIDS

UPS grids are portrayed north of 84° N and south of 80° S.

### 2-4-3 TRANSFORMED GRIDS

a. If a map or chart portrays a UTM or UPS grid but is not projected with the corresponding UTM or UPS map projection parameters, the grid must be transformed so that the grid lines and their intersections have the correct positional relationship to the graticule.

b. Transformed grid lines will vary slightly from the pattern of perfect parallel lines, right-angle intersections, and squares (in most cases, this variation cannot be detected visually).

c. The same transformation process applies for maps and charts that portray multiple grids.

d. For further guidance see “Converting Coordinates between Grid Systems” (Section 2-5).

### 2-4-4 MULTIPLE GRIDS

a. The boundary between UTM grid zones, or between UTM and UPS coverage, is called a grid zone junction. The grid zone junction is formed by parallels and/or meridians. Grid lines for a particular grid zone end at the grid zone junction. Two sets of grid lines, each corresponding to its own UTM or UPS parameters, will be portrayed separately on each side of the grid zone junction.

b. Normally, maps and charts that portray multiple grids are projected with the map projection parameters for the grid zone that covers the greatest portion of the chart. The other grid(s) must be converted.

### 2-4-5 OVERLAPPING GRIDS

a. In some cases, a grid may be portrayed beyond its grid zone boundary into an adjacent grid zone, resulting in overlapping grids. The grid portrayed within its own grid zone is termed the major grid. The grid portrayed beyond its grid zone is termed the minor grid. The minor grid is always indicated by ticks instead of lines.

b. The concept of overlapping grids should not be confused with the concept of multiple grids. The latter refers to the portrayal of two or more major grids.

### 2-4-6 GRID LINES, TICKS, AND INTERVALS

a. For each UTM and UPS grid, the X-axis and Y-axis coincides with the Origin Latitude and Origin Longitude, respectively. The remaining grid lines are spaced from the axes at a predetermined interval, in meters, in accordance with the map scale. Normally, the interval is a power of ten (e.g. 100, 1000, 10,000, or 100,000). Table 9 shows some selected NGA products with their grid intervals:

| Product Type | Map Scale | Grid Interval |
|---|---|---|
| Urban maps | >1:3,001 | 100 meters |
| Topographic Map (TM) | 1:25,000, 1:50,000 or 1:100,000 | 1,000 meters |
| Joint Operations Graphic (JOG) | 1:250,000 | 10,000 meters |

*Table 9.* Grid Intervals for some NGA Products

b. Consult individual NGA product specifications to determine grid line interval.

c. In some cases, grids are represented by ticks instead of lines. For example, on many hydrographic charts, the grid is indicated by intersection interior ticks and neatline ticks.

d. Ticks also are portrayed in conjunction with grid lines. For example, on many topographic maps, the major grid is portrayed with lines while the minor grid is indicated by neatline ticks.

e. Ticks often are used in conjunction with grid lines to provide a supplemental grid interval for aid in referencing. Examples:

1) On many aeronautical charts, grid lines are spaced at 100,000 meter intervals and ticks are spaced at 10,000 meter intervals.

2) On some NGA standard City Graphics, grid lines are spaced at 1,000 meter intervals and ticks are spaced at 100 meter intervals.

3) On many NGA urban maps, grid lines are spaced at 100 meter intervals and ticks are spaced at 10 meter intervals.

## 2-5 CONVERTING COORDINATES BETWEEN GRID SYSTEMS

Coordinates may be converted from one grid system to another grid system, for instance, between a grid constructed on the Lambert Conformal Conic projection and a UTM grid, or between a UTM grid and an adjacent UTM grid. The preferred procedure is to convert the grid coordinates from the first grid system to geographic positions, then convert the geographic positions to grid coordinates of the second grid system. Note: This procedure does not change the horizontal datum.

# CHAPTER 3
# THE MILITARY GRID REFERENCE SYSTEM (MGRS)

## 3-1 GENERAL DESCRIPTION

a. MGRS was designed for use with the Universal Transverse Mercator (UTM) and Universal Polar Stereographic (UPS) grids and provides a unique alphanumeric reference for reporting a UTM or UPS grid location.

b. For convenience, the world is generally divided into 8° of latitude by 6° degree of longitude, each of which is given a unique identification, called the Grid Zone Designation (Figure 1). These areas are covered by a pattern of 100,000-meter squares. Each square is identified by two letters called the 100,000-meter square identification. This identification is unique within the area covered by the Grid Zone Designation.

c. Ordinarily, a reference keyed to a gridded map of any scale is made by giving the 100,000-meter square identification together with the numerical location. Numerical references within the 100,000-meter square are given to the desired precision in terms of the easting (E) and northing (N) grid coordinates for the point.

d. The Grid Zone Designation usually is prefixed to the 100,000-meter square identification when references are made in more than one Grid Zone Designation area. For more information, see Appendix A.

## 3-2 THE GRID ZONE DESIGNATION

a. For that portion of the world where the UTM grid is specified (80° S to 84° N), the UTM grid zone in Table 6 is the first element of the Grid Zone Designation. This number sets the zone longitude limits. Zone 32 has been widened to 9° (at the expense of zone 31) between latitudes 56° N and 64° N as specified in Table 7, and Zones 31-37 have been modified or eliminated between latitudes 72° N and 84° N as specified in Table 8. Otherwise, the zones have the limits given in Table 6.

b. The other element of the Grid Zone Designation is a letter which designates a latitude band. Beginning at 80° south and proceeding northward, twenty latitude bands are lettered C through X, omitting I and O. The bands are all 8° tall except for band X which is 12° tall. Thus, in the UTM portion of the MGRS, the first three characters designate one of the 1197 areas with the dimensions as shown in Figure 1 and tabulated in Table 10.

c. In the Polar regions, there is no zone number. A single letter designates a semicircular area and hemisphere. Since the letters A, B, Y, and Z are used only in the Polar regions, their presence in an MGRS, with the omission of a zone number, designates that the coordinates are UPS.

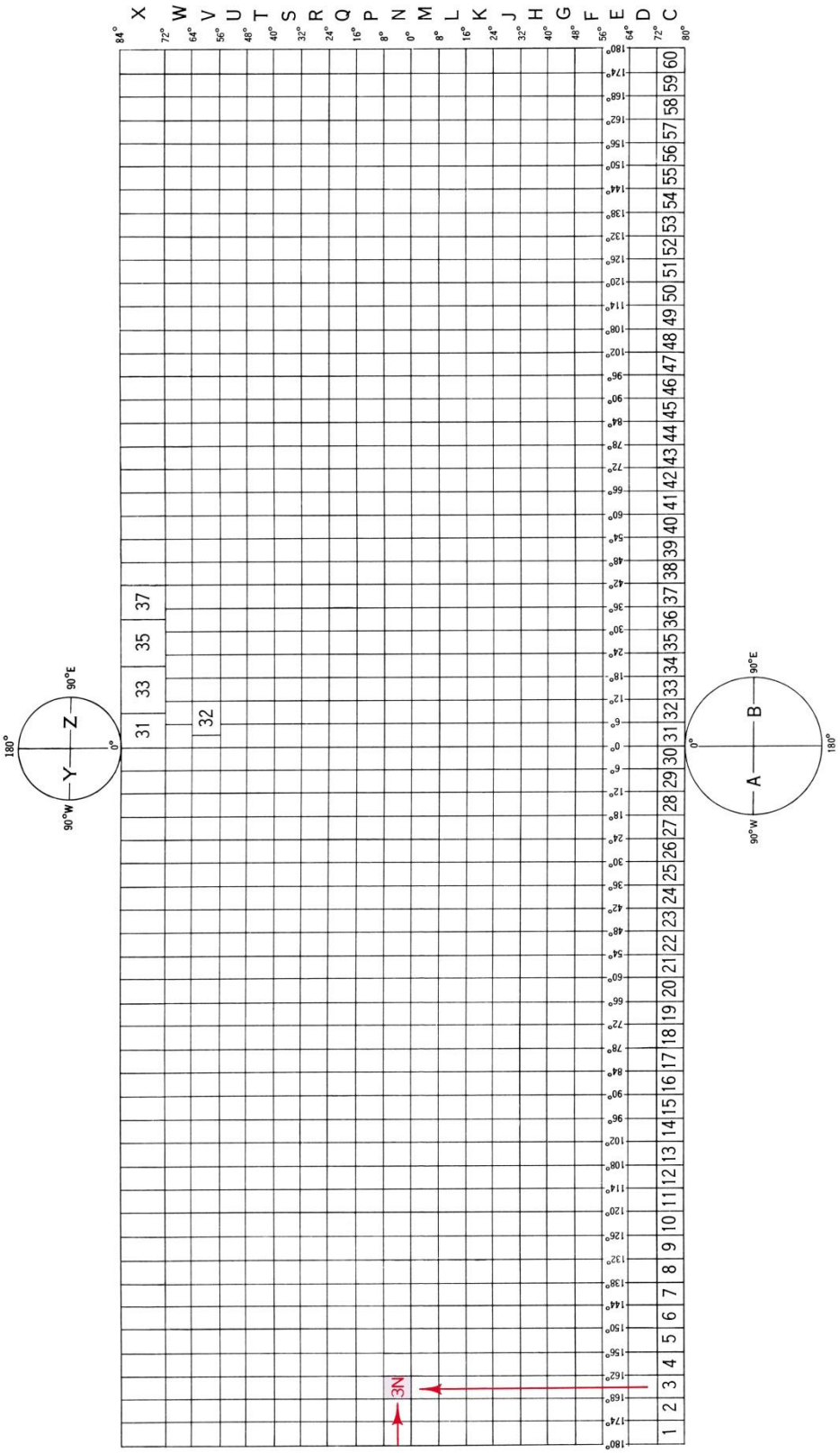


*Figure 1.* Grid Zone Designations of the Military Grid Reference System

d. Following are the dimensions of Grid Zone Designation Areas:

| Latitude Interval | Longitude Interval | Number of Areas |
|---|---|---|
| 8° | 6° | 1138 |
| 8° | 9° | 1 |
| 8° | 3° | 1 |
| 12° | 6° | 53 |
| 12° | 9° | 2 |
| 12° | 12° | 2 |

*Table 10.* Dimensions of Grid Zone Designation Areas

e. The remainder of this chapter describes the determination of the 100,000-meter square identification and the military grid reference.

## 3-3 100,000-METER SQUARE IDENTIFICATION

a. MGRS uses a lettering scheme to identify the square, 100,000 meters on a side, that contains the UTM or UPS position of interest. This section introduces the UTM portion of this scheme. Details with examples are given in Appendix B and Figure 2.

b. Figure B-3 is divided into six panels, corresponding to the division of the 60 UTM zones into six sets, as indicated in the headings of the panels. Each panel is an 8 x 20 array of letterings that identify a 100,000 meter square. The eight squares in a row represent the interval of eastings from 100,000mE to 900,000mE. The 20 squares in a column represent a 2,000,000m interval of northings repeated as often as necessary to cover the entire range of UTM northings. In other words the same 20 squares represent 0mN to 2,000,000mN, and 2,000,000mN to 4,000,000mN, and 4,000,000mN to 6,000,000mN and so on. This applies equally to the southern hemisphere UTM as it does to the northern.

c. Users are cautioned that deviations from the Figure B-3 scheme were made in the past. These deviations were an attempt to provide unique grid references within a complicated and disparate world-wide mapping system.

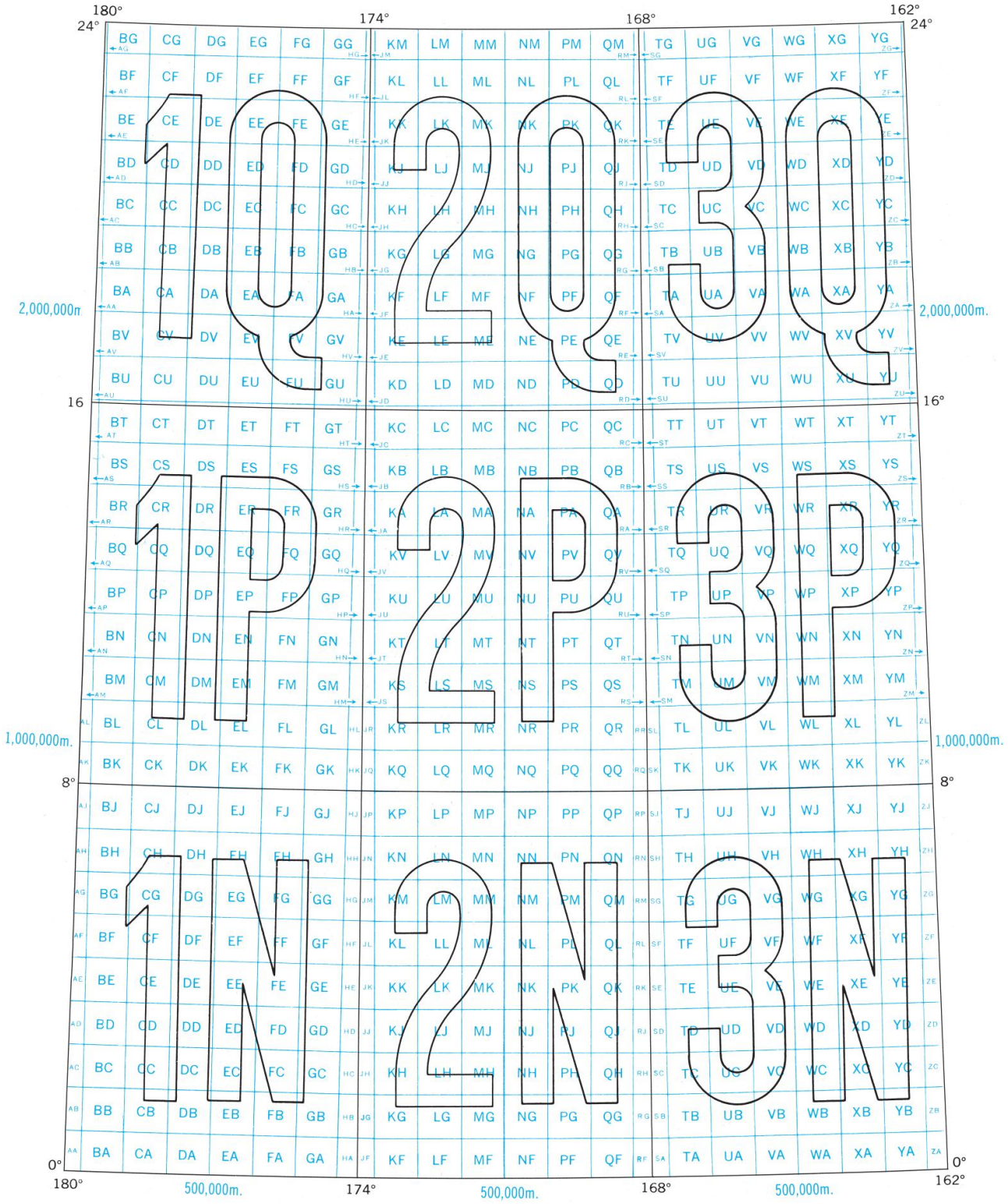


*Figure 2.* Basic plan of the 100,000-meter Square Identifications of the U.S. Military Grid Reference System, Between 84° N and 80° S

## 3-4 THE MILITARY GRID REFERENCE

a. The MGRS reference for a position consists of a string of letters and numbers which include the following elements:

1) The Grid Zone Designation.

2) The 100,000-meter square identification.

3) The grid coordinates (also referred to as rectangular coordinates), which provides the numerical portion of the reference expressed to a desired refinement (this element is not included for a refinement level of 100,000-meters).

b. An MGRS point reference is written as an entity without spaces, parentheses, dashes, or decimal points. Examples:

| | |
|---|---|
| 18SUU | (Locating a point at 100,000-meter precision) |
| 18SUU80 | (Locating a point at 10,000-meter precision) |
| 18SUU8301 | (Locating a point at 1,000-meter precision) |
| 18SUU836014 | (Locating a point at 100-meter precision) |
| 18SUU83620143 | (Locating a point at 10-meter precision) |
| 18SUU8362601432 | (Locating a point at one-meter precision) |

c. In some circumstances, users may want to reduce the refinement of a position reference, often to bring the reference to the same refinement as other references of a particular set. In such cases, refinement is reduced not by rounding values (as with conventional mathematical methods), but by truncation.

d. The MGRS references can be used to identify grid squares, whether graphical (as on a map or computer display) or theoretical. The precision level of the reference corresponds to the size of the grid square. Grid squares smaller than 100,000 meters are identified by the MGRS reference of the point at the southwest corner of the square, truncated to the appropriate precision level. Examples:

| | |
|---|---|
| 18SUU | (Identifying a 100,000-meter square) |
| 18SUU80 | (Identifying a 10,000-meter square) |
| 18SUU8301 | (Identifying a 1,000-meter square) |
| 18SUU836014 | (Identifying a 100-meter square) |
| 18SUU83620143 | (Identifying a 10-meter square) |
| 18SUU8362601432 | (Identifying a one-meter square) |

1) For grid square 18SUU80, the 8 represents the 10,000-meter digit of the easting grid line that forms the west side of the square. The 0 represents the 10,000-meter digit of the northing grid line that forms the south side of the square.

2) For grid square 18SUU8301, the 83 represents the 10,000-meter and 1,000-meter digits of the easting grid line that forms the west side of the square. The 01 represents the 10,000-meter and 1,000-meter digits of the northing grid line that forms the south side of the square.

3) For grid square 18SUU836014, the 836 represents the 10,000-meter, 1,000-meter and 100-meter digits of the easting grid line that forms the west side of the square. The 014 represents the 10,000-meter, 1,000-meter and 100-meter digits of the northing grid line that forms the south side of the square.

4) The pattern continues for 10-meter and one-meter squares.

## 3-5 MGRS APPLICATION

a. All elements of a grid reference need not be used. Their use depends upon the size of the area of activities, the type of military operations, and the scale of the map to which the reference is keyed. The military area commander usually designates the elements of the grid references to be used. The following paragraphs provide guidance for the use of Grid Zone Designations and 100,000-meter square identifications.

   1) For military operations spanning large geographical areas, the Grid Zone Designation is usually given (such as 18R). This designation will alleviate ambiguity between identical references that may occur when reporting to a station outside the area. The Grid Zone Designation is always used in giving references on 1:1,000,000 scale and 1:500,000 scale maps.

   2) For operational areas of lesser extent, but exceeding 100,000 meters, the 100,000-meter square identification is used (such as UU80). The 100,000-meter square identification is used in reporting references on the 1:250,000 and larger scale maps to avoid ambiguity between identical references which occur every 100,000 meters, and near grid zone junctions.

   3) For small and localized operational areas, the Grid Zone Designations and 100,000-meter square identifications are not used, unless reporting falls within the parameters explained in preceding paragraphs. In the instance of local reporting only the numerical part of the grid reference is used (such as 836014). This condition applies to 1:100,000 scale maps and larger.

   4) Topographic maps at scales 1:500,000 and larger provide a grid reference box with the elements and instructions for making a complete grid reference.

b. The numerical part of a grid reference always contains an even number of digits. The first half of the total number of digits represents the easting, and second half the northing. The standard military practice of reading "right (easting) and up (northing)" is employed.

   1) To read the easting coordinate, locate the first easting (vertical) grid line to the west of the point of reference and read the large digit (or digits), the principal digit labeling the line either in the top or bottom margin or on the line itself. Smaller digits shown as part of a grid number are ignored. Estimate, or scale to the closest tenth of the grid interval, the distance between the easting grid line to the west of the point and the point itself.

   2) The reading of the northing coordinate is made in a similar manner. Locate the first northing (horizontal) grid line south of the point of reference and read the principal digits labeling the line located in the left or right margin or on the line itself. Then estimate, or scale to the closest tenth of the grid interval, the distance between the northing grid line south of the point and the point itself.

   3) The numerical part of a point reference taken from a 100,000-meter grid (on maps of 1:1,000,000 scale) is a two-digit number; for example: 80. Reading from left to right, the 8 represents the 10,000 digit of the first easting grid line (or grid tick) to the west of the point; the 0 represents the 10,000 digit of the first northing grid line (or grid tick) south of the point.

4) The numerical part of a point reference taken from a 10,000-meter grid (on maps smaller than 1:100,000 scale and larger than 1:1,000,000 scale) is a four-digit number; for example: 8706. Reading from left to right, the 8 represents the 10,000 digit of the first easting grid line to the west of the point, the 7 represents the estimated tenths (nearest 1,000 meters) from the easting grid line to the point, the 0 represents the 10,000 digit of the first northing grid line south of the point, and the 6 represents the estimated tenths (nearest 1,000 meters) from the northing grid line to the point. See Figure 3.

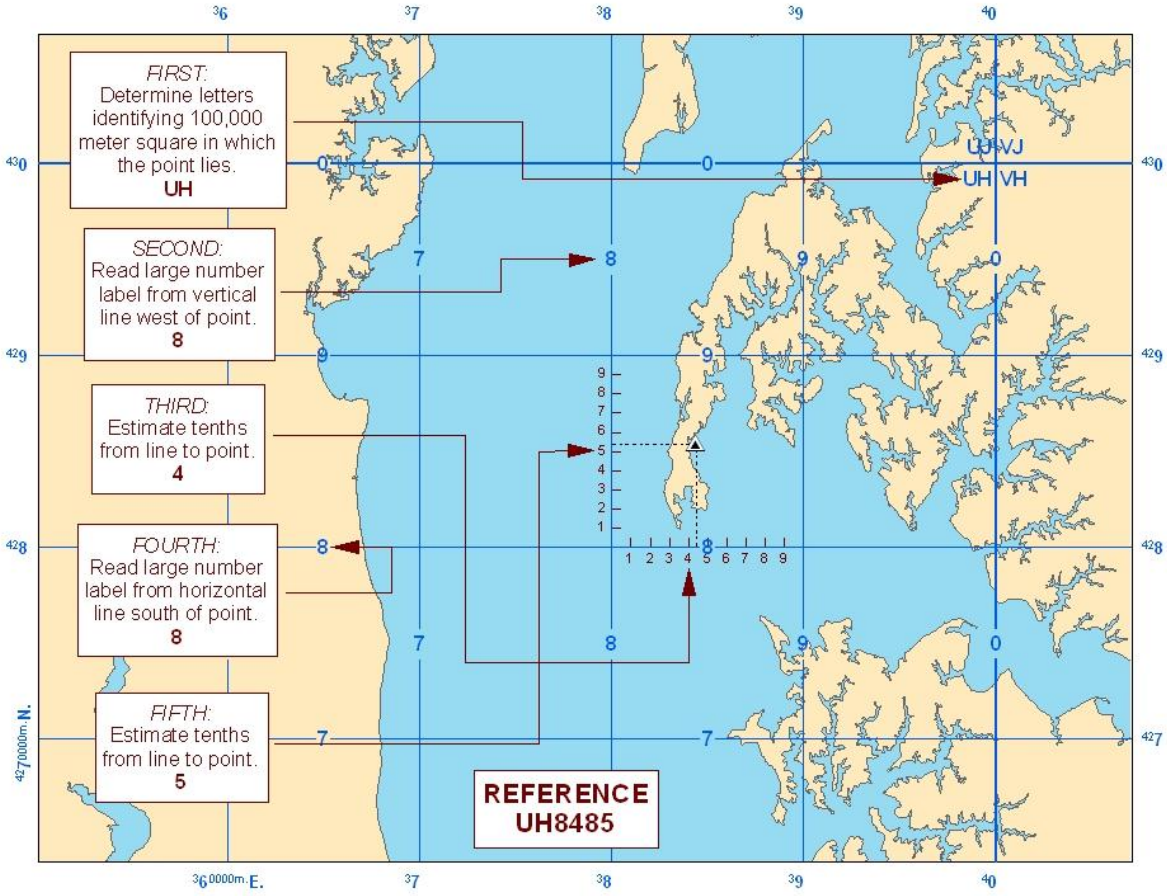


*Figure 3.* Method of Reading a 1,000 Meter Coordinate from a 10,000-meter Grid

5) Normally, the numerical part of a point reference taken from a 1,000-meter grid (on maps at scales of 1:100,000 and larger) is a six-digit number; for example: 872066. Reading from left to right, the 87 represents the 10,000 and 1,000 digits of the first easting grid line to the west of the point, the 2 represents the estimated or scaled tenths (nearest 100 meters) from the easting line to the point, the 06 represents the 10,000 and 1,000 digits of the first northing grid line south of the point, and the 6 represents the estimated or scaled tenths (nearest 100 meters) from the northing grid line to the point. See Figure 4.

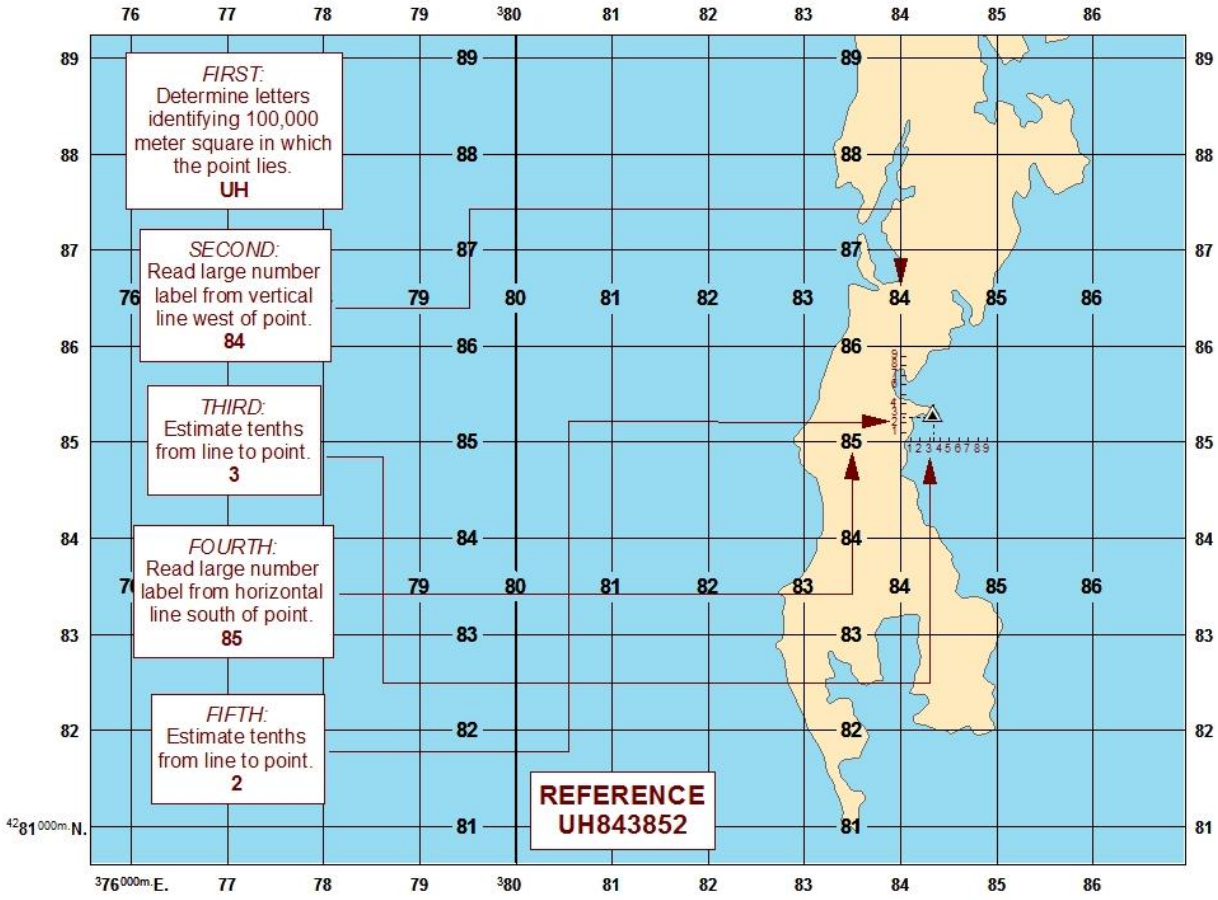


*Figure 4.* Method of Reading a 100 Meter Coordinate from a 1,000-meter Grid

6) The numerical part of a point reference taken from a 100-meter grid is an eight-digit number; for example: 87230664. Reading from left to right, the 872 represents the 10,000, 1,000 and 100 digits of the first easting grid line to the west of the point, the 3 represents the estimated or scaled tenths (nearest 10 meters) from the easting line to the point. The 066 represents the 10,000, 1,000 and 100 digits of the first northing grid line south of the point, and the last 4 represents the estimated or scaled tenths (nearest 10 meters) from the northing grid line to the point. See Figure 5.

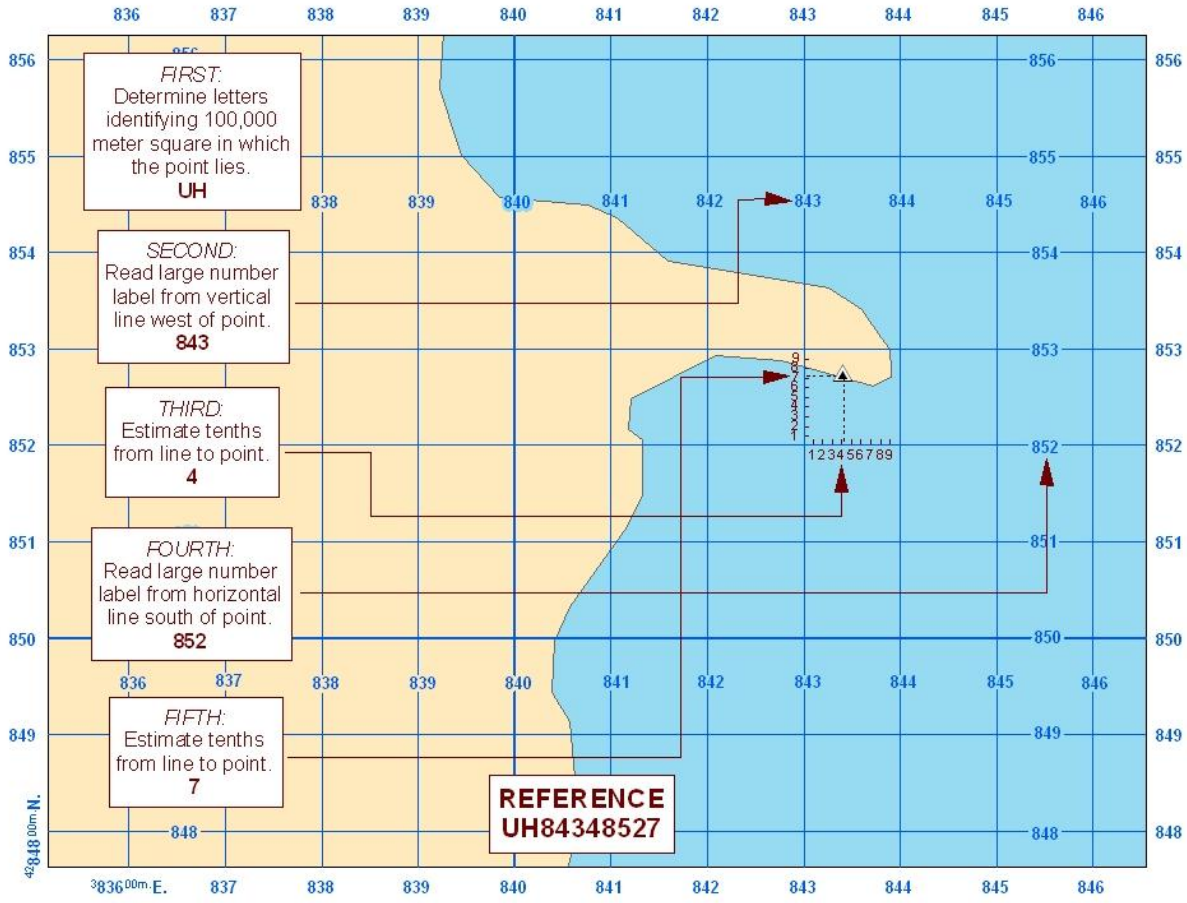


*Figure 5.* Method of Reading a 10 Meter Coordinate from a 100-meter Grid

7) The numerical part of a point reference taken from a 10-meter grid is a ten digit number; for example: 8723X0664Y. Reading from left to right, the 8723 represents the 10,000, 1,000, 100 and 10 digits of the first easting grid line to the west of the point, the 6 represents the estimated or scaled tenths (nearest meter) from the easting line to the point. The 0664 represents the 10,000, 1,000 and 100 and 10 digits of the first northing grid line south of the point, and the second 6 represents the estimated or scaled tenths (nearest meter) from the northing grid line to the point. See Figure 6.

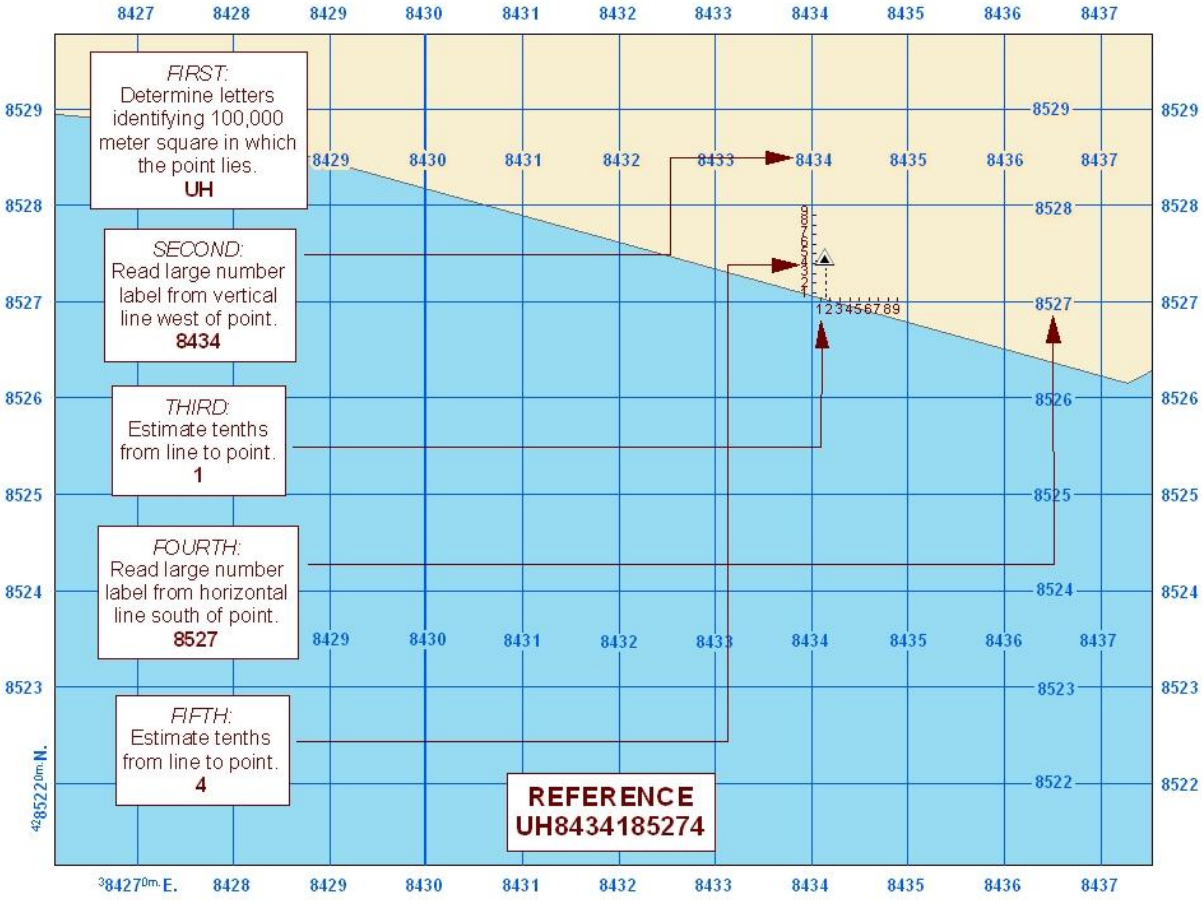


*Figure 6.* Method of Reading a 1 Meter Coordinate from a 10-meter Grid

# CHAPTER 4
# GRATICULE-BASED AREA REFERENCE SYSTEMS

## 4-1 THE GLOBAL AREA REFERENCE SYSTEM (GARS)

a. The Global Area Reference System (GARS) is the standard reference system authorized by Chairman Joint Chiefs of Staff Instruction (CJCSI) 3900.01C, *Position (Point and Area) Reference Procedures*, 30 June 2007, for reporting and referencing areas (referenced to the WGS-84 horizontal datum).

b. The GARS is an operational-level administrative measure and was designed to provide an integrated common frame of reference for joint force situational awareness and to coordinate areas rapidly to facilitate deconfliction, integration and synchronization. It provides a common language between Services and components and simplifies communication.

c. The GARS uses a single grid origin and covers the entire globe, improving coordination and communications between areas of responsibility. It provides a 2D construct from which control and coordination measures are built. The GARS was designed for battle space management and not intended for precise targeting or navigation, nor is it intended to replace any previous referencing system such as the Military Grid Reference System (MGRS), Universal Transverse Mercator (UTM) or Universal Polar Stereographic (UPS) grid systems, or the World Geographic Reference System (GEOREF). However, it is intended to replace its predecessor, the Common Geographic Referencing System (CGRS), unless it is determined by the combatant commander that the CGRS is mission critical.

d. In addition to military forces, there may be a large number of other U.S. government agencies, intergovernmental organizations, nongovernmental organizations and regional organizations that could use the GARS.

## 4-2 THE GARS DESIGN

a. The GARS divides the surface of the earth into 30-minute by 30-minute cells. Each cell is identified by a five-character designation. (ex. 006AG)

b. The first three characters designate a 30-minute wide longitudinal band. Beginning with the 180-degree meridian and proceeding eastward, the bands are numbered from 001 to 720, so the 180° 00'E/W to 179° 30'W is band 001; 179° 30'W to 179° 00'W is band 002; and so on.

c. The fourth and fifth characters designate a 30-minute tall latitudinal band. Beginning at the south pole and proceeding northward, the bands are lettered from AA to QZ (omitting I and O) so that 90° 00'S to 89° 30'S is band AA; 89° 30'S to 89° 00'S is band AB; and so on.

d. Each 30-minute cell is divided into four 15-minute by 15-minute quadrants.

e. The quadrants are numbered sequentially, from west to east, starting with the northernmost band. Specifically, the northwest quadrant is "1"; the northeast quadrant is "2"; the southwest quadrant is "3"; the southeast quadrant is "4".

f. Each quadrant is identified by a six-character designation. (ex. 006AG3) The first five characters comprise the 30-minute cell designation. The sixth character is the quadrant number.

g. Each 15-minute quadrant is divided into a 3 by 3 area array of nine 5-minute areas.

h. The areas are numbered sequentially, from west to east, starting with the northernmost band, specifically, starting with the northwest 5-minute by 5-minute area as “1” and the southeast 5-minute area as “9”.

i. Each 5-minute by 5-minute area or “key” is identified by a seven-character designation. The first six characters comprise the 15-minute quadrant designation. The seventh character is the “key” number. (ex. 006AG39)

j. Figure 7 depicts the GARS construct and labeling.

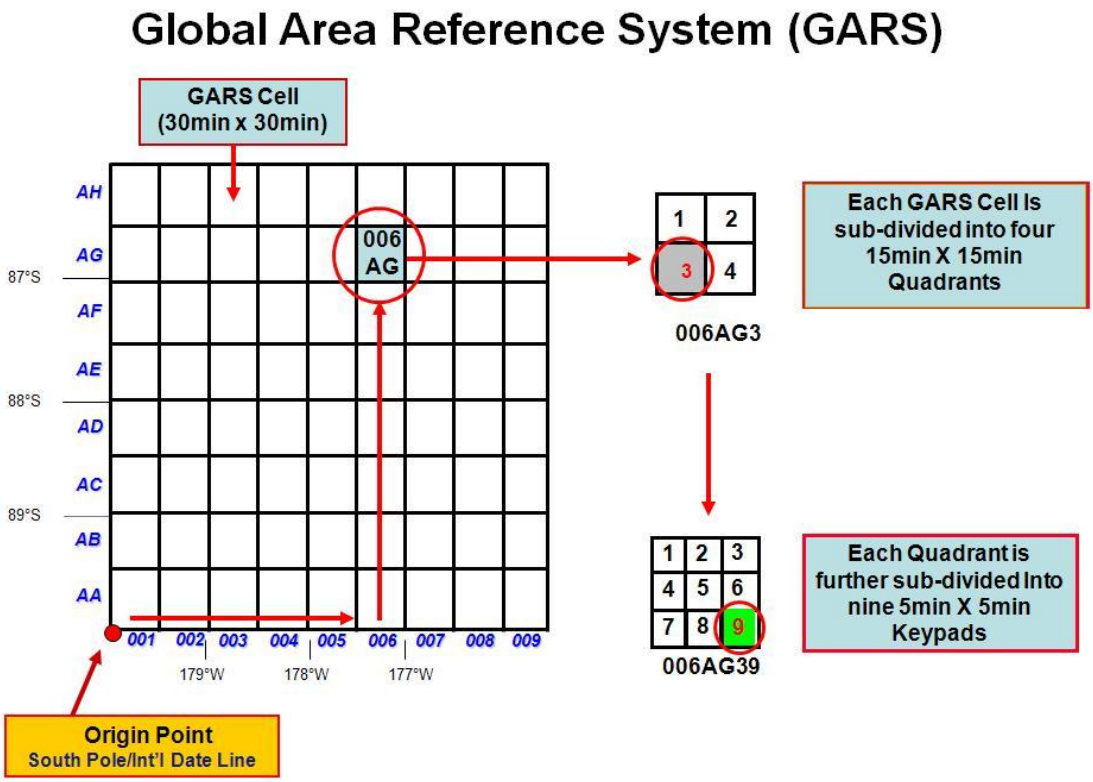


*Figure 7.* GARS Construct and Labeling

## 4-3 THE WORLD GEOGRAPHIC REFERENCE SYSTEM

a. The World Geographic Reference System (GEOREF) is a system used for position reporting. It is not a military grid, and therefore does not replace existing military grids. It is an area-designation method designed for inter-service and inter-allied position reporting for air defense and strategic air operations. Positions are expressed in a form suitable for reporting and plotting on any map or chart graduated in latitude and longitude regardless of map projection.

b. The system divides the surface of the earth into quadrangles, the sides of which are specific arc lengths of longitude and latitude; each quadrangle is identified by a simple systematic letter code giving positive identification with no risk of ambiguity.

c. There are 24 longitudinal zones each of 15 degrees width extending eastward from the 180° meridian around the globe through 360 degrees of longitude. These zones are lettered from A to Z inclusive (omitting I and O). There are 12 bands of latitude each of 15 degrees height, extending northward from the South Pole. These bands are lettered from A to M inclusive (omitting I) northward from the

South Pole. This code divides the earth's surface into 288 15-degree quadrangles, each of which is identified by two letters. The first letter is that of the longitude zone and the second letter that of the latitude band. Thus the major part of the United Kingdom is in the 15-degree quadrangle MK. See Figure 8.

d. Each 15-degree quadrangle is sub-divided into 15 one-degree zones of longitude, eastward from the western meridian of the quadrangle, these one-degree units being lettered from A to Q inclusive (omitting I and O). Each 15-degree quadrangle is also subdivided into 15 one-degree bands of latitude northward from the southern parallel of the quadrangle, these bands being lettered from A to Q inclusive (omitting I and O). A one-degree quadrangle anywhere on the earth's surface may now be identified by four letters. Salisbury therefore is in the one-degree quadrangle MKPG. See Figure 8.

e. Each one-degree quadrangle is divided into 60 minutes of longitude, numbered eastward from its western meridian, and 60 minutes of latitude, numbered northward from its southern parallel. This direction of numbering is used wherever the one-degree quadrangle is located, i.e., it does not vary even though the location may be west of the prime meridian or south of the equator. A unique reference defining the position of a point to an accuracy of one minute in latitude and longitude (i.e., 2 km or less) can now be given by quoting four letters and four numerals. The four letters identify the one degree quadrangle. The first two numerals are the number of minutes of longitude by which the point lies eastward of the western meridian of the one-degree quadrangle, and the last two numerals are the number of minutes of latitude by which the point lies northward of the southern parallel of the one-degree quadrangle. If the number of minutes is less than 10, then the first numeral will be a zero and must be written, e.g., 04. The GEOREF of Salisbury Cathedral is MK PG 12 04. See Figure 8.

f. Each of the one-degree quadrangles may be further divided into decimal parts (1/10th and 1/100th) eastward and northward. Thus, four letters and six numerals will define a location to 0.1-minute; four letters and eight numerals will define a location to 0.01-minute.

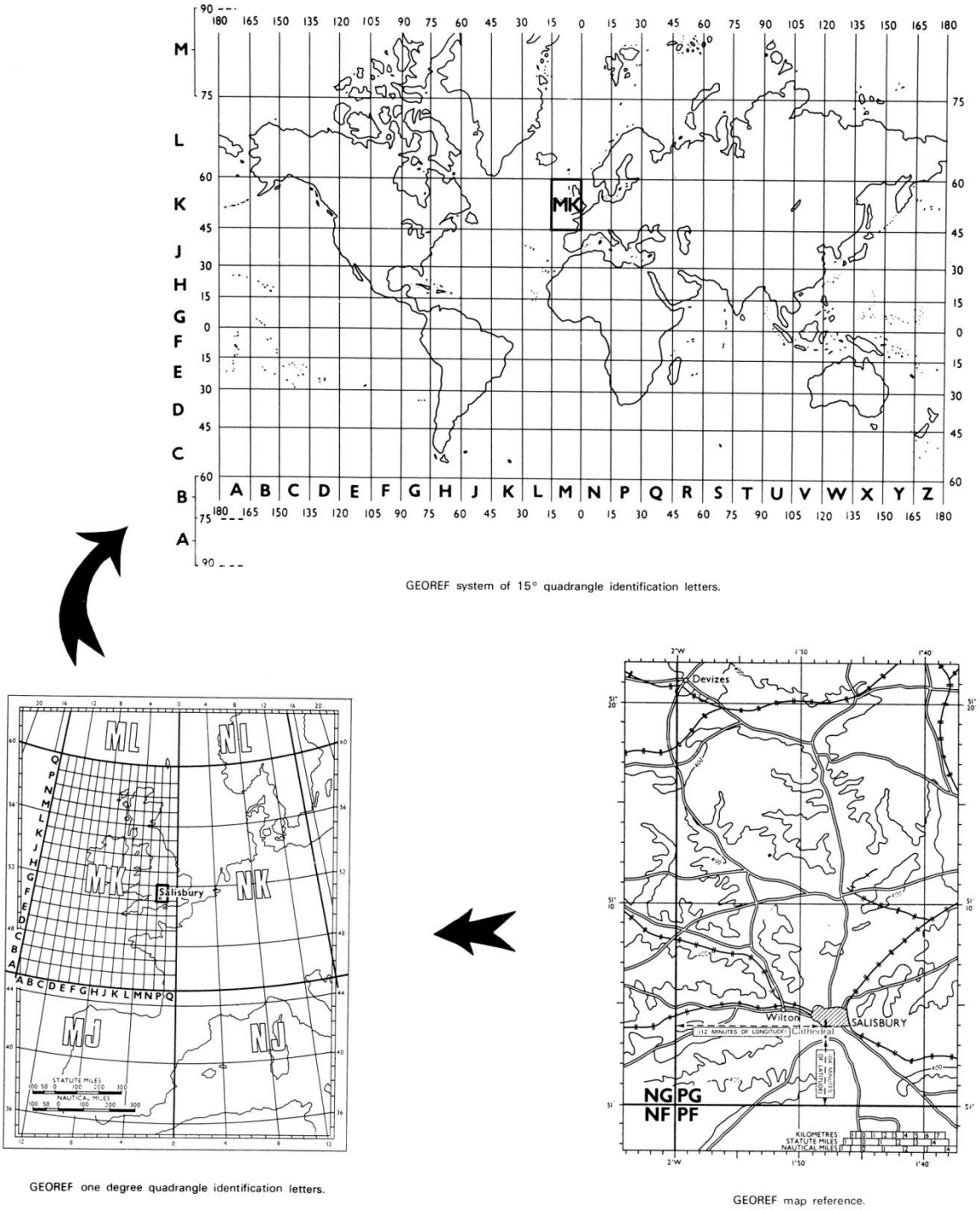


*Figure 8*. World Geographic Reference (GEOREF) System

# CHAPTER 5
# GEOGRAPHIC COORDINATE REFERENCES

## 5-1 GENERAL

a. The use of geographic coordinates as a system of reference is accepted worldwide. It is based on the expression of position by latitude (parallels) and longitude (meridians) in terms of arc (degrees, minutes, and seconds) referred to the Equator (north and south) and a prime meridian (east and west).

b. U.S. Military maps use the sexagesimal system of angular measurement (the division of a circle into 360°) for designating the values of the graticule. A degree is divided into 60 minutes, and each minute into 60 seconds. Parallels are numbered north and south from 0° at the equator to 90° at the poles. Meridians are numbered east and west from 0° at the prime meridian to a common 180° meridian. In WGS 84, longitudes are referred to the IERS Reference Meridian (colloquially known as the "International Reference Meridian") which is now defined by the International Earth Rotation and Reference Systems Service (IERS). This definition maintains the prime meridian to pass through Greenwich, England U.K.

c. Some foreign produced maps may use the centesimal (decimal) system of angular measurement (the division of a circle into 400 grads). A grad (or gon) is divided into 100 centigrads (grad minutes), and each centigrad into 100 deci-milligrads (grad seconds). Other prime meridians may be used in non-U.S. mapping.

## 5-2 THE GEOGRAPHIC REFERENCE

The degree of accuracy of a geographic reference is influenced by the map scale and accuracy requirements for plotting and scaling purposes. Examples of references are:

40°N 132°E (In degrees of latitude and longitude)
40°21'N 132°14'E (To minutes of latitude and longitude)
40°21.2'N 132°14.3'E (To tenths of minutes of latitude and longitude)
40°21'12"N 132°14'18"E (To seconds of latitude and longitude)
40°21'12.4"N 132°14'17.7"E (To tenths of seconds of latitude and longitude)
40°21'12.45"N 132°14'17.73"E (To hundredths of seconds of latitude and longitude)

## 5-3 GEOGRAPHIC COORDINATES ON MAPS AND CHARTS

a. U.S. military maps and charts include a graticule (parallels and meridians) for plotting and scaling geographic coordinates. Graticule values are shown in the map margin.

b. On most maps and charts at the scale of 1:1,000,000, the parallels and meridians are shown by intersections or lines at one-degree intervals. The intersections or lines are labeled in degree values.

c. On maps and charts at the scale of 1:500,000, parallels and meridians are shown by lines at 30-minute intervals. The degree lines are labeled in degree values; the intermediate lines are labeled in minutes only.

d. On maps and charts at scales of 1:250,000 and larger, the graticule is indicated in the map interior by ticks at prescribed intervals. Table 11 indicates these intervals.

| Scale | Tick Interval | Labeling at Corners | Labeling of ticks |
|---|---|---|---|
| 1:250,000 | 1 minute | Degrees-minutes | 15 minutes[1] |
| 1:100,000 | 1 minute | Degrees-minutes | 10 minutes |
| 1:50,000 | 1 minute | Degrees-minutes | 5 minutes |
| 1:25,000 to 1:7,501 | 1 minute | Degrees-minutes-seconds[2] | 1 minute |
| 1:7,500 to 1:3,001 | 30 seconds | Degrees-minutes-seconds | 30 seconds |
| 1:3,000 and larger | 10 seconds | Degrees-minutes-seconds | 10 Seconds |

*Table 11.* Tick and Label Intervals at Common Map Scales

e. Deviation from these specifications may vary depending on operations requirements.

1. On Joint Operations Graphics (JOG), between 0° and 76°, meridians are shown by lines at 15-minute intervals with 1-minute ticks. Between 76° and 84° North and between 76° and 80° South, meridians are shown by lines at 30 minute intervals with 1-minute ticks.

2. Seconds are omitted if all corner values are even minutes.

# CHAPTER 6
# PORTRAYAL OF GRIDS ON MAPS AT 1:100,000 SCALE AND LARGER

## 6-1 GENERAL

a. Requirements for grid data and grid formats on maps prepared for Department of Defense (DoD) at 1:100,000 scale and larger are essentially the same for Universal Transverse Mercator (UTM) grids and Universal Polar Stereographic (UPS) grids.

b. The grid data for DoD maps usually include the major grid, a magnetic diagram, a grid reference box, and notes identifying the grid.

c. The adjacent grid is provided as an overlapping grid when a map lies within approximately 40 kilometers of a grid zone junction line. A separate magnetic diagram and notes identifying the overlapping grid appear in the margin.

d. Specific dimensions, size and style of type, and placement of margin data relating to grids and grid formats at 1:100,000 scale and larger are contained in NGA product specifications.

e. Grid portrayal for both map face and insets on 1:25,000 topographic maps (TM) follows the same product specifications as on 1:50,000 TM maps.

## 6-2 THE MAJOR GRID FOR 1:100,000, 1:50,000 AND 1:25,000 SCALE (TM) MAPS

a. The major grid is indicated by lines at 1,000-meter intervals. Every 10,000-meter grid line is accentuated in weight.

b. Grid numbers appear outside the neatline on all four sides of the sheet, labeling each grid line. Where a grid line coincides with a neatline of the map, the grid line is omitted, but the neatline is labeled in the margin with the values for the grid line.

c. Basically, all grid lines are labeled with two principal digits which represent the 10,000- and 1,000-meter values of the grid line, respectively. Some variations to this basic labeling are:

   1. On all 10,000-meter grid lines, the basic two principal digits are preceded by the 100,000-meter digits. See Figures 9 and 10.

   2. On sheets with one major grid, only the first grid lines in each direction from the southwest corner are given full coordinate values. See Figures 9 and 10.

   3. On sheets containing grid zone junctions, the first grid lines in each direction from all four corners are given full coordinate values. See Figures 14 and 15.

   4. On sheets showing the major and overlapping grids, the first grid line and grid tick in each direction from the southwest corner are given the full coordinate values for both grids. See Figures 16 and 17.

d. The grid lines in the map interior contain a pattern of grid value labels (principal digits) designed to assist in position referencing on a folded map. The pattern, referred to as a grid ladder, may appear in either of two forms:

One row (easting) and one column (northing) intersecting at the approximate center of the sheet.

Two rows (easting) and two columns (northing) intersecting at approximate one-third intervals across the sheet. The principal digits are centered between adjacent horizontal (northing) and vertical (easting) grid lines. The digits may be displaced or omitted if they impair the legibility of important map detail. Omissions are held to a minimum. Grid ladder treatments are illustrated in Figures 9 and 10.

Label every line for 1:50,000 scale and larger; label every even numbered line for 1:100,000 scale.

e. The color of the grid and grid values is black for 1:25,000, 1:50,000 and 1:100,000 scale maps used when the major grid is the UTM or UPS.

f. The Military Grid Reference System (MGRS) 100,000-meter square identification letters are portrayed directly on a map with a single major grid where the 100,000-meter grid lines intersect with each other and/or where the 100,000-meter lines intersect with the neatlines. See Figure 9.

g. A note identifying the ellipsoid, grid, and grid's datum appears in the lower margin of a sheet. The note is modeled after the following:

ELLIPSOID.....WORLD GEODETIC SYSTEM 1984
GRID.....1,000 METER UTM ZONE 53
HORIZONTAL DATUM.....WORLD GEODETIC SYSTEM 1984

h. Figures 9 and 10 illustrate the treatment for the major grid on DoD mapping at 1:50,000 and 1:100,000 scales.

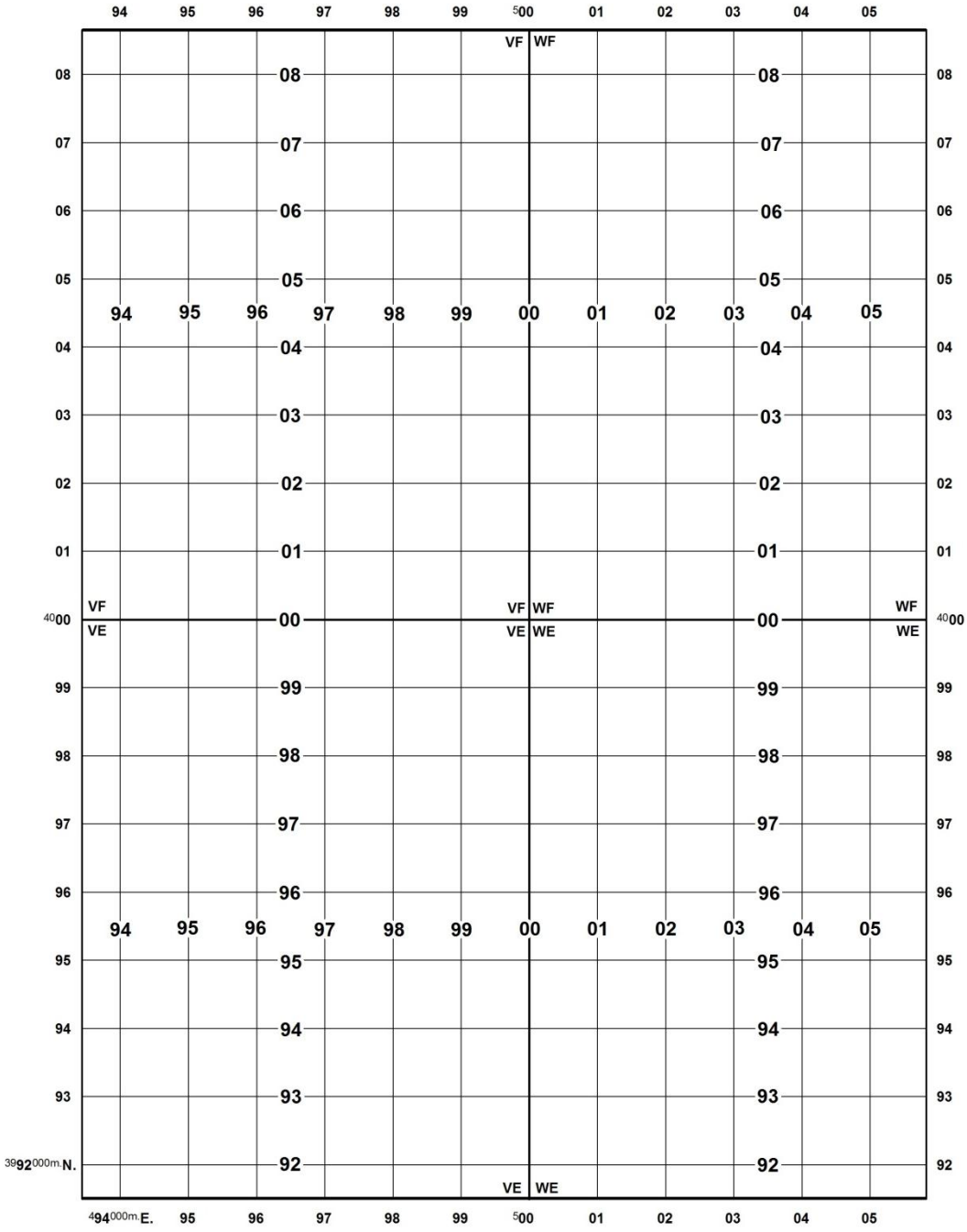


*Figure 9.* The Major Grid as Shown on a 1:50,000 Scale Map

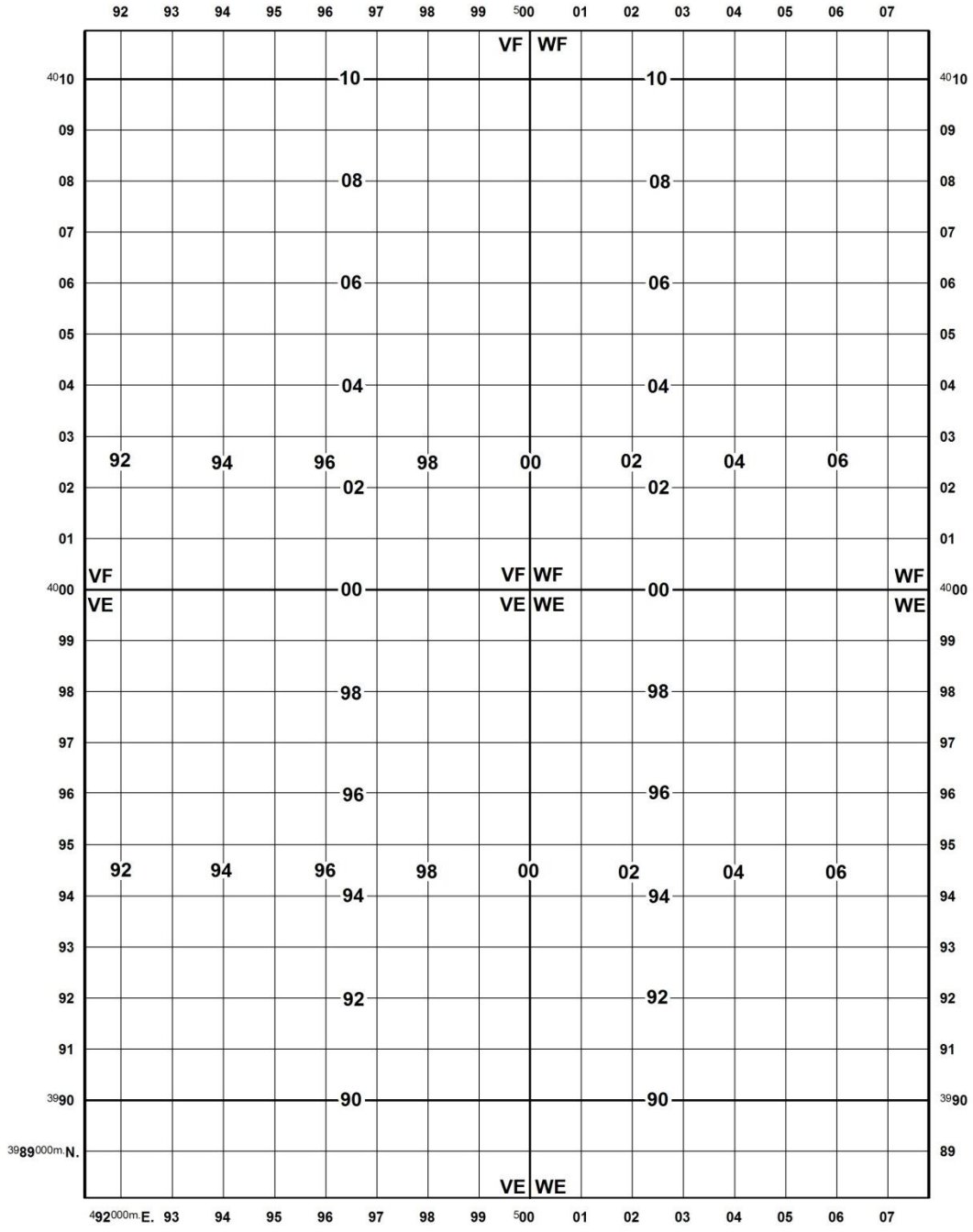


*Figure 10.* The Major Grid as Shown on a 1:100,000 Scale Map.

## 6-3 THE MAJOR GRID FOR 1:25,000 TO 1:15,001 SCALE URBAN MAPS

a. The major grid is indicated by blue lines shown at 1,000-meter intervals. Every 10,000-meter grid line is accentuated by weight. See Figure 11, bullets a through d.

b. Neither neatline ticks nor gridline ticks are used. The treatment of the grid ladder follows the same requirements as those for 1:100,000 scale, 1:50,000 scale, and 1:25,000 scale TM maps. Label every 1,000-meter gridline using the two rows (easting) and two columns (northing) method described in 6-2-d. Additional grid ladder values may be required as indicated in the specifications for the product.

c. A note identifying the ellipsoid, grid, and datum is the same as that of the 1:100,000 scale, 1:50,000 scale, and 1:25,000 scale TM maps.

d. The Military Grid Reference System (MGRS) 100,000-meter square identification letters are depicted directly on maps with a single major grid where the 100,000-meter grid lines intersect with each other and/or where the 100,000-meter lines intersect with the neatlines.

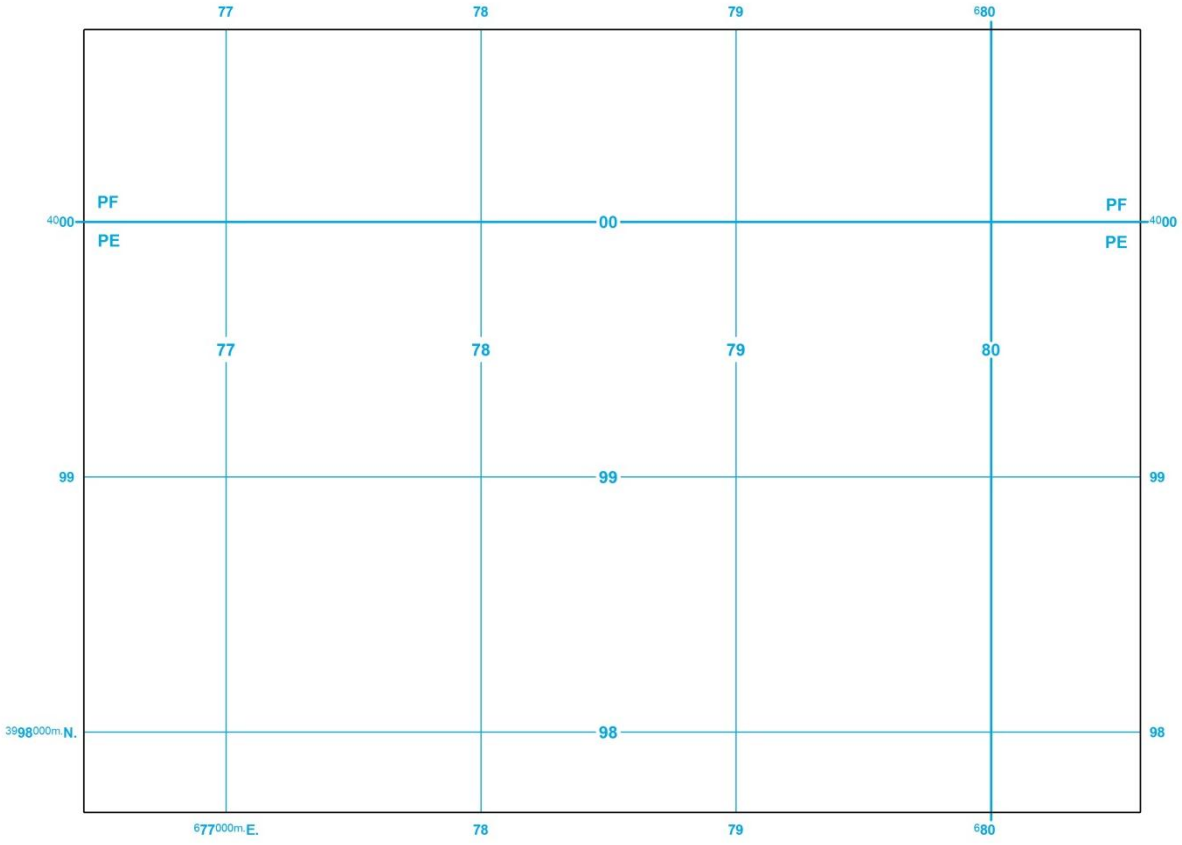


*Figure 11.* The Major Grid as Shown on 1:25,000 to 1:15,001 Scale Maps

## 6-4 THE MAJOR GRID FOR 1:15,000 TO 1:3,001 SCALE URBAN MAPS

a. The major grid is indicated by blue lines at 1,000-meter intervals. Every 10,000-meter grid line is accentuated in weight. See Figure 12 for bullets a through e.

b. 100-meter and 500-meter ticks are used and intersect the 1,000-meter grid and neatline at the respective interval. The 500-meter ticks are slightly longer than the 100-meter ticks. The treatment of the grid ladder follows the same requirements as those for 1:100,000 scale, 1:50,000 scale, and 1:25,000 scale TM maps. Label every 1,000-meter gridline using the two rows (easting) and two columns (northing) method described in 6-2-d. Additional grid ladder values may be required as indicated in the specifications for the product.

c. The gridlines are labeled with two principal digits which represent the 10,000-meter and 1,000-meter values of the grid line and follow the same requirements as those for 1:100,000 scale, 1:50,000 scale, and 1:25,000 scale maps.

d. The Military Grid Reference System (MGRS) 100,000-meter square identification letters are depicted directly on maps with a single major grid where the 100,000-meter grid lines intersect with each other and/or where the 100,000-meter lines intersect the neatlines.

e. A note identifying the ellipsoid, grid, and grid's datum is modeled after the following:

ELLIPSOID.....WORLD GEODETIC SYSTEM 1984
GRID.....1,000 METER UTM ZONE 53
HORIZONTAL DATUM.....WORLD GEODETIC SYSTEM 1984

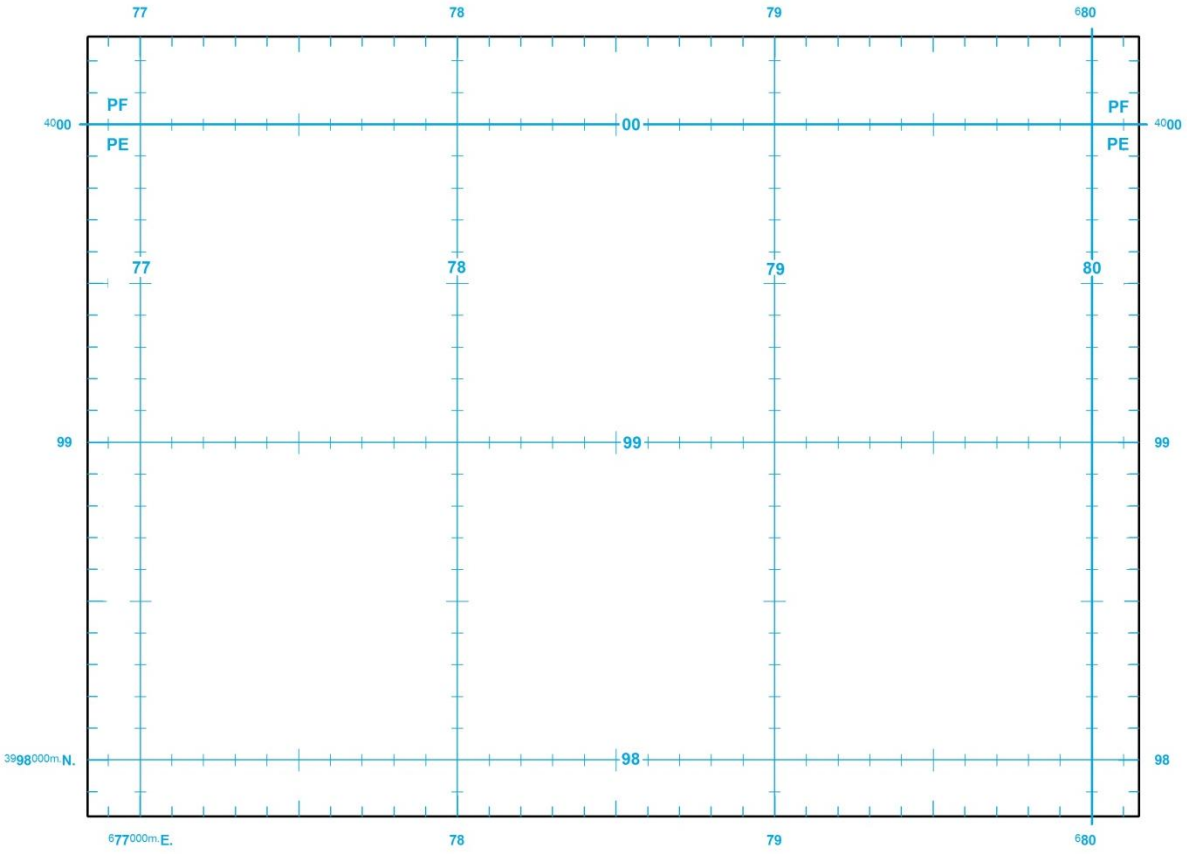


*Figure 12.* The Major Grid as Shown on 1:15,000 to 1:3,001 Scale Maps

## 6-5 THE MAJOR GRID FOR 1:3,000 AND LARGER SCALE URBAN MAPS

a. The major grid is indicated by blue lines at 100-meter intervals. Every 1,000-meter grid line is accentuated in weight. See Figure 13 for bullets a through e.

b. 10-meter and 50-meter ticks are used and intersect the neatline at the respective interval. The 50-meter ticks are slightly longer than the 10-meter ticks. The treatment of the grid ladder follows the same requirements as those for 1:100,000 scale, 1:50,000 scale, and 1:25,000 scale TM maps. Label every even numbered 100-meter gridline using the two rows (easting) and two columns (northing) method described in 6-2-d. Additional grid ladder values may be required as indicated in the specifications for the product.

c. The gridlines are labeled with three principal digits which represent the 1,000-meter, 100-meter, and 10-meter values of the grid line and follow the same requirements as those for 1:100,000 scale, 1:50,000 scale, and 1:25,000 scale maps.

d. The Military Grid Reference System (MGRS) 100,000-meter square identification letters are depicted directly on maps with a single major grid where the 100,000-meter grid lines intersect with each other and/or where the 100,000-meter lines intersect the neatlines.

e. A note identifying the ellipsoid, grid, and grid's datum is modeled after the following:

ELLIPSOID.....WORLD GEODETIC SYSTEM 1984
GRID.....100 METER UTM ZONE 53
HORIZONTAL DATUM.....WORLD GEODETIC SYSTEM 1984

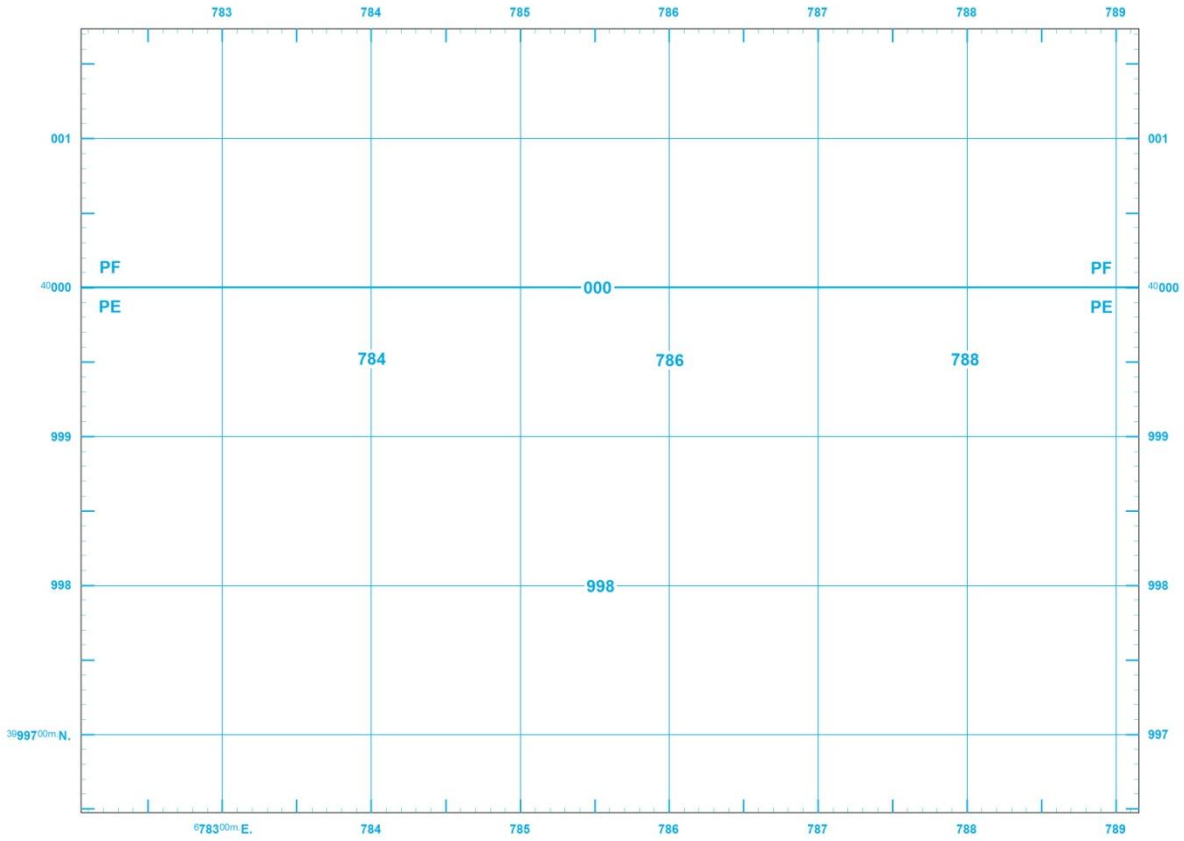


*Figure 13.* The Major Grid as Shown on a 1:3,000 and Larger Scale Maps

## 6-6 MULTIPLE MAJOR GRIDS

a. In certain instances a sheet contains more than one major grid.

b. With the UTM and UPS grids this may occur:

1) Where a sheet is shifted from the normal position to avoid making additional sheets.

2) Where a grid zone junction occurs within the Minimum Bounding Rectangle (MBR) of the map that does not conform to standard indexing.

c. Grid zone junctions are indicated by accentuated lines, printed in black for 1:25,000, 1:50,000, and 1:100,000 scale maps. Labels identifying the junction appear parallel to and on each side of the junction line. The label may be shown more than once to facilitate identification. Each label is printed in the color designated for the particular grid. When a grid zone junction line is coincident with a neatline, both the junction line and the identifying labels are omitted. If the junction line falls within 2.5 mm (0.10 inch) of the neatline, the junction line is not shown; it is considered as being coincident with the neatline.

d. The label for a UTM grid zone junction, or a UPS grid zone junction, includes the identification of the Grid Zone Designation and is written in MGRS terms as:

UTM GRID ZONE DESIGNATION: 47T

UPS GRID ZONE DESIGNATION: B

e. Each grid is shown by lines within its own area only, being represented at 1,000-meter intervals with every 10,000-meter line accentuated in weight.

f. On maps bearing two major grids, the extension of either grid into the area of the other (overlapping grid) is shown by outside ticks emanating from the neatline correctly aligned with its respective major grid. The 10,000-meter ticks are accentuated in weight.

g. Grid values appear on all four sides of the sheet labeling each grid line and those grid ticks whose values are multiples of 5,000. Full grid values appear at each corner, labeling the first grid line and grid tick in each direction from the corner.

h. For UTM and UPS grids at 1:25,000, 1:50,000, and 1:100,000 scales, the values for the different grids appear in black and blue. Black is reserved for the grid which covers the greater portion of the sheet. See Figure 14. If the grid zone junction divides the sheet equally, black is used for the western major grid labels and blue is used for the eastern major grid labels. See Figure 15.

i. The MGRS 100,000-meter grid square identifications are depicted on maps with multiple major grids as follows:

1) For 1:25,000 and 1:50,000 scale maps with only one MGRS identification, the 2-letter identifications are shown only in the grid reference box located in the bottom margin. They are not shown on the map itself. This also applies to 1:100,000 scale maps with only one MGRS identification in each zone. See Figure 23 and 24.

2) When a 1:25,000, 1:50,000, or 1:100,000 scale map contains more than one 100,000-meter identification, the identifications are portrayed directly on the map where the 100,000-meter grid lines intersect with each other and/or where the 100,000-meter lines intersect with the neatlines. Additionally, the identifications are labeled where the 100,000-meter grid lines intersect the grid zone junction and/or where the grid zone junction intersects the north and south neatlines. See Figures 14 and 15.

j. Dual major grids are always accompanied by two overlapping grids. Both major grids are portrayed by black lines. Each overlapping grid extends into the adjacent major zone grid and is portrayed by black ticks along the neatlines of the adjacent major zone. Overlapping grid labels assume the same color as those of their respective major grid. Figure 14 demonstrates this. The blue-numbered grid lines of Major Zone 37 become blue-numbered minor black ticks that extend across Major Zone 38. Figure 15 demonstrates the same situation on a 1:100,000 scale map.

k. Grid values, expressed in principal digits only, appear on the face of the map labeling each grid line. Refer to Figures 14 and 15 for sample treatments of the grid ladder numbers when a sheet contains more than one major grid.

l. Notes identifying each grid appear in the lower margin of the sheet. For 1:25,000, 1:50,000, and 1:100,000 scale maps, the notes are:

GRID.....1,000 METER UTM ZONE 47 (BLACK NUMBERED LINES AND TICKS)
1,000 METER UTM ZONE 48 (BLUE NUMBERED LINES AND TICKS)

m. Figures 14 and 15 illustrate the treatments described for sheets containing more than one major grid.

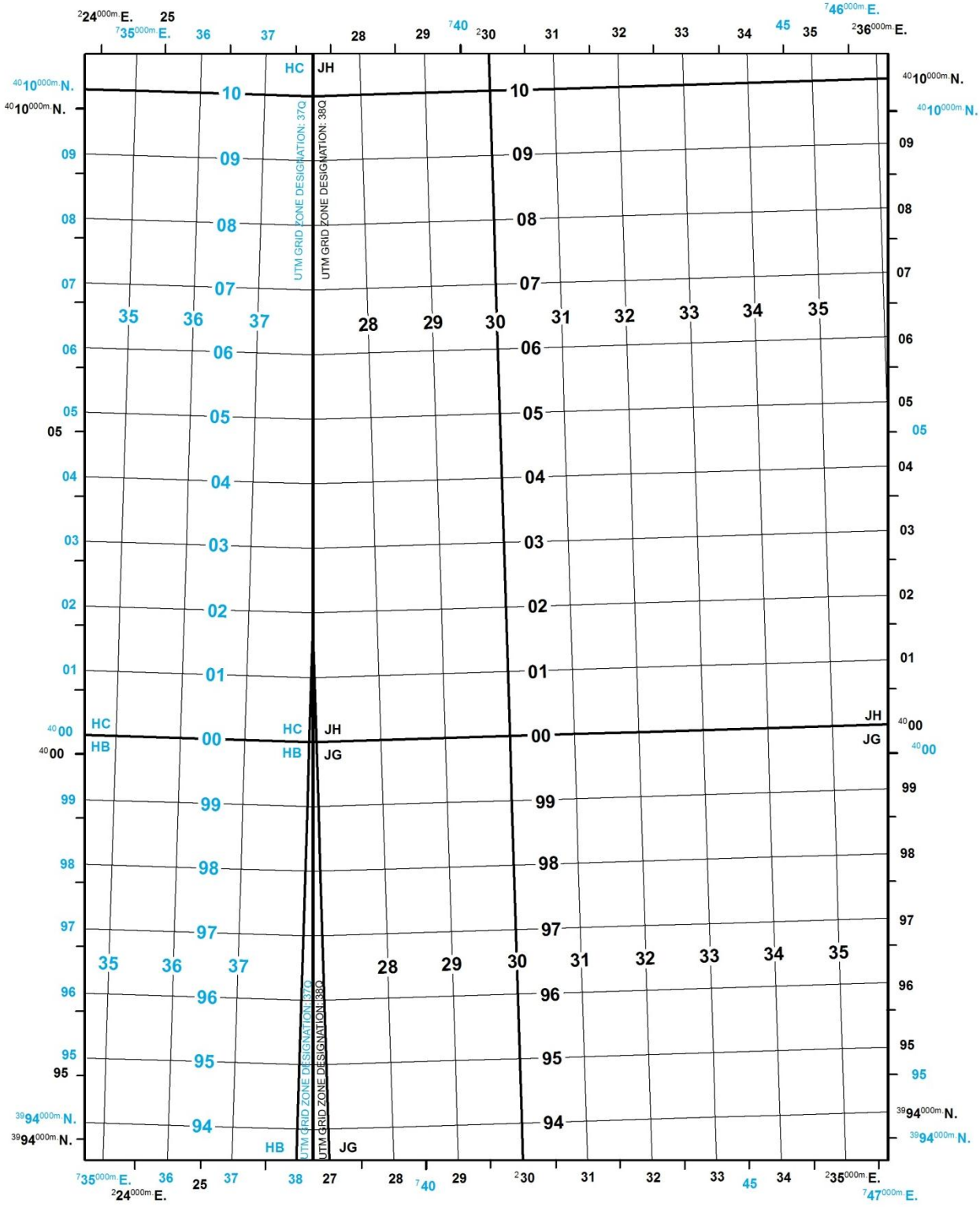


*Figure 14.* Two Major UTM Grids Separated by a Grid Junction as Shown on a 1:50,000 Scale Map

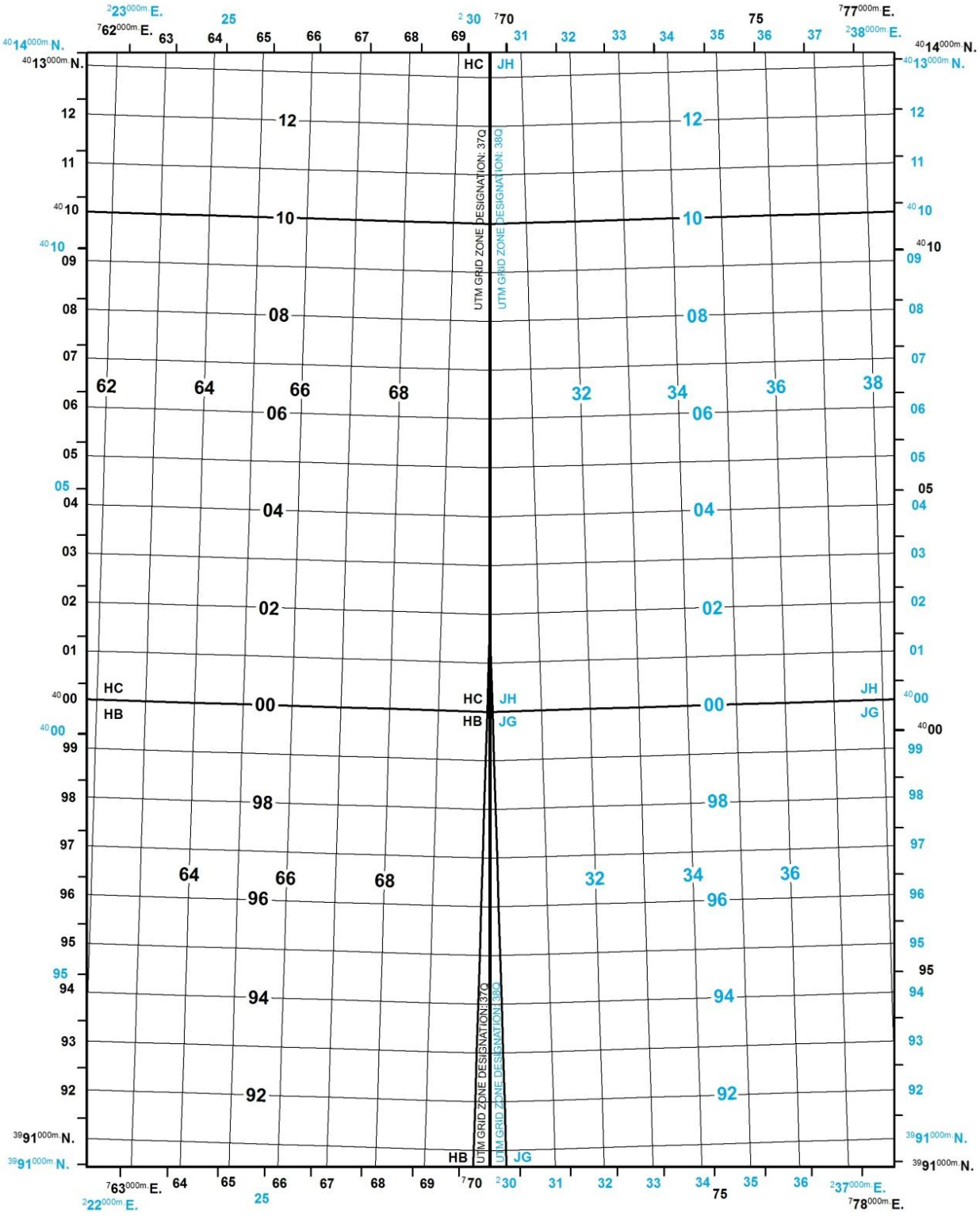


*Figure 15.* Two Major UTM Grids Separated by a Grid Junction as Shown on a 1:100,000 Scale Map

## 6-7 OVERLAPPING (MINOR) GRIDS

a. An overlapping or minor grid is generally required within approximately 40 kilometers of a grid zone junction. It is the extension of the grid from the adjacent zone onto the area bounded by the neatlines of the major grid. The overlapping grid may be omitted if there are no land bodies within the 40 kilometer overlap area.

b. The overlapping grid is shown by outside ticks printed in black emanating from the neatline correctly aligned with its respective grid and spaced at 1,000-meter intervals. The even 10,000-meter ticks are accentuated in weight.

c. The overlapping grid tick values for 1:25,000, 1:50,000, and 1:100,000 scale maps are labeled in blue.

d. Labels appear on all four sides of the sheet for those grid ticks whose values are multiples of 5,000. The first grid tick in each direction from the southwest corner is given a full coordinate value.

e. When there is a single major grid with a single overlapping grid, the major grid is depicted by black numbered lines and the overlapping grid is depicted by blue numbered ticks, along the neatline perimeter. See Figures 16 and 17.

f. If it becomes necessary to portray a third grid, red/brown color is used to avoid any connection with the unrelated overlapping grids.

g. The MGRS 100,000-meter grid square identifications on maps having one major grid with an overlapping (minor) grid are portrayed in the same manner as maps with single major grids and are associated with major zones only. See Figure 16.

h. Notes identifying each grid appear in the lower margin of the sheet. For 1:25,000, 1:50,000, and 1:100,000 scale maps the note is modeled after the following:

GRID.....1,000 METER UTM ZONE 47 (BLACK NUMBERED LINES)
1,000 METER UTM ZONE 48 (BLUE NUMBERED TICKS)

i. Figures 16 and 17 illustrate the treatments described for sheets containing major and overlapping grids.

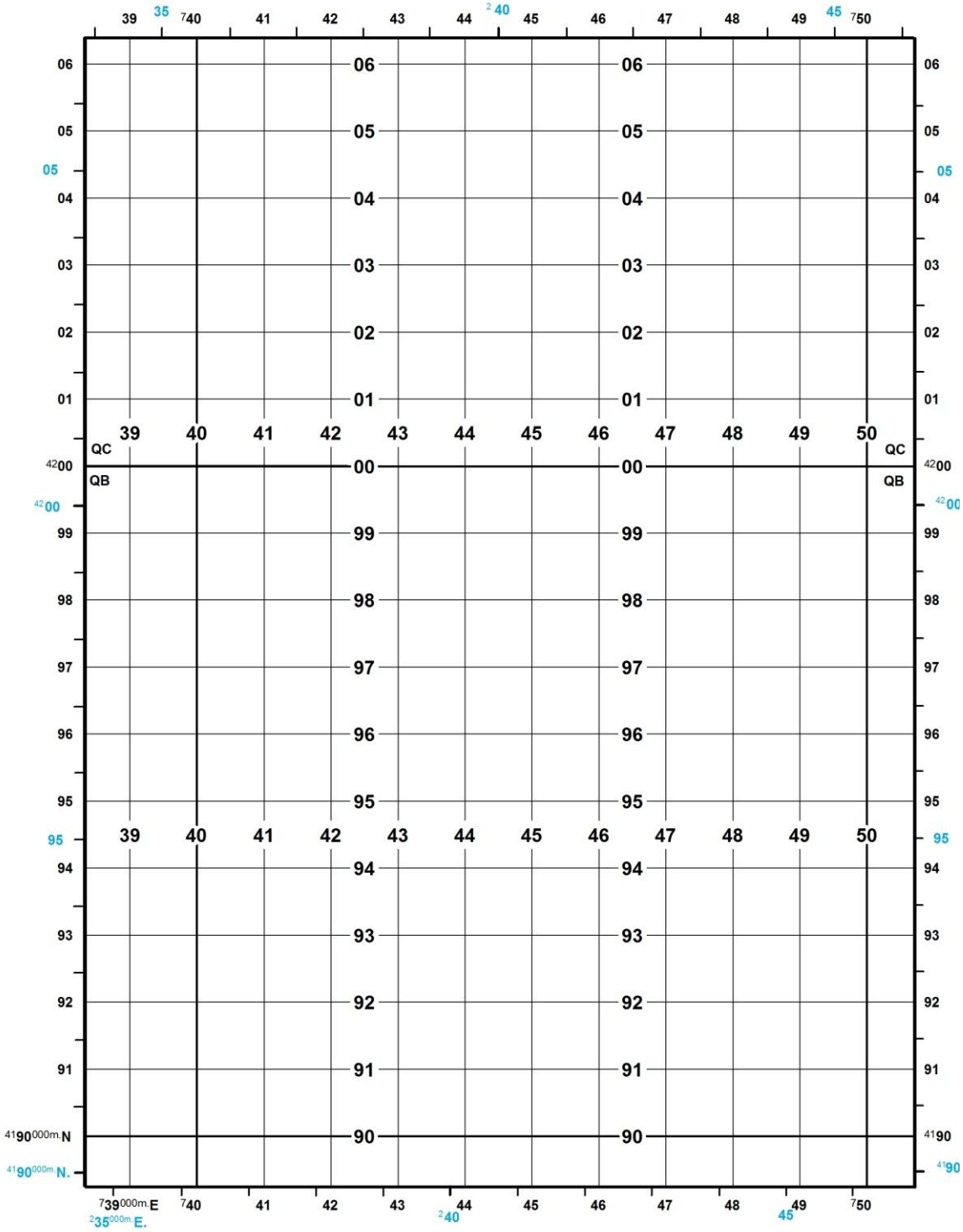


*Figure 16.* Major and Overlapping (Minor) Grids as Shown on a 1:50,000 Scale Map

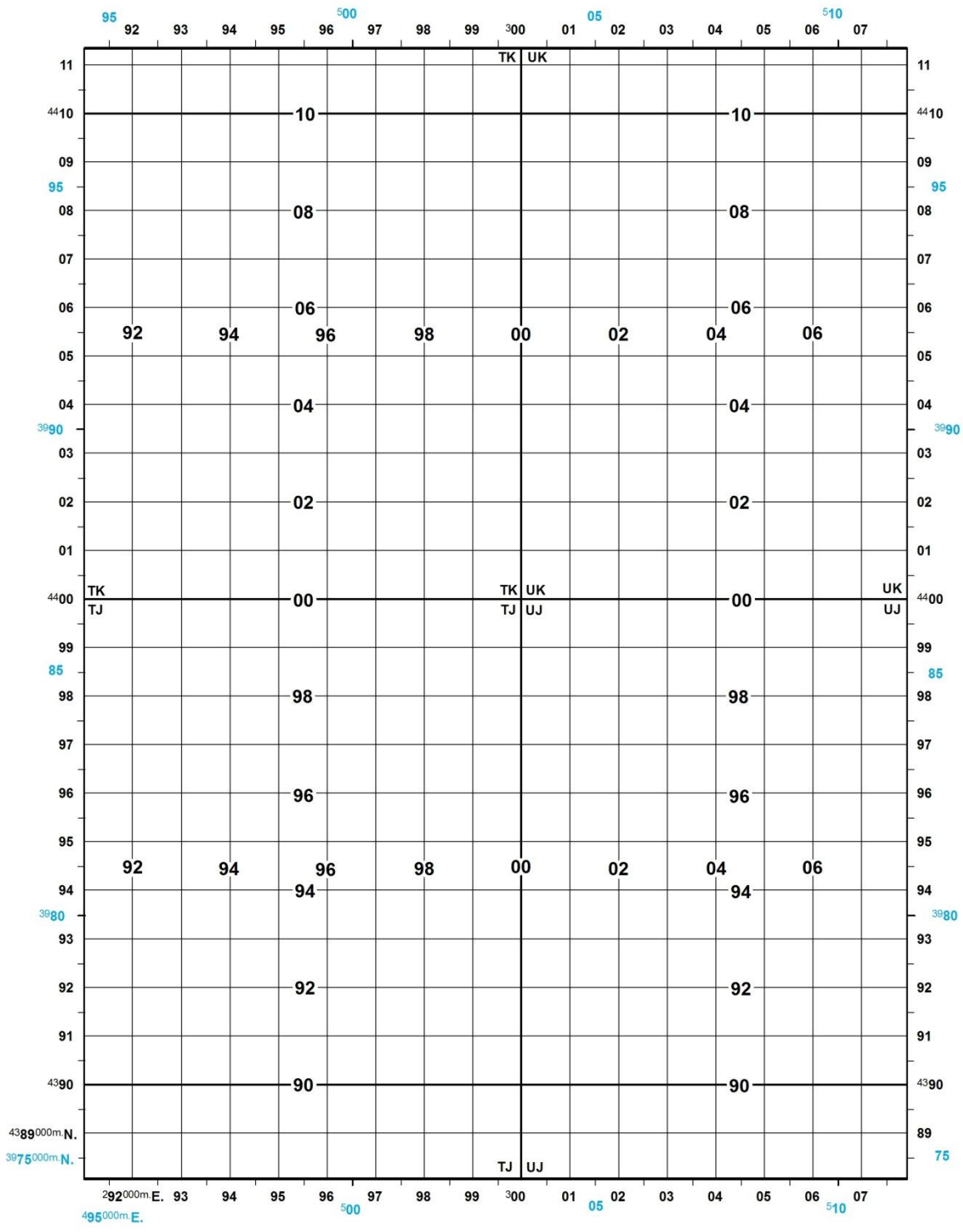


*Figure 17.* Major and Overlapping (Minor) Grids as Shown on a 1:100,000 Scale Map

## 6-8 THE MAGNETIC DIAGRAM (ONE GRID)

a. A magnetic diagram appears in the margin of each sheet. The diagram shows the relationship of magnetic north and true north to grid north at the center of the sheet. It also provides information regarding the use of this data. See Figures 18 and 19.

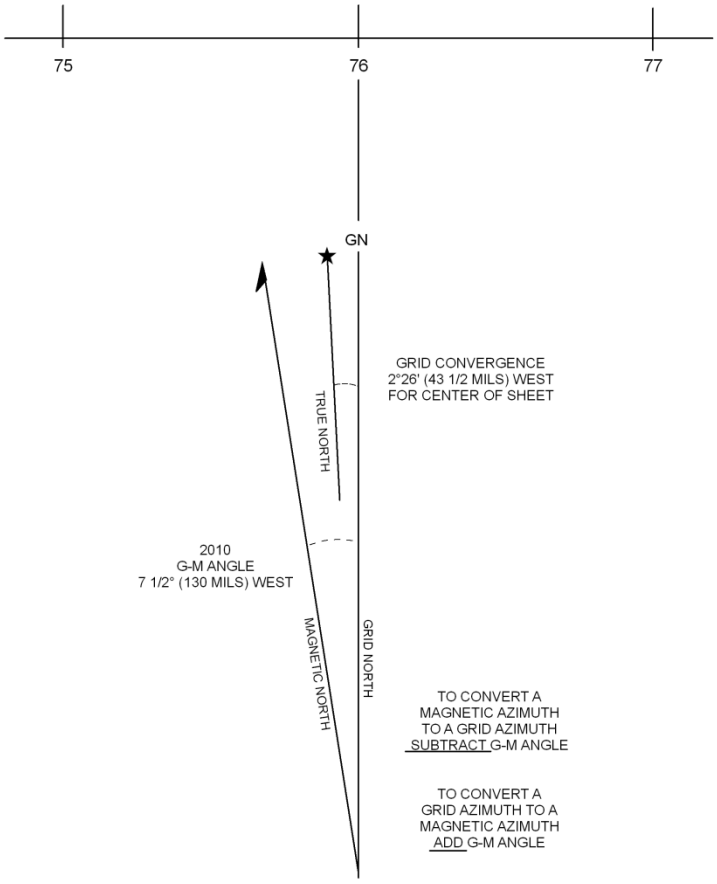


*Figure 18.* The Magnetic Diagram and Accompanying Notes with True North Appearing as the Center Prong

b. The diagram contains three prongs which emanate from a central point. These represent grid north, magnetic north, and true north, and are appropriately labeled.

c. The grid north prong is an extension of an easting (vertical) grid line; the extension is a continuous line, which stops at the central point near the bottom work limits of the sheet. The prong is broken for the letters GN.

d. The magnetic north prong emanates from the central point to the approximate extent of the letters GN. It is surmounted with a half-arrowhead; a left half-arrowhead is used when magnetic north lies to the west of grid north, while a right half-arrowhead is used when magnetic north lies to the east of grid north.

e. The true north prong, surmounted with a five-point star, is shorter in length than the other two prongs. When it occurs as the left or right prong of the diagram, it emanates from the central point. When true

north occurs as the middle prong, its characteristic star appears at the approximate height of the magnetic north arrowhead; the prong is shown as an extension from the central point.

f. Angles between the prongs are approximately represented. The magnetic north and true north prongs are plotted within 30 minutes of their given angular position from grid north, except that the magnetic prong is never shown within three degrees of the grid north prong. In maintaining relative symmetry between prongs, the characteristic star of the true north prong must never touch another prong. When there is no declination between prongs, a single prong represents the coincidence, and distinguishing characteristics (star, arrowhead, or letters GN) of each are shown on the composite prong.

g. The grid-magnetic angle (G-M Angle) is expressed by a note alongside a dashed arc connecting the grid north and magnetic north prongs. The value of this angle is derived from the latest isogonic data for a standard epoch; i.e., a year that is divisible by five, such as 2010, 2015, etc. The value of the grid-magnetic angle is given to the nearest one-half degree with mil equivalent to the nearest ten mils. (See Appendix D for a table of mil equivalents).

h. The grid-magnetic note is modeled after the following:

2010
G-M ANGLE
7 1/2° (130 MILS) WEST

i. For sheets with 0° grid-magnetic angle the note is shown as follows:

2010
G-M ANGLE
0° (0 MILS)

j. The grid convergence is the angle between grid north and true north. The value of the angle is expressed to the nearest whole minute, with the mils equivalent to the nearest one-half mil.

k. In the diagram, the grid convergence is indicated by a note alongside a dashed arc which connects the grid north and true north prongs. The convergence angle is given for the center of the sheet and is modeled after the following:

GRID CONVERGENCE
2° 26' (43 1/2 MILS) WEST
FOR CENTER OF SHEET

l. Notes appear in conjunction with the diagram explaining the use of the G-M Angle. See Figure 19.

m. When the magnetic north prong of the diagram is east of the grid north prong, the notes read as follows:

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

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

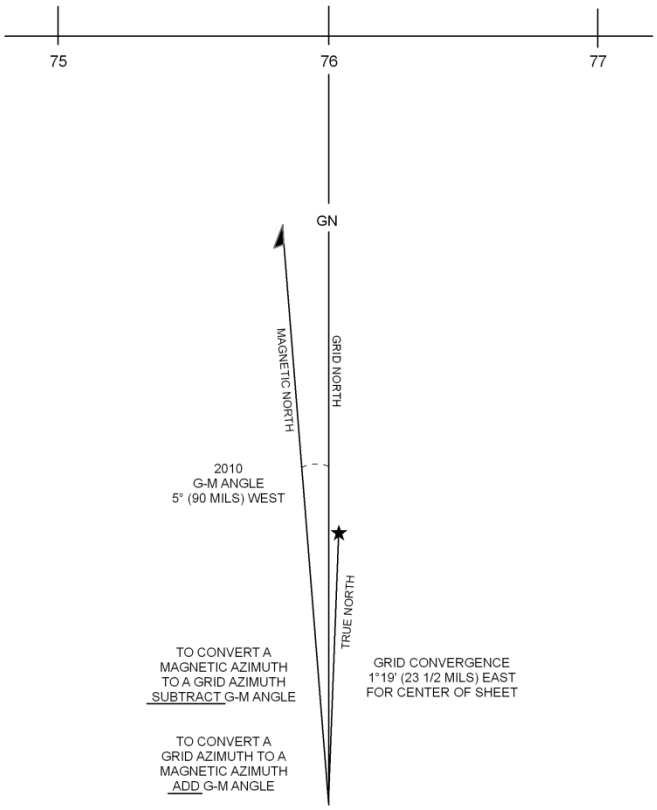


*Figure 19.* The Magnetic Diagram and Accompanying Notes with True North Appearing as an Outside Prong

n. When the magnetic north prong of the diagram is west of the grid north prong, the notes read as follows:

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

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

o. When the magnetic north and grid north prongs are coincident, azimuth conversion notes are omitted.

p. The azimuth conversion notes are based on the principle that an azimuth (of any kind) is an angle between 0° and 360° measured clockwise.

q. Azimuth conversion notes are not shown for insets.

r. The diagram and related notes are printed in the same color as the grid values to which they pertain.

## 6-9 THE MAGNETIC DIAGRAM (MORE THAN ONE GRID)

a. When a sheet bears more than one major grid, or major and overlapping grids, a separate diagram appears for each grid shown on the map. Figure 20 illustrates the magnetic data shown on a sheet which contains more than one grid.

b. The grid north prong of each diagram is aligned with the easting (vertical) grid lines or grid ticks of the grid to which it pertains. No connection is shown between the grid north prong and any grid line or grid tick.

c. The composition of each diagram is the same as described in section 6-7, except:

1. The diagram is miniaturized, and the three prongs are shown as lines of the same length.

2. The minimum plotted angle between any two prongs is three degrees with relative symmetry maintained.

3. Each diagram bears the identification of the grid to which it pertains.

4. Each diagram and its related notes are printed in the same color as the grid values to which they pertain.

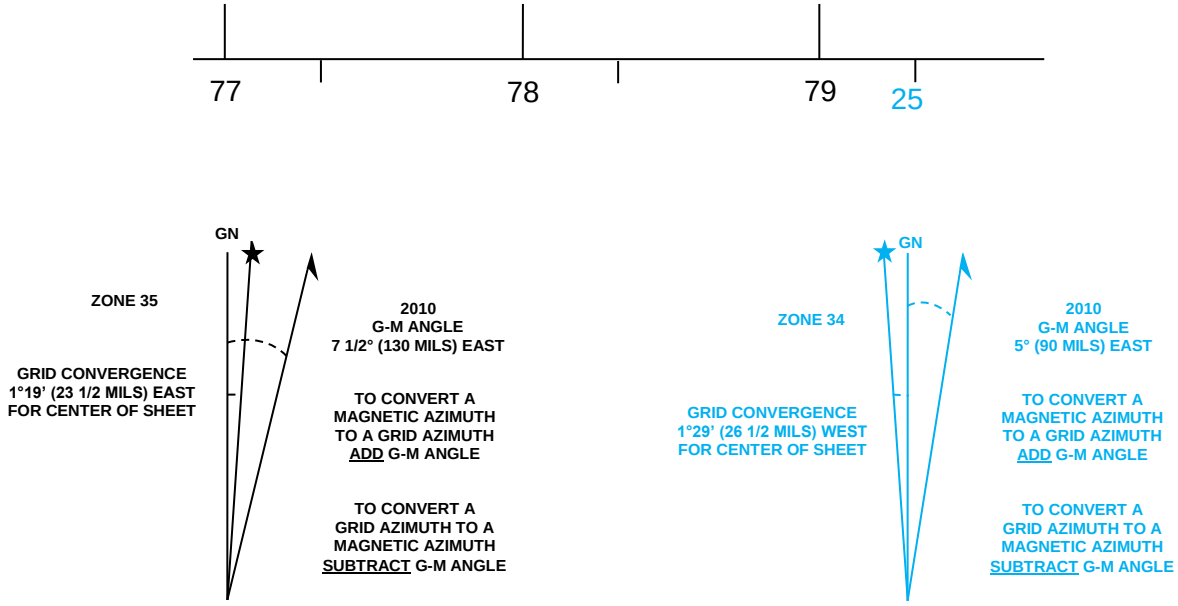


*Figure 20.* The Magnetic Data when a Sheet Contains an Overlapping Grid and/or more than One Major Grid

## 6-10 LAND INSETS

a. Figures 21 and 22 portray typical insets for land products.

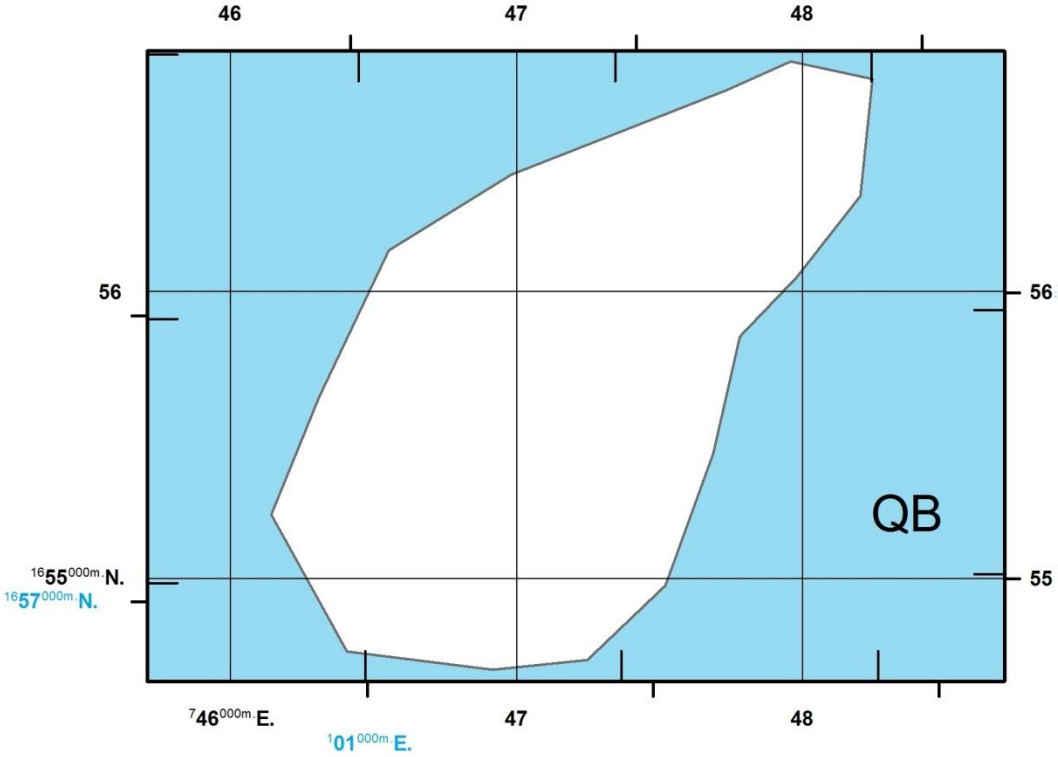


*Figure 21.* Inset for 1:25,000 and 1:50,000 Scale Maps

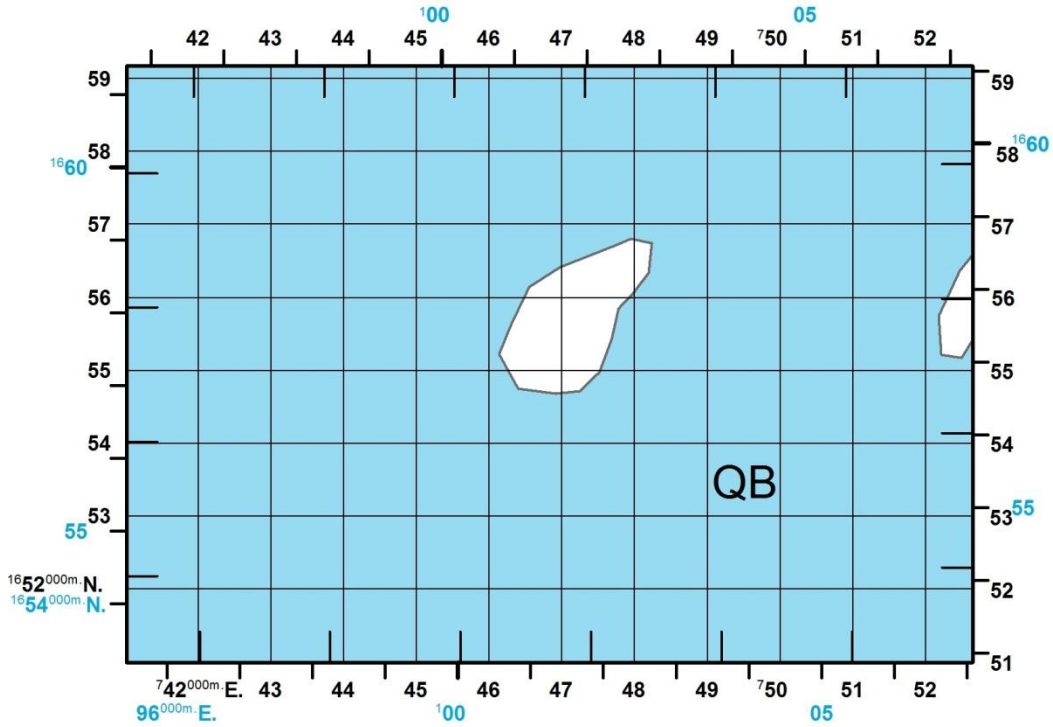


*Figure 22.* Inset for 1:100,000 Scale Maps

b. It is not necessary to depict the datum (World Geodetic System 1984) and ellipsoid (World Geodetic System 1984) in the inset margin as they are already depicted on the map proper.

c. 100,000-meter square identifications are shown appropriately on the map face of the inset in black. For an inset containing more than one 100,000-meter identification or a grid zone junction, use the same guidance as defined for the map proper.

d. As with the map proper, inset minor grid zones are not associated with any 100,000-meter grid square identifications.

e. Appropriate grid notes are depicted in black in the bottom margin of the inset. Note that Grid Zone Designations are used in the inset notes while, grid zone numbers are used in the grid notes for the map proper.

f. Inset grid notes for 1:25,000, 1:50,000, and 1:100,000 scale maps are as follows:

1) **One major zone only:**

GRID.....1,000 METER UTM ZONE 51K

2) **One major and one minor zone:**

GRID.....1,000 METER UTM ZONE 35R (BLACK NUMBERED LINES)
1,000 METER UTM ZONE 34R (BLUE NUMBERED TICKS)

3) **Two major and two minor zones:**

GRID.....1,000 METER UTM ZONE 30T (BLACK NUMBERED LINES AND TICKS)
1,000 METER UTM ZONE 31T (BLUE NUMBERED LINES AND TICKS)

g. If an inset has a major and a minor zone, the minor Grid Zone Designation is composed of the minor grid zone number plus the latitude band letter from the major zone.

h. Grid reference boxes are not portrayed on insets.

i. A magnetic diagram is not shown on insets. Instead the magnetic data are portrayed in margin notes.

j. When an inset has only one major zone, both of the following notes will be shown in black for 1:25,000, 1:50,000, and 1:100,000 scale maps:

GRID TO MAGNETIC DECLINATION FOR 2010 IS 1½° (30 MILS)
WESTERLY OVER THE ENTIRE INSET

GRID TO TRUE NORTH CONVERGENCE FOR THE CENTER OF THE INSET IS
1°54' (34 MILS) EASTERLY

k. When an inset has both a major zone and minor zone or two major zones, the Grid to Magnetic Declination notes for both zones are combined into one G-M note:

GRID TO MAGNETIC DECLINATION FOR 2010 IS: ZONE 37 IS 9½° (170 MILS) WESTERLY; ZONE 38 IS 5½° (100 MILS) EASTERLY OVER THE ENTIRE INSET.

l. Likewise, the Grid to True North Convergence notes for both zones are combined into one G-T note:

> GRID TO TRUE NORTH CONVERGENCE FOR THE CENTER OF THE INSET IS: ZONE 37 IS 1°37' (29 MILS) EASTERLY; ZONE 38 IS 1°43' (31 MILS) WESTERLY.

## 6-11 THE GRID REFERENCE BOX

a. A grid reference box appears in the margin of each sheet. The box contains instructions and attendant data to enable the user to compose standard grid references.

b. The grid reference box used on maps 1:100,000 scale and larger is illustrated in Figure 23.

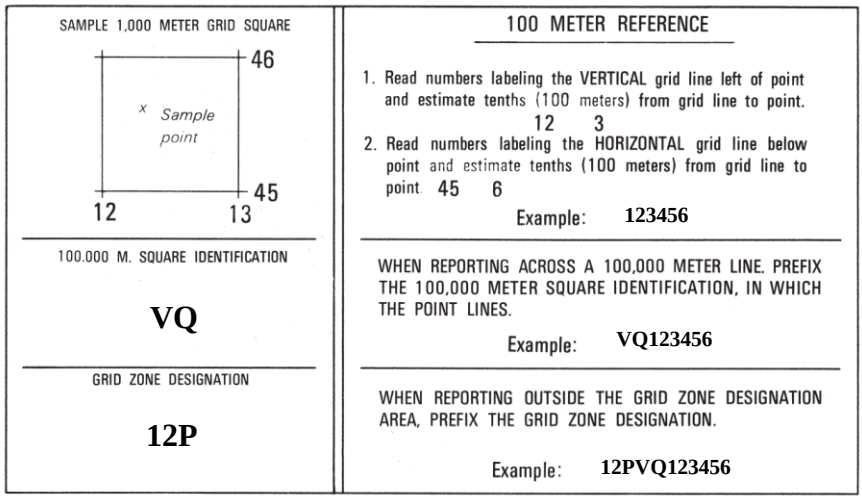


*Figure 23.* Grid Reference Box Used on Maps at Scales of 1:100,000 and Larger

### 6-11-1 FOR USE WITH UTM AND UPS

a. The grid reference box also contains diagrams identifying applicable Grid Zone Designations and grid square identifications.

b. For the UTM and UPS grids, the diagrams show the Grid Zone Designation, the 100,000-meter grid lines and their values in abbreviated form, and the 100,000-meter square identifications. Figure 24 illustrates the composition of the diagrams under various conditions.

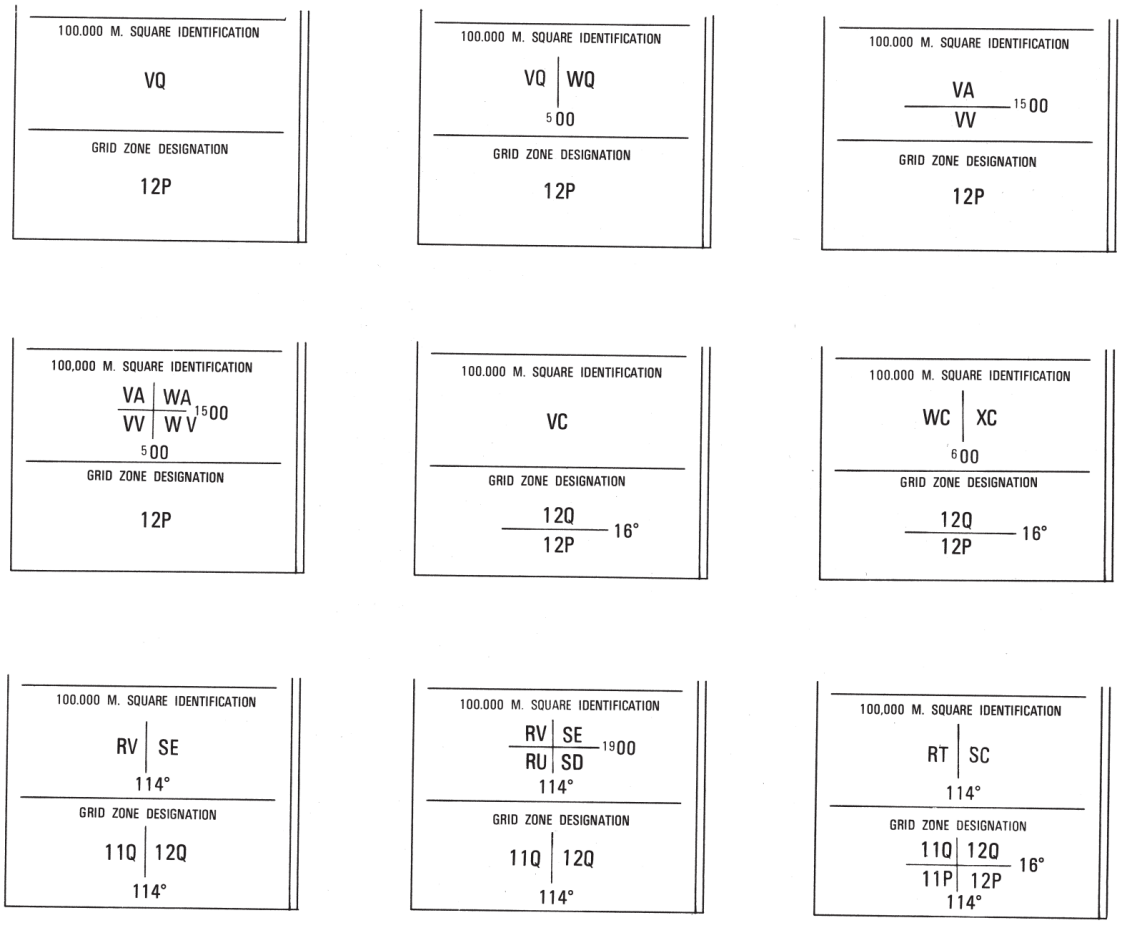


*Figure 24.* Methods of Showing Grid Zone Designations and 100,000-meter Squares of the UTM in the Grid Reference Boxes Used on Maps at Scales of 1:100,000 and Larger

c. When more than one major grid appears on a sheet and the method for giving a reference is the same for all grids, a common reference box is used.

# CHAPTER 7
# PORTRAYAL OF GRIDS ON MAPS AT 1:250,000 AND 1:500,000 SCALE

## 7-1 GENERAL

a. Grid data and grid format for maps at scales of 1:250,000 and 1:500,000 are essentially the same for Universal Transverse Mercator (UTM) grids and Universal Polar Stereographic (UPS) grids. When possible, sheet lines of maps at these scales are planned to coincide with grid junctions.

b. The grid data consist of grid lines and values, grid reference boxes, notes identifying the grids, and notes giving the range of magnetic declination over the sheet. Overlapping and extended grids are not shown.

c. On 1:250,000 scale maps, the graticule is depicted by black lines at even 15-minute parallels and meridians. One-minute half ticks and five-minute ticks are portrayed on each graticule line.

d. Descriptions and illustrations are keyed to 1:250,000 scale, unless otherwise indicated.

## 7-2 THE MAJOR GRID

a. The major grid is shown by lines printed in blue, at 10,000-meter intervals. Every 100,000-meter grid line is accentuated in weight and definitive designations are shown at their intersections in the map interior.

b. Grid values appear outside the neatline on all four sides of the sheet, labeling each grid line.

c. Where a grid line coincides with a neatline of the map, the grid line is omitted but the neatline is labeled with the values for the grid line. Except for the values labeling the first grid line in each direction from the southwest corner of the sheet, the last four digits (0000) of the values are omitted. The values are shown in two sizes of type, with the larger size being reserved for the principal digits.

d. With UTM and UPS grids, one principal digit is used. This represents the 10,000 digit of the grid values.

e. At 1:250,000 scale, a grid ladder is shown in the interior of the map. The grid ladder is an established pattern of columns and rows of grid values, expressed in principal digits only. Positioning of the columns and rows is illustrated in Figure 25. In areas of dense detail, a ladder number may be moved along a grid line a maximum of one-fourth of the grid interval, or omitted if it impairs legibility of map detail.

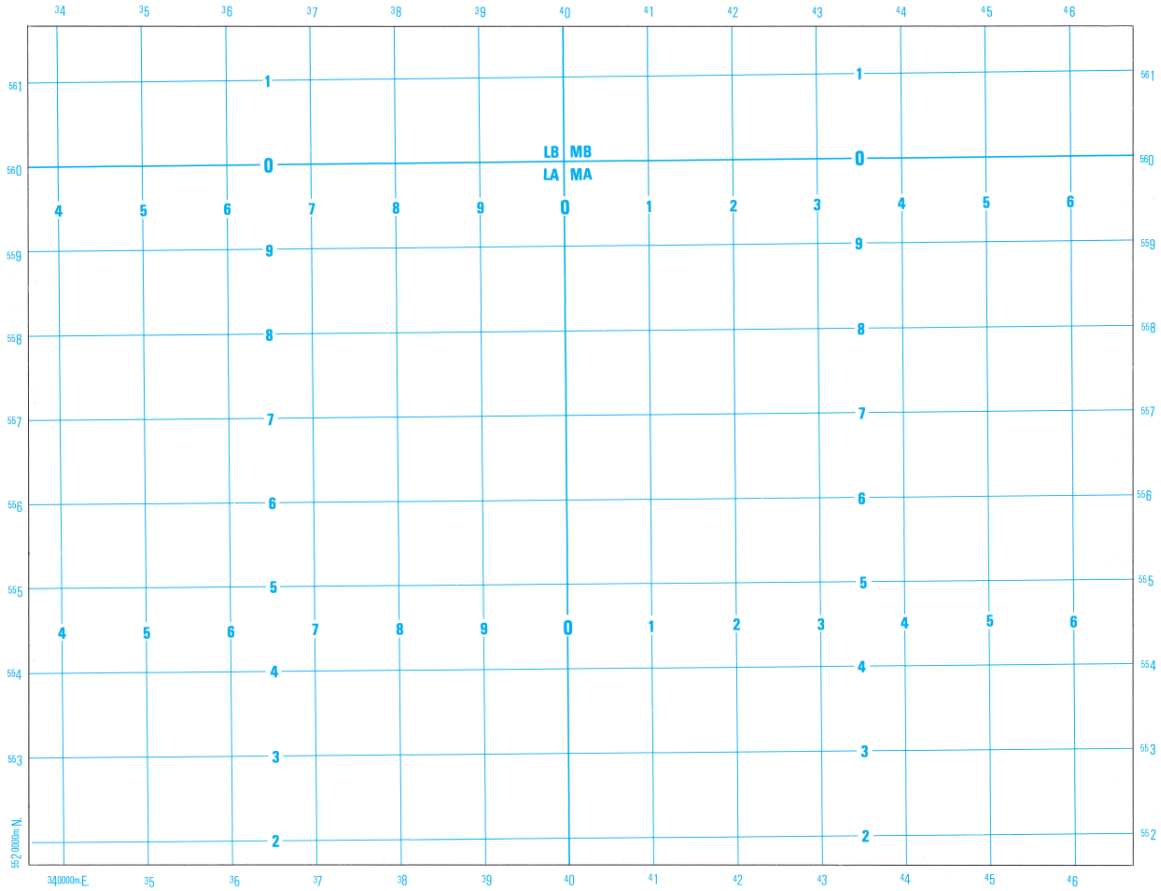


*Figure 25.* Treatment for the Major Grid in UTM Areas as Shown on a 1:250,000 Scale Map

f. Omissions are held to a minimum.

g. At the intersection of two 100,000-meter grid lines, the appropriate meter square identification letters are always shown. When this intersection coincides with a neatline, only those identification letters falling inside the neatline are shown. Identification letters are similarly shown – inside the neatline – when the intersection of a 100,000-meter line with a grid junction line coincides with a neatline.

h. At the 1:500,000 scale, the grid ladder is designed to treat each specific 100,000-meter square. Figure 26 illustrates the treatment. Note the relationship of the ladder to the accentuated 100,000-meter lines.

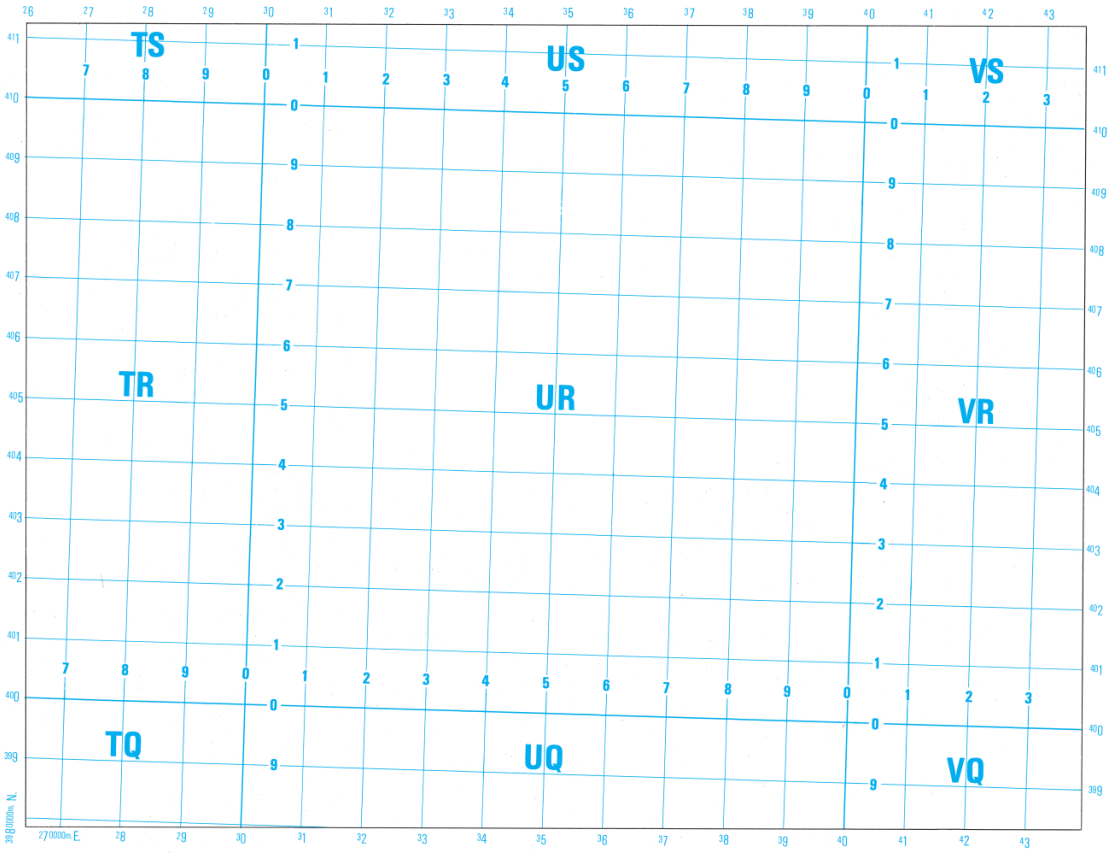


*Figure 26.* Treatment for the Major Grid in UTM Areas as Shown on Maps Smaller Than 1:250,000 Scale and Larger Than 1:1,000,000

i. Blue is the color of the grid values and ladder values when the grid system is either the UTM or the UPS.

j. A grid note printed in the same color as the values for the major grid appears in the lower margin of each sheet to identify the grid. The note is modeled after the following:

**BLUE NUMBERED LINES INDICATE THE 10,000 METER UNIVERSAL TRANSVERSE MERCATOR GRID, ZONE 53, WGS 84 ELLIPSOID**

**BLUE NUMBERED LINES INDICATE THE 10,000 METER UNIVERSAL POLAR STEREOGRAPHIC GRID, SOUTH, ZONE A, WGS 84 ELLIPSOID**

k. On sheets having land insets for which the grid zone differs from that of the map proper, the appropriate grid note is shown within the inset. (A JOG does not have insets.)

## 7-3 MULTIPLE MAJOR GRIDS

a. In certain instances a sheet contains more than one major grid.

b. With the UTM and UPS grids this may occur in higher latitudes, where sheets may be wide in longitudinal extent.

c. Grid zone junctions are indicated by accentuated lines printed in blue. Labels may appear on each side of the junction line. The labels may be shown more than once to facilitate identification. Each label is printed in the color designated for the particular grid system. Where a grid zone junction line is coincident with a neatline, both the junction line and the identifying labels are omitted.

d. The label for a UTM grid junction, or a UPS grid junction, includes the identification of the Grid Zone Designation and is written in Military Grid Reference System (MGRS) terms as:

**UTM GRID ZONE DESIGNATION: 47T**

**UPS GRID ZONE DESIGNATION: B**

e. Each grid is shown by lines within its own area only, being represented in the normal manner at 10,000-meter intervals with every 100,000-meter line accentuated in weight. All grid lines are printed in blue.

f. Grid values appear on all four sides of the sheet (outside the neatline) labeling each grid line. The composition of the number is similar to that described in paragraph 7-2-c, except that full grid values label the first grid line in each direction from each corner of the sheet.

g. Where appropriate for the grid, at 1:250,000 scale, identification of 100,000-meter squares appears on the face of the map at all 100,000-meter grid line intersections as described in paragraph 7-2-e. The meter-square identifications appear in the same color as the grid values.

h. The UTM and UPS grid values are shown in blue when either grid appears alone. When both the UTM and UPS grids appear on the same sheet, the grid values are shown in blue for whichever of the two grids occurs most frequently on the sheets in the general area. The values for the other grid are shown in red-brown.

i. Notes identifying each grid appear in the lower margin of the sheet. These are printed in the same color as that used for the values for the grid each identifies.

j. When the grids are different zones of the UTM grid, the note is modeled after the following:

**BLUE NUMBERED LINES INDICATE THE 10,000 METER UNIVERSAL TRANSVERSE MERCATOR GRID, ZONES 50 AND 51, WGS 84 ELLIPSOID**

k. Figure 27 depicts a grid zone junction that resides within the map interior.

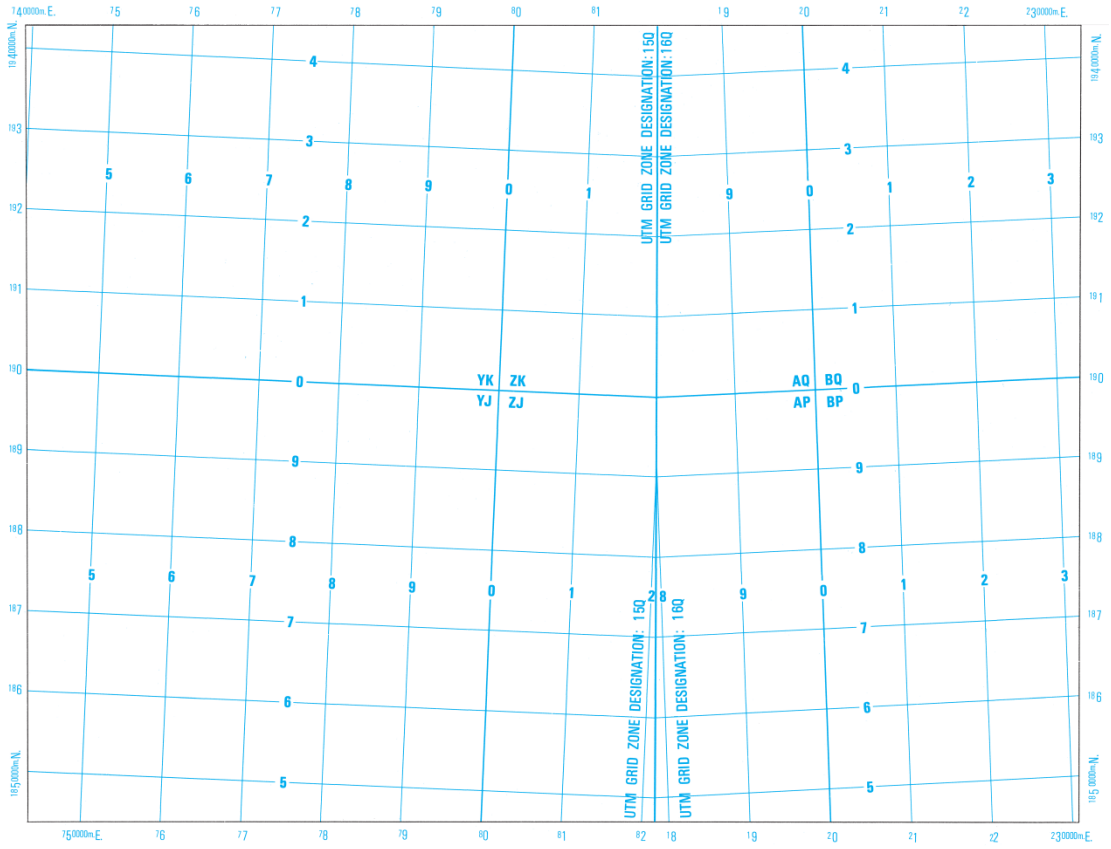


*Figure 27*. Two Major UTM Grid Zones Separated by a Grid Junction as Shown on a 1:250,000 Scale Map

l. When more than one grid is involved, the notes are modeled after the following:

**BLUE NUMBERED LINES INDICATE THE 10,000 METER UNIVERSAL TRANSVERSE MERCATOR GRID, ZONE 37, WGS 84 ELLIPSOID**

**RED/BROWN NUMBERED LINES INDICATE THE 10,000 METER UNIVERSAL POLAR STEREOGRAPHIC GRID, NORTH, ZONE Z, WGS 84 ELLIPSOID**

m. A separate marginal note is not shown for the grid or grid zone in the north or east overlap (bleeding-edge) of a JOG. Such a grid is identified only on the face of the map along the grid junction line. See Figure 27.

n. In certain cases, a sheet bearing the UTM grid may straddle a parallel which marks the division between different Grid Zone Designations. The grid and corresponding labeling appear as previously described. A continuous line in black indicates the dividing parallel. The proper Grid Zone Designations, printed in the same color as the grid values, appear on each side of the line. The dividing parallel is omitted when it falls within 2.5 mm (0.10 inch) of the north or south neatlines. Figure 28 illustrates these principles.

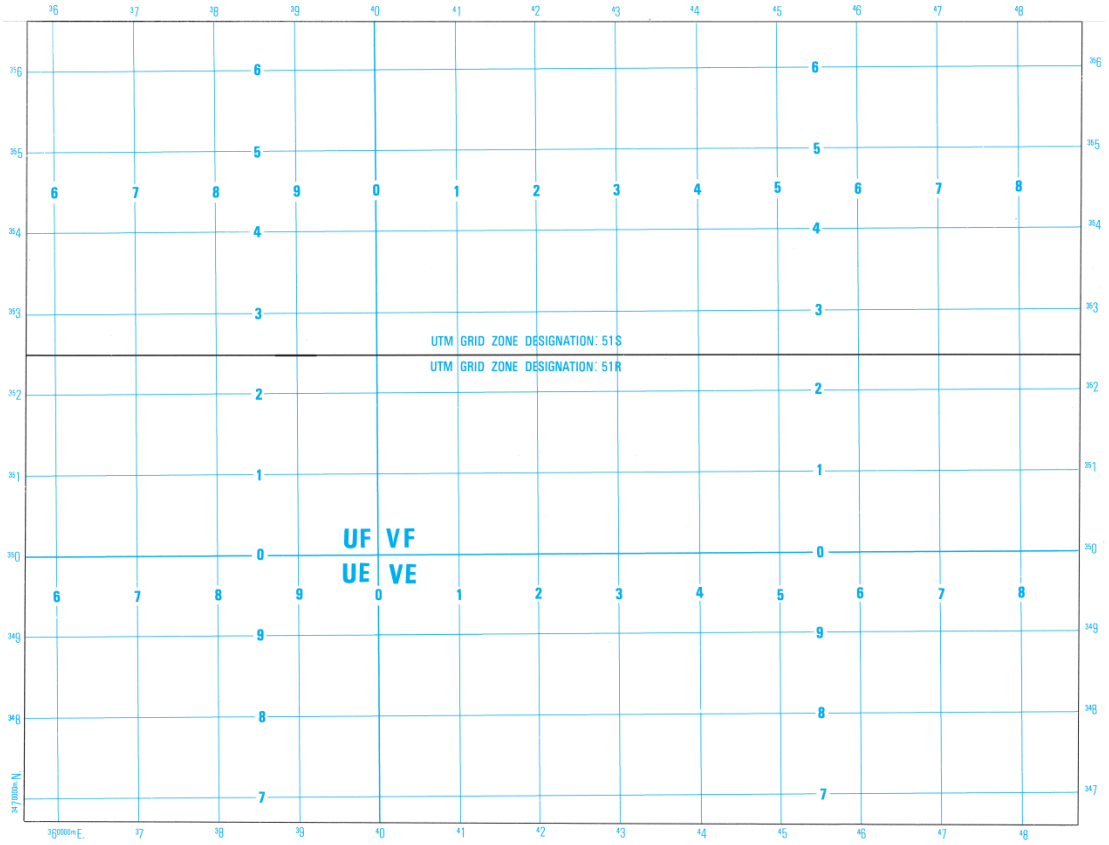


*Figure 28.* Treatment When Grid Falls Within More Than One UTM Grid Zone Designation Area as Shown on a 1:250,000 Scale Map

## 7-4 OVERLAPPING AND EXTENDED GRIDS

Overlapping and extended grids are not shown on maps at these scales.

## 7-5 GRID DECLINATION

Grid declinations from true north are not shown on maps at these scales.

## 7-6 MAGNETIC DECLINATION

a. In the margin of each sheet a note is shown to give the magnetic declination, usually for the centers of the west and east edges of the sheet. The declination is expressed to the nearest 1/2 degree, with mil equivalents to the nearest 10 mils.

b. The declination is obtained from the latest isogonic data for a standard epoch (i.e., a year that is divisible by five, such as 2010, 2015).

c. No reference is made to the annual magnetic change.

d. The note is printed in purple and is modeled after the following:

**2010 MAGNETIC DECLINATION FROM TRUE NORTH VARIES FROM 1 1/2° (30 MILS) WESTERLY FOR THE CENTER OF THE WEST EDGE TO 2° (40 MILS) WESTERLY FOR THE CENTER OF THE EAST EDGE**

e. On sheets where the declination is the same over the entire sheet, the note is modeled after the following:

**MAGNETIC DECLINATION FOR 2010 IS 1 1/2° (30 MILS) WESTERLY OVER THE ENTIRE AREA**

## 7-7 THE GRID REFERENCE BOX

a. A grid reference box appears in the margin of each sheet. The box contains step-by-step instructions for composing a grid reference. See Figure 29 for an example. The applicable Grid Zone Designation is also identified in the box.

b. When more than one major grid appears on a sheet and the method for giving a reference is the same for all the grids, a common reference box is used.

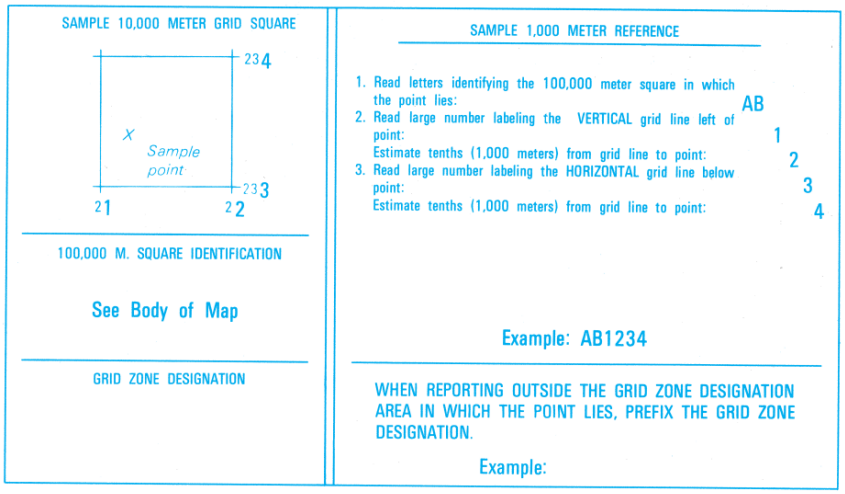


*Figure 29.* Grid Reference Box Most Commonly Used on Maps at Scales of 1:250,000 and 1:500,000

# CHAPTER 8
# PORTRAYAL OF GRIDS ON MAPS AT 1:1,000,000 SCALE

## 8-1 GENERAL

Grid data and grid format for maps at 1:1,000,000 scale generally appear as described in this section. Except for minor differences, the design is essentially the same for Universal Transverse Mercator (UTM) grids and Universal Polar Stereographic (UPS) grids. The maps usually show grid lines and ticks, their values, grid letters, and notes in the margin identifying the grid and the Grid Zone Designation. Variations in the specifications for particular types of products at 1:1,000,000 scale exist. The individual product specifications must be followed. A typical treatment is shown in Figure 30.

## 8-2 THE MAJOR GRID

a. The major grid is shown by lines at 100,000-meter intervals, intersected by ticks at 10,000-meter intervals. Where a grid line coincides with a neatline of the map, the grid line and its intersecting ticks are omitted. However, the neatline is labeled in the margin with the values for the grid line.

b. Grid values appear outside the neatline on all four sides of the sheet, labeling each grid line. They may also label only the first grid line in each direction from the southwest corner. Except for the values labeling the first grid line in each direction from the southwest corner of the sheet, the last four digits (0000) of the values are omitted. The values are shown in two sizes of type, with the larger size being used for the principal digits.

c. With most grids, one principal digit is used. This represents the 10,000 digit of the grid values.

d. When the grid system is one which identifies its 100,000-unit squares, the identifications appear on the face of the map, centered within the appropriate squares.

e. Blue is used for all grid information, including grid lines, grid ticks, 100,000-unit square identifications, grid values, and all margin grid information.

f. A note printed in blue appears in the lower margin or in the legend of each sheet to identify the grid and the Grid Zone Designation. The note is modeled after the following:

**BLUE LINES AT 100,000 METER INTERVALS AND BLUE TICKS AT 10,000 METER INTERVALS INDICATE THE UNIVERSAL TRANSVERSE MERCATOR GRID, ZONE DESIGNATION 37T, WGS84 ELLIPSOID**

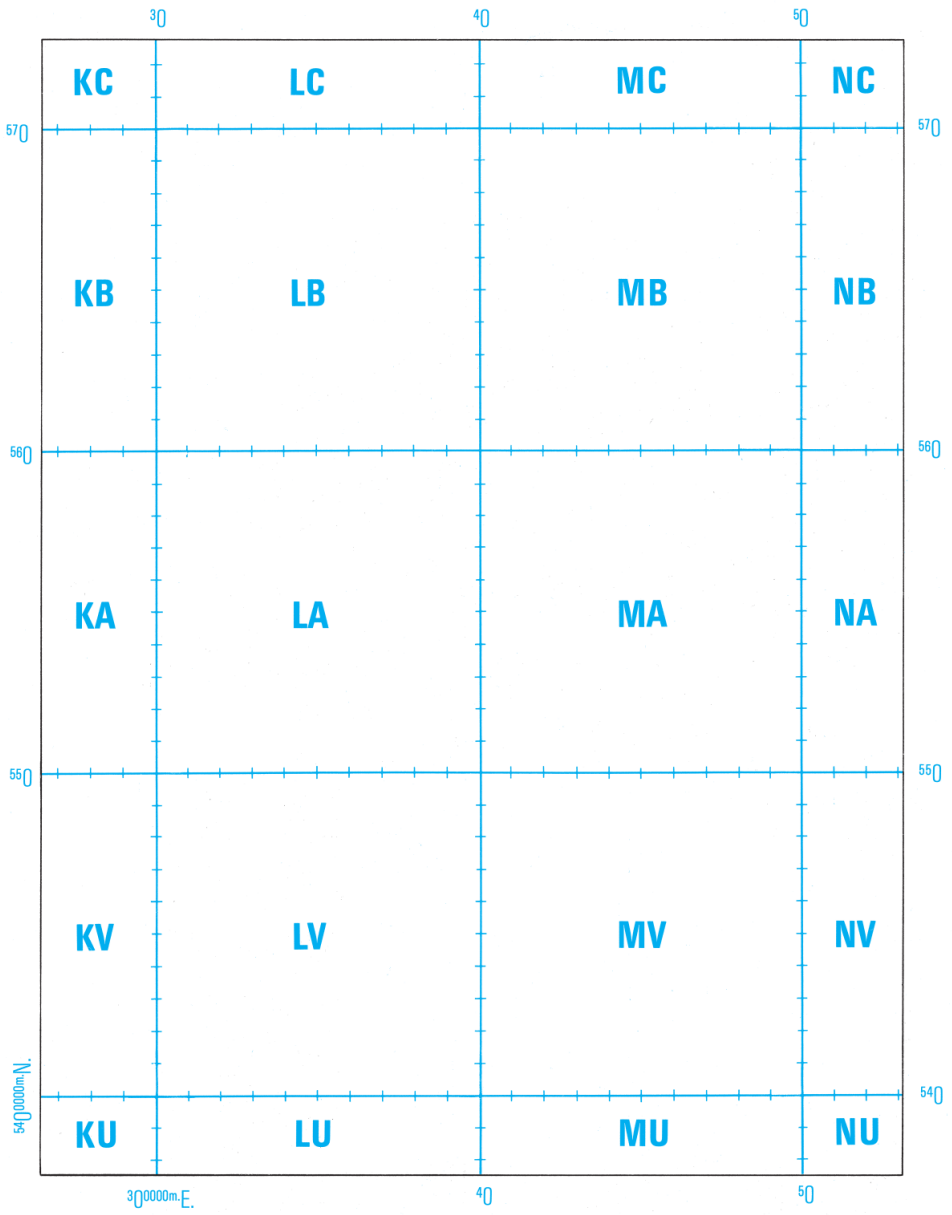


*Figure 30.* Treatment for the Major Grid in UTM Areas Shown on Maps at 1:1,000,000 Scale

g. On maps having land insets for which the grid or grid zone differs from that of the map proper, the appropriate grid note is shown within the inset.

## 8-3 MULTIPLE MAJOR GRIDS

a. In many instances a sheet contains more than one major grid. This occurs especially in higher latitudes, where sheets may be wide in longitudinal extent.

b. Zone junctions are indicated by accentuated lines, printed in blue. Labels appear on each side of the junction line. The labels may be shown more than once to facilitate identification. Where a zone junction line is coincident with a neatline, both the junction line and the identifying labels are omitted.

c. The label for a UTM grid junction, or a UPS grid junction, includes the identification of the Grid Zone Designation and is written in Military Grid Reference System (MGRS) terms as:

**UTM GRID ZONE DESIGNATION: 22W**

**UPS GRID ZONE DESIGNATION: A**

d. Each grid is shown by lines within its own area only, being represented in the normal manner at 100,000-meter intervals, intersected by ticks at 10,000-meter intervals. All grid lines are printed in blue.

e. Grid values appear on all four sides of the sheet (outside the neatline) labeling each grid line. They may also label only the first grid line in each direction from each corner of the sheet. The composition of the number is similar to that described in paragraph 8-2-b, except that full grid values label the first grid line in each direction from each corner of the sheet.

f. Where appropriate for the grid, identification of 100,000-meter squares and larger unit squares appear on the face of the map, centered within the appropriate squares, as described in paragraph 8-2-d.

g. Notes identifying each grid appear in the lower margin of the sheet. The note is modeled after the following:

**BLUE LINES AT 100,000 METER INTERVALS AND BLUE TICKS AT 10,000 METER INTERVALS INDICATE THE UNIVERSAL TRANSVERSE MERCATOR GRID, ZONE DESIGNATIONS 22K AND 23K, WGS 84 ELLIPSOID**

h. In certain cases, a sheet bearing the UTM grid may straddle a parallel which marks the division between different Grid Zone Designations. A line in black or blue indicates the dividing parallel. The proper Grid Zone Designations, printed in blue appear on each side of the line.

i. Figure 31 illustrates principles described for sheets with more than one major grid.

## 8-3-1 OVERLAPPING AND EXTENDED GRIDS

Overlapping or extended grids are not shown on 1:1,000,000 scale maps.

## 8-3-2 GRID AND MAGNETIC DECLINATIONS

Grid and magnetic declination data are not shown on 1:1,000,000 scale maps.

## 8-3-3 THE GRID REFERENCE BOX

a. A grid reference box may be shown in the margin of the sheet. The box contains explicit step-by-step instructions for composing a grid reference. See Figure 32 for a typical grid reference box.

b. The grid system(s) in use on the map dictates the referencing instructions contained in the grid reference box.

c. When more than one major grid appears on a sheet, a common reference box is used for all grids.

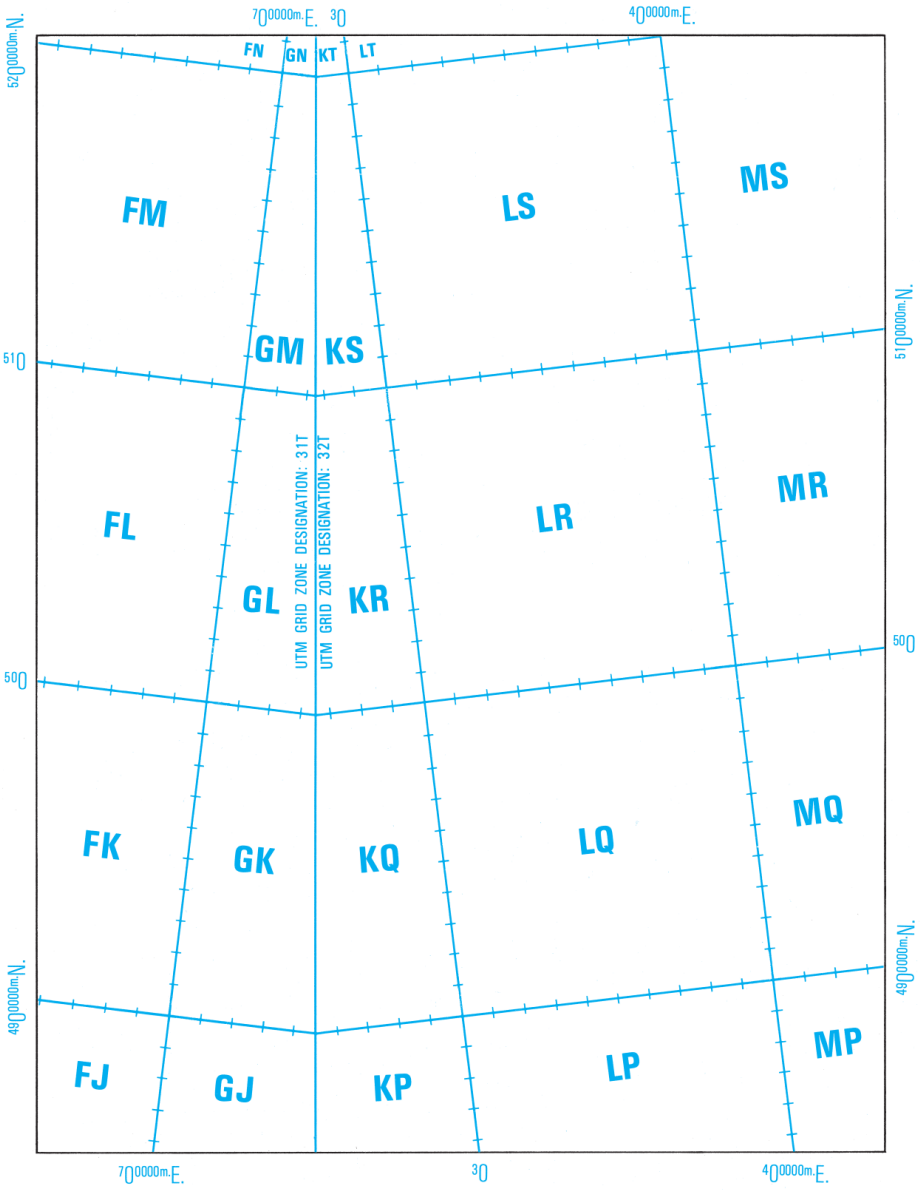


*Figure 31.* Two Major Grids (in this Case, Zones of the UTM) Separated by a Grid Junction, as Shown on a Map at 1:1,000,000 Scale

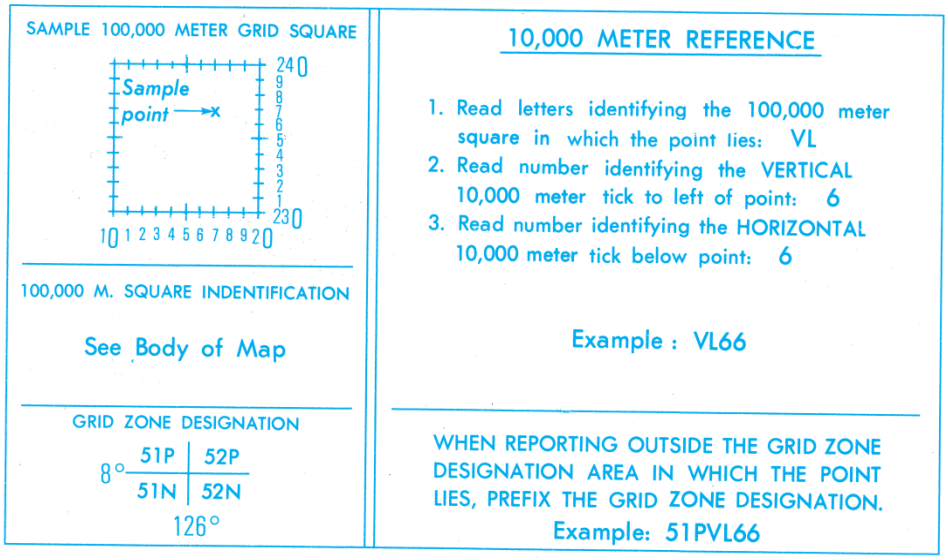


*Figure 32.* Grid Reference Box for 1:1,000,000 Scale Map

# CHAPTER 9
# GRIDS ON NAUTICAL CHARTS AT 1:75,000 SCALE AND LARGER

## 9-1 GENERAL

a. Requirements for grid data and grid formats on nautical charts prepared for the Department of Defense (DoD) at 1:75,000 scale and larger are essentially the same for Universal Transverse Mercator (UTM) grids and Universal Polar Stereographic (UPS) grids.

b. The grid data for DoD charts usually include the major grid, a grid reference box, and notes identifying the grid. Littoral Planning Charts also include a declination note.

c. The adjacent grid is provided as an overlapping grid when a chart lies within approximately 40 kilometers of a grid junction line. A separate declination note, and notes identifying the overlapping grid, appears in the margin for grid junctions.

d. Specific dimensions, size and style of type, and placement of margin data relating to grids and grid formats at 1:75,000 scale and larger are contained in National Geospatial-Intelligence Agency (NGA) product specifications.

## 9-2 THE MAJOR GRID ON LITTORAL PLANNING CHARTS

a. The major grid on Littoral Planning Charts is indicated by lines at 1,000-meter intervals. Every 10,000-meter grid line at scales of 1:45,001 and smaller or 5,000-meter grid line at scales of 1:45,000 and larger are accentuated in weight (index line).

b. Grid numbers appear outside the neatline on all four sides of the chart. Each 1,000-meter line is labeled with the principal digits and the higher order digits, i.e. $^{7}81$ or $^{67}45$. Each 10,000-meter line has a full numerical label, i.e., $^{6}90^{000}$ or $^{47}50^{000}$.

c. Full grid labels, including unit and direction, will be shown on the first grid line in each direction from each corner, i.e., $^{3}92^{000m.}$E or $^{23}11^{000m.}$N.

d. Where a grid line coincides with a neatline, the grid line is overprinted and labeled in the margin with its value.

e. On charts showing the major and overlapping grids, the first grid line and grid tick in each direction from each corner are given the full coordinate values for both grids.

f. Only the index grid lines are labeled in the margin of skewed charts. These labels include the appropriate northing or easting abbreviation and the unit of measurement.

g. The grid lines in the chart interior contain a pattern of grid value labels (principal digits) designed to assist in position referencing on a folded chart. The 1,000-meter northing grid lines are labeled to the right of each 10,000-meter easting grid line and the 1,000-meter easting grid lines are labeled above each 10,000-meter northing grid line.

h. The color of the grid lines and values is purple for the primary major grid, blue for the second major or overlapping grid.

i. A note identifying the grid and ellipsoid appears in the margin of a chart. The note is modeled after the following:

PURPLE LINES INDICATE THE 1,000 METER UNIVERSAL TRANSVERSE MERCATOR GRID, ZONE 59N, WGS 84 ELLIPSOID

j. Figures 33 and 34 illustrate the treatment for the major grid on Littoral Planning Charts.

## 9-3 THE MAJOR GRID ON MINE WARFARE CHARTS

a. The major grid is indicated by interior ticks at 10,000-meter intersections and by ticks along the neatlines at 1,000-meter intervals. The 10,000-meter ticks along the border are accentuated in weight. The major grid ticks are printed in purple.

b. Grid numbers appear outside the neatlines on all four sides of the chart, labeling every 5,000-meter grid tick. Every 10,000-meter grid tick is labeled with the full coordinate value. The intermediate 5,000-meter grid tick is labeled by the principle digits preceded by the 100,000-meter and 1,000,000-meter digits. The first 10,000-meter tick from each corner includes the E for easting and the N for northing. All grid values are printed in the same color as the ticks. See Figure 35.

c. A note identifying the grid and ellipsoid appears in the margin of a chart. The note is modeled after the following:

UNIVERSAL TRANSVERSE MERCATOR (UTM) GRID, ZONE 10T,
WGS 84 DATUM, WGS 84 ELLIPSOID
FOR MILITARY GRID REFERENCE

## 9-4 THE MAJOR GRID ON STANDARD NAUTICAL CHARTS

a. The major grid is indicated by interior and neatline ticks at 5,000-meter intervals for scales of 1:25,000 to 1:45,000. For charts at scales of 1:45,000 and larger, a 10,000-meter interval is used. The grid ticks are printed in purple. Sometimes the size and scale of charts may require the interval to be modified to show at least two ticks in each direction. Since nautical charts do not normally show grid lines, ticks are used to represent the grid allowing the user to construct a grid by drawing straight line segments between the ticks. The ticks must be positioned close enough together to allow the chart user to approximate the curve of the true grid line by drawing straight line segments. On all charts at scales greater than 1:75,000 the maximum acceptable deviation between the true grid line and the one which the user would construct by joining the ticks is <0.5 mm (0.02in.). The tick spacing and maximum acceptable deviation for 1:75,000 scale and larger is summarized in Table 12.

| SCALE | TICK SPACING | MAXIMUM ACCEPTABLE DEVIATION |
|---|---|---|
| Larger than 1:25,000 | None | n/a |
| 1:25,000-1:45,000 | 5,000m | <0.5mm (0.02in.) |
| 1:45,001-1:75,000 | 10,000m | <0.5mm (0.02in.) |

*Table 12.* Maximum Acceptable Deviation of the Constructed Grid from the True Grid

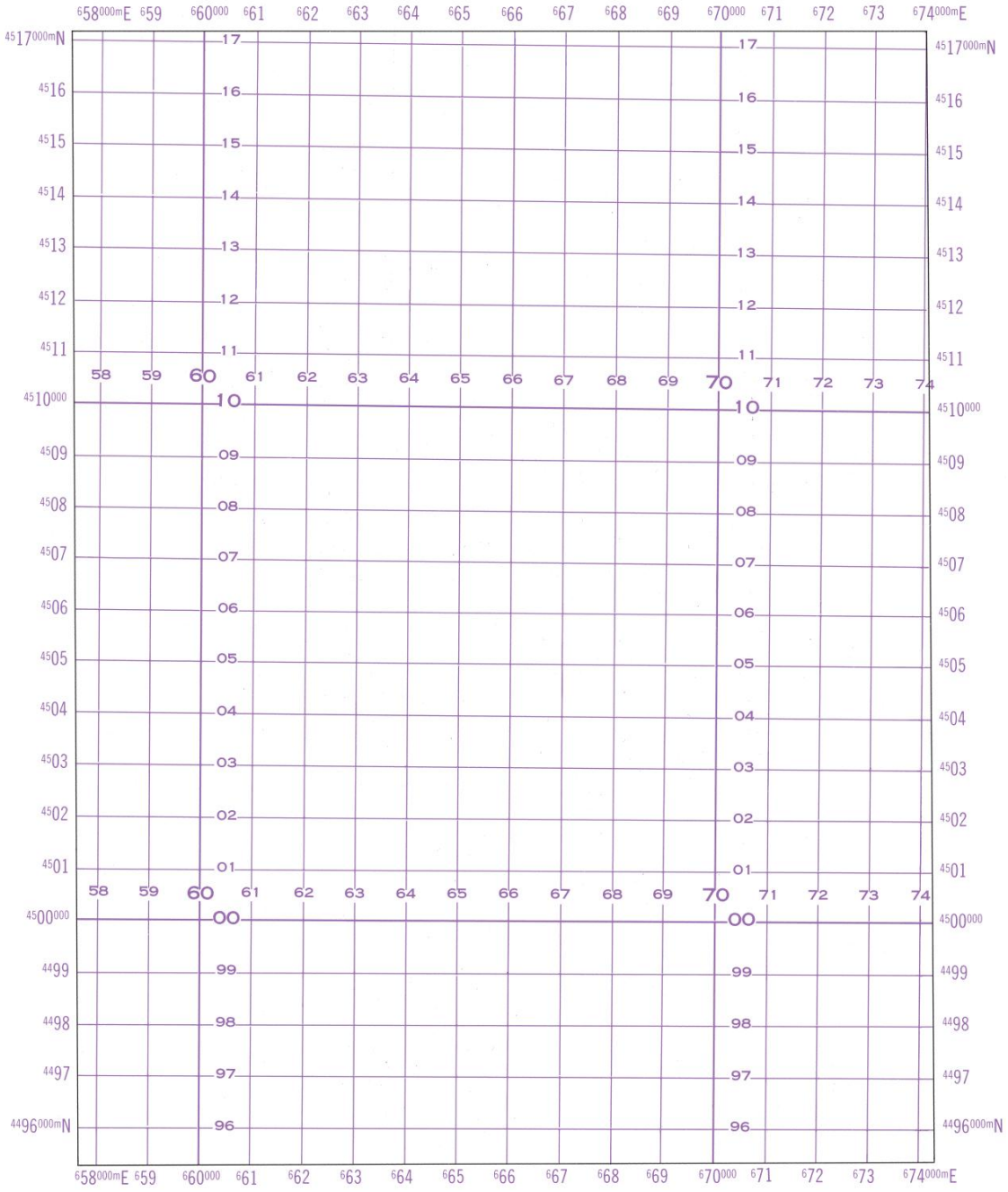


*Figure 33.* The Major Grid as Shown on Littoral Planning Charts

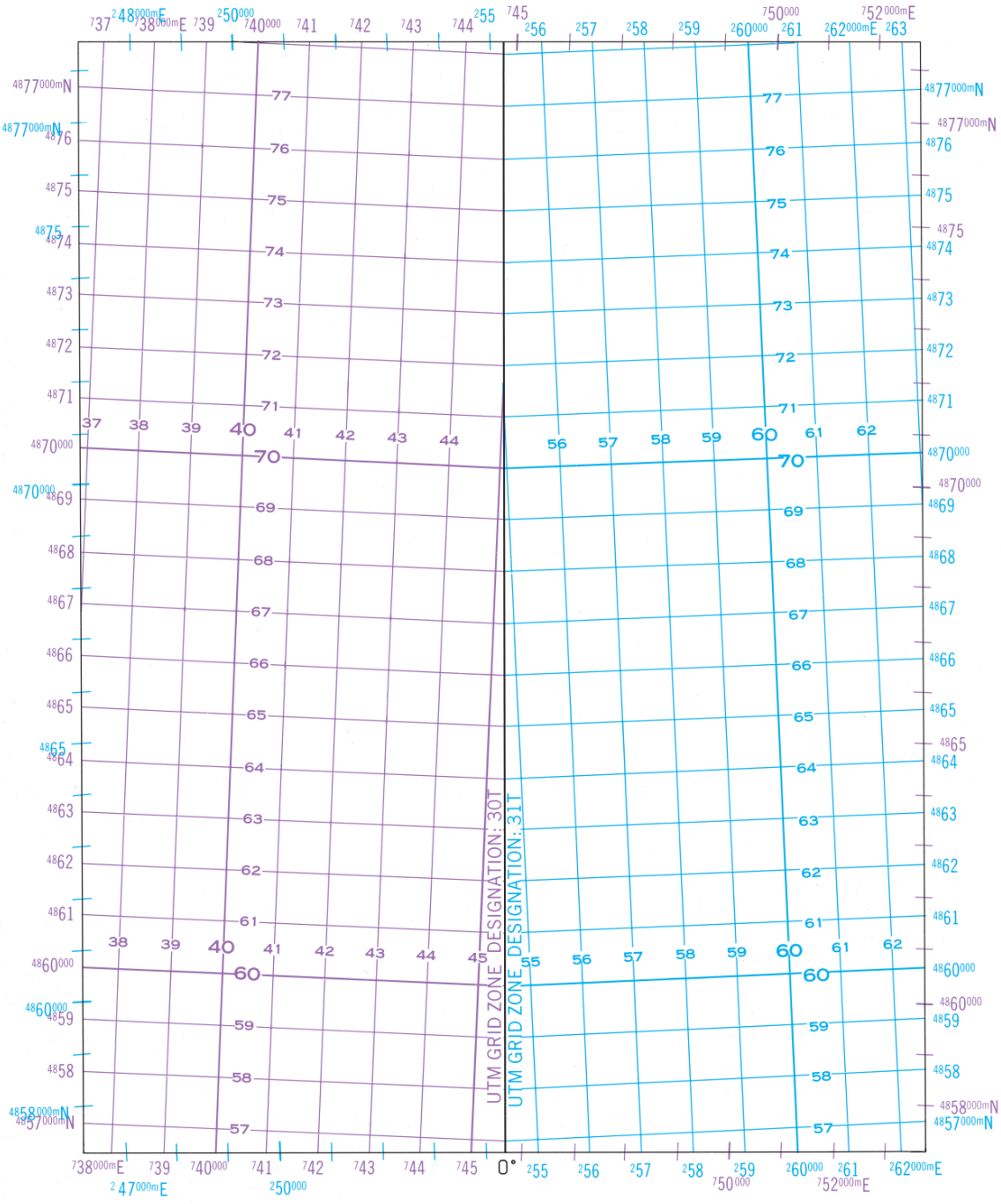


*Figure 34.* Two Major Grids (in this Case, Zones of the UTM) Separated by a Grid Junction as Shown on Littoral Planning Charts

b. Grid numbers appear outside the neatline on all four sides of the chart, labeling every grid tick. The first tick from each corner includes the E for Easting and the N for Northing, then the m for meters. All grid values are printed in the same color as the ticks. See Figure 36.

c. A note identifying the grid and ellipsoid appears in the margin of a chart. The note is modeled after the following:

UNIVERSAL TRANSVERSE MERCATOR (UTM) GRID, ZONE 10T,
WGS 84 DATUM, WGS 84 ELLIPSOID
FOR MILITARY GRID REFERENCE

## 9-5 MULTIPLE MAJOR GRIDS ON LITTORAL PLANNING CHARTS

a. In certain instances a chart contains more than one major grid.

b. With the UTM and UPS grids this may occur:

1. Where original chart limits are retained as established by a mapping agency of a foreign country.

2. Where a chart is shifted from the normal position to avoid making additional charts.

c. Zone junctions are indicated by accentuated lines, tinted in black. Labels identifying the junction appear parallel to and on each side of the Junction line. The labels may be shown more than once to facilitate identification. Each label is printed in the color designated for the particular grid zone. When a zone junction line is coincident with a neatline, both the junction line and the identifying labels are omitted. If the junction line falls within 2.5 mm (0.10 inch) of the neatline, the junction line is not, shown; it is considered as being coincident with the neatline.

d. The label for a UTM grid junction, or a UPS grid junction, includes the identification of the Grid Zone Designation and is written in MGRS terms as:

UTM GRID ZONE DESIGNATION: 54T

UPS GRID ZONE DESIGNATION: B

e. Each grid is shown by lines within its own area only, being represented at 1,000-meter intervals with every 10,000-meter line accentuated in weight. The first major grid is printed in purple, the second major grid in blue, and the third major grid in red-brown.

f. On charts bearing two major grids, the extension of either grid into the area of the other (overlapping grid) is shown by ticks crossing the neatline correctly aligned with its respective major grid. The even 10,000-meter ticks are accentuated in weight.

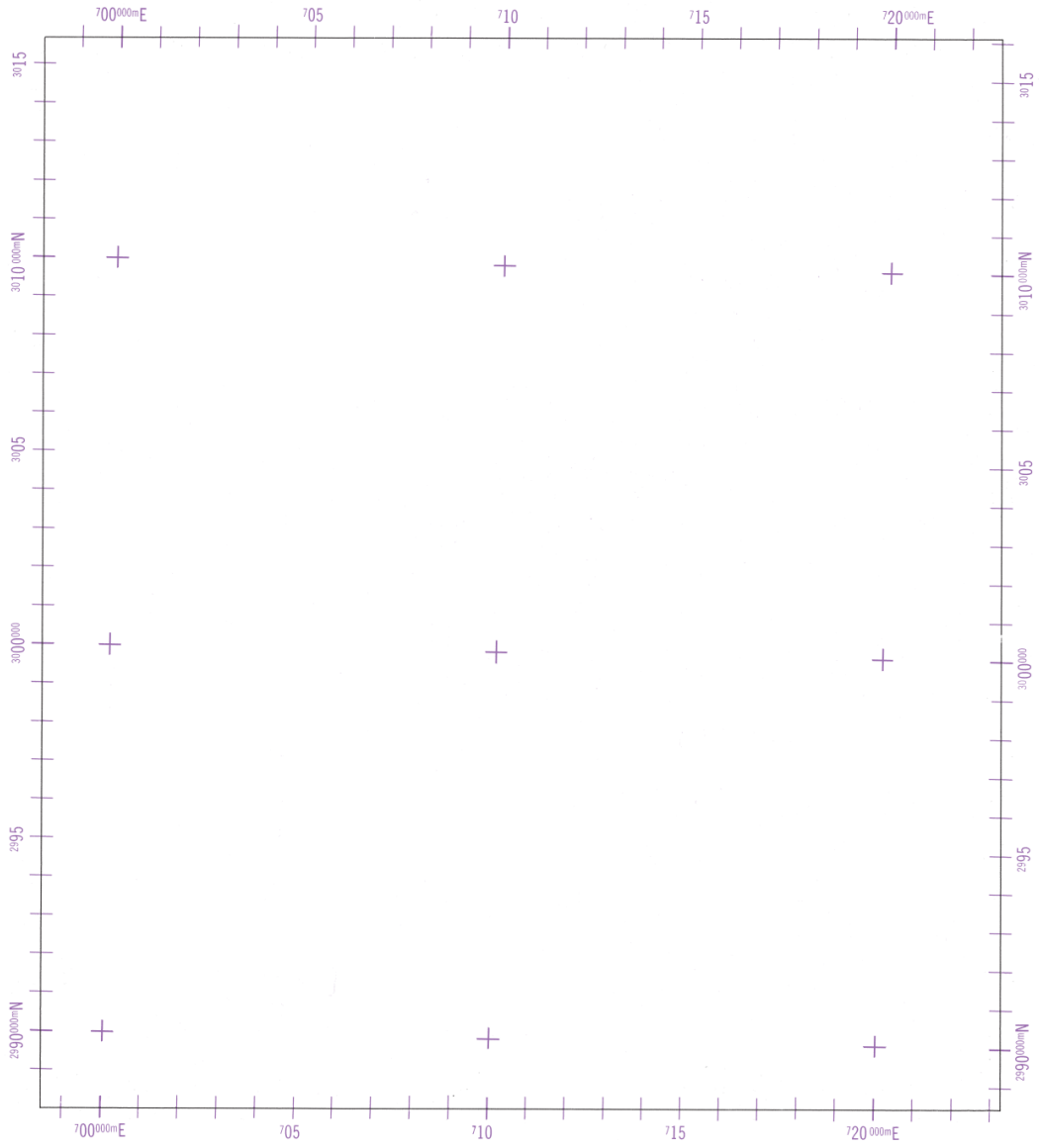


*Figure 35.* Treatment for the Major Grid on Mine Warfare Charts at 1:75,000 Scale and Larger

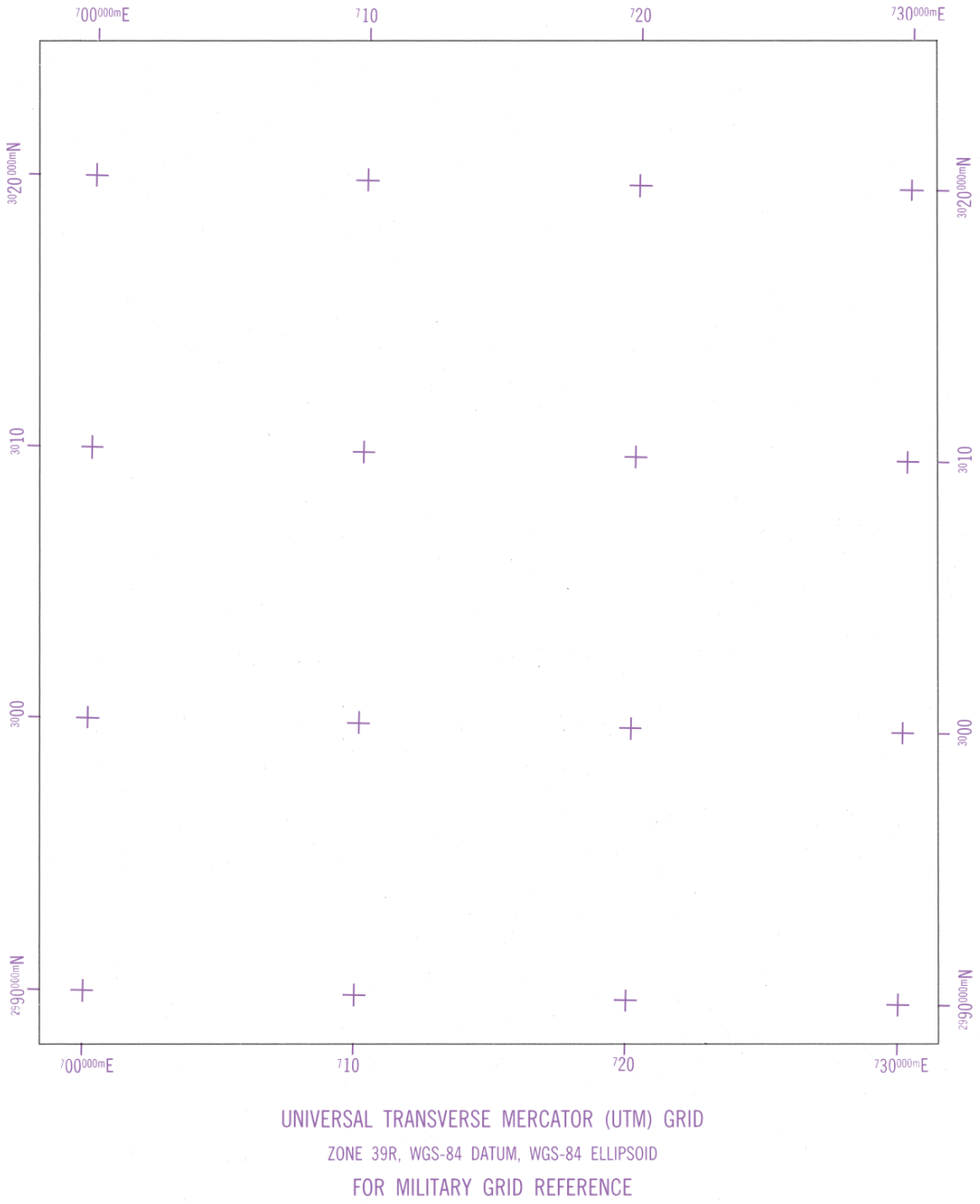


*Figure 36.* Treatment for the Major Grid on Standard Nautical Charts at 1:75,000 Scale and Larger

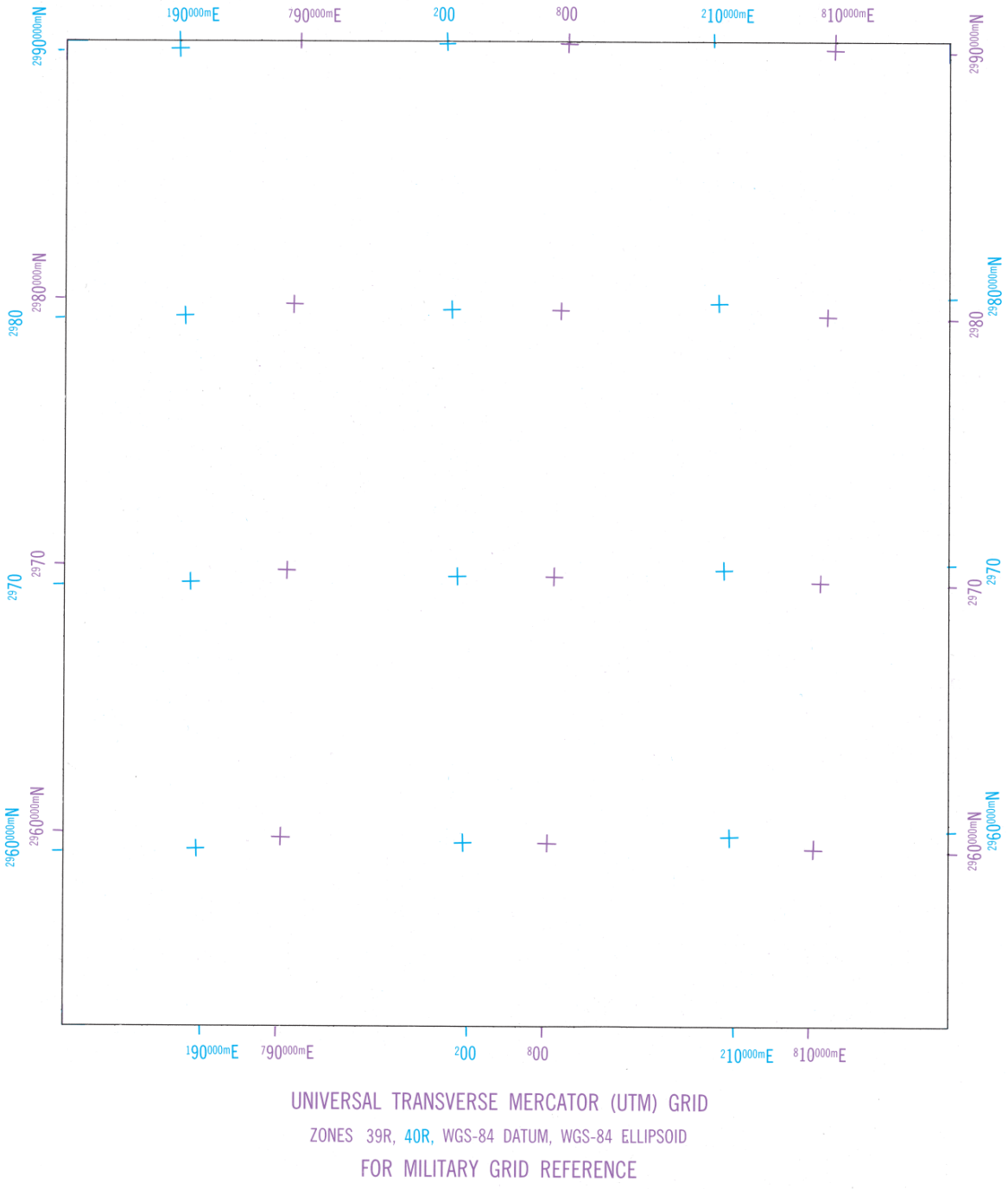


*Figure 37.* Treatment for the Multiple Major Grids on Standard Nautical Charts at 1:75,000 Scale and Larger

g. On charts bearing three major grids, a similar practice is followed.

h. Grid values appear on all four sides of the chart labeling each grid line and those grid ticks whose values are multiples of 5,000. Full values appear at each corner, labeling the first grid line in each direction from the corner.

i. Grid values, expressed in principal digits only, appear on the face of the chart labeling each grid line.

j. Notes identifying each grid appear in the margin of the chart. The notes are modeled after the following:

PURPLE LINES AND TICKS INDICATE THE 1,000 METER UNIVERSAL TRANSVERSE MERCATOR GRID, ZONE 59N, WGS 84 ELLIPSOID

BLUE LINES AND TICKS INDICATE THE 1,000 METER UNIVERSAL TRANSVERSE MERCATOR GRID, ZONE 60N, WGS 84 ELLIPSOID

## 9-6 MULTIPLE MAJOR GRIDS ON STANDARD NAUTICAL CHARTS

a. In certain instances a chart contains more than one major grid. See paragraph 9-5-a.

b. Zone junctions are not indicated in the interior of the chart. They are marked only in the grid reference box.

c. Each grid is depicted across the entire area of the chart. The first major grid is represented in purple. The second major grid is represented in blue, and a third major grid is shown in red-brown. Figure 37 illustrates the treatment of multiple major grids.

d. Examples of notes identifying each grid appear in Figure 38. These notes may be placed within the chart neatlines or outside the border as space permits.

## 9-7 OVERLAPPING GRIDS ON LITTORAL PLANNING CHARTS, AND MINE WARFARE CHARTS

a. An overlapping grid is generally required within approximately 40 kilometers of a zone junction. The overlapping grid may be omitted if there are no land bodies within the 40 kilometer overlap area.

b. The overlapping grid is shown by ticks, printed in blue if there is one major grid and red-brown if there are two major grids, crossing the neatline correctly aligned with its respective grid and spaced at 1,000-meter intervals. The even 10,000-meter ticks are accentuated in weight.

c. Values, similar in composition to those labeling the major grid lines or ticks, appear on all four sides of the chart. The first grid tick in each direction from each corner of the chart whose values are multiples of 5,000 are labeled. These values are printed in the same color as that of the grid.

d. Notes identifying overlapping grids appear in the margin of each chart. The notes are patterned after those used to identify multiple major grids. Figures 33 and 34 illustrate the treatments described for charts containing major and overlapping grids.

## 9-8 OVERLAPPING GRIDS ON STANDARD NAUTICAL CHARTS

a. An overlapping grid may be required within approximately 40 kilometers of a zone junction. The overlapping grid may be omitted if there are no land bodies within the 40 kilometer overlap area.

b. The overlapping grid is shown in the same manner as a major grid, with interior and neatline ticks at 10,000-meter intervals, printed in blue if there is one major grid and red-brown if there are two major grids.

c. Values, similar in composition to those labeling the major grid ticks, appear on all four sides of the chart. The first grid tick in each direction from each corner of the chart is labeled with the full grid value. These values are printed in the same color as that of the grid.

d. Notes identifying overlapping grids appear within the chart or outside the heavy border of each chart. The notes are patterned after those used to identify multiple major grids. Figure 38 illustrates the treatments described for charts containing major and overlapping grids.

## 9-9 THE DECLINATION NOTE

a. A grid declination note appears in the margin of each Littoral Planning Chart. The note identifies the grid declination from true north for the approximate mid-latitude of the east and west chart edges.

b. The note for the first major grid is shown in purple. The note for the second major or overlapping grid is show in blue. If an overlapping grid occurs in combination with two major grids, the grid declination note for the overlapping grid is shown in red-brown.

c. The grid declination note is modeled after the following:

CAUTION
GRID LINES ARE NOT TRUE NORTH AND SOUTH
At West edge of chart Grid N. is 0°40'E. of True N.
At East edge of chart Grid N. is 1°15'E. of True N.

d. Magnetic information will be derived from the magnetic compass rose.

## 9-10 THE GRID REFERENCE BOX

a. A grid reference box on a Littoral Planning Chart is printed in purple and appears in the margin of each chart. The box contains instructions and attendant data to enable the user to compose standard grid references.

b. The grid system(s) in use on the chart dictates the referencing instructions contained in the grid reference box. The grid reference boxes most commonly used on charts, 1:175,000 scale and larger, are illustrated in Figure 38. The boxes are subject to modifications.

c. The grid reference box also contains diagrams identifying applicable Grid Zone Designations and grid square identifications.

d. The diagrams show the Grid Zone Designation in black, the 100,000-meter grid lines and their values (in abbreviated form) in the appropriate grid color, and the 100,000-meter square identification(s) in the appropriate grid color. Figure 38 illustrates the composition of the diagrams under various conditions.

e. For charts that have an inset whose 100,000-meter square identification letters differ from those of the chart proper, the identification letters are shown in the interior of the inset, rather than in the grid reference box.

f. A grid reference diagram for a Mine Warfare or Standard Nautical Chart is printed in purple and may be located within the chart or in the margin (where space permits).

g. The grid reference diagram identifies the applicable Grid Zone Designation(s) and Grid Square Identification(s).

h. The diagrams show the Grid Zone Designation(s) in the same color to which they apply.

i. The 100,000-meter line(s), square identification(s) and value(s) in abbreviated form are always printed in the same color as the grid values to which they pertain.

j. Grid junction lines are printed in black. For charts that consist of panels, the line depicting the panel limits is printed in black.

k. For charts that have an inset/plan whose 100,000-meter square identification letters differ from those of the main chart, the identification letters are shown below the inset/ plan title rather than the grid reference diagram.

l. Standard nautical charts do NOT show grid lines and therefore will carry a note below the grid reference diagram for constructing a line grid, for example:

TO FORM 10,000 METER SQUARES, JOIN THE TICKS ON NEATLINES WITH STRAIGHT LINE SEGMENTS THROUGH THE INTERIOR TICKS.

## 9-11 WORLD GEODETIC SYSTEM 1984 (WGS 84) DATUM NOTE

a. All nautical charts, other than Littoral Planning Charts, and certain modified facsimiles, are constructed on WGS 84 wherever possible. When the chart is not on the latest World Geodetic System 1984 datum, a note is shown in black indicating the correction needed to convert a coordinate to that datum.

Example for Combat Chart:

COORDINATE CONVERSIONS
EUROPEAN DATUM TO WORLD GEODETIC SYSTEM 1984
Grid: Subtract 65m E; Subtract 296m N
Geographic: Subtract 3.5" Long; Subtract 3.0" Lat

b. When there is insufficient data available or inconsistent deviations result from the available geodetic control, one of the following notes, as appropriate, is shown in place of the WGS 84 correction note:

WORLD GEODETIC SYSTEM 1984 DATA ADJUSTMENT
Due to unavailability of geodetic data, this chart
cannot be placed on the World Geodetic System 1984 (WGS 84)
Datum.

The available geodetic control does not indicate a uniform deviation; therefore, this chart cannot be placed on the World Geodetic System (WGS) Datum.

c. When a Mine Warfare or Standard Nautical Chart is on WGS 84, a datum note is shown as follows:

DATUM NOTE
Positions obtained from satellite navigation systems
referred to the World Geodetic System 1984 (WGS 84) can be
plotted directly on this chart.

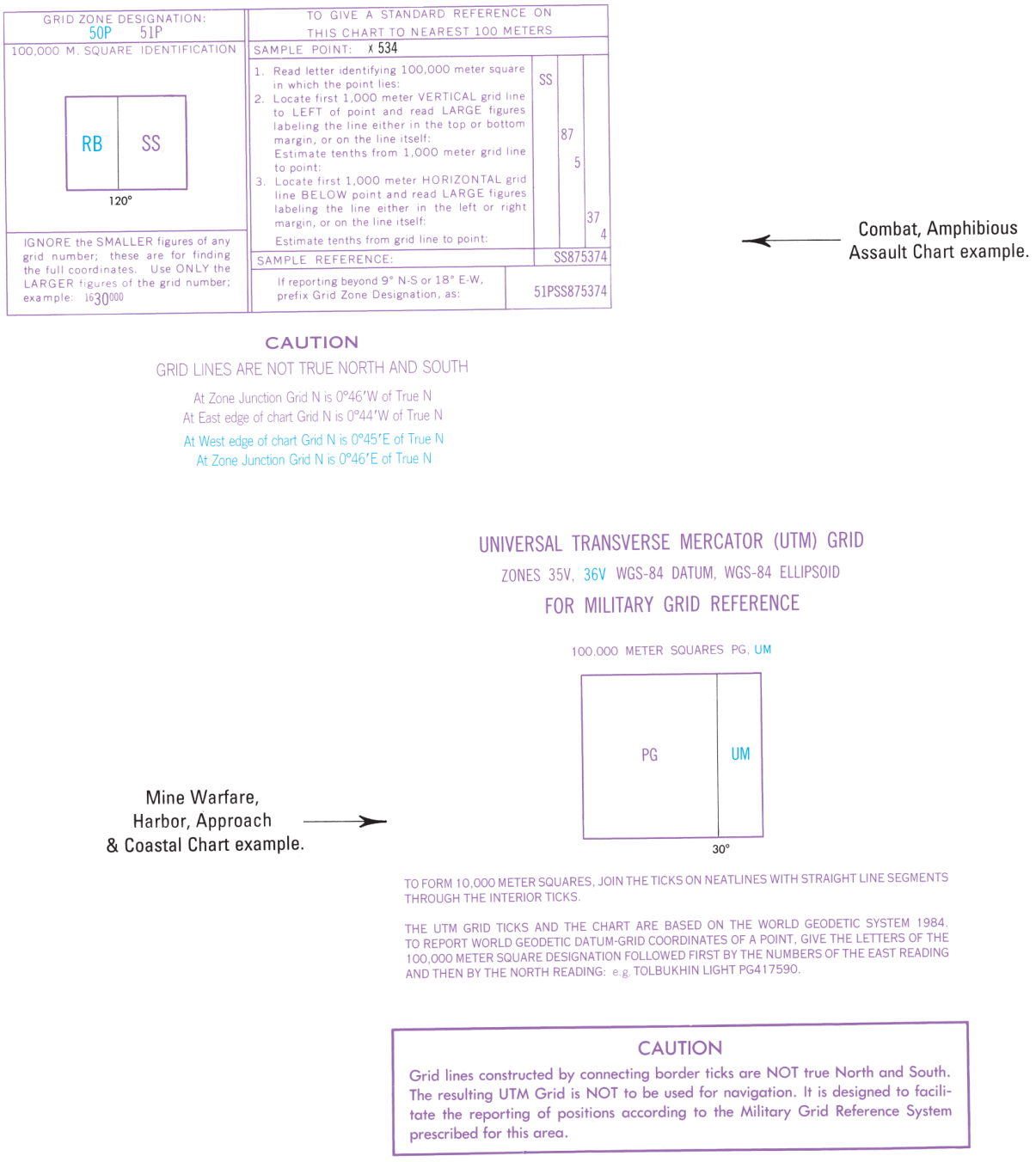


*Figure 38.* Grid Reference Boxes Commonly Used on Nautical Charts at Scales of 1:75,000 and Larger

# CHAPTER 10
# GRIDS ON NAUTICAL CHARTS AT SCALES SMALLER THAN 1:75,000

## 10-1 GENERAL

a. Grids are required on nautical charts at scales from 1:75,001 to 1:300,000. For charts at scales smaller than 1:300,000, reference should be made to individual project instructions to determine grid requirements.

b. The grid data for Department of Defense (DoD) charts usually include the major grid, a grid reference box, and notes identifying the grid.

c. Specific dimensions, size, style of type, and placement of margin data relating to grids and grid formats at scales smaller than 1:75,000 are contained in National Geospatial-Intelligence Agency (NGA) product specifications.

## 10-2 THE MAJOR GRID

a. The grid is indicated by ticks at interior intersections and along the neatline. The spacing of the ticks depends upon the scale and size of the chart and upon the need to keep the grid information within acceptable limits of accuracy. Nautical charts at scales smaller than 1:75,000 are typically constructed on Mercator projections. Grid lines which appear straight on Transverse Mercator projections will therefore appear curved when plotted on a Mercator. Since nautical charts do not normally show grid lines, ticks are used to represent the grid allowing the user to construct a grid by drawing straight line segments between the ticks. The ticks must be positioned close enough together to allow the chart user to approximate the curve of the true grid line by drawing straight line segments. On charts at scales from 1:75,001 to 1:95,000 the maximum acceptable deviation between the true grid line and the one which the user would construct by joining the ticks is 0.5mm (0.02in.). As a general rule, charts at this scale should indicate grids by ticks at 10,000-meter intervals. For charts at extreme latitudes, care should be taken to make sure that the maximum acceptable deviation is not exceeded.

b. Similarly, for charts at scales from 1:95,001 to 1:199,999, the maximum acceptable deviation is 1.0 mm (0.04in.) which generally would require ticks at 20,000-meter intervals. Again, care should be taken on charts in the extreme latitudes to see that the maximum acceptable deviation is not exceeded. This paragraph is summarized in Table 13.

| SCALE | TICK SPACING | MAXIMUM ACCEPTABLE DEVIATION |
|---|---|---|
| 1:75,001-1:95,000 | 10,000m | <0.5mm (0.02in.) |
| 1:95,001-1:199,999 | 20,000m | 0.5mm (0.02in.) |
| 1:200,000-1:300,000 | 50,000m | 1.0mm (0.04in.) |
| 1:300,001 and smaller | None | n/a |

*Table 13.* Maximum Acceptable Deviation of the Constructed Grid from the True Grid

c. Grid numbers appear outside the neatline on all four sides of the chart, labeling every grid tick. Every 100,000-meter grid tick is labeled with the full coordinate value. The intermediate grid tick(s) is (are) labeled by the principal digits preceded by the 100,000-meter digits. The first tick from each corner includes the ‘E’ for Easting and the ‘N’ for Northing. All grid values are printed in the same color as the ticks.

d. A note identifying the grid and ellipsoid appears in the margin or on the face of a chart depending on the available space. The note is modeled after the following:

UNIVERSAL TRANSVERSE MERCATOR (UTM) GRID, ZONE 19,
WGS 84 DATUM, WGS 84 ELLIPSOID
FOR MILITARY GRID REFERENCE

e. Figure 39 illustrates the treatment for the major grid.

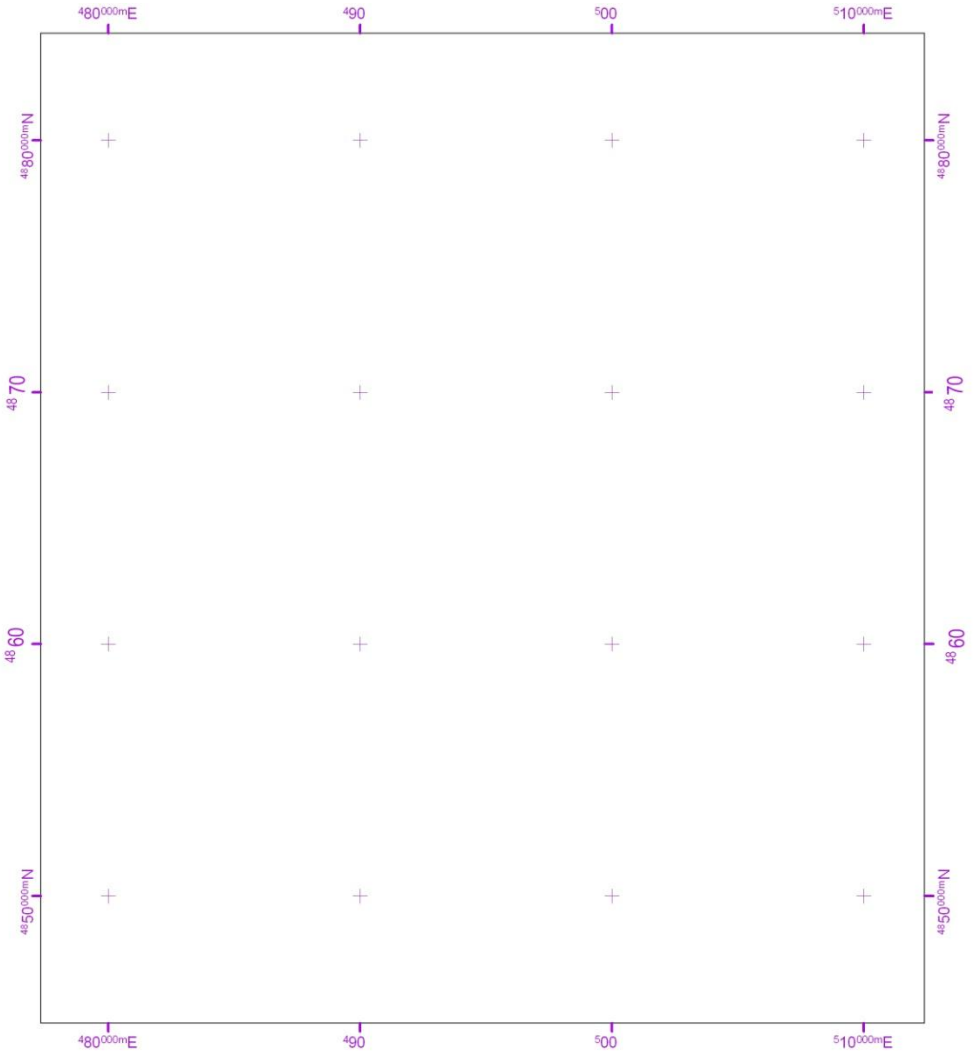


*Figure 39.* Treatment for the Major Grid on Nautical Charts at Scales Smaller than 1:75,000

## 10-3 MULTIPLE GRIDS

a. In many instances a chart contains multiple major grids.

b. Zone junctions are indicated in the grid reference box and are not shown on the face of the chart.

c. Each grid is depicted within its own area by the use of internal and neatline ticks as described in section 10-2.

d. The grid is extended one tick beyond any grid junction line. The first major grid ticks and values are represented in purple. The second major grid ticks and values are represented in blue, and a third major grid is shown in red-brown. Figure 40 illustrates the treatment of multiple major grids.

e. Notes identifying each grid appear on the chart. The notes are modeled after the following:

UNIVERSAL TRANSVERSE MERCATOR (UTM) GRID, ZONE 19,
WGS 84 DATUM, WGS 84 ELLIPSOID
FOR MILITARY REFERENCE

UNIVERSAL TRANSVERSE MERCATOR (UTM) GRID, ZONE 20,
WGS 84 DATUM, WGS 84 ELLIPSOID
FOR MILITARY GRID REFERENCE

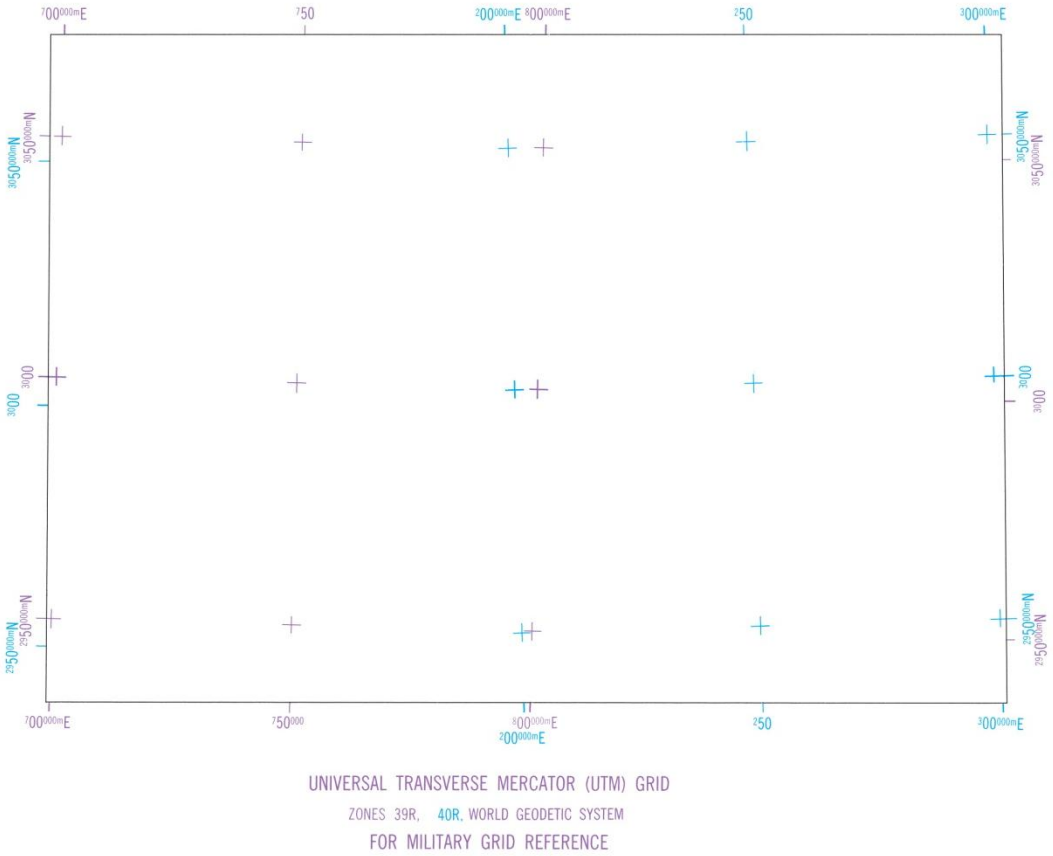


*Figure 40.* Treatment for Multiple Grids on Nautical Charts at Scales Smaller than 1:75,000

## 10-4 THE GRID REFERENCE BOX (OR NOTES)

A grid reference box, printed in purple appears in the margin or on the face of each chart depending on available space. The box contains instructions and attendant data to enable the user to compose standard grid references. For information relating to the grid reference box, see Chapter 9, section 9-10.

## 10-5 WORLD GEODETIC SYSTEM 1984 (WGS 84) DATUM NOTE

For information relating to the appropriate WGS 84 Datum Note, see Chapter 9, section 9-11.

# CHAPTER 11
# GRIDS ON AERONAUTICAL CHARTS AT 1:1,000,000 SCALE AND LARGER

## 11-1 GENERAL

a. The treatment of the grid for the 1:250,000 scale Joint Operations Graphic Air (JOG-A) series is contained in Chapter 7.

b. Grid data and grid format for the aeronautical chart at 1:1,000,000 scale are essentially the same for Universal Transverse Mercator (UTM) grids and Universal Polar Stereographic (UPS) grids. Sheet lines of charts at these scales are planned to provide a uniform sheet size. Details of the chart format and size are contained in the appropriate product specification.

c. The grid data consist of grid lines and values, grid reference boxes, notes identifying the grids, and information concerning the magnetic declination over the sheet. Overlapping and extended grids are not shown.

## 11-2 THE MAJOR GRID

a. The major grid is shown by lines printed in blue, at 100,000-meter intervals. Ticks are shown at 10,000-meter intervals along the grid lines and neatlines. (For sheets covering the United States, grid lines will be shown at 50,000-meter intervals, with intensified lines at 100,000-meter intervals.)

b. Grid lines are labeled along the margins.

c. Full grid line values shall be shown at the first grid line in each direction from each corner. Except for the values labeling the first grid line from each corner, the last four digits (0000) of the values are omitted. The values are shown in two sizes of type, with the larger size being reserved for the principal digits.

d. Full grid tick values shall include the abbreviated designation of the measuring unit "m" for meters and the abbreviated geographic designation of the tick, "N" for Northings and "E" for Eastings.

e. Intermediate grid line and tick values are shown in the margins and include only the principal digit and digits prefixing the principal digits. The ends of each grid line within the neatline are labeled in this manner. The principal digit represents the 10,000-meter digit of the UTM or UPS grid.

f. The grid square identification (100,000-meter squares) is shown near each 100,000-meter grid line intersection. When the intersection is coincident with the west or south neatline, only the identification letters falling inside the neatline are shown. When the intersection is coincident with the east or north neatline, identification letters are shown on both sides of the neatline.

g. All grid information is printed in blue.

h. A grid note appears in the lower margin of each sheet to identify the grid. The note is part of the grid reference box and is modeled after the following:

BLUE NUMBERED LINES INDICATE 100,000 METERS,
TICKS 10,000 METERS, UNIVERSAL TRANSVERSE MERCATOR
GRID, ZONE 53S, WGS 84 ELLIPSOID

i. In most instances a sheet contains more than one major grid. Grid and zone junctions are indicated by solid blue lines. Labels are shown on each side of the junction line. The labels may be shown more than once to facilitate identification. Where a grid or zone junction is coincident with the south or west neatline, only the identifying names within the chart area will be shown.

j. Junction line labels are modeled after the following:

**UTM GRID ZONE DESIGNATION: 15C**

**UPS GRID ZONE DESIGNATION: A**

k. When the grids are different zones of the UTM grid, the note is modeled after the following:

BLUE NUMBERED LINES INDICATE 100,000 METERS,
TICKS 10.000 METERS, UNIVERSAL TRANSVERSE MERCATOR
GRID, ZONES 50 AND 51, WGS 84 ELLIPSOID

l. When UTM and UPS grids are involved, the notes are modeled after the following:

IN AREAS COVERED BY UTM GRID: BLUE NUMBERED LINES
INDICATE THE 100,000 METERS, TICKS 10,000 METERS,
UNIVERSAL TRANSVERSE MERCATOR GRID, ZONE 37X,
WGS 84 ELLIPSOID

IN AREAS COVERED BY UPS GRID: BLUE NUMBERED LINES
INDICATE THE 100,000 METERS, TICKS 10,000 METERS
UNIVERSAL POLAR STEREOGRAPHIC GRID, ZONE Z,
WGS 84 ELLIPSOID

m. A separate marginal note is not shown for the grid in the north or east overlap of a chart. Such a grid is identified on the face of the chart only.

n. In certain cases, a sheet bearing the UTM grid may straddle a parallel which marks the division between different Grid Zone Designations. The grid and corresponding labeling appear as previously described. A continuous line in black indicates the dividing parallel. The proper Grid Zone Designations appear on each side of the line. The dividing parallel is omitted when it falls within 2.5 mm (0.10 inch) of the north or south neatlines. Figure 28 in Chapter 7 illustrates these principles.

## 11-3 GRID DECLINATION

Grid declination from true north is not shown on 1:1,000,000 scale or 1:500,000 scale aeronautical charts.

## 11-4 MAGNETIC DECLINATION

a. Isogonic lines are shown on the face of the sheet. In addition to the isogonic lines, a note modeled after the following is shown in the margin:

**LINES OF EQUAL MAGNETIC VARIATION FOR 2010**
**(Annual rate of change, no change)**

b. When the magnetic variation is approximately the same over the entire chart, no isogonic lines are shown, and the magnetic variation is indicated by a note modeled after the following:

**MAGNETIC VARIATION FOR 2010 IS APPROXIMATELY**
**1° WEST OVER THE ENTIRE CHART**
**(Annual rate of change 7' decrease)**

Refer to individual product specifications for guidance on the portrayal of isogonic lines.

## 11-5 THE GRID REFERENCE BOX

a. A grid reference box appears in the margin of each sheet. The box contains step-by-step instructions for composing a grid reference. For example, see Figure 41. The applicable Grid Zone Designation is also identified in the box.

b. The grid system(s) in use on the map dictates the referencing instructions contained in the grid reference box.

c. When more than one major grid appears on a sheet, a common reference box is used for all grids.

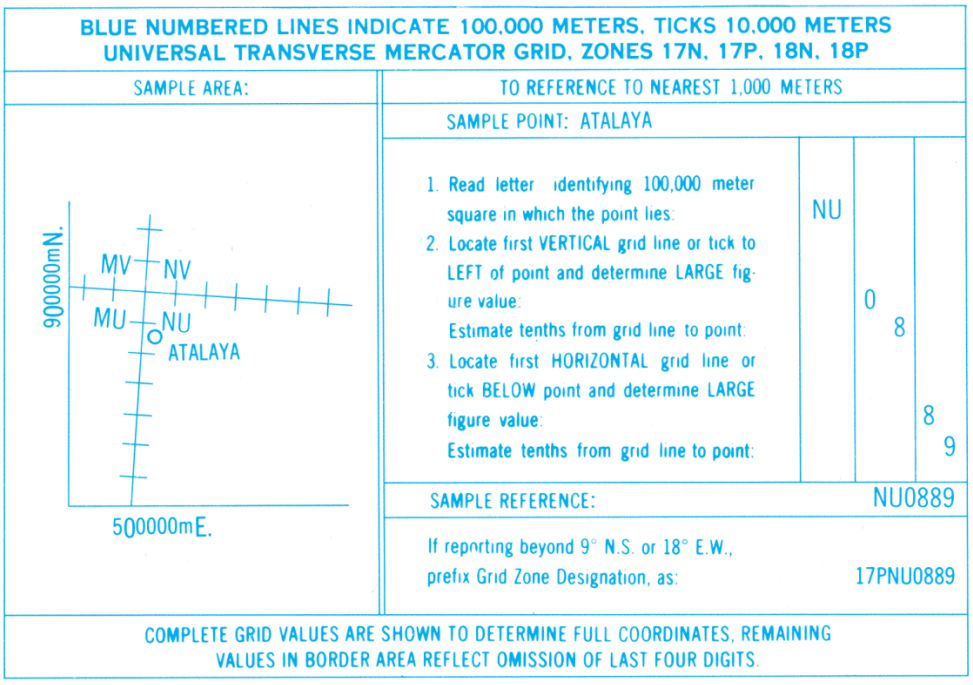


*Figure 41.* Grid Reference Box Commonly Used on Aeronautical Charts at 1:500,000 Scale and Larger

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# APPENDIX A
# FULL UTM/UPS COORDINATES

A-1. The Military Grid Reference System (MGRS) is the official Department of Defense (DoD) system for expressing Universal Transverse Mercator and Universal Polar Stereographic (UTM/UPS) coordinates for the purpose of location referencing to support ground-based operations.

A-2. The advantage of MGRS is that each location reference defines a unique worldwide location by specifying easting, northing, UTM/UPS zone and hemisphere within a manageable space of characters in one unified character string. This is done by following certain rules for displaying UTM/UPS values: Certain digits are replaced with grid-square identifiers; values are rounded and truncated to reflect accuracy or precision; decimal values are not allowed.

A-3. In some circumstances, full UTM/UPS easting and northing values are displayed. For mapping and charting, rules for displaying full UTM/UPS values are specified in the main body of this manual.

A-4. Other applications such as coordinate readouts in Geographic Information Systems (GIS) or coordinate conversion software also may require the display of full UTM/UPS easting and northing values. In such cases, UTM/UPS coordinates are preceded by the grid zone designator. Examples for UTM and UPS, respectively:

15F, 486911, 3852087

Y, 1735147, 2243078

A-5. When referencing full UTM coordinates, the hemisphere must NOT be designated with a capital “S” or “N” immediately after the UTM zone, e.g. “15S”. The danger of doing so is that the “S” may be interpreted as the MGRS latitudinal band from 32°N to 40°N. Instead, the MGRS latitudinal band identifies the hemisphere.

A-6. When displaying a UTM grid zone designator on maps and charts (e.g. grid reference box in a map margin; grid zone junction label in body of map), the capital letter immediately after the UTM zone refers to the MGRS latitudinal band and not the hemisphere.

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# APPENDIX B
# 100,000-METER SQUARE IDENTIFICATIONS OF THE MILITARY GRID REFERENCE SYSTEM (MGRS)

TO DETERMINE THE UTM OR UPS 100,000-METER SQUARE MGRS IDENTIFICATION

B-1. These instructions provide a method for determining the correct Universal Transverse Mercator (UTM) or Universal Polar Stereographic (UPS) 100,000- meter square identification for any point in the world. See Chapter 3 for an introduction to the 100,000-meter square identification. If geographic coordinates are the only coordinates given, they must be transformed to UTM or UPS grid coordinates. The following data and procedures are necessary to determine the correct 100,000-meter square letters:

B-2. For the UPS grid:

a. UPS grid coordinates (easting and northing).

b. UPS Zone – north or south.

B-3. For the UTM grid:

a. UTM grid coordinates (easting and northing).

b. UTM grid zone

B-4. Determine by area which of the following figures is appropriate:

a. Figure B-1: North of 84°N.

b. Figure B-2: South of 80°S.

c. Figure B-3: Between 84°N and 80°S.

B-5. Method of use with the UPS grid:

a. If the coordinates fall in the north Polar region, use Figure B-1 to determine the correct square identification letters. If the coordinates fall in the south Polar region, use Figure B-2.

b. In Figures B-1 and B-2, the easting lines are labeled every 500,000 meters from left to right with the 2,000,000 meter line being coincident with the 0° and 180° line. The northing lines are labeled every 500,000 meters from bottom to top with the 2,000,000 meter line coincident with the 90°W and 90°E line. If the easting is less than 2,000,000 meters the Grid Zone Designation will be Y or A depending on whether the point is in the North or South Polar region. If the easting is greater than 2,000,000 meters the Grid Zone Designation will be Z or B.

c. Reduce both easting and northing to the nearest 100,000 meters.

d. Find these grid lines on the figure.

e. The 100,000-meter square will be to the right and above these lines.

f. The procedure is the same for the north Polar region or the south Polar region.

Example: -At latitude 86°46' north, longitude 132°30' west,
UPS grid coordinates were scaled, E = 1,735,000
N = 2,243,000.
North Polar area, Use Figure B-1.
-The easting is less than 2,000,000 meters, therefore,
the grid zone designation is Y.
-The coordinates reduced to the nearest 100,000 meters
are: E = 1,700,000 N = 2,200,000.
-The 100,000-meter square letters to the right and above
the intersection of these lines are XK.
-MGRS to the nearest 1,000 meters is YXK3543

B-6. Method of use with the UTM grid:

a. To determine the 100,000-meter square letters for UTM grid coordinates, first locate the zone number in the list at the top of the figure. This identifies the set of designators in which the letters will be found.

b. If the 8° latitude band letter is given, it will be used as the grid designation letter. If the geographic coordinates are given, use the latitude of the point to determine the grid zone designation letter from Figure 1 in Chapter 3.

c. Reduce the easting to the nearest 100,000 meters. Find the 100,000-meter easting grid line within the grid zone identified in the list at the top of Figure B-3. The easting lines are labeled below the figure, from 200,000 meters to 800,000 meters within each zone.

d. Reduce the grid northing by multiples of 2,000,000 meters until the resulting value is between 0 and 2,000,000 meters. Further reduce the grid northing to the nearest 100,000 meters. Find the 100,000-meter northing grid line. The northing lines are labeled at the left side of the figure.

e. The 100,000-meter square will be to the right and above the intersection of the lines found in Figure B-3.

f. The procedure is the some for the northern hemisphere or the southern hemisphere.

Example: - At latitude 34°15' north, longitude 88°36' east,
UTM grid coordinates were scaled, E = 647,000
N = 3,791,000 in UTM zone 45, grid zone
designation letter S.
-Grid zone designation is 45S.
-The easting is reduced to 600,000 meters.
-For an easting of 600,000 meters start at the column ‘X_’.
-Reduce the northing by 2,000,000 meters and then to the
nearest 100,000 meters, obtaining 1,700,000 and
read across that grid line to the intersection
with the 600,000 meter easting line in zone 45.
-The 100,000-meter square letters to the right and above
this intersection is XT.
-MGRS to the nearest 1,000 meters is 45SXT4791.

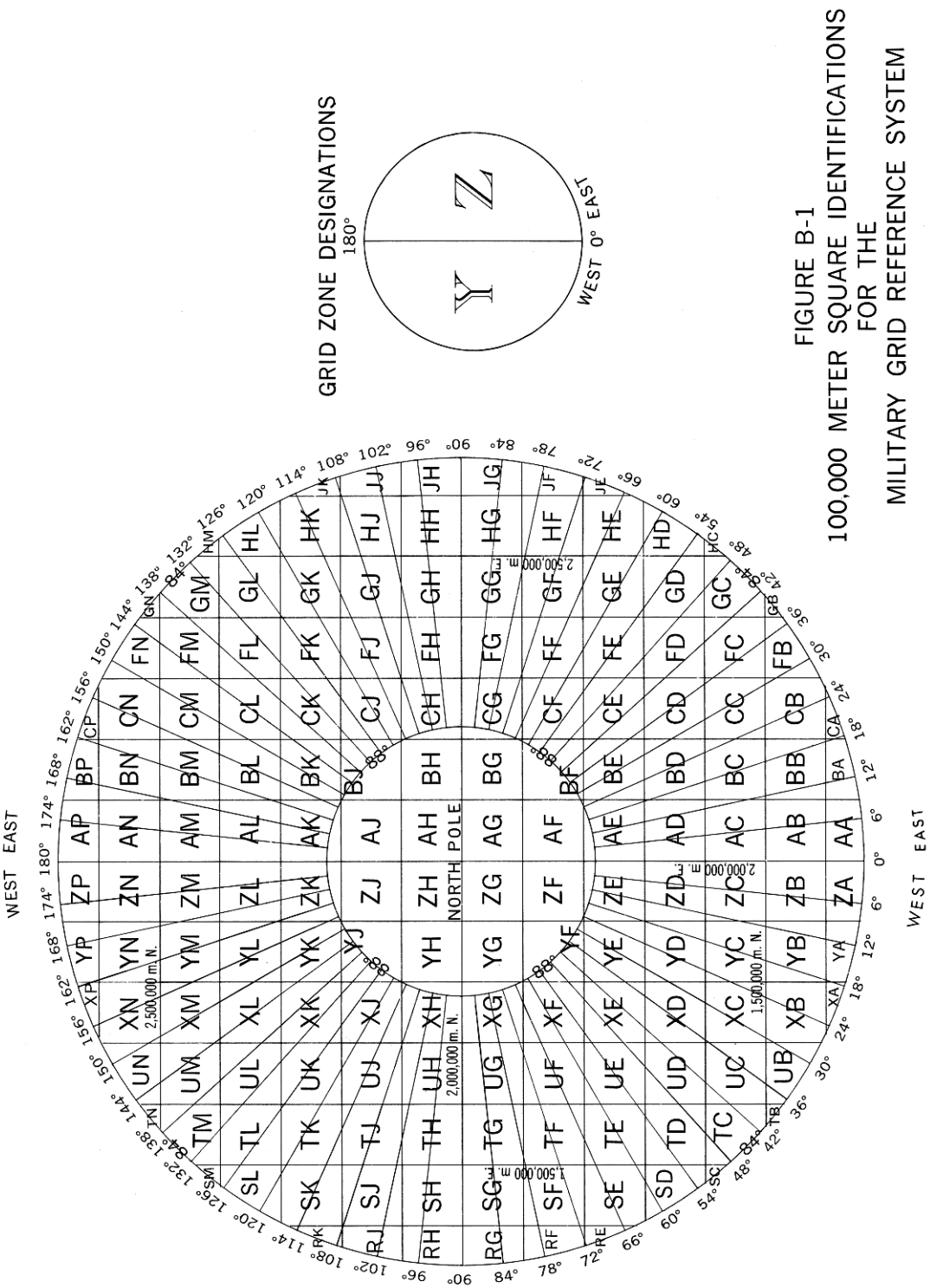


FIGURE B-1
100,000 METER SQUARE IDENTIFICATIONS
FOR THE
MILITARY GRID REFERENCE SYSTEM

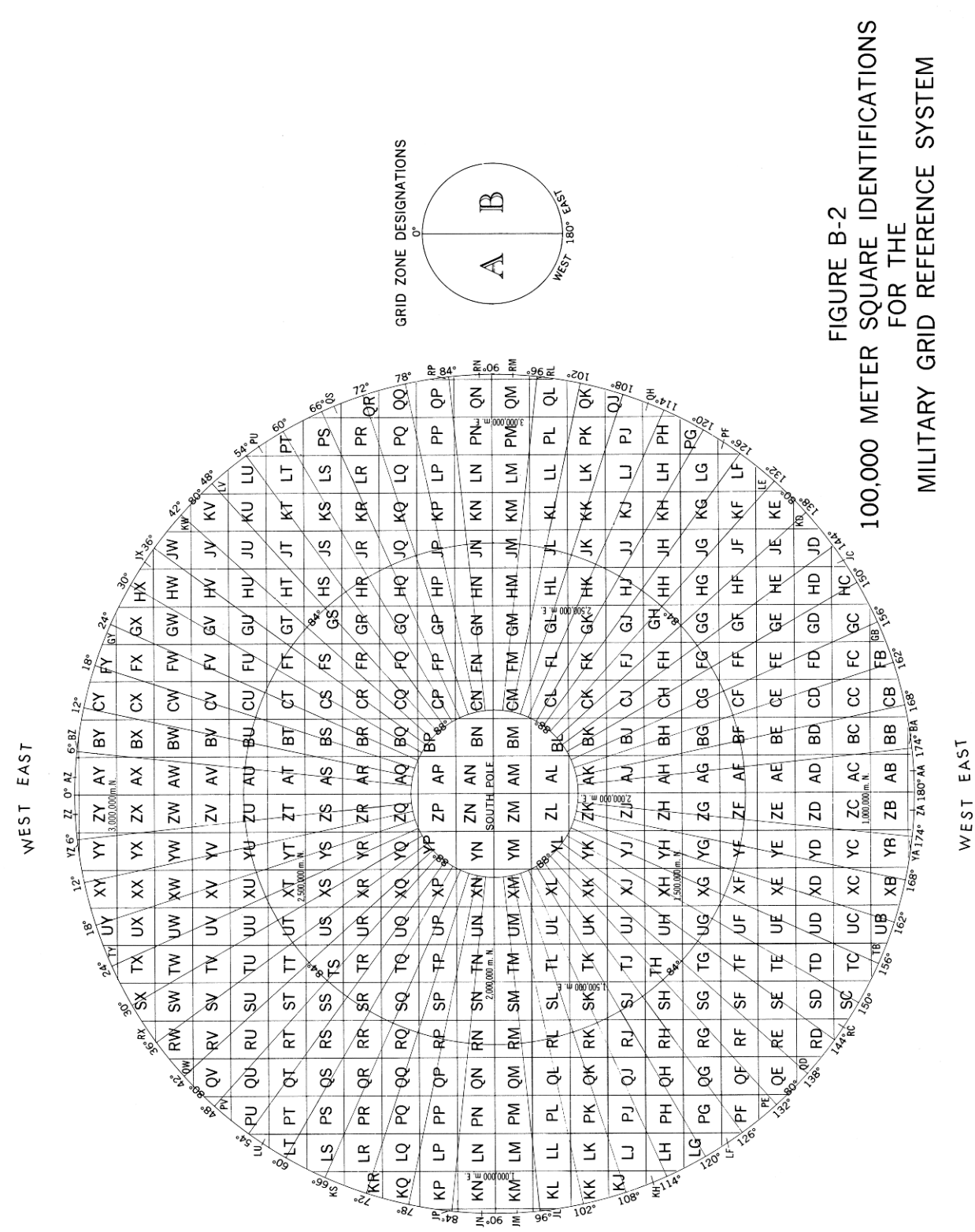


FIGURE B-2
100,000 METER SQUARE IDENTIFICATIONS
FOR THE
MILITARY GRID REFERENCE SYSTEM

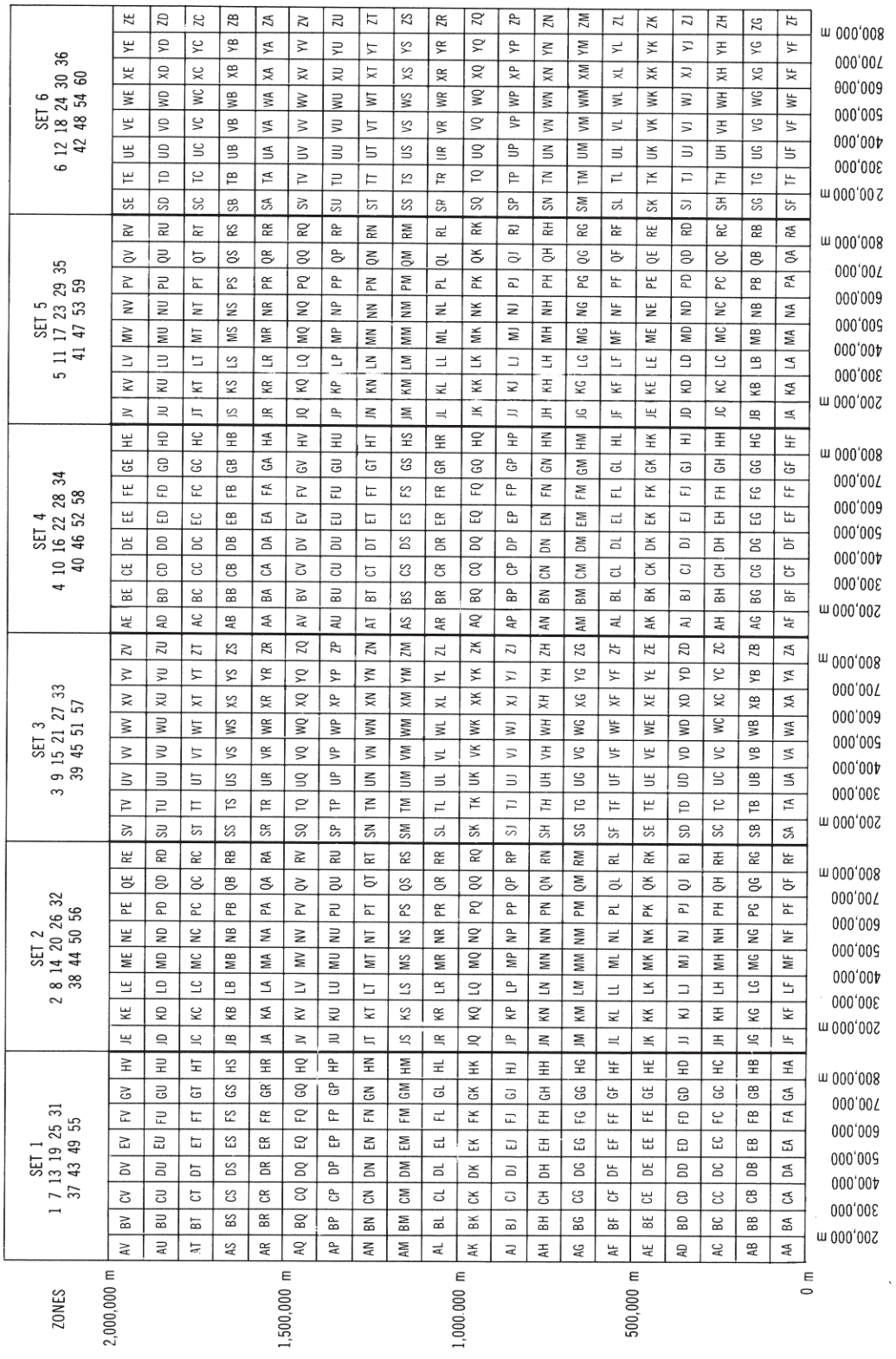


FIGURE B-3 USE THIS DIAGRAM FOR: WORLD GEODETIC SYSTEM 1984 ELLIPSOID

IN THE NORTH AND SOUTH HEMISPHERES

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# APPENDIX C
# LEGACY GRID LETTERING SCHEMES

C-1. Appendix B describes the lettering scheme for 100,000-meter square identification for the Universal Transverse Mercator (UTM) grid coverage (between 84°N and 80°S). The two-letter identification is based on UTM easting, northing, and grid zone.

C-2. Users should be aware that a legacy alternate lettering scheme exists for UTM grid coverage. Maps and charts that were produced on certain non-WGS 84 ellipsoids, as well as location data referenced to these ellipsoids, employ the alternate scheme. Table 13 lists these ellipsoids, with the main areas affected:

| ELLIPSOID | AFFECTED DATUM | DATUM COVERAGE AREA |
|---|---|---|
| Bessel 1841 | -Tokyo Datum<br><br>-Djakarta and other nearby classical datums | -Japan, Korea<br><br>-Indonesia |
| Clarke 1866* | -North American Datum 1927 (NAD 27) | -North American continent and nearby islands (Greenland, Cuba, etc.) |
| Clarke 1880 | -Most classical datums of Africa | -Africa |

*Table 14.* non-WGS 84 Ellipsoids, Affected Datum, and Datum Coverage Areas

*DoD mapping and charting referenced to Luzon Datum (Philippines), Clarke 1866 Ellipsoid, employs the standard lettering scheme.

C-3. Before the DoD adopted WGS 84 as a universal ellipsoid, DoD coordinate systems were referenced to several different ellipsoids according to geographic region. The purpose of the alternate lettering scheme was to prevent ambiguity or duplication of Military Grid Reference System (MGRS) references along the boundaries of these geographic regions, termed “ellipsoid junctions.”

C-4. In the alternate lettering scheme, the row alphabet (second letter) of the 100,000-meter grid square is shifted ten letters (excluding I and O). For example, grid square “AA” in the standard scheme is identified as “AL” in the alternate scheme.

C-5. In cases where each ellipsoid along an ellipsoid junction employed the same lettering scheme, adjustments were made locally. For grid squares straddling longitudinal (vertical) junctions, the second letter of the two-letter identifier was shifted ten letters for one of the ellipsoids. For grid squares straddling latitudinal (horizontal) junctions, the second letter was replaced by an “X” (or, in some cases, W, Y, or Z).

C-6. For maps, charts and other geospatial data that employ either the alternate lettering scheme or a local adjustment to the grid square lettering pattern, users will find that an MGRS grid square identifier for

articular grid square will differ significantly from an identifier for the same grid square on newer maps, charts and data.

C-7. NGA's Geographic Translator (GeoTrans), the DoD application for datum transformations and coordinate conversions, applies the alternate lettering scheme for coordinates referenced to the Bessel 1841, Clarke 1866, and Clarke 1880 ellipsoids.

# APPENDIX D
# TABLE OF MIL EQUIVALENTS

**DEGREES TO MILS**

| DEG | MILS | DEG | MILS | DEG | MILS |
|---|---|---|---|---|---|
| 1 | 17.7778 | 21 | 373.3333 | 41 | 728.8889 |
| 2 | 35.5556 | 22 | 391.1111 | 42 | 746.6667 |
| 3 | 53.3333 | 23 | 408.8889 | 43 | 764.4444 |
| 4 | 71.1111 | 24 | 426.6667 | 44 | 782.2222 |
| 5 | 88.8889 | 25 | 444.4444 | 45 | 800.0000 |
| 6 | 106.6667 | 26 | 462.2222 | 46 | 817.7778 |
| 7 | 124.4444 | 27 | 480.0000 | 47 | 835.5556 |
| 8 | 142.2222 | 28 | 497.7778 | 48 | 853.3333 |
| 9 | 160.0000 | 29 | 515.5556 | 49 | 871.1111 |
| 10 | 177.7778 | 30 | 533.3333 | 50 | 888.8889 |
| 11 | 195.5556 | 31 | 551.1111 | 51 | 906.6667 |
| 12 | 213.3333 | 32 | 568.8889 | 52 | 924.4444 |
| 13 | 231.1111 | 33 | 586.6667 | 53 | 942.2222 |
| 14 | 248.8889 | 34 | 604.4444 | 54 | 960.0000 |
| 15 | 266.6667 | 35 | 622.2222 | 55 | 977.7778 |
| 16 | 284.4444 | 36 | 640.0000 | 56 | 995.5556 |
| 17 | 302.2222 | 37 | 657.7778 | 57 | 1013.3333 |
| 18 | 320.0000 | 38 | 675.5556 | 58 | 1031.1111 |
| 19 | 337.7778 | 39 | 693.3333 | 59 | 1048.8889 |
| 20 | 355.5556 | 40 | 711.1111 | 60 | 1066.6667 |

**MINUTES TO MILS**

| MIN | MILS | MIN | MILS | MIN | MILS |
|---|---|---|---|---|---|
| 1 | 0.2963 | 21 | 6.2222 | 41 | 12.1481 |
| 2 | 0.5926 | 22 | 6.5185 | 42 | 12.4444 |
| 3 | 0.8889 | 23 | 6.8148 | 43 | 12.7407 |
| 4 | 1.1852 | 24 | 7.1111 | 44 | 13.0370 |
| 5 | 1.4815 | 25 | 7.4074 | 45 | 13.3333 |
| 6 | 1.7778 | 26 | 7.7037 | 46 | 13.6296 |
| 7 | 2.0741 | 27 | 8.0000 | 47 | 13.9259 |
| 8 | 2.3704 | 28 | 8.2963 | 48 | 14.2222 |
| 9 | 2.6667 | 29 | 8.5926 | 49 | 14.5185 |
| 10 | 2.9630 | 30 | 8.8889 | 50 | 14.8148 |
| 11 | 3.2593 | 31 | 9.1852 | 51 | 15.1111 |
| 12 | 3.5556 | 32 | 9.4815 | 52 | 15.4074 |
| 13 | 3.8519 | 33 | 9.7778 | 53 | 15.7037 |
| 14 | 4.1481 | 34 | 10.0741 | 54 | 16.0000 |
| 15 | 4.4444 | 35 | 10.3704 | 55 | 16.2963 |
| 16 | 4.7407 | 36 | 10.6667 | 56 | 16.5926 |
| 17 | 5.0370 | 37 | 10.9630 | 57 | 16.8889 |
| 18 | 5.3333 | 38 | 11.2593 | 58 | 17.1852 |
| 19 | 5.6296 | 39 | 11.5556 | 59 | 17.4815 |
| 20 | 5.9259 | 40 | 11.8519 | 60 | 17.7778 |

**SECONDS TO MILS**

| SEC | MILS | SEC | MILS | SEC | MILS |
|---|---|---|---|---|---|
| 1 | 0.0049 | 21 | 0.1037 | 41 | 0.2025 |
| 2 | 0.0099 | 22 | 0.1086 | 42 | 0.2074 |
| 3 | 0.0148 | 23 | 0.1136 | 43 | 0.2123 |
| 4 | 0.0198 | 24 | 0.1185 | 44 | 0.2173 |
| 5 | 0.0247 | 25 | 0.1235 | 45 | 0.2222 |
| 6 | 0.0296 | 26 | 0.1284 | 46 | 0.2272 |
| 7 | 0.0346 | 27 | 0.1333 | 47 | 0.2321 |
| 8 | 0.0395 | 28 | 0.1383 | 48 | 0.2370 |
| 9 | 0.0444 | 29 | 0.1432 | 49 | 0.2420 |
| 10 | 0.0494 | 30 | 0.1481 | 50 | 0.2469 |
| 11 | 0.0543 | 31 | 0.1531 | 51 | 0.2519 |
| 12 | 0.0593 | 32 | 0.1580 | 52 | 0.2568 |
| 13 | 0.0642 | 33 | 0.1630 | 53 | 0.2617 |
| 14 | 0.0691 | 34 | 0.1679 | 54 | 0.2667 |
| 15 | 0.0741 | 35 | 0.1728 | 55 | 0.2716 |
| 16 | 0.0790 | 36 | 0.1778 | 56 | 0.2765 |
| 17 | 0.0840 | 37 | 0.1827 | 57 | 0.2815 |
| 18 | 0.0889 | 38 | 0.1877 | 58 | 0.2864 |
| 19 | 0.0938 | 39 | 0.1926 | 59 | 0.2914 |
| 20 | 0.0988 | 40 | 0.1975 | 60 | 0.2963 |

**NOTE: 360 DEGREES = 6400 MILS**