FGDC Document Number

National Spatial Data Infrastructure

United States National Grid
(Final Draft)

Standards Working Group
Federal Geographic Data Committee

September, 2001

Federal Geographic Data Committee

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For more information about the committee, or to be added to the committee's newsletter mailing list, please contact:

Federal Geographic Data Committee Secretariat
c/o U.S. Geological Survey
590 National Center
12201 Sunrise Valley Drive
Reston, Virginia 22092

Telephone: (703) 648-5514
Facsimile: (703) 648-5755
Internet (electronic mail): gdc@usgs.gov
Anonymous FTP: www.fgdc.gov/pub/
home page: www.fgdc.gov

The following is the recommended bibliographic citation for this publication:

United States National Grid (USNG),
FGDC, September 2001, Reston, Virginia.

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1. INTRODUCTION

1.1 Objective

The objective of this standard is to create a more favorable environment for developing location-based services within the United States and to increase the interoperability of location services appliances with printed map products by establishing a nationally consistent grid reference system as the preferred grid for National Spatial Data Infrastructure (NSDI) applications. This standard defines the US National Grid. The U.S. National Grid is based on universally defined coordinate and grid systems and can, therefore, be easily extended for use world-wide as a universal grid reference system.

There are a number of coordinate reference systems that can be used either in location service appliances or on printed maps for the purpose of establishing a location. Within automated location service appliances, the conversion of coordinates based on one well-defined reference system to coordinates based on another can be both automatic and transparent to the user. These devices can support multiple coordinate reference systems with little difficulty. However, it is not easy for humans to work in multiple reference systems and humans cannot convert between systems without the aid of location service appliances, calculators, or conversion tables. Furthermore, it is difficult for humans to accurately determine a location coordinate from paper maps when latitude and longitude are used because they do not appear square on the flat map. As a consequence paper maps created for the general public frequently have a square reference grid that overlays the non-rectangular coordinate reference system. It is computationally difficult, labor intensive, and time consuming to convert the reference grid coordinate obtained from one printed map to another printed map with a different grid even when both grid reference systems are well defined. It can be impossible when proprietary grids are used. This situation greatly limits the ability of humans to use location service devices with traditional printed maps. Subsequently, location based services in this country have been limited to totally digital environments, restricting the number of uses and retarding the development of the location based service industry.

This standard seeks to improve the current situation by identifying a single nationally consistent, humanly facile grid reference system as the preferred U.S. National Grid (USNG) and promoting its use within the NSDI.

1.2 Scope

This standard defines a preferred U.S. National Grid (USNG) for mapping applications at scales of approximately 1:1,000,000 and larger. It defines how to present Universal Transverse Mercator (UTM) coordinates at various levels of precision. It specifies the use of those coordinates with the grid system defined by the Military Grid Reference System (MGRS). Additionally, it addresses specific presentation issues such as grid spacing. The UTM coordinate representation, the MGRS grid, and the specific grid presentation requirements together define the USNG. This standard is a process standard as defined by the Federal Geographic Data Committee (FGDC) Standards Reference Model. Specifically, it is a presentation process standard.

1.3 Applicability

This standard is for use in the acquisition or production, either directly or indirectly through contracts and partnerships, of printed maps and the acquisition, either directly or indirectly, of location service appliances. The USNG addresses the geospatial coordinate, human interface of products and services designed as interoperable components of the NSDI. This standard applies to printed maps that are intended to be used or are likely to be used by humans in conjunction with location service appliances and to location service appliances that are intended to be used or are likely to be used by humans in conjunction with printed map products.

This standard is not primarily intended for the collection of geospatial data, either remote sensed data collection or field surveys. Nor is it intended for internal data storage structure of any Geographic Information System (GIS) or location service appliance or to the transfer of coordinates between databases or appliances.

Use of USNG grid coordinates may be useful or even desirable within some systems or enterprises. The decision to use USNG grid coordinates or some other coordinate system internal to geographic information systems or location service appliances is left to the discretion of the system developer as long as the human interface provides for USNG grid coordinate readout as one option.

The USNG is not designed for surveying. This standard is not intended to replace the State Plane Coordinate Systems (SPCS) established by the National Geodetic Survey. The SPCS is specifically designed to meet the requirements of surveyors and engineers in determining location and boundaries and some states mandate its use for specific purposes. SPCS coordinates can be readily converted to USNG grid coordinates for subsequent use within the NSDI. The state plane coordinate system (SPCS), Public Land Survey System (PLSS) and other accepted local spatial reference systems may continue to be used where preferred for property descriptions and other specialized uses.

The USNG is interoperable with the MGRS. This will be of critical importance to safety of life during times of disaster relief operations.

1.4 Related Standards

This standard is compatible with:

- ANSI X3.61-1986, Representation of Geographic Point Locations for Information Interchange, which standardizes representation of UTM coordinates for computer representation.

- ISO/DIS 19116, Positioning Services, which provides an interface for real-time output from a GPS receiver and other positioning technologies.

- ISO/DIS 19111, Spatial Referencing by Geographic Coordinates, which provides a conceptual schema for the description of coordinate reference systems.

- The USNG standard is based on the Military Grid Reference System

1.5 Standards Development Process

The USNG is an initiative of the Public XY Mapping Project, which is a not-for-profit organization created specifically to promote the acceptance of a national grid for the United States. The original concept can be traced to discussions within the American Society for Photogrammetry and Remote Sensing. The Public XY Mapping Project developed the idea, conducting informal tests and surveys to determine which coordinate reference system best met the requirements of national consistency and ease of human use. Based on its findings, a standard based on the MGRS was adopted.

Because of the importance of this project to the NSDI, the Public XY Project brought its findings to the FGDC in 1998. After briefing the FGDC Coordination Group, an ad hoc study group, that included the FGDC Staff Director and the Chair of the FGDC Standards Working Group, recommended that the FGDC accept the project as an FGDC standard development activity. The FGDC Standards Working Group then created a subgroup led by the Public XY Mapping Project to husband the project through the FGDC standards process. The subgroup contains members from both the public and private sector, including key participation from the National Imagery and Mapping Agency (NIMA) to assure that the USNG retains interoperability with the MGRS. The subgroup refined the standard and through an iterative review process with the FGDC Standards Working Group, produced, in November 2000, a final draft for public review consistent with the FGDC standards directives.

1.6 Maintenance Authority

The Public XY Mapping Project will maintain this standard for the first five years. The Public XY Mapping Project has demonstrated the ability to marshal the resources needed to develop, promote, and initially implement the standard. After five years, the FGDC Standards Working Group will evaluate the need to move maintenance responsibility to one of the FGDC agencies.

2. CONFORMANCE

Location service appliances that claim conformance to this standard shall accept USNG coordinates, as defined in Section 3, as input from the human user and provide USNG coordinate output to the human user, as at least one option.

Printed map products that claim conformance to this standard shall provide a means for humans to accurately locate a USNG coordinate on the map and for humans to extract, for any point on the map, an accurate USNG coordinate. This will usually mean that the USNG will be printed on the map according to the guidance in this specification.

3. MAIN FEATUES AND SPECIFICATIONS.

3.1 Equivalency With MGRS

USNG coordinates shall be identical to the MGRS numbering scheme over all areas of the United States including outlying territories and possessions.

3.2 Basic Numbering

USNG basic coordinate values and numbering are identical to UTM coordinate values over all areas of the United States including outlying territories and possessions.

3.3 Referencing Scheme

Numbering scheme shall be alphanumeric as follows:

3.3.1 Grid Zone Designation

First, the U.S. geographic area shall be divided into 6-degree longitudinal zones designated by a number and 8-degree latitudinal bands designated by a letter. Thus each area is given a unique alphanumeric Grid Zone Designator (GZD) (Figure 1 – pg. 8).

The longitude zone numbers and latitude band letters for GZD over the United States shall be taken from the global scheme of MGRS.

18S – Identifies a GZD.

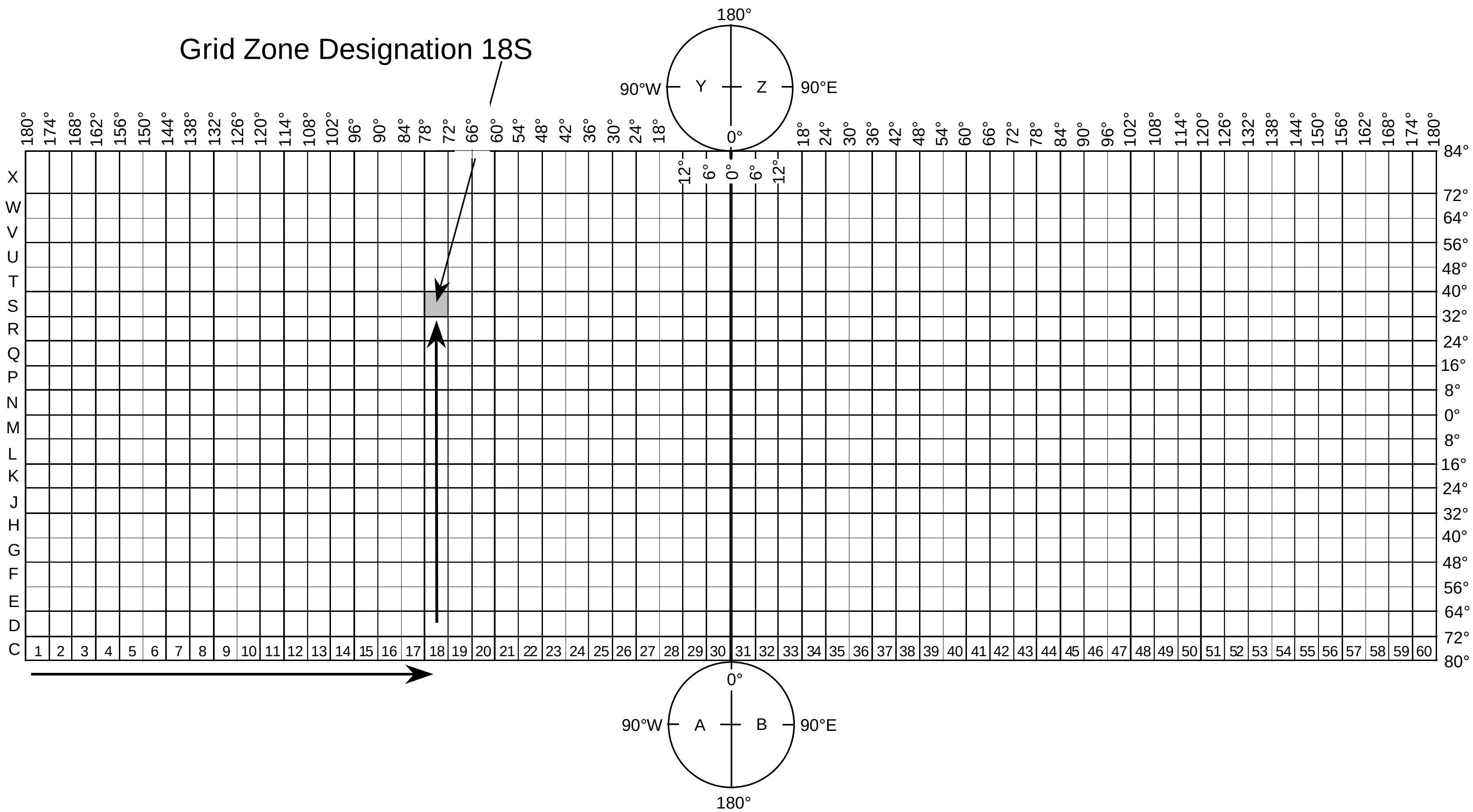

Figure 1. Grid Zone Designations of the U.S. National Grid (USNG)

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3.3.2 100,000-meter Square Identification

Each GZD 6x8 degree area shall be covered by a specific scheme of 100,000-meter squares where a two-letter pair identifies each square (Figures 2 and 3 – pgs. 10 and 11).

18SUJ – Identifies a specific 100,000-meter square in the specified GZD.

3.3.3 Grid Coordinates

A point position within the 100,000-meter square shall be given by the UTM grid coordinates in terms of its Easting (E) and Northing (N). For specific requirements or applications, the number of digits will depend on the precision desired in position referencing. In this convention, the reading shall be from left with Easting first, then Northing. An equal number of digits shall always be used for E and N.

Examples:

18SUJ20	- Locates a point with a precision of 10 km
18SUJ2306	- Locates a point with a precision of 1 km
18SUJ234064	- Locates a point with a precision of 100 meters
18SUJ23480647	- Locates a point with a precision of 10 meters
18SUJ2348306479	- Locates a point with a precision of 1 meter

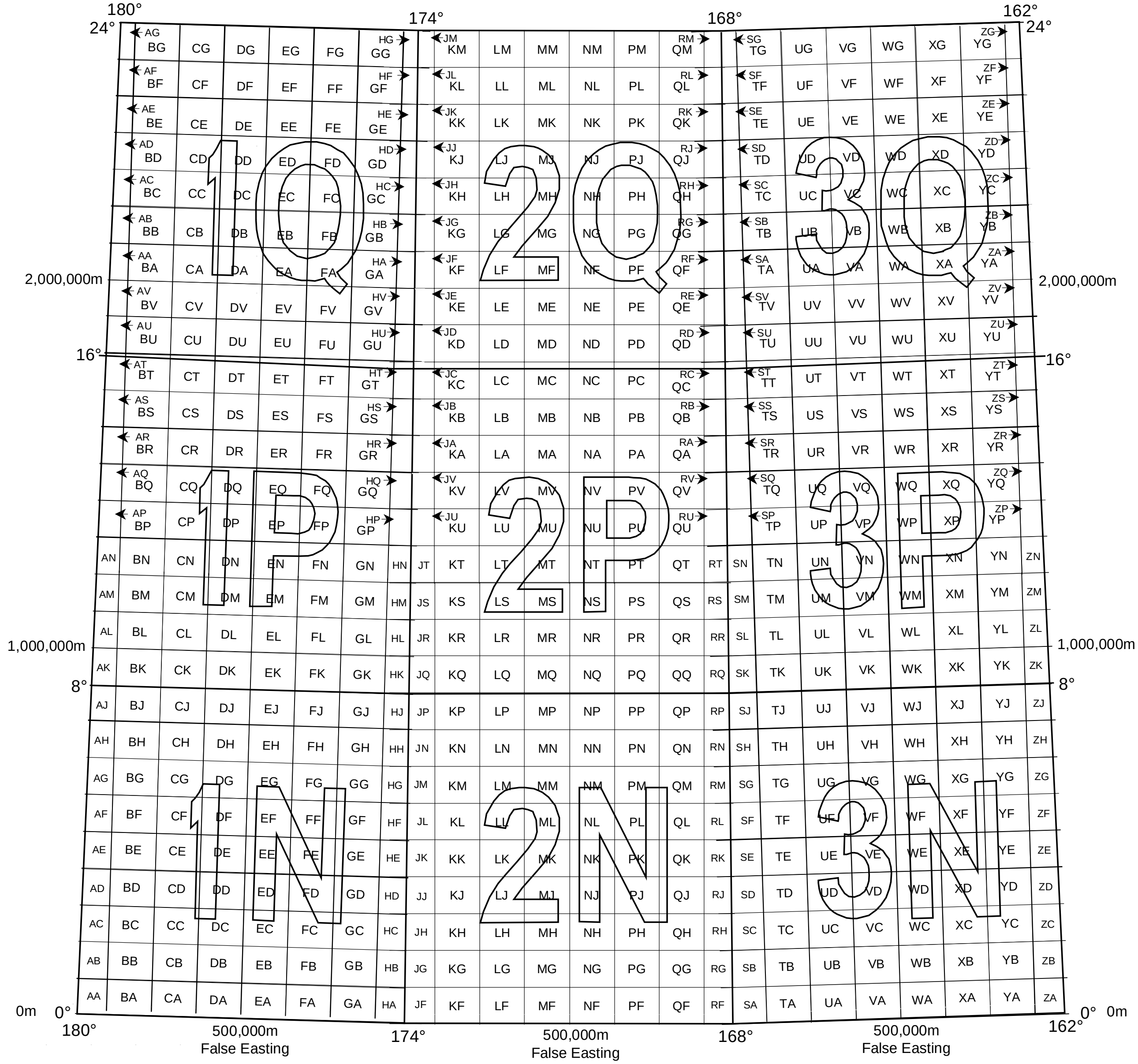

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Figure 2. Basic Plan of the 100,000-meter Square Identification of the United States National Grid (USNG)

ZONES	SET 1 1, 7, 13, 19, 25, 31, 37, 43, 49, 55								SET 2 2, 8, 14, 20, 26, 32, 38, 44, 50, 56								SET 3 3, 9, 15, 21, 27, 33, 39, 45, 51, 57								SET 4 4, 10, 16, 22, 28, 34, 40, 46, 52, 58								SET 5 5, 11, 17, 23, 29, 35, 41, 47, 53, 59								SET 6 6, 12, 18, 24, 30, 36, 42, 48, 54, 60							
2,000,000 m	AV	BV	CV	DV	EV	FV	GV	HV	JE	KE	LE	ME	NE	PE	QE	RE	SV	TV	UV	VV	WV	XV	YV	ZV	AE	BE	CE	DE	EE	FE	GE	HE	JV	KV	LV	MV	NV	PV	QV	RV	SE	TE	UE	VE	WE	XE	YE	ZE
	AU	BU	CU	DU	EU	FU	GU	HU	JD	KD	LD	MD	ND	PD	QD	RD	SU	TU	UU	VU	WU	XU	YU	ZU	AD	BD	CD	DD	ED	FD	GD	HD	JU	KU	LU	MU	NU	PU	QU	RU	SD	TD	UD	VD	WD	XD	YD	ZD
	AT	BT	CT	DT	ET	FT	GT	HT	JC	KC	LC	MC	NC	PC	QC	RC	ST	TT	UT	VT	WT	XT	YT	ZT	AC	BC	CC	DC	EC	FC	GC	HC	JT	KT	LT	MT	NT	PT	QT	RT	SC	TC	UC	VC	WC	XC	YC	ZC
	AS	BS	CS	DS	ES	FS	GS	HS	JB	KB	LB	MB	NB	PB	QB	RB	SS	TS	US	VS	WS	XS	YS	ZS	AB	BB	CB	DB	EB	FB	GB	HB	JS	KS	LS	MS	NS	PS	QS	RS	SB	TB	UB	VB	WB	XB	YB	ZB
1,500,000 m	AR	BR	CR	DR	ER	FR	GR	HR	JA	KA	LA	MA	NA	PA	QA	RA	SR	TR	UR	VR	WR	XR	YR	ZR	AA	BA	CA	DA	EA	FA	GA	HA	JR	KR	LR	MR	NR	PR	QR	RR	SA	TA	UA	VA	WA	XA	YA	ZA
	AQ	BQ	CQ	DQ	EQ	FQ	GQ	HQ	JV	KV	LV	MV	NV	PV	QV	RV	SQ	TQ	UQ	VQ	WQ	XQ	YQ	ZQ	AV	BV	CV	DV	EV	FV	GV	HV	JQ	KQ	LQ	MQ	NQ	PQ	QQ	RQ	SV	TV	UV	VV	WV	XV	YV	ZV
	AP	BP	CP	DP	EP	FP	GP	HP	JU	KU	LU	MU	NU	PU	QU	RU	SP	TP	UP	VP	WP	XP	YP	ZP	AU	BU	CU	DU	EU	FU	GU	HU	JP	KP	LP	MP	NP	PP	QP	RP	SU	TU	UU	VU	WU	XU	YU	ZU
	AN	BN	CN	DN	EN	FN	GN	HN	JT	KT	LT	MT	NT	PT	QT	RT	SN	TN	UN	VN	WN	XN	YN	ZN	AT	BT	CT	DT	ET	FT	GT	HT	JN	KN	LN	MN	NN	PN	QN	RN	ST	TT	UT	VT	WT	XT	YT	ZT
	AM	BM	CM	DM	EM	FM	GM	HM	JS	KS	LS	MS	NS	PS	QS	RS	SM	TM	UM	VM	WM	XM	YM	ZM	AS	BS	CS	DS	ES	FS	GS	HS	JM	KM	LM	MM	NM	PM	QM	RM	SS	TS	US	VS	WS	XS	YS	ZS
1,000,000 m	AL	BL	CL	DL	EL	FL	GL	HL	JR	KR	LR	MR	NR	PR	QR	RR	SL	TL	UL	VL	WL	XL	YL	ZL	AR	BR	CR	DR	ER	FR	GR	HR	JL	KL	LL	ML	NL	PL	QL	RL	SR	TR	UR	VR	WR	XR	YR	ZR
	AK	BK	CK	DK	EK	FK	GK	HK	JQ	KQ	LQ	MQ	NQ	PQ	QQ	RQ	SK	TK	UK	VK	WK	XK	YK	ZK	AQ	BQ	CQ	DQ	EQ	FQ	GQ	HQ	JK	KK	LK	MK	NK	PK	QK	RK	SQ	TQ	UQ	VQ	WQ	XQ	YQ	ZQ
	AJ	BJ	CJ	DJ	EJ	FJ	GJ	HJ	JP	KP	LP	MP	NP	PP	QP	RP	SJ	TJ	UJ	VJ	WJ	XJ	YJ	ZJ	AP	BP	CP	DP	EP	FP	GP	HP	JJ	KJ	LJ	MJ	NJ	PJ	QJ	RJ	SP	TP	UP	VP	WP	XP	YP	ZP
	AH	BH	CH	DH	EH	FH	GH	HH	JN	KN	LN	MN	NN	PN	QN	RN	SH	TH	UH	VH	WH	XH	YH	ZH	AN	BN	CN	DN	EN	FN	GN	HN	JH	KH	LH	MH	NH	PH	QH	RH	SN	TN	UN	VN	WN	XN	YN	ZN
	AG	BG	CG	DG	EG	FG	GG	HG	JM	KM	LM	MM	NM	PM	QM	RM	SG	TG	UG	VG	WG	XG	YG	ZG	AM	BM	CM	DM	EM	FM	GM	HM	JG	KG	LG	MG	NG	PG	QG	RG	SM	TM	UM	VM	WM	XM	YM	ZM
500,000 m	AF	BF	CF	DF	EF	FF	GF	HF	JL	KL	LL	ML	NL	PL	QL	RL	SF	TF	UF	VF	WF	XF	YF	ZF	AL	BL	CL	DL	EL	FL	GL	HL	JF	KF	LF	MF	NF	PF	QF	RF	SL	TL	UL	VL	WL	XL	YL	ZL
	AE	BE	CE	DE	EE	FE	GE	HE	JK	KK	LK	MK	NK	PK	QK	RK	SE	TE	UE	VE	WE	XE	YE	ZE	AK	BK	CK	DK	EK	FK	GK	HK	JE	KE	LE	ME	NE	PE	QE	RE	SK	TK	UK	VK	WK	XK	YK	ZK
	AD	BD	CD	DD	ED	FD	GD	HD	JJ	KJ	LJ	MJ	NJ	PJ	QJ	RJ	SD	TD	UD	VD	WD	XD	YD	ZD	AJ	BJ	CJ	DJ	EJ	FJ	GJ	HJ	JD	KD	LD	MD	ND	PD	QD	RD	SJ	TJ	UJ	VJ	WJ	XJ	YJ	ZJ
	AC	BC	CC	DC	EC	FC	GC	HC	JH	KH	LH	MH	NH	PH	QH	RH	SC	TC	UC	VC	WC	XC	YC	ZC	AH	BH	CH	DH	EH	FH	GH	HH	JC	KC	LC	MC	NC	PC	QC	RC	SH	TH	UH	VH	WH	XH	YH	ZH
	AB	BB	CB	DB	EB	FB	GB	HB	JG	KG	LG	MG	NG	PG	QG	RG	SB	TB	UB	VB	WB	XB	YB	ZB	AG	BG	CG	DG	EG	FG	GG	HG	JB	KB	LB	MB	NB	PB	QB	RB	SG	TG	UG	VG	WG	XG	YG	ZG
0 m	AA	BA	CA	DA	EA	FA	GA	HA	JF	KF	LF	MF	NF	PF	QF	RF	SA	TA	UA	VA	WA	XA	YA	ZA	AF	BF	CF	DF	EF	FF	GF	HF	JA	KA	LA	MA	NA	PA	QA	RA	SF	TF	UF	VF	WF	XF	YF	ZF
	200,000 m	300,000	400,000	500,000	600,000	700,000	800,000 m		200,000 m	300,000	400,000	500,000	600,000	700,000	800,000 m		200,000 m	300,000	400,000	500,000	600,000	700,000	800,000 m		200,000 m	300,000	400,000	500,000	600,000	700,000	800,000 m		200,000 m	300,000	400,000	500,000	600,000	700,000	800,000 m		200,000 m	300,000	400,000	500,000	600,000	700,000	800,000 m	

Figure 3. Organization of the U.S. National Grid (USNG) 100,000-meter Grid Squares

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4. RELATIONSHIP TO DATUMS

The standard datum for USNG coordinates shall be the North American Datum 1983 (NAD 83) or its international equivalent, the World Geodetic System 1984 (WGS 84).

For practical applications using an existing map referenced to North American Datum 1927 (NAD 27), see Annex A.

5. ACCURACY AND PRECISION

5.1 Accuracy

Paper maps using the USNG grid shall conform to the National Map Accuracy Standard.

5.2 Precision

USNG provides a flexible numbering scheme to accommodate variable precision from tens of kilometers to one meter or higher.

5.2.1 Field Applications

For general field applications, a precision of one hundred or ten meters will be typical.
For general applications, precision of up to one meter may be used.

5.2.2 Special Applications

For special applications, the USNG can provide precision greater than one meter.

For example, the location of the Washington Monument in Washington, DC can be identified on NAD 83 datum.

General reference: 18SUJ23480647 – precision 10 meters.

Special application: 18SUJ2348316806479498 – precision 1 millimeter.

6. REFERENCES

American National Standards Institute, Inc. (ANSI), 1986, American National Standard for Information Systems - X3.61-1986, Representation of Geographic Point Locations for Information Interchange (Formerly Federal Information Processing Standard 70-1)

National Imagery and Mapping Agency (NIMA), 1990, DMA Technical Manual 8358.1 Datums, Ellipsoids, Grids, and Grid Reference Systems, Edition 1

Synder, John P., 1987, Map Projections - A Working Manual; U.S. Geological Survey Professional Paper 1395, US Government Printing Office, Washington, DC

Thompson, M.M., 1979, Maps for America, US Government Printing Office, Washington, DC

United States National Grid

Annex A (Normative)

Use of North American Datum 1927 (NAD27)

ANNEX A (Normative)

Use of North American Datum 1927 (NAD 27)

Published spatial references, such as a database or published list of spatial values for point features, shall be referenced to NAD 83 whenever possible. When it is necessary to identify a point on NAD 27, the coordinate values shall be followed by (NAD 27). For example, the NAD 83 coordinates of a point are designated 18SUJ23480647, while the NAD 27 coordinates of the same point are designated 18SUJ23450626 (NAD 27).

United States National Grid

Annex B (Normative)

Truncation of USNG Coordinate Values

ANNEX B (Normative)

Truncation of USNG Coordinate Values

A uniform system of truncation is adopted for the USNG[1]. Truncated coordinates begin with the 10,000-meter digit. Truncated coordinate values shall always consist of an even number of digits. Table 1 demonstrates how to truncate USNG grid coordinate values and compares these with truncated UTM grid coordinates. The portions of the USNG grid coordinate that is imbedded in the UTM coordinate value are underlined for illustrative purposes.

Table 1. Truncation of USNG values Examples of truncated grid coordinates

	Complete grid reference	Truncated coordinates			
		Four digit (1 km)	Six digit (100 m)	Eight digit (10 m)	Ten digit (1 m)
UTM	+18,323483.168,4306479.498	2306	234064	23480647	2348306479
USNG	18SUJ2348306479	2306	234064	23480647	2348306479

[1] A similar system of coordinate truncation can be employed for UTM grid coordinates. However, such a system of truncation is not part of the definition of the UTM system or the coordinate representation standard, ANSI X3.61, and is included here in Table 1 for illustration and uniformity purposes.

United States National Grid

Annex C (Informative)

USNG Implementations

ANNEX C (Informative)

USNG Implementations

C.1 Applications

C.1.1 General features

All elements of a grid reference need not be used. Their use depends upon the size of the area of activities, the type of use, and the scale of map to which the reference is keyed. Users will decide which elements of the grid references are needed for specific circumstances. The following paragraphs provide guidance for the use of GZDs and 100,000-meter Square Identifications.

C.1.2 Large geographic areas

For situations or issues spanning large geographical areas, such as conterminous United States or Alaska, the GZD is usually given (such as 18S in 18SUJ23480647). The designation will alleviate ambiguity between identical references that may occur when reporting to a station outside the area. The GZD is always used in giving references on 1:1,000,000-scale to 1:500,000 scale maps.

C.1.3 Regional areas

For areas less than a grid zone wide, but exceeding 100,000 meters, only the 100,000-meter Square Identification need be used (such as UJ in UJ23480647).

C.1.4 Local areas

For small and localized areas, the GZDs and 100,000-meter Square Identifications need not be used, unless reporting falls within the parameters explained in following paragraphs. For an area falling within a single 100,000-meter square, only the numerical part of the grid reference is required (such as 23480647).

C.1.5 For local areas near Grid Zone and/or 100,000-meter Square boundaries

C.1.5.1 Grid Zone Boundary

In this case, GZD and 100,000-meter Square Identification have to be used with the USNG coordinate.

C.1.5.2 100,000-meter Square Boundary

In this case, the 100,000-meter Square Identification has to be used with the USNG coordinate.

C.1.6 Complete grid reference

Topographic maps at 1:500,000 and larger scales should provide a grid reference box that contains the elements for making a complete grid reference. See Figure 4 (pg. 22). Figure 5 (pg. 23) provides an example of an option for a grid reference box with instructions for making a complete grid reference.

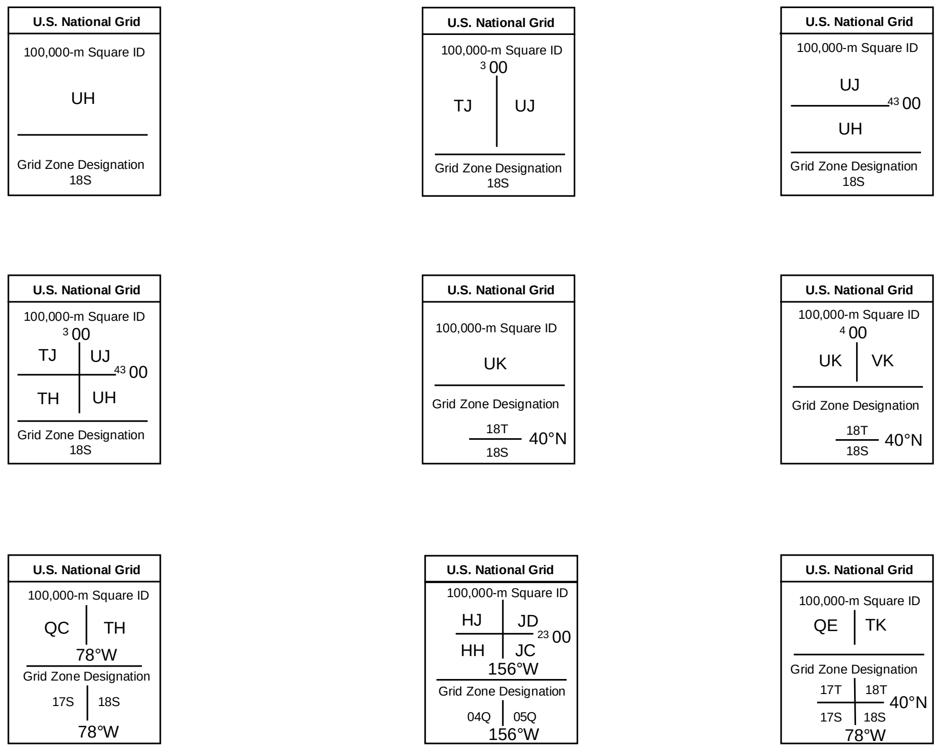

Figure 4. Methods for depicting Grid Zone Designations and 100,000-meter Square Identifications on the US National Grid in the Grid Reference Box.

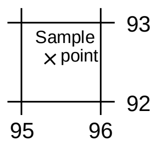	1. Read numbers labeling the VERTICAL grid line left of point and estimate tenths (100 meters) from grid line to point. 95 4 2. Read numbers labeling the HORIZONTAL grid line below point and estimate tenths (100 meters) from grid line to point. 92 6 Example: 954926
100,000-m Square ID TH	WHEN REPORTING ACROSS A 100,000 METER LINE, PREFIX THE 100,000 METER SQUARE IDENTIFICATION IN WHICH THE POINT LIES. Example: TH954926
Grid Zone Designation 18S	WHEN REPORTING OUTSIDE THE GRID ZONE DESIGNATION AREA, PREFIX THE GRID ZONE DESIGNATION. Example: 18STH954926

Figure 5. Sample Grid Reference Box with instructions for giving a complete reference.

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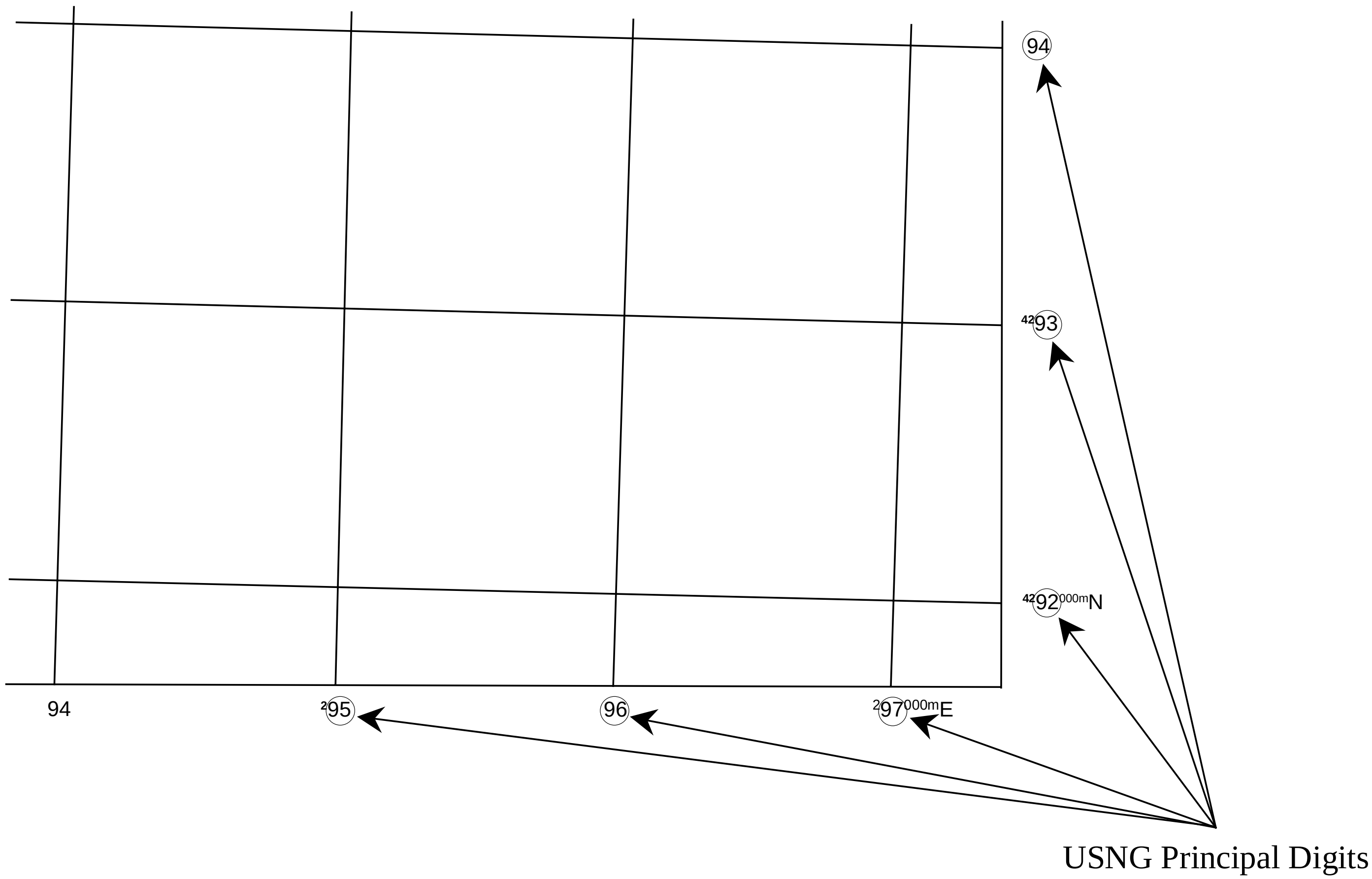
C.1.7 Reading grid coordinates

C.1.7.1 Principal digits

The 10,000-meter and 1,000-meter digits are known as the principal digits and identify USNG grid lines. Preceding and following UTM digits are shown as superscript. Alternatively, only the principal digits for grid lines need be shown, but a sample full UTM value for both the Easting and Northing axis must be depicted at least once on the map, usually near the southeast corner. See Figures 6, 7 and 8 (pgs 25 – 27).



The 10,000 and 1,000 meter values in UTM coordinates are known as the principal digits in USNG coordinates. In this illustration, six examples of Principal Digits have been circled. Note how the USNG principal digits are portrayed in larger type, and the preceding and post principal digit UTM values are included as superscript. This well established convention provides both USNG and UTM values in a manner that is easy to read and prevents confusion. Alternatively, grid lines may be identified by only the principal digits as seen in lines 96 and line 94 as long as at least one full set of UTM grid values are provided. (See Figure 7 for additional details.).

Figure 6. United States National Grid (USNG) Principal Digits.

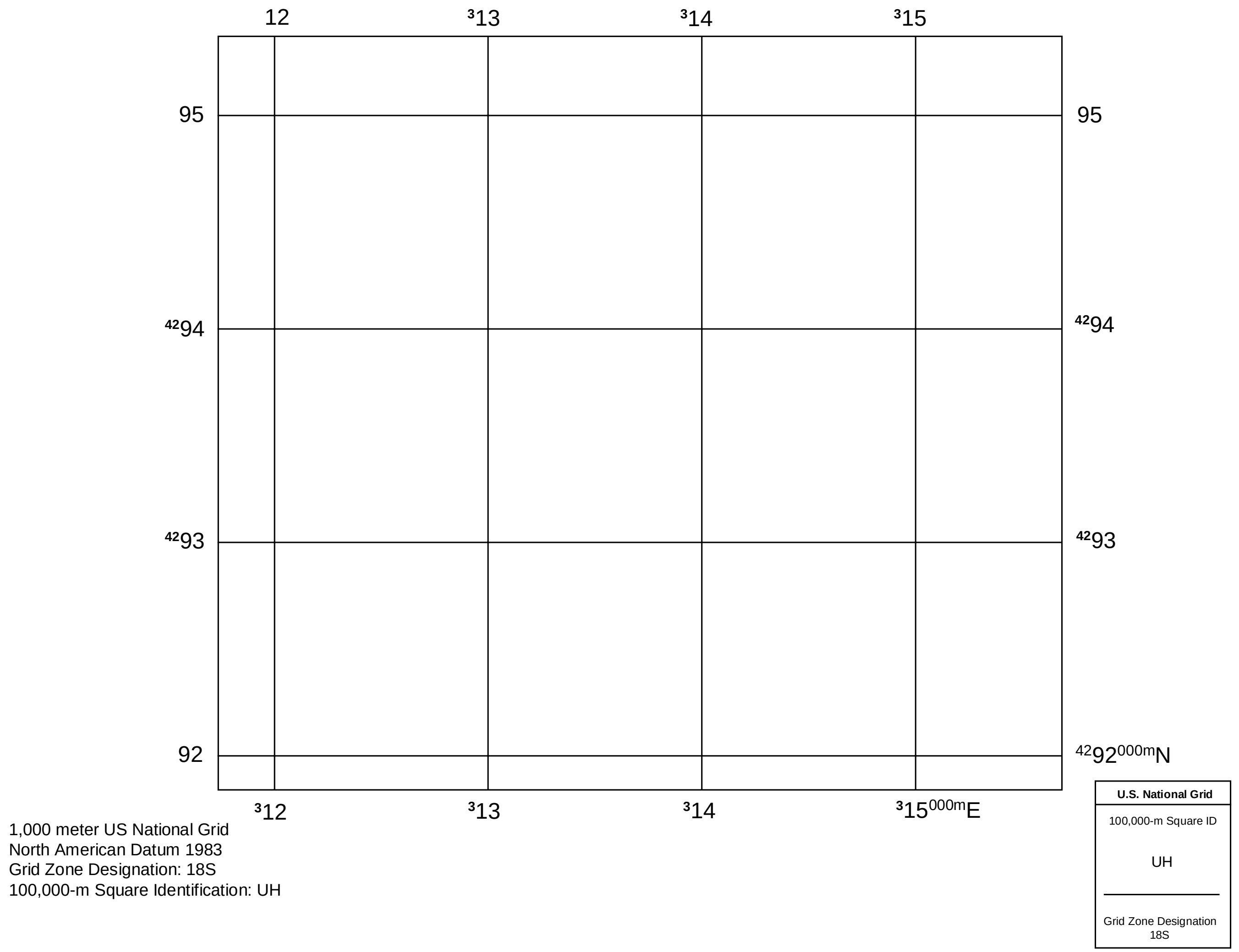


Figure 7. Convention for portrayal of grid lines, UTM values, and single USNG 100,000-meter Square Identification

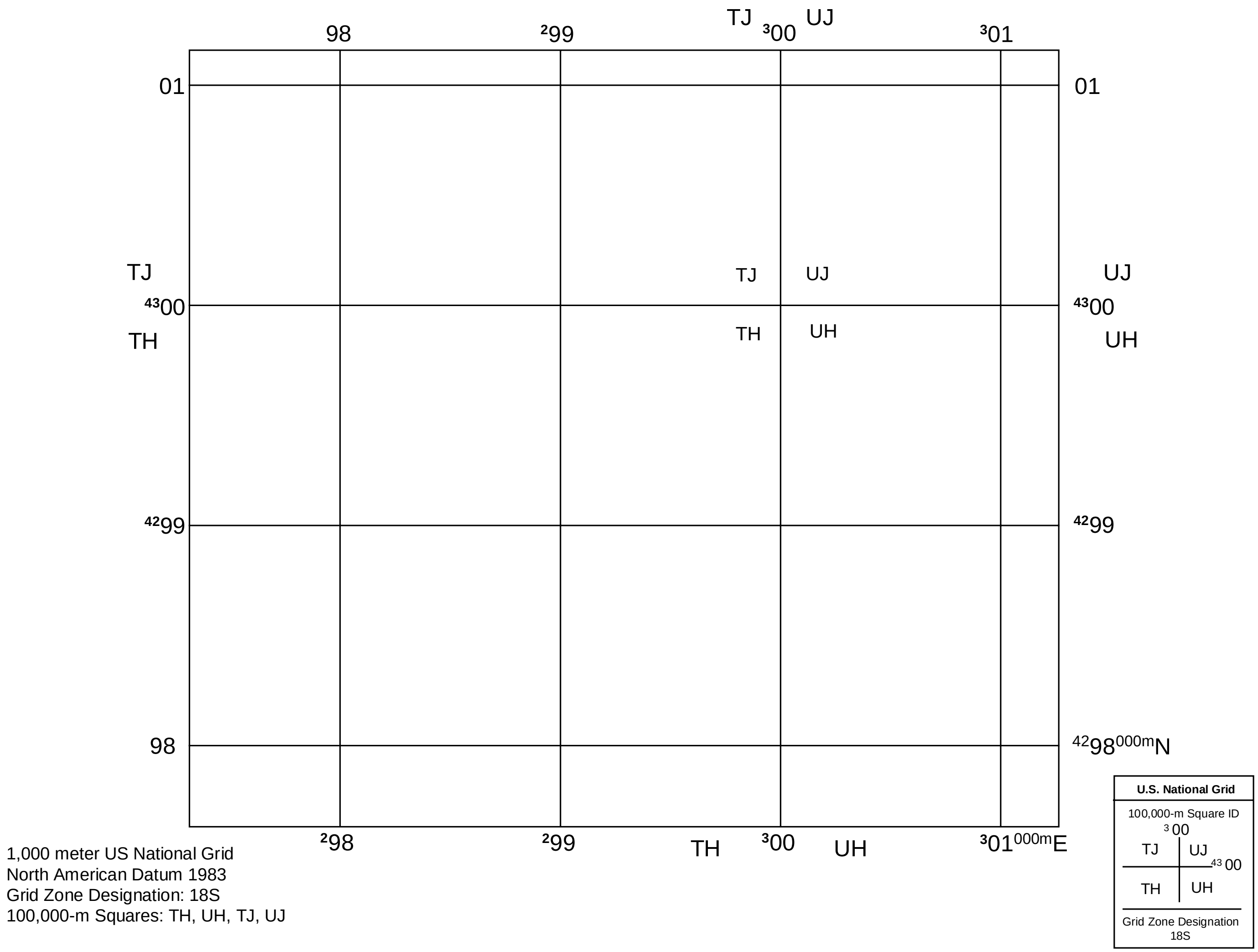


Figure 8. Convention for portrayal of grid lines, UTM values, and multiple USNG 100,000-meter Square Identifications

C.1.7.2 Read right and up

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 the second half the Northing. The standard convention of reading "right (Easting) and up (Northing)" is employed.

C.1.7.3 Read right

To read the Easting coordinate, locate the first Easting (vertical grid line to the left of the point of reference and read the large digits, the principal digits 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 the distance between the Easting line to the left of the point and the point itself.

C.1.7.4 Read up

The reading of the Northing coordinate is made in a similar manner. Locate the first Northing (horizontal) grid line below 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 the distance between the Northing grid line below the point and the point itself.

C.1.7.5 Grid coordinates

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 typically either a six-digit or eight-digit number; for example 234064 or 23480647. For a six-digit grid coordinate (i.e. 234064), reading from left to right, the 23 represents the 10,000 and 1,000 digits of the first Easting grid line to the left of the point, the 4 represents the estimated or scaled (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 below the point, and the 4 represents the estimated or scaled (nearest 100 meters) from the Northing grid line to the point.

C.1.7.6 Example reading of grid coordinates

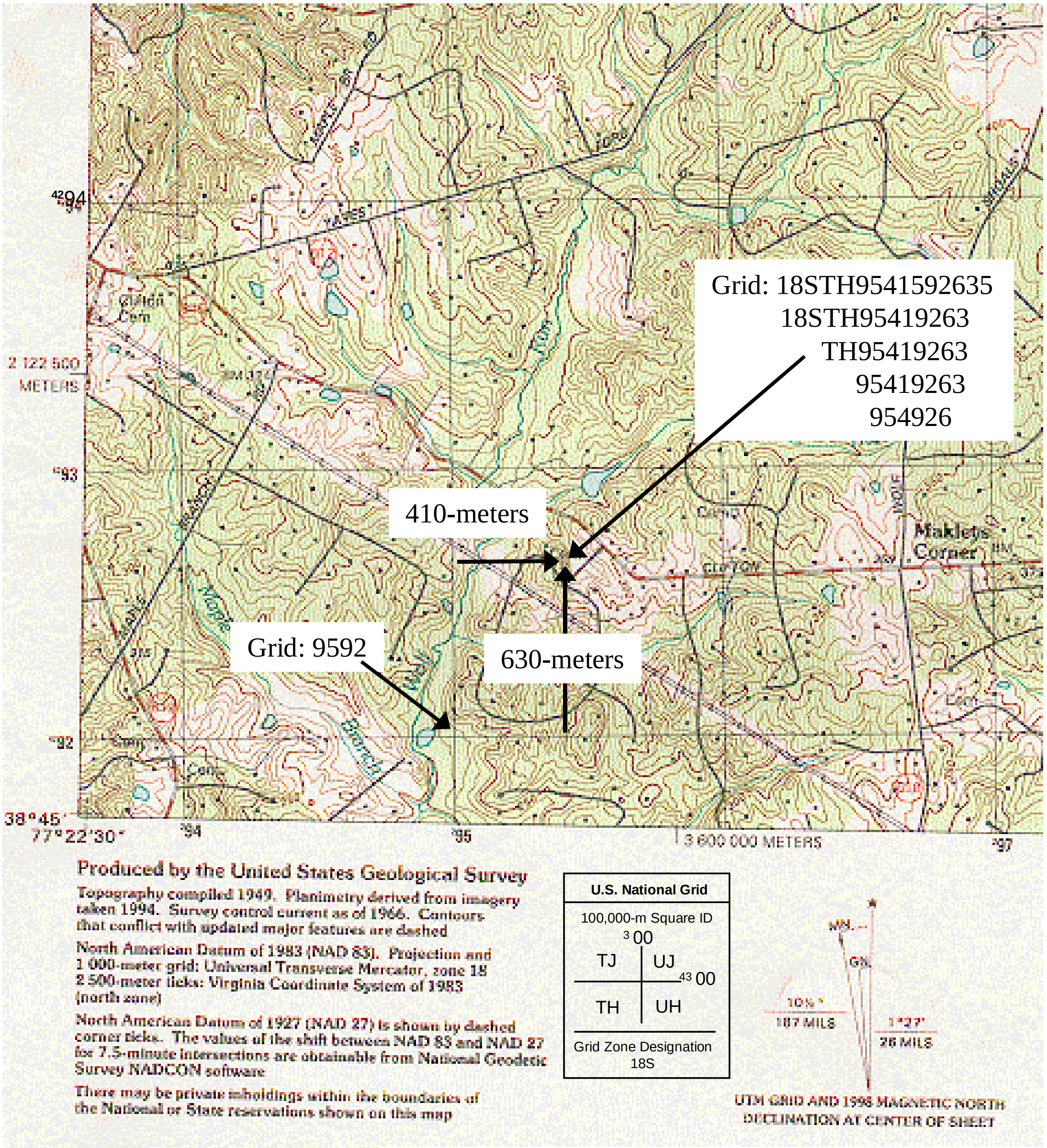
Refer to Figure 9 (pg. 31) for the following example.

A USNG reference is formally written as an entity without spaces, parentheses, dashes, or decimal points. In this example the grid coordinates are shown for a map feature, a small cemetery. From the legend the feature is located in GZD (18S) and 100,000-meter square (TH). For the grid coordinates, read right to the grid intersection immediately left of the place of interest. In Figure 9, it is line 95. Then identify the grid line below the point (in this example 92). The coordinate value 9592 gives the location to within 1,000 meters. Measuring or estimating right in meters from line 95, finds the cemetery is another 415 meters. The complete USNG Easting component is 95415. Measuring up (north) from line 92, the cemetery is another 635 meters. The complete USNG Northing component is 92635. In this example a precision of 10 meters is required, thus the eight-digit coordinate value of the cemetery is 95419263. Notice how the 1-meter values of 5 have been dropped in the eight-digit grid coordinates. The USNG coordinate values are:

Full USNG:	18STH95419263
Without GZD:	TH95419263
Without GZD and 100,000-meter Square Identification:	95419263

Using the example of the cemetery above, grid coordinates are illustrated below for four, six, eight, and ten digits. These values represent a point position (the southwest corner) for an area of refinement.

Four digits	9592	Locating a point within a 1,000-meter square.
Six digits	954926	Locating a point within a 100-meter square.
Eight digits	95419263	Locating a point within a 10-meter square.
Ten digits	9541592635	Locating a point within a 1-meter square.



This figure illustrates how to obtain the spatial address for a feature on the map, in this case a cemetery. Coordinates are depicted as full and truncated values. Values preceding grid coordinates are the Grid Zone Designation, and 100,000-meter Square Identification (In this case 18S and TH respectively). These values are found in the Grid Reference Box in the map legend and are used as appropriate to locate the feature within increasingly larger areas. A full coordinate (i.e. 18STH95419263) provides a unique value over the entire world. TH95419263 provides a value with 10-meters precision out of a large, regional size area.

Finding 95419263. Think 9541 / 9263.

- Reading right to grid line 95, measure right another 410-meters. Dropping the one-meter digit 0 produces the grid coordinate Easting value 9541.
- Read up to grid line 92. Measure up another 630-meters. The Northing coordinate value is produced from grid line 92 + 630-meters (drop the 0) to make 9263. This makes the grid coordinate 95419263 (think 9541 / 9263).

Truncated examples:

Feature:	USNG Grid Coordinates:
Bench Mark 324	94349341
Pond	94329206
Building	95649379
Road intersection	96189260

Map extract from US Geological Survey 7.5-minute quadrangle FAIRFAX, VA, 1994 edition.

Figure 9. How to read United States National Grid (USNG) grid coordinates.

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United States National Grid

Annex D (Informative)

General Conventions for the USNG

ANNEX D (Informative)

General Conventions for the USNG.

D.1 Appropriate use of truncated values

Full USNG values should be provided when they are used to indicate a geoaddress on stationary letterhead, business cards, etc., even though the reader will know from the street address that it is in the vicinity of a given town. This will facilitate someone using USNG geoaddresses with a GPS receiver or digital map. For example:

Department of Interior

1849 C Street NW, Washington, DC 20006

USNG: 18SUJ22850705

Alternatively, when two people are exchanging positioning information by voice or other informal means, they will often use only the USNG grid coordinate, such as: "We're located in Washington at 1849 C Street, NW, grid 22850705."

A USNG spatial reference is formally written for general applications as an entity without spaces, parentheses, dashes, or decimal points as depicted above. If users must break a spatial reference into segments to facilitate reading, the following convention shall be used.

18S UJ 228070
or
18S UJ 2286 0705

This convention is most appropriate in hand written notes or GPS receiver equipment displays.

D.2 Geographic indexing

D.2.1 National Atlas or Map

Features should be referenced in a map or atlas index using truncated USNG values because such an index can then be used with any map conforming to this standard thus promoting interoperability and the sharing of index information. In the case of an atlas, the particular page numbers would also be indicated. For example, the cities of Huntsville can be referenced as:

Huntsville, AL	ED 3743
Huntsville, AR	VV 3393
Huntsville, MO	WD 3965
Huntsville, OH	KE 6280
Huntsville, TN	GF 2532
Huntsville, TX	TQ 5501
Huntsville, UT	VL 3567

The exception to this format is Alaska, which exceeds 18° of latitude and longitude in extent (more than three grid zones). For Alaska, the GZD should also be shown.

D.2.2 State map index

An index for a state atlas or map for Texas can reference cities as:

Huntington	UQ 4961
Huntoon	LF 5335
Huntsville	TQ 5501

Huntsville St Park	TP 5790
Hurlwood	GT 7419

In the case of a state atlas, the page numbers for each feature would also be indicated. The exception to this format is again Alaska, where the GZD should also be shown.

D.2.3 City street index

A large-scale atlas or street map for Huntsville, TX can index street names as:

Baker	TP 562995
Beto	TP 571981
Bowers	TQ 570005
Brook	TP 567984
Bush	TQ 543021

The coordinate values would usually be for the place where the street name appears on the map. Note that since the extent of Huntsville, TX is not larger than 100 x 100 kilometers, the 100,000-meter Square Identifications are not essential in this street index. A city street atlas would also reference the page number unique to that atlas for the street.

D.3 Portrayal of USNG grids and grid values on maps

D.3.1 Grid spacing

On large-scale paper maps, precise measurement requires a fine line square grid. Grids provide the user with a geodetic reference in close proximity to any point on the map facilitating measurement and compensating for paper distortion. The size of grid squares is a trade off between a precise reference and map clutter. Table 2 provides a proven and useful convention and guide where grid squares on maps are no smaller than 20mm nor larger than 100mm along each side.

Table 2. Grid spacing recommendation

Map scale	Grid spacing (On ground in meters.)	Grid spacing (On map in millimeters.)
1:10,000	1,000	100
1:20,000	1,000	50.0
1:24,000	1,000	41.6
1:25,000	1,000	40.0
1:50,000	1,000 or 5,000	20 or 100.0
1:62,500	5,000	80.0
1:63,360	5,000	78.7
1:100,000	10,000	100.0
1:250,000	10,000	40.0
1:500,000	50,000	100.0
1:1,000,000	100,000	100.0

D.3.2 Grid value portrayal

The USNG is based on the UTM grid, and as such the first two digits in USNG Easting and Northing are the same as the 10,000-meter and 1,000-meter digits of UTM Easting and Northing coordinates. Provisions should be made so map users can have essential information for identifying the UTM coordinate equivalent of each USNG coordinate. A sample of at least one full UTM value should be shown for both an Easting and Northing values, preferably in the lower right corner of the map. When UTM values are shown, the principal digits are provided in larger type. Other grid lines should be identified using UTM principal digits (both the 10,000-meter and 1,000-meter UTM values) with the proceeding digits as superscript. Alternatively, only the principal digits for grid lines need be shown, but a sample full UTM value for both the Easting and Northing axis must be depicted at least once on the map. Annex C, Figure 6, 7, and 8 (pgs. 25 – 27) depicts how grid lines are labeled and 100,000-meter squares identified on the map and along the neatline.

D.3.3 Grid reference box

Maps at scales 1:500,000 and larger should provide a grid reference box with the content illustrated in either Figure 4 or 5 (Annex C, pgs. 22 and 23) and similarly configured.

D.3.4 Map legend information.

Map legends should contain the following information regarding the grid;

- Size of grid squares and identify grid as US National Grid
- Datum to which grid is referenced.
- Grid Zone Designation data.
- 100,000-meter Square Identification data.

Example for maps contained within a single 100,000-meter square:

1,000-meter grid, US National Grid
North American Datum 1983
Grid Zone Designation: 18S
100,000-m Square Identification: UH

Example for maps that cover two or more 100,000-m squares:

1,000-meter grid, US National Grid
North American Datum 1983
Grid Zone Designation: 18S
100,000-m Squares: TH, UH, TJ, UJ

United States National Grid

Annex E (Informative)

USNG Standardized Numbering for NAD 27

ANNEX E

USNG Standardized Numbering for NAD 27 Maps

Since the adoption of the NAD 83 as the U.S. national datum, there has been a sustained effort by federal government mapping agencies to change national maps from the NAD 27 to the NAD 83 datum. However, a substantial percentage of maps over the U.S. remain on the NAD 27 datum and that situation may continue for some time.

The U.S. National Grid (USNG) numbering scheme for the 100,000-meter squares, is identical to the Military Grid Reference System (MGRS) scheme for 100,000-meter squares designed for use with the WGS 84 over U.S. areas. This same numbering scheme shall also be used with the NAD 27 on the Clarke 1866 ellipsoid for the USNG.

By use of one single scheme (Figure 3 – pg. 11), the Grid Zone Designation and 100,000-meter Square Identification will be the same for NAD 83 and NAD 27 datums. The ONLY difference will be in the two UTM coordinates, which will be based on the geodetic coordinates as defined on their respective datums.

For example, the scheme for two adjacent 1: 24,000-scale quads within the same 100,000 meter square, e.g., FALLS CHURCH, VA-MD (NAD 83) and WASHINGTON DC WEST, DC-MD-VA (NAD 27), would portray the same 100,000-meter Square Identifications "UJ". The ONLY difference will be in the datum based UTM coordinates.

Example - The Washington Monument (USNG):

18S UJ 2348 0647 *[NAD 83 is implied]*

18S UJ 2345 0626 (NAD 27)

United States National Grid

Annex F (Informative)

Glossary

ANNEX F (Informative)

Glossary

ANSI	American National Standards Institute
FGDC	Federal Geographic Data Committee
GIS	Geographic Information System
GPS	Global Positioning System
GZD	Grid Zone Designation
DMA	Defense Mapping Agency
ISO	International Organization for Standardization
MGRS	Military Grid Reference System
NAD 27	North American Datum 1927
NAD 83	North American Datum 1983
NSDI	National Spatial Data Infrastructure
NIMA	National Imagery and Mapping Agency
PLSS	Public Land Survey System
SPCS	State Plane Coordinate System
UGRS	Universal Grid Reference System
USNG	United States National Grid
UTM	Universal Transverse Mercator
WGS 84	World Geodetic System 1984