



SYSTEMS MANAGEMENT STANDARD

SAE1002™

Issued

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U.S. National Grid Standard

RATIONALE

The U.S. National Grid (USNG) is the civilian version of the Military Grid Reference System (MGRS) the Department of Defense uses for tactical operations. The USNG enables geocoding incident locations from 100 m to 1 m precision. Federal Emergency Management Agency (FEMA) Urban Search and Rescue (USAR) teams have been using USNG for years but many other first responder organizations and agencies are slow in adopting it. Examples include E911, Firstnet™, the Coast Guard, and state/local emergency response jurisdictions. In October, 2017, FEMA issued its third edition of the National Incident Management System, which states, "The (U.S.) National Grid is simple to apply to support risk assessment, planning, response, and recovery operations. Individuals, public agencies, voluntary organizations, and commercial enterprises may use the National Grid within and across diverse geographic areas and disciplines. The use of the National Grid promotes consistent situational awareness across all levels of government, disciplines, threats, and hazards, regardless of an individual or program's role." Adoption of the USNG as an SAE International standard by its Position, Navigation, and Timing (PNT) Committee will enhance the Committee's ongoing work in Critical Infrastructure support efforts relative to mobilization and coordination of resources for all types of emergency response operations.

FOREWORD

This standard is a process standard as defined by the Federal Geographic Data Committee (FGDC) Standards Reference Model, document number FGDC-STD-011-2001 (see 2.1.1). This standard defines the USNG. The USNG is based on universally defined coordinate and grid systems and can, therefore, be easily extended for world-wide use as a universal grid reference system.

There are a number of coordinate reference systems that may 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 may be both automatic and transparent to the user. These devices may 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 maps when latitude and longitude are used because they do not appear square on a flat map. As a consequence, 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 may be impossible when proprietary grids are used. This situation 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.

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Documents

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1. SCOPE

This standard, SAE1002, is a republication of FGDC-STD-011-2001, and defines a preferred USNG for mapping applications at scales of approximately 1:1000000 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. Together, the UTM coordinate representation, the MGRS grid, and the specific grid presentation requirements define the USNG.

Use of USNG grid coordinates may be useful, and 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.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1.1 References

This standard is a process standard as defined by the Federal Geographic Data Committee (FGDC) Standards Reference Model. Document number FGDC-STD-011-2001 <https://www.fgdc.gov/standards/projects/FGDC-standards-projects/usng>

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE standard.

2.2.1 ANSI Accredited Publications

Copies of these documents are available online at <http://webstore.ansi.org/>

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

Copies of these documents are available online at <http://webstore.ansi.org/>

ISO/DIS 19116	Positioning Services, which provides an interface for real-time output from a GPS (GNSS) receiver and other positioning technologies.
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ISO/DIS 19111	Spatial Referencing by Geographic Coordinates, which provides a conceptual schema for the description of coordinate reference systems.
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The USNG standard is based on the Military Grid Reference System (MGRS) and fully interoperable with it. This is of critical importance to safety of life during times of disaster relief operations.

2.2.3 USGS Publications

The National Map Accuracy Standards, available online at <https://nationalmap.gov/standards/nmas.html>.

2.3 Acronyms

ANSI	American National Standards Institute
ASF	Additional Secondary Factor
CRS	Coordinate Reference Systems
FGDC	Federal Geographic Data Committee
GIS	Geographic Information System
GPS	Global Positioning System
GNSS	Global Navigation Satellite System
GZD	Grid Zone Designator
ISO	International Organization for Standardization
ITRS	International Terrestrial Reference Systems
NAD	North American Datum
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
UPS	Universal Polar Stereographic
USNG	U. S. National Grid
UTM	Universal Transverse Mercator
WGS 84	World Geodetic Survey 1984

3. MAIN FEATURES 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), as shown in Figure 1.

Each zone is segmented into 20 latitude bands. Each latitude band is 8 degrees high, and is lettered starting from "C" at 80 degrees south, increasing up the English alphabet until "X", omitting the letters "I" and "O" (because of their similarity to the numerals one and zero). The last latitude band, "X," is extended an extra 4 degrees, so it ends at 84 degrees north latitude, thus covering the northernmost land on Earth. Latitude bands "A" and "B" do exist, as do bands "Y" and "Z." They cover the western and eastern sides of the Antarctic and Arctic regions respectively.

In the polar regions, a different convention is used. South of 80 degrees south, Universal Polar Stereographic (UPS) South is used instead of a UTM projection. The west half-circle forms a grid zone with designation A; the east half-circle forms one with designation B; see Figure 1. North of 84 degrees north, UPS North is used, and the west half-circle is Y, the east one is Z. Since the letters A, B, Y, and Z are not used for any latitude bands of UTM, their presence in an MGRS coordinate, with the omission of a zone number, indicates that the coordinates are in the UPS system. Further discussion of the UPS projections as they are used in areas outside of the areas covered by the USNG are left to MGRS references.

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 in Figure 1.

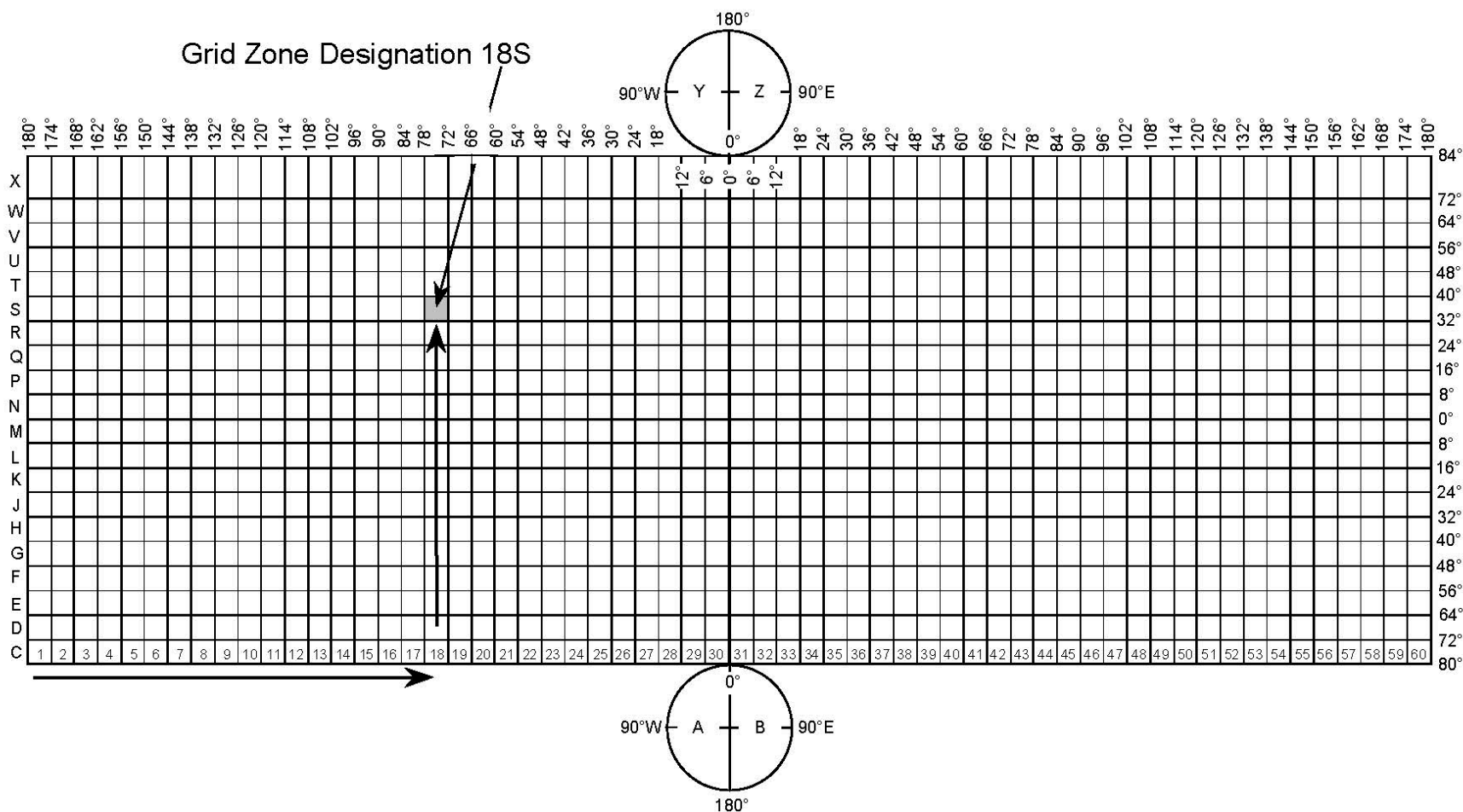


Figure 1 – Grid zone designation of the USNG

3.3.2 100000-Meter Square Identification

The second part of a USNG coordinate is the 100000-meter square identification. Each UTM zone is divided into 100000-meter squares, so that their corners have UTM-coordinates that are multiples of 100000 meters. The identification consists of a column letter (A–Z, omitting I and O) followed by a row letter (A–V, omitting I and O).

Near the equator, the columns of UTM zone 1 have the letters A–H, the columns of UTM zone 2 have the letters J–R (omitting O), and the columns of UTM zone 3 have the letters S–Z. At zone 4, the column letters start over from A, and so on around the world.

Each GZD 6x8 degree area shall be covered by a specific scheme of 100000-meter squares where a two-letter pair identifies each square, as shown in Figures 2 and 3.

18SUJ – Identifies a specific 100000-meter square in the specified GZD.

3.3.3 Grid Coordinates

A point position within the 100000-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 E first, then N. An equal number of digits shall always be used for E and N.

Examples:

18SUJ20	Locates a point with a precision of 10 kilometers.
18SUJ2306	Locates a point with a precision of 1 kilometer.
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.

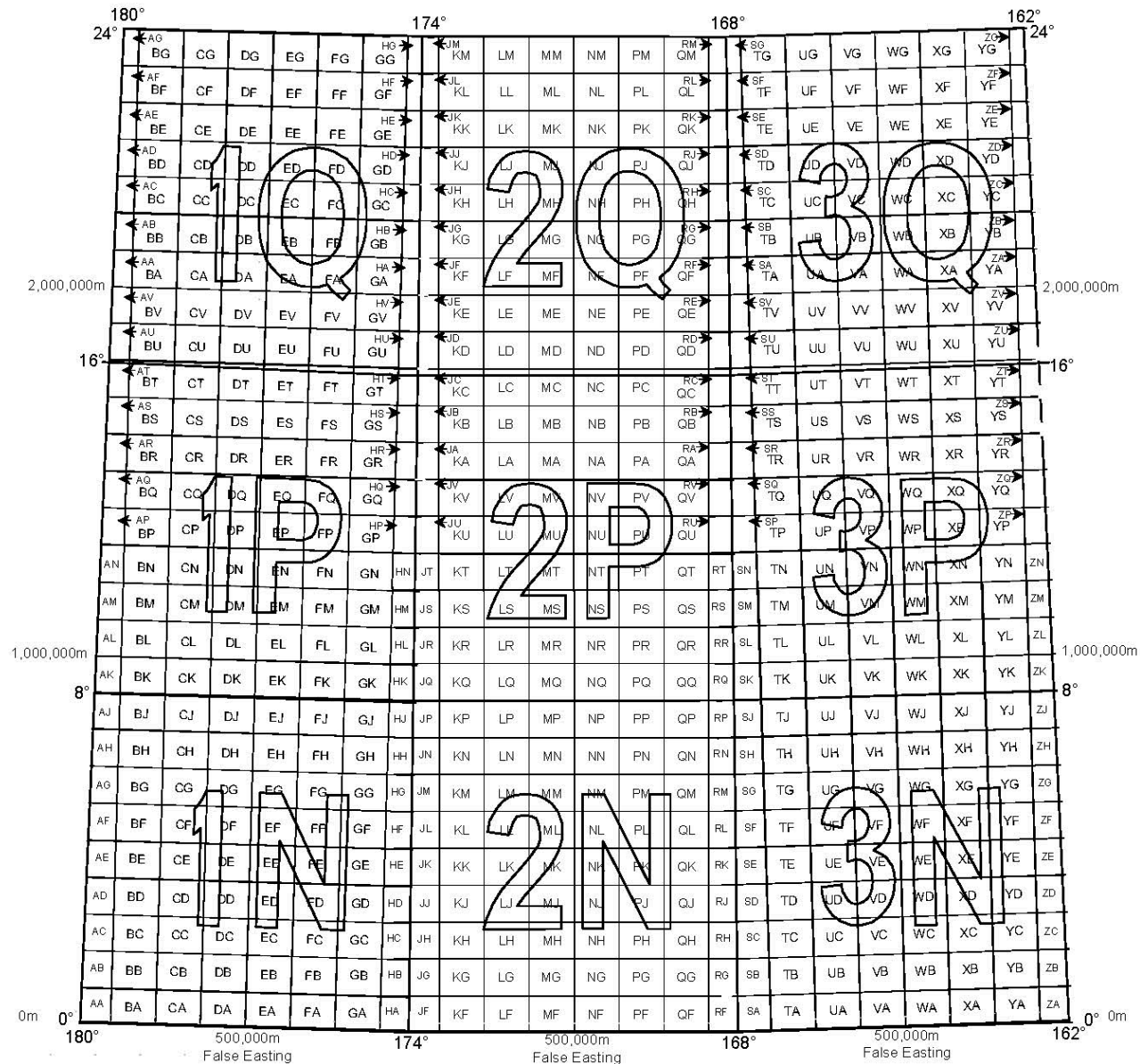


Figure 2 – Basic plan of the 100000-meter square identification of the USNG

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							
	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
2,000,000 m	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
	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
1,500,000 m	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
500,000 m	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
	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
0 m	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
200,000 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

Figure 3 – Organization of the USNG 100000-meter grid squares