

METRIC

MIL-F-89018
1 OCTOBER 1992
SUPERSEDING
PS/3ED/601
December 1989

MILITARY SPECIFICATION
FIREFINDER ELEVATION DATA (FFED)

These specifications are approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification defines the requirements for preparing the digital elevation data used to support the Firefinder artillery and mortar locating radar systems.

1.2 Purpose. The purpose of this specification is to assure uniformity of treatment among all mapping and charting elements engaged in a coordinated production and maintenance program for this product.

1.3 Security.

1.3.1 Security classification of specification. This specification is UNCLASSIFIED.

1.3.2 Product classification. The Firefinder digital data generated by the use of these specifications shall be classified according to existing regulations and policies.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Director, Defense Mapping Agency, ATTN: PRS, Stop A-13, 8613 Lee Highway, Fairfax, VA 22031-2137 by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

AREA MCGT

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the current Department of Defense Index of Specifications and Standards (DODISS) and the supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

MIL-D-89000	Digital Terrain Elevation Data (DTED) Level 1
MIL-D-89001	Digital Terrain Elevation Data (DTED) Level 2

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Naval Publications and Forms Center, Standardization Documents Order Desk, Bldg. 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.1.2 Other government documents, drawings, and publications. The following other government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

DMA TM 8358.1 - "Datums, Ellipsoids, Grids, and Grid Reference Systems"
(Stock number DMATM83581TEXT)

DMA TM 8358.2 - "The Universal Grids: Universal Transverse Mercator (UTM) and Universal Polar Stereographic (UPS)"
(Stock number DMATM83582)

DMA TR 8400.1 - "Error Theory as Applied to Mapping, Charting and Geodesy"

DMA TR 8350.2 - "Department of Defense World Geodetic System 1984"
(Stock number DMATR83502WGS84)

(Copies of DMA TM 8358.1, DMA TM 8358.2, and DMA TR 8350.2 are available, to Department of Defense users, from the Defense Mapping Agency Combat Support Center, ATTN: DDCP, 6001 MacArthur Blvd., Bethesda, MD 20816-5001. DMA TR 8400.1 is available from

the National Technical Information Center, Cameron Station, Alexandria, Va. 22304-6145).

2.2 Non-Government publications. This section is not applicable to this specification.

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related associated detail specifications, specification sheets, or standards) the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Accuracy. The relative vertical accuracy of FFED derived directly from Digital Terrain Elevation Data (DTED) Level 1, produced from photogrammetric sources, will be specified as 25 meters at 90% (Linear Error) L.E. or 10.3 meters at 50% L.E. This accuracy applies to the elevation data in the Firefinder format before rounding and compression (see 3.5) and does not include interpolation error for points between the 125 meter grid spacing.

3.2 Datums and ellipsoids.

3.2.1 Horizontal datum. The horizontal datum for FFED for any given area of the world will be consistent with that used to compile those topographic line maps designated for local use by operational U.S. forces. The latest edition of DMA TM 8358.1, "Datums, Ellipsoids, Grids, and Grid Reference Systems", will be used to prescribe the horizontal datum when topographic line maps for a particular area have been compiled based on information contained in that document. The datum of reference for FFED is identified on the tape label and in the header of the file. Users of FFED are responsible for verifying that the map sheets they use are referenced to the same datum as the FFED or for performing coordinate transformations as required. Guidance in the form of transformation algorithms and parameters for conversion to WGS 84 is provided in DMA TR 8350.2, "Department of Defense World Geodetic System 1984". DMA supports approximately 100 datum transformations. As the need arises, and data becomes available, additional datum transformations will be made available. If no transformation exists for a datum, the FFED will be produced on WGS 84.

3.2.2 Vertical datum. The vertical datum for FFED is mean sea level.

3.3 Cell sizes, overlap, and storage.

a. Each 6 degree longitude by 8 degree latitude Universal Transverse Mercator (UTM) grid zone designation will be expanded to include a minimum of 30 km of valid data from each adjacent grid zone designation. These expanded grid zone designations will be subdivided into 100 km by 100 km cells (commonly called Firefinder cells) according to the Military Grid Reference System (Appendix A). These 100 km by 100 km cells will have one row or one column of elevation data in common with each adjacent cell within its grid zone designation.

b. In areas where cells include a datum boundary, two or more cells are prepared, one with each datum. A separate tape is furnished for each cell(s), one for each datum.

c. Where DTED which meets the prescribed accuracy requirements is not available within a cell, the cell will be completed firstly, with the best available DTED, and secondly, the highest elevation of that cell will be used to populate the missing elevation matrix positions. When the highest elevation method is used, users will be provided with a graphic in hard copy form identifying these fill areas, and these areas will not be incorporated into the cell accuracy.

3.4 Data spacing. The FFED cell matrix will be furnished in south to north profile scans at 125 m post position intervals. These profile scans will be separated by 125 m in the west to east direction.

3.5 Data compression. Firefinder format requires that the maximum and minimum elevation in meters for each cell be specified. From this specified elevation range, the next highest full integer multiplier of 255 will be taken as the height scale factor. FFED expressed in meters will be compressed by subtracting the minimum elevation, dividing by the height of the scale factor, and rounding to the nearest integer.

3.6 Physical characteristics. The tape on which data are recorded must be half-inch, 9 track (8 data bits plus odd parity bit), 1600 BPI PE, IBM compatible, standard 3.6 inch hub.

3.7 Data structure.

a. A FFED magnetic tape will contain one or more files. Appendix B shows the order of records within these files. Each file will consist of one Fixed Length Record, one Definition Record, a group of data records constituting one Firefinder cell and one End of File Record.

(1) The Fixed Length Record format is at Appendix C.

(2) The Definition Record format is at Appendix D.

(3) The Data Record format is at Appendix E. The number of Data Records will always be 801 (100 km). The number of height deviation values having a common X coordinate will always be 801 (100 km).

(4) Each file will terminate with the standard IBM End of File Record. The last file of the tape will terminate with two End of File Records.

b. UTM grid zone designations will be identified by the ASCII Data Convention for FFED, Appendix F. Each grid zone designation will be six ASCII characters long and left justified, blank fill.

c. All numbers will be twos complement 16 or 32 bit binary integers.

3.8 Documentation.

a. A separate data and statistics printout sheet will be provided for each Firefinder cell. It will be formatted to allow bound filing. Each printout will include as a minimum:

(1) The input control card parameters used for the Firefinder conversion programs, including UTM cell identification.

(2) The definition record for each UTM cell in both octal and readable form (decimal, except alpha numeric UTM grid zone designation and cell ID using symbols identified in Appendix D).

(3) The total number of Definition and Data Records per file (i.e., per cell) excluding EOF record.

(4) Notes on any special conditions.

(5) An estimate of the accuracy of the data in meters with 90 percent confidence.

(6) Security classifications.

(7) Identification of corresponding magnetic tape and date the tape was generated.

(8) Statistical summary to include:

- minimum and maximum elevations within a cell.
- histogram of elevations values within the cell.
- count of points within the cell truncated by the data compression.
- average elevation of points within the cell.

-table or graph of elevation range frequency and percentage.

b. A properly joined printed map of each cell at 1:250,000 scale for visual reference purposes will be provided.

c. The tape reel will have a label affixed to it identifying the datum/ellipsoids used, UTM grid zone designations, cells contained on the tape, relative vertical accuracy of the data in meters (90% confidence), and the date it was generated.

3.9 Security. Classification of Firefinder elevation data must be specified on the tape label. Classifications will be determined by DMA on a cell-by-cell basis.

3.10 Definitions. See Appendix G, GLOSSARY OF TERMS.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsible for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.1.2 Final product quality. DMA policy makes the producer of the FFED responsible for the accuracy of the final product as well as for the evaluation of the source from which the data were derived.

5. PACKAGING

This section is not applicable to this specification.

6. NOTES

This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.

6.1 Intended use. This specification deals with (a) the derivation of FFED from cartographic and photogrammetric sources, and (b) output format requirements for Firefinder digital elevation data tapes. FFED may be produced from either cartographic or photogrammetric derived DTED. DTED which meets or exceeds all accuracy specifications will be used as the primary source. The Firefinder system was designed to meet the requirement for detecting and locating enemy mortars and artillery with sufficient accuracy to permit immediate engagement by friendly counterfire. The system uses FFED to determine the location of targets through computation of projectile trajectories. FFED are used to establish a database for field use with the AN/TPQ36 mortar and AN/TPQ37 artillery radars. These radars provide a capability to locate hostile mortar and artillery units by detecting in-flight projectiles, determining their trajectory, computing the intersection of this trajectory with the ground, and identifying the firing battery position. FFED allows the radar computer to use extrapolated tracking data to determine adjusted positional coordinates and hence, the location of the firing positions to the desired accuracy without operator intervention.

6.2 Acquisition requirements. When this specification is used in acquisition, the applicable issue of the DODISS must be cited in the solicitation (See 2.1.1).

6.3 Supersession. These specifications supersede Defense Mapping Agency Product Specifications for Digitized Elevation Data for Firefinder, PS/3ED/601, Third Edition, December, 1989.

6.4 International standardization agreements.

Certain provisions of this specification may be subject to international standardization agreements. When amendment, revision, or cancellation of this specification is proposed that will modify the international agreement concerned, the preparing activity will take appropriate action through international standardization channels, including departmental standardization offices, to change the agreement or make other appropriate accommodations.

6.4.1 International Standardization Agreements (STANAGs).
This section is not applicable to this specification.

6.4.2 Quadripartite Standardization Agreements (OSTAGs). This section is not applicable to this specification.

6.4.3 Air Standardization Coordinating Committee Agreements (ASCC AIR STDs/STDs/ADV PUBs). This section is not applicable to this specification.

6.4.4 International MC&G Agreements. This section is not applicable to this specification.

6.4.5 Executive Orders. This section is not applicable to this specification.

6.4.6 Interagency Agreements. This section is not applicable to this specification.

6.4.7 Other Documentation. This section is not applicable to this specification.

6.5 Subject term (key word) listing.

AN/TPQ36

AN/TPQ37

Grid zone designation

DTED

APPENDIX A

MILITARY GRID REFERENCE SYSTEM

10. SCOPE

10.1 Scope. This Appendix provides an example of the Basic Plan of the 100,000 meter square identifications of the Military Grid Reference System between 84°N. and 80°S. (DMA TM 8358.1, Figure 8). This appendix is a mandatory part of this specification. The information contained herein is intended for compliance.

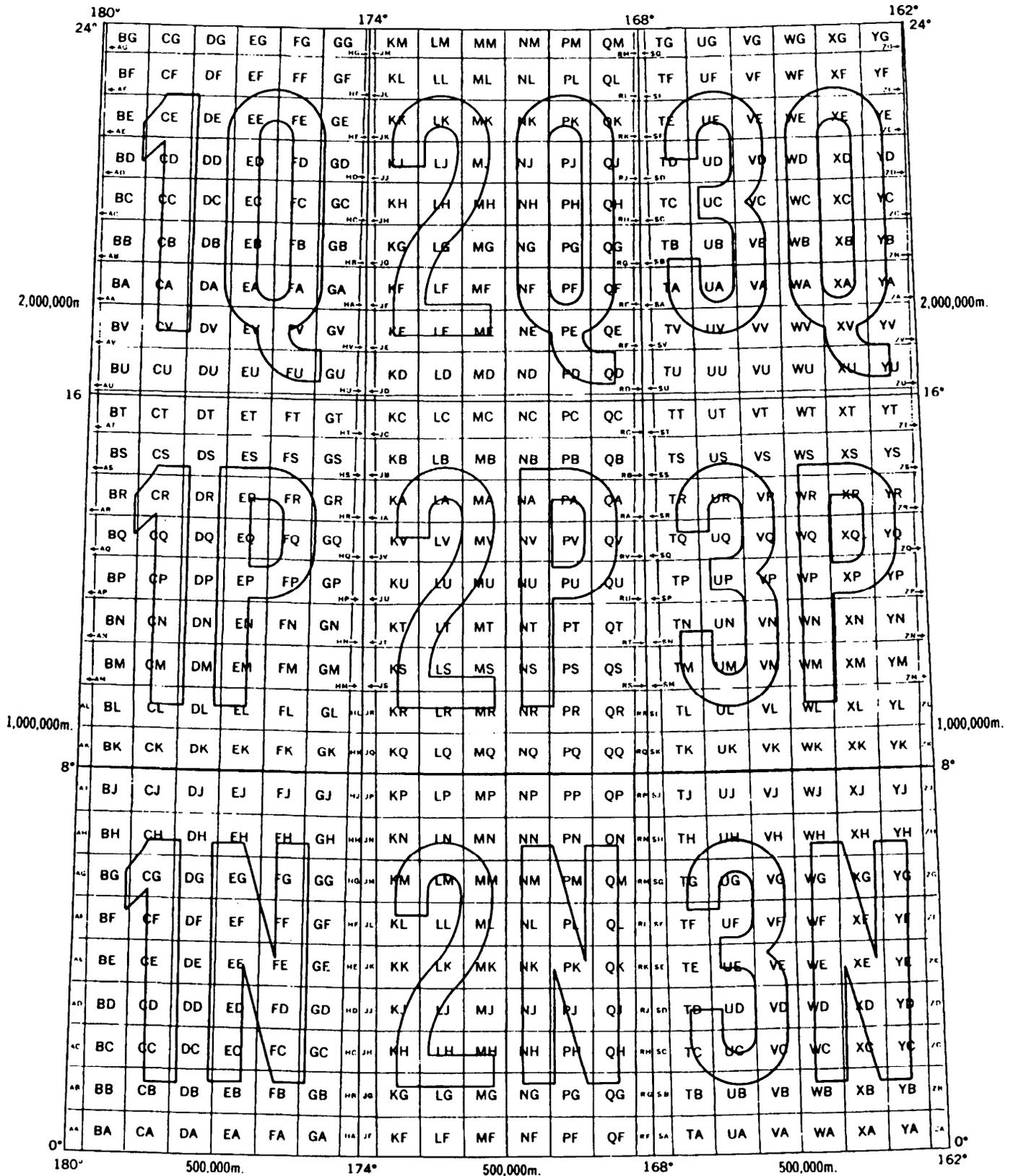
20. APPLICABLE DOCUMENTS

This section is not applicable to this Appendix.

30. MILITARY GRID REFERENCE SYSTEM

30.1 Military Grid Reference System. See Chapter 3 of DMA TM 8358.1. The next page illustrates the Basic Plan of the 100,000-meter Square Identification of the Military Grid Reference System (MGRS) and is **not** an explanation of the MGRS.

APPENDIX A



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

APPENDIX B

FILE DESCRIPTION

10. SCOPE

10.1 Scope. This appendix shows the order of records within each file contained on the FFED magnetic tape. This appendix is a mandatory part of this specification. The information contained herein is intended for compliance.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. FILE DESCRIPTION

30.1 File Description. See the next page for the order of records for each file contained on a FFED magnetic tape.

APPENDIX B

Fixed Length Record	FLR	(20 bytes)
Definition Record	DEFR	(60 bytes)
Data Records	DATAR 1	
	DATAR 2	
	:	
UTM Cell #1	:	
	:	
	DATAR 801	
End of File Mark	*	
	FLR	(20 bytes)
	DEFR	(60 bytes)
	DATAR 1	
	DATAR 2	
	:	
UTM Cell #2	:	
	:	
	DATAR 801	
End of File Mark	*	
	FLR	(20 bytes)
	DEFR	(60 bytes)
	DATAR 1	
	DATAR 2	
	:	
UTM Cell #N	:	
	:	
	DATAR 801	
	*	
Double EOF Mark	*	

NOTE: Files 1 through N will be referenced to the same 6 degree longitude by 8 degree latitude UTM grid zone designation.

APPENDIX C

FIXED LENGTH RECORD FORMAT

10. SCOPE

10.1 Scope. This appendix contains the format for the fixed length record within each file. This appendix is a mandatory part of this specification. The information contained herein is intended for compliance.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. FIXED LENGTH RECORD FORMAT

30.1 Fixed length record format. See the next page for the format for each fixed length record.

APPENDIX C

Fixed Length Record¹ (ten 16 Bit words or 20 bytes)

<u>Symbol</u>	<u>Word #</u>	<u>Content</u>	<u>Description</u>
II	1	$(152152)_8$	= -11158
RN	2	0	Record count
RT	3	$(000001)_8=1$	No. of on-tape cells per file
LDFR	4	$(29)_{10}$	Length of definition record (16 bit words used)
UU	5-7	Blank	Unused (zero fill)
ENS	8	All ones	End of record
SC	9	---	² Check Sum (twos complement)
-	10	0	Zero Fill

NOTES:

1. This record is used in FORTRAN Version only (minimum length required = 18 Bytes)
2. 16 Bit Addition

APPENDIX D

DEFINITION RECORD FORMAT
Definition Record (Thirty 16 Bit Words)

10. SCOPE

10.1 Scope. This appendix provides the format for the definition record contained in each file on the FFED magnetic tape. This appendix is a mandatory part of this specification. The information contained herein is intended for compliance.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. DEFINITION RECORD FORMAT

30.1 Definition record format. See the next page for the format of each the definition record.

APPENDIX D

Definition record (thirty 16 Bit words or 60 bytes)

<u>Symbol</u>	<u>Word #</u>	<u>Content</u>	<u>Description</u>
I	1	$(125125)_8$	= -21931
BF	2	1	Record Count
W1	3	$(000001)_8 = (1)$	No. of cells per file
MN	4-6		UTM Grid Zone Designation (ASCII)
NO	7-8		SW Corner Northing (UTM Coordinates in meters)
EO	9-10		SW Corner Easting (UTM Coordinates in meters)
UTM	11-12	UTM Scale Factor 16 times 2	UTM Correction Constant
BH	13		Base Height (Lowest elevation in cell in meters)
MH	14	1-16	Height Scale Factor
SM	15	1, 2, 4, or 8	Spacing Multiple = $1000/SP$
NR	16	100	¹ No. of kilometers in North/South direction
NC	17	100	² No. of kilometers in East/West direction
FRN	18	2	No. of first Data Record of each UTM cell
AFN	19		Grid North Azimuth (Mils)

APPENDIX D

Definition record (thirty 16 Bit words or 60 bytes)

<u>Symbol</u>	<u>Word #</u>	<u>Content</u>	<u>Description</u>
MXH	20		Max Height (highest elevation in cell in meters)
LDE	21		³ No. of 16 bit words per Data Record not including zero fill
RPM	22		³ No. of Scan Profiles for each UTM cell
LLR	23		³ Length of Last Data Record not including zero fill
SRN	24		Ellipsoid Reference Number (ASCII)
DIN	25		Datum Identification Number
FIL	26-27	Blank	Unused (ASCII Blanks)
ENS	28	All Ones	End of Record
SC	29	--	Check Sum (twos complement)
-	30	0	Zero Fill

NOTES:

1. Total Number of Rows = (NR * SM) + 1
2. Total Number of Columns = (NC * SM) + 1
3. Used in FORTRAN version only
See Appendix G for definitions of symbols.
Symbols "MN" through "FIL" recur for multiple cells/file

APPENDIX E

DATA RECORD FORMAT

10. SCOPE

10.1 Scope. This appendix provides the format for the group of data records contained in each FFED cell. This appendix is a mandatory part of this specification. The information contained herein is intended for compliance.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. DATA RECORD FORMAT

30.1 Data record format. See the next page for the format of the data records contained in each file.

APPENDIX E

(Data record format all 16 Bit Words)

<u>Symbols</u>	<u>Word#</u>	<u>Content</u>	<u>Description</u>
	1	$(102000)_8$	= -31744
RC	2	2 at Start	Record count increases with each Data Record
SPR	3	1-254	No. of profile scans in this Data Record
XC	4	0 to NC*SM	X Coordinate
SN	5	0	Upper Byte: Reserved
HD1	Scan Line 1	0-254	Lower Byte: First Height Deviation Value
HD	6	Upper, Lower 0-254, 0-254	Remaining Height Deviation Values
.	.	.	
.	.	.	
.	N	.	
XC	N+1	0 to NC*SM	X Coordinate
SN	N+2	0	Upper Byte: Reserved
HD1	Scan Line 2	0-254	Lower Byte: Height First Deviation Value
HD	N+3	Upper, Lower 0-254, 0-254	Remaining Height Deviation Values
.	.	.	
.	.	.	
.	M	.	
	M+1	All Ones	End Of Record
	M+2	$M+1 - \sum_{i=1} \text{word } i$	Check Sum (twos complement)
	M+3	0	Zero Fill

NOTES:

1. Data Record Length (LDE) less than 2048 16 bit words.
2. Length of Last Record (LLR) less than 2048 16 bit words.
3. Number of records in each UTM cell must be less than or equal to 32767.
4. Height deviation values of 255 will not occur, as only 255 segments are used, not 256 (values range from 0-254).
5. If the spacing multiple equals 1 and the number of north/south intervals is odd, then repeat last profile scan value to obtain full word to terminate scan.

APPENDIX F

ASCII DATA CONVENTION FOR FIREFINDER

10. SCOPE

10.1 Scope. This appendix provides the definition record for each UTM cell in both octal and readable form. This appendix is a mandatory part of this specification. The information contained herein is intended for compliance.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. ASCII DATA FOR FIREFINDER.

30.1 ASCII data for Firefinder. See next page for the ASCII data for Firefinder.

APPENDIX F

ASCII		ASCII	
Octal Code	Symbol	Octal Code	Symbol
40	SPACE	106	F
41	!	107	G
42	"	110	H
43	#	111	I
44	\$	112	J
45	%	113	K
46	&	114	L
47	'	115	M
50	(116	N
51)	117	O
52	*	120	P
53	+	121	Q
54	,	122	R
55	-(minus)	123	S
56	.	124	T
57	/	125	U
60	0	126	V
61	1	127	W
62	2	130	X
63	3	131	Y
64	4	132	Z
65	5	133	[
66	6	134	\
67	7	135]
70	8	136	^
71	9	137	¯
72	:	140	␣
73	;	141	a
74	<	through	through
75	=	172	z
76	>	173	{
77	?	174	!
100	@	175	}
101	A	176	~
102	B	177	DEL
103	C		
104	D		
105	E		

APPENDIX G

GLOSSARY OF TERMS

10. SCOPE

10.1 Scope. This appendix is provided for the definition of terms and acronyms within this specification. This appendix is a mandatory part of this specification. The information contained herein is intended for compliance.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. GLOSSARY OF TERMS

30.1 Glossary of terms. See the next page for the definition of terms.

APPENDIX G

ASCII	-American Standard Code for Information Interchange
AFN	-Grid North (Mils) Angle from North, i.e., the angle at point p from true north to grid north (convergence), where p is the center of a 100 km square area (DMA TM 8358.1), clockwise rotation is positive, counterclockwise is negative.
BH	-Base Height. Minimum elevation (in meters) within a UTM cell.
Cell	- 100 km by 100 km UTM square subdivision of each 6 degree longitude by 8 degree latitude UTM grid zone designation starting at the intersection of the south edge and the central meridian for the UTM grid zone.
Data Spacing	-Ground distance between South to North profile scan and ground distance between points along the profile scan.
Datum	-A reference surface to which all computations are reduced.
DIN	-Datum Identification Number

TABLE I. Datum Identification Number.

Identification No.	Code	Datum Name
1	WGA	1/ World Geodetic System 1960
1	WGB	1/ World Geodetic System 1966
1	WGC	World Geodetic System 1972
1	WGD	World Geodetic System 1984
2	NAR	North American 1983
3	NAS	North American 1927
4	QUO	Qornoq
5	HJO	Hjorsey 1955
6	NAP	Naparima
7	PRP	Provisional South American 1956
8	COA	Corrego Alegre
9	CHU	Chua Astro
10	CAI	Campo Inchauspe

1/ NOTE - World Geodetic System 1960 and 1966 are no longer used but may identify previously produced FFED.

TABLE I. Datum Identification Number Reference - Continued.

Identification No.	Code	Datum Name
11	YAC	Yacare
12	EUR	European 1950
13	OGB	Ordnance Survey of Great Britain 1936
14	IRL	Ireland 1965
15	TAN	Tananarive Observatory 1925
16	TOY	Tokyo 1918
17	HTN	Hu-Tzu-Shan
18	LUZ	Luzon
19		Indonesian 1974
20	AUA	Australian Geodetic 1966
21	GEO	Geodetic Datum 1949 (New Zealand)
22	AFG	Afgooye
23	ADI	Adindan
24	AIA	Antigua Island Astro 1943
25	AIN	Ain el Abd 1970
26	ANO	Anna l Astro (1965)
27	ARF	Arc 1950
28	ARS	Arc 1960
29	ASC	Ascension Island 1958
30	ASM	Monstserrat Island Astro 1958
31	ASQ	Astronomical Station 1952
32	ATF	Astro Beacon "E" 1945
33	AUG	Australian Geodetic 1984
34	BAT	Djakarta (Batavia)
35	BER	Bermuda 1957
36	BID	Bissau
37	BOO	Bogota Observatory
38	CAC	Cape Canaveral
39	CAO	Canton Astro 1966
40	CAP	Cape
41	CGE	Carthage
42	CHI	Chatham Island Astro 1971
43	DAL	Dabola
44	DOB	GUX 1 Astro
45	EAS	Eater Island 1967
46	ENW	Wake-Eniwetok 1960
47	EUS	European 1979
48	FAH	Oman
49	FLO	Observatorio Meteorologico 1939
50	FOT	Fort Thomas 1955
51	GAA	Gan 1970
52	GIZ	DOS 1968
53	GRA	Graciosa Base SW 1948
54	GUA	Guam 1963
55	HIT	Provisional South Chilean 1963 (Hito XVIII)
56	HXD	Hong Kong 1963

TABLE I. Datum Identification Number Reference - Continued.

Identification No.	Code	Datum Name
57	IBE	Bellevue (IGN)
58	IND	Indian 1916
59	INF	Indian 1954
60	INH	Indian 1975
61	ISG	ISTS 061 Astro 1968
62	IST	ISTS 073 Astro 1969
63	JOH	Johnston Island 1961
64	KAN	Kandawala
65	KEA	Kertau 1948
66	KEG	Kerguelen Island 1949
67	KUS	Kusaie Astro 1951
68	LCF	L. C. 5 Astro 1961
69	LEH	Leigon
70	LIB	Liberia 1964
71	MAS	Massawa
72	MER	Merchich
73	MID	Midway Astro 1961
74	MIK	Mahe 1971
75	MIN	Minna
76	MOD	Rome 1940
77	MPO	M'Poraloko
78	MVS	Viti Levu 1916
79	NAH	Nahrwan
80	OEG	Old Egyptian 1907
81	OHA	Old Hawaiian
82	PHA	Ayabelle Lighthouse
83	PIT	Pitcairn Astro 1967
84	PLN	Pico de las Nieves
85	POS	Porto Santo 1936
86	PTB	Point 58
87	PTN	Pointe Noire 1948
88	PUR	Puerto Rico
89	QAT	Qatar National
90	REU	Reunion
91	SAE	Santo (DOS) 1965
92	SAN	South American 1869
93	SAO	Sao Braz
94	SAP	Sapper Hill 1943
95	SCK	Schwarzeck
96	SGM	Selvagem Grande 1938
97	SHB	Astro DOS 71/4
98	SOA	South Asia
99	TDC	Tristan Astro 1968
100	TIL	Timbalai 1948
101	TRN	Astro Tern Island (FRIG) 1961
102	WAK	Wake Island Astro 1952
103	ZAN	Zanderij

DTED -Digital Terrain Elevation Data.

Elevation -Estimate of absolute elevation at X-coordinate, Y-coordinate (XC, YC).

EO -Southwest Corner Easting (in meters) reference point, such that the absolute Easting for a point is specified as (EO + X-coordinate * SP)

FFED -Firefinder Elevation Data

HD -Height Deviation. Represents the data that is actually placed on the tape. It is an integer whose value ranges from 0 to 254 (8 bits).

$$HD = \frac{\text{Elevation} - \text{Base Height}}{\text{Height Scale Factor}} = \frac{\text{Elevation} - \text{BH}}{\text{MH}}$$

(rounded to the nearest integer in meters)

$$HD = \text{INTEGER} \left[\frac{\text{ELEVATION} - \text{BH}}{\text{MH}} + 0.5 \right]$$

Therefore:

Elevation is Numerically equal to height deviation * height scale factor + base height (i.e., HD * MH + BH).

LDE -Data Record Length less than 2048 16 bit words.

LDFR -Length of Definition Record: The physical length of the Definition Record on tape is 30 sixteen bit words. For Firefinder only the 29 used words are reflected in the fixed length record.

LLR -Length of Last Record less than 2048 16 bit words.

MH -Height Scale Factor is a reference interval, such that all UTM cell true elevations are expressed as a height deviation.
(HD) (0-254) from a base height.

$$MH = \text{INTEGER} \left[\frac{\text{MXH} - \text{BH}}{255} + 1 \right]$$

MN -Subdivision Map Number. Number corresponding to grid zone designations of the Military Grid Reference System. (see DMA TM 8358.1 Figure 8)

NOTE: latitude bands N through X imply Northern Hemisphere.

MXH -Maximum Height. Maximum elevation (in meters) within a UTM cell.

NC -The number of east/west intervals obtained by dividing the total length (meters) of the eastwest boundary of a UTM cell by an interval length associated with NR. In the Firefinder case, NC interval length is 1,000 meters (i.e., a UTM grid spacing). Therefore, in the Firefinder case, the number of east/west intervals:

$$NC = \frac{100000}{1000} = 100$$

NO -Southwest Corner Northing (in meters) reference point, such that the absolute northing for a point is specified as (NO + Y-coordinate * SP)

NR -The number of north/south intervals obtained by dividing the total length (meters) of the north/south boundary of a UTM cell by an interval associated with NR. In the Firefinder case, NR interval length is 1,000 meters (i.e., a UTM grid spacing). Therefore, in the Firefinder case, the number of north/south intervals:

$$NR = \frac{100000}{1000} = 100$$

Overlap -That part of a cell extending at least 30 kilometers over a UTM grid zone junction or over the 8 degree latitude band junction.

PE -Phase encoded.

RL -The maximum data record length is 2048, 16 bit words.

$$LDE - (NR * SM/2 + 4) * (SPR + 4) \leq 2048$$

e.g., if NR = 100 corresponds to 100 km square area and SM = 8 which represents a 125 meter grid space, then

$$RL = (404 + 4) * (SPR + 4)$$

which must be less than 2048; therefore Max SPR = 5.

SC -Checksum: The sum of all 16 bit words comprising a record. For Firefinder the

checksum computing the twos complement for that number.

- SM - Spacing Multiple is the number of intervals into which NR is divided. If NR interval length is 1,000 meters and spacing of points in meters are 1,000, 500, 150, 125 then SM = 1,2,4,8, respectively. If SM equals 1 and NR is odd, then double last profile scan value to obtain full word to terminate scan.
- SP - Spacing of points is minimum spacing of points in meters (i.e., 1,000, 500, 250, 125).
- SPR - Total number of profile scans in the record; that is, a single data record will contain one south to north profile scan.
- SRN - Ellipsoid Reference Number.

TABLE II. Ellipsoid Reference Number.

Reference No.	Code	Ellipsoid Name
0	WD	World Geodetic System 1972
1	CC	Clarke 1866
2	IN	International (1924) or Hayford 1909 or Madrid 1924
3	BR	Bessel (1841) Revised
4	AN	Australian National (1966) or S. American 1969 [SA]
5	AA	Airy (1830)
6	HO	^{2/} Hough
7	FA	Fischer 1960 (South Asia)
8	CD	Clarke 1880 (Modified)
9	EA	Everest (1830)
10	WC	^{2/} World Geodetic System 1966
11	FM	^{2/} Fischer 1960 (Mercury)
12	FC	^{2/} Fischer 1968
13	WE	World Geodetic System 1984
14	AM	Airy Modified
15	BM	Bessel (Modified)
16	BN	Bessel (Namibia)
17	CE	Clarke 1880 (Cape)
18	CF	Clarke 1880 (Palestine)

^{2/} NOTE - Obsolete ellipsoid but may reference previously produced FFED.

TABLE II. Ellipsoid Reference Number - Continued.

Reference No.	Code	Ellipsoid Name
19	CG	Clarke 1880 (IGN)
20	EB	Everest Borneo)
21	EC	Everest (India 1956)
22	ED	Everest (Malaya RSO 1969)
23	EE	Everest (Malaya RKT)
24	HE	Helmert 1906
25	ID	Indonesian National (1974)
26	RE	Reference Ellipsoid 1967 or GRS 67
27	RF	Reference Ellipsoid 1980 or GRS 80
28	SG	Soviet Geodetic System 1985

- UTM -Universal Transverse Mercator grid. UTM correction constant, i.e., the scale factor at point p applied to all geodetic lengths to reduce the maximum scale distortion of the projection.
- XC -X-coordinate of the point whose elevation is to be stored (referenced to NO, EO).
- YC -Y-coordinate of the point whose elevation is to be stored (referenced to NO, EO).

INDEX

	<u>PARAGRAPH</u>	<u>PAGE</u>
Accuracy	3.1	3
Acquisition requirements	6.2	7
Air standardization coordinating committee agreements (ASCC AIR STDs/STDs/ADV PUBs) ..	6.4.3	8
Appendix A Military Grid Reference System ...		9
B File Description		11
C Fixed Length Record Format		13
D Definition Record Format		15
E Data Record Format		18
F ASCII Data Convention		21
G Glossary of Terms		23
Applicable documents	2.	2
Cell sizes, overlap, and storage	3.3	4
Concluding material		31
Data compression	3.5	4
Data spacing	3.4	4
Data structure	3.7	4
Datums and ellipsoids	3.2	3
Definitions	3.10	6
Documentation	3.8	5
Executive orders	6.4.5	8
Final product quality	4.1.2	6
Government documents	2.1	2
Horizontal datum	3.2.1	3
Intended use	6.1	7
Interagency agreements	6.4.6	8
International MC&G agreements	6.4.4	8
International standardization agreements	6.4	7
International standardization agreements (STANAGS)	6.4.1	7
Non-government publications	2.2	2
Notes	6.	7
Order of precedence	2.3	3
Other documentation	6.4.7	8
Other government documents, drawings, and publications	2.1.2	2
Packaging	5.	7
Physical characteristics	3.6	4
Product classification	1.3.2	2
Purpose	1.2	1
Quadripartite standardization agreement (QSTAGS)	6.4.2	8
Quality assurance provisions	4.	6
Requirements	3.	3
Responsibility for compliance	4.1.1	6
Responsibility for inspection	4.1	6

INDEX

	<u>PARAGRAPH</u>	<u>PAGE</u>
Scope	1.1	1
Security	1.3	1
.....	3.9	6
Security classification	1.3.1	1
Specifications, standards, and handbooks	2.1.1	2
Subject term (key word) listing	6.5	8
Supersession	6.3	7
Vertical datum	3.2.2	3

CONCLUDING MATERIAL

Preparing activity:
DMA - MP

(Project MCGT-0059)

Custodian:
DMA - MP

Review activities:
AIR FORCE - 09
ARMY - PO

User activities:
AIR FORCE: 09
ARMY: PO
DMA: MP

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:		1. DOCUMENT NUMBER MIL-F-89018	2. DOCUMENT DATE (YYMMDD) 921001
3. DOCUMENT TITLE Military Specification for Firefinder Elevation Data (FFED)			
4. NATURE OF CHANGE <i>(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)</i>			
5. REASON FOR RECOMMENDATION			
6. SUBMITTER			
a. NAME <i>(Last, First, Middle Initial)</i>		b. ORGANIZATION	
c. ADDRESS <i>(Include Zip Code)</i>		d. TELEPHONE <i>(Include Area Code)</i> (1) Commercial (2) AUTOVON <i>(if applicable)</i>	7. DATE SUBMITTED (YYMMDD)
8. PREPARING ACTIVITY			
a. NAME Defense Mapping Agency ATTN: PRS, ST A-13		b. TELEPHONE <i>(Include Area Code)</i> (1) Commercial (703) 285-9240	(2) AUTOVON 356-9240
c. ADDRESS <i>(Include Zip Code)</i> 8613 Lee Highway Fairfax, VA 22031-2137		IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340	