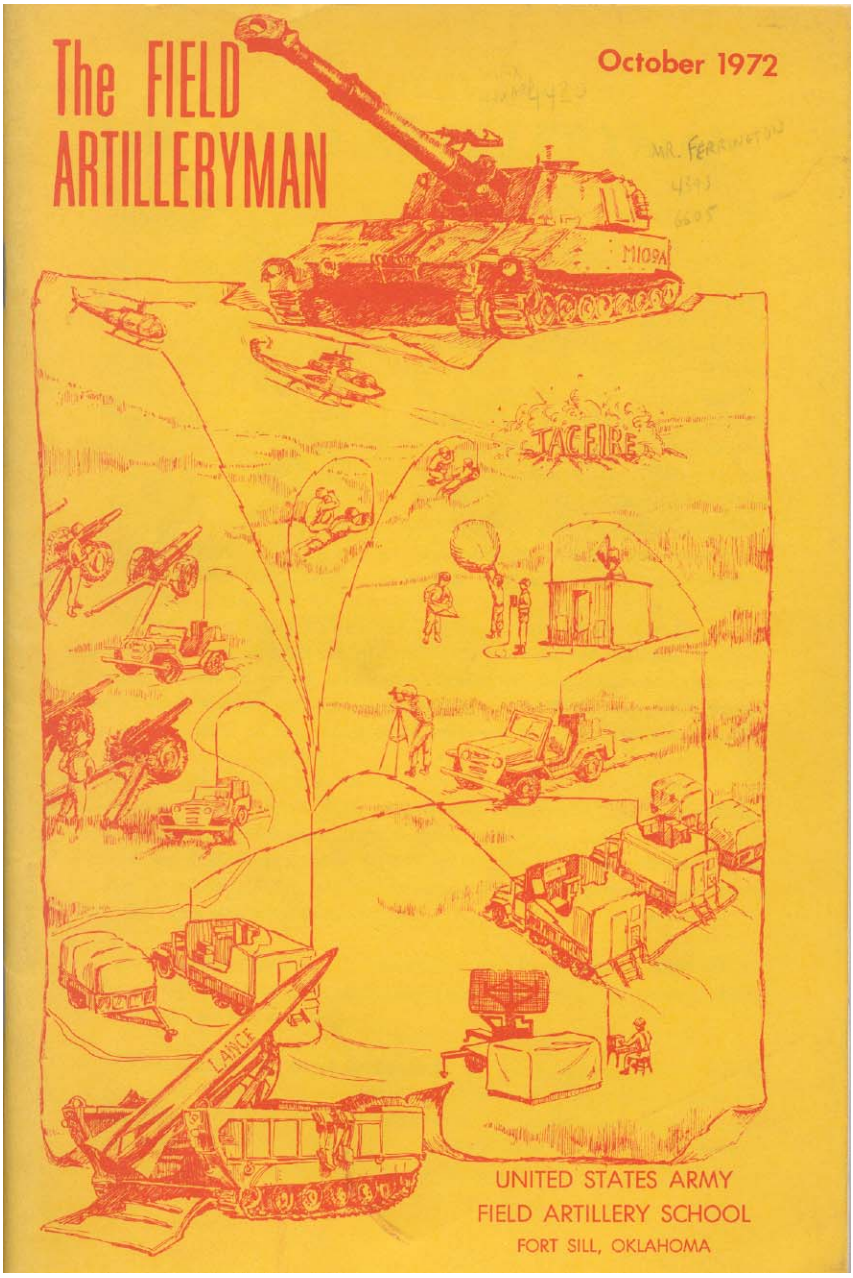
The FIELD ARTILLERYMAN

October 1972



UNITED STATES ARMY
FIELD ARTILLERY SCHOOL
FORT SILL, OKLAHOMA

A MESSAGE FROM THE NEW AC

Fellow Field Artillerymen:

One of the primary objectives I hope to accomplish during my tour as the Assistant Commandant of the Field Artillery School is to increase and broaden the channels of communication between the School and Redlegs in the field everywhere.

I am taking this opportunity to open the dialogue by asking for your thoughts and opinions regarding a new field artillery periodical.

I believe a new magazine can be a very valuable adjunct in developing and maintaining this two-way communication. Our new magazine will be more than an instructional aid of the School; we want it to be a forum for all field artillerymen. In addition to publishing the latest information on field artillery systems, tactics and techniques, we are considering the inclusion of features such as Letters to the Editor, notes from the field, as well as opinion pieces. We will print any article that merits publication regardless of rank or component of the author.

In as much as this will be **YOUR** professional journal, I heartily solicit any suggestions or recommendations you may have concerning the magazine and the new format.

In this regard we are extremely interested in the thoughts of you Reservists and Guardsmen as well as those of you on active duty and ask that you send your ideas and suggestions to:

Commandant
US Army Field Artillery School
ATTN: ATSFA-PL-FM
Fort Sill, Oklahoma 73503

Once again, let us hear from you.

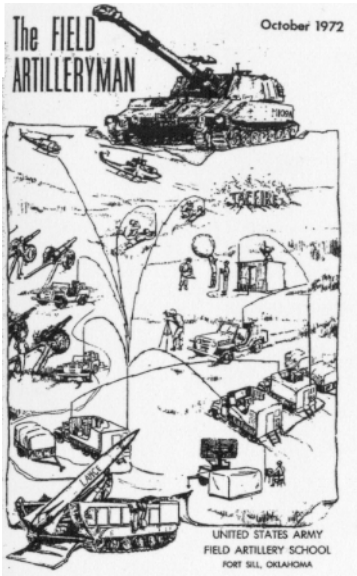
Sincerely,

Robert J. Koch

ROBERT J. KOCH
Brigadier General, USA
Assistant Commandant

REPLY REQUESTEDI

THE FIELD ARTILLERYMAN



This Reference Issue of **The Field Artilleryman** provides a brief and up-to-date compilation of information on field artillery equipment, organization and operations. It is intended to be used as a reference guide by field artillerymen at all levels. As reflected by the pictures on the cover, the field artillery in the past few years has adopted new weapons, as well as new tactics and techniques. This issue attempts to present a summary of the field artillery as it exists today. It supersedes the previous Reference Issue, which was published in July, 1968.

Section One deals with field artillery equipment, giving capsule descriptions, photographs, and performance data for howitzers, ammunition, missiles, transport, communications, and target acquisition items. Some items have been included because they are used by USAR or ARNGUS units, even though they are no longer in the active Army inventory (e.g., the 105-mm howitzer, SP, M108).

Section Two presents TOE organizational diagrams for field artillery units. Since the changeover from G-series to H-series TOE's is still in progress, H-series TOE's are shown if they have been published. Otherwise the G-series is shown. TOE's are current as of March 1972; H-series published after that date are not included.

Section Three consists of information on field artillery operations—missions, fire planning, etc.—and concludes with tables of artillery mathematics and conversion factors.

All readers of **The Field Artilleryman** are encouraged to submit articles for publication, comment on previously published articles, or offer suggestions for the improvement of this instructional aid's content and format. Correspondence should be addressed to: Commandant, US Army Field Artillery School, ATTN: ATSFA-PL-FM, Fort Sill, Oklahoma 73503.

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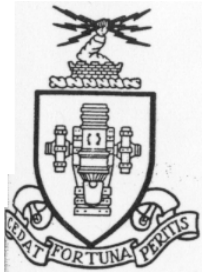

THE FIELD ARTILLERYMAN is an instructional aid of the United States Army Field Artillery School published only when sufficient material of an instructional nature can be gathered. It is prepared and distributed for information only. Nothing contained within it is to be considered directive in nature.

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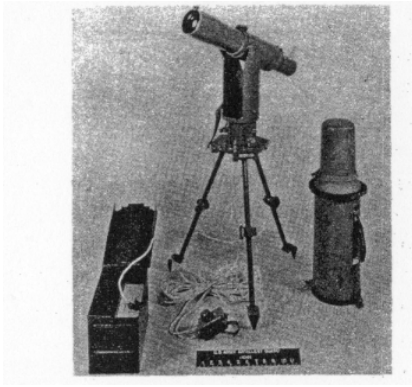
SECTION
FIELD ARTILLERY EQUIPMENT

COLLIMATOR, M1

The infinity aiming reference collimator M1 is basically an optical instrument used in indirect fire by cannon artillery weapons. It is intended to complement the M1 series aiming posts (for 6,400-mil operation) as a reference from which deflection angles may be measured. After the weapon has been laid for direction, the collimator may be positioned 15 to 48 feet to the left front of the panoramic telescope sight at a deflection established by unit SOP. However, the best results are obtained from 17 to 35 feet, depending on the weapon.

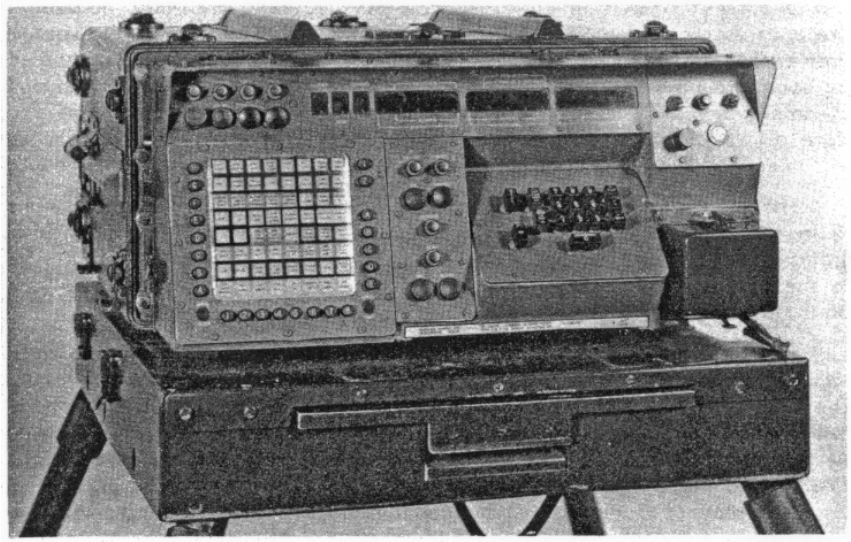


GUN DIRECTION COMPUTER M18 (FADAC)

The Computer, Gun Direction, M18 is a portable, general purpose, solid state, non-volatile, digital computer designed to solve fire control, sound, flash and survey computations for the Artillery. As a general purpose computer, it will solve any computational task assigned for which a program has been written. The limiting factor is the size of the rotating magnetic disc memory (8,192 words). The size of the memory will allow the storing of parameters for a one-caliber cannon ballistic trajectory solution or one rocket trajectory solution. A punched paper tape program representing ballistic parameters known for these weapons is read into the computer memory using the Signal Data Reproducer AN/GSQ-64 (performed only at authorized levels). The memory once loaded cannot be altered by normal operator action. Additional information affecting the ballistics of the battery weapons may be inserted by the computer operator. Meteorological data may be entered into the computer memory by a self-contained mechanical tape reader or manually through the keyboard. The computer consists of a control panel assembly, a power supply assembly, circuit boards and a magnetic memory disc assembly. Three phase, 120/208 volt, 400 cycle power must be supplied the computer from an external generator set through a cable and reel assembly.

Associated equipment consists of a computer table with integral power connection panel, a power cable and reel assembly, and a 3 kw, 120/208 volt, 400 cycle, three phase, four-wire generator.

Auxiliary equipment consists of the signal data reproducer (SDR) AN/GSQ-64 and the computer logic unit test set (CLUT) AN/GSM-70. The SDR is used by the organizational FADAC radio mechanic to load the various programs into the computer. The CLUT is used with the SDR to determine which part of the computer has failed in the event of a malfunction.



Gun Direction Computer M18 (FADAC)

TACFIRE

TACFIRE (**Tac**tical **Fire** Direction System) is a tactical, automatic, data processing system with computer centers located at cannon field artillery battalion and division artillery levels. TACFIRE will assist the field artilleryman in many of his tasks with more speed, more accuracy, and with greater effect and economy than is possible with currently used methods. TACFIRE will assume the time-consuming burdens of computation and data handling which are now done manually or with FADAC.

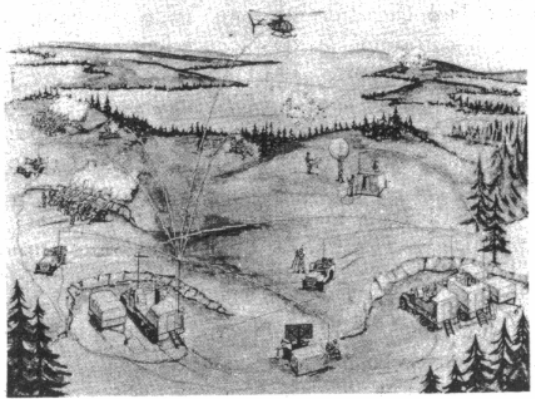
The objective of TACFIRE is to increase the effectiveness of field artillery fire support through improved response, better and more rapid use of artillery target information, improved and faster fire support planning, and greater efficiency in the determination of fire capabilities and allocation of fire units to targets. TACFIRE automates the same field artillery techniques and procedures that have been used in manual systems.

TACFIRE's major programs include an ammunition and fire unit program, which keeps account of the fire unit status and ammunition available to support the other programs.

The preliminary target analysis program considers available Army, Navy, and Air Force fire support and provides data to assist the fire support element in determining the best means to defeat a target. The nuclear target analysis, chemical target analysis, and fallout prediction programs provide fire units, nuclear munitions, contingent effects, and other data to defeat targets using nuclear or chemical means. The non-nuclear fire planning program provides for the selection of targets for an integrated fire plan. It assigns fire units, number of rounds, types of ammunition and fuzes, and the specific time each target is to be attacked. Planning incorporates limitations imposed by boundaries, no-fire lines, fire coordination areas, air corridors, and amount of ammunition available. As an example, the Div Arty computer can produce a non-nuclear fire plan for the attack of 150 targets by 30 fire units in fifteen minutes, compared to several hours required with manual methods.

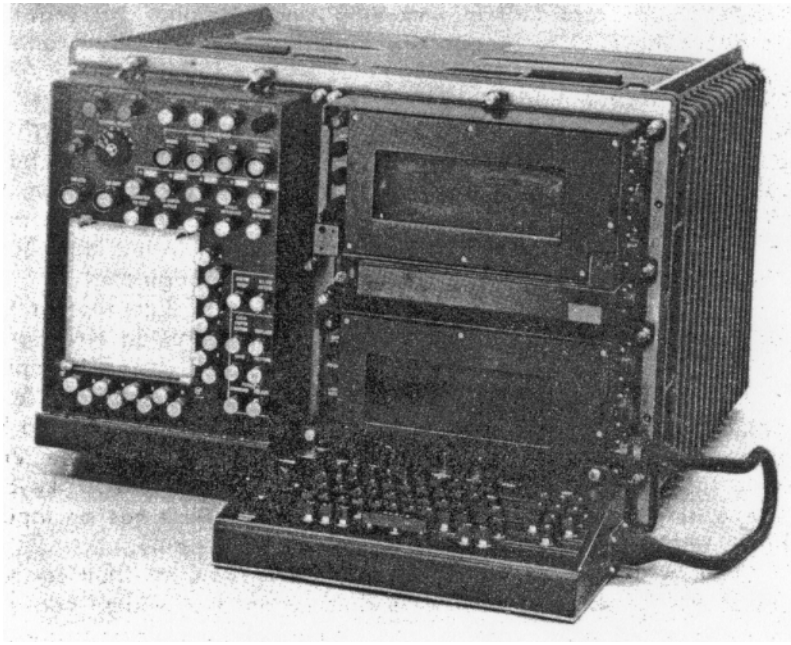
The target intelligence program at Div Arty provides assistance to the S2 in all phases of the intelligence cycle. The tactical and technical programs accept fire mission requests and produce fire commands appropriate to the specified target. Survey and meteorological programs are also part of the TACFIRE system.

To illustrate the operation of TACFIRE at the battalion level, assume a forward observer has just transmitted a request for fire to the battalion FDC. The observer used a fixed format message entry device (FFMED), connected to his organic radio or telephone, to send the messages in coded digital form. At the battalion FDC, the request is authenticated, expanded, and entered directly into the computer. The artillery control console (ACC) presents a visual display of firing data generated by the AN/GYK-12 computer. Also located in the battalion FDC is the digital plotter map (DPM) for large scale display of the tactical situation, and an electronic line printer (ELP) which

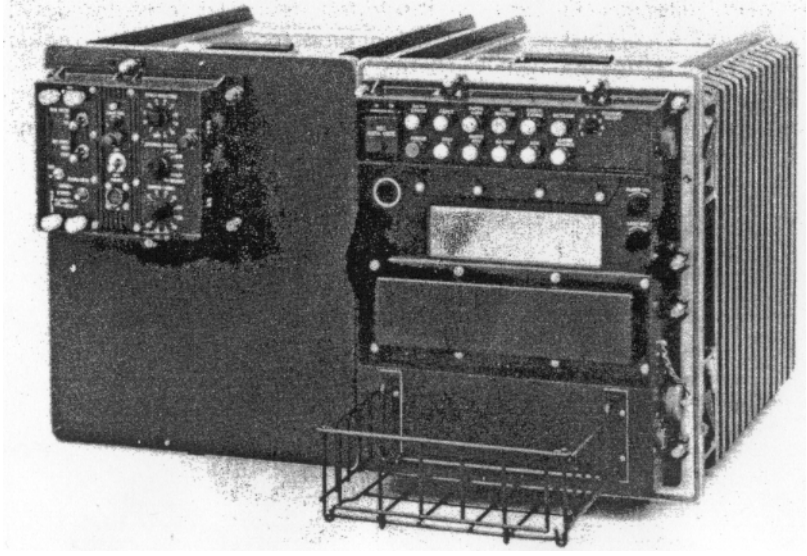


TACFIRE In A Tactical Situation

FIRE DIRECTION



Artillery Control Console (ACC)



Battery Display Unit (BDU)

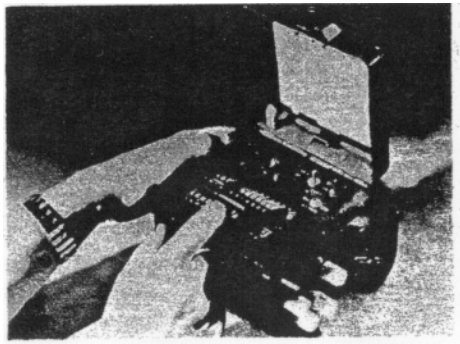
gives a hard copy record of all incoming and outgoing messages. These devices allow the FDO to monitor the situation and retain full control of the FDC operations.

Once the fire commands produced by the computer have been reviewed by the FDO, the ACC operator sends them directly to the firing batteries, where they are printed on the battery display unit (BDU). The battery executive officer then announces the fire commands to the guns from the hard copy furnished him by the BDU. The speed of computer decisions and calculations results in printed fire commands at the battery in less than 10 seconds from the time the observer's original call for fire is originated.

TACFIRE equipment at division artillery is identical to that at battalion, with an additional memory drum, a second printer, and an electronic tactical display (ETD). The ETD gives the S2 and S3 a rapidly updated graphical display of the tactical situation. A variable format message entry device (VFMED) provides two-way communication between the division, brigade, and battalion fire support elements, and to the missile battalion FDC's. The VFMED is similar to the BDU but includes a display/edit scope and a keyboard to facilitate editing and composing messages. The VFMED has an input/output capability, unlike the BDU which is an output device only.

TACFIRE is unique in that maintenance programs for fault correction are resident in the system. The system is checked on a scheduled non-interfering basis by a maintenance program to determine if all components are operable. If a fault is detected, comprehensive programs perform detailed analysis of the faulty component and indicate possible defective circuit cards. To isolate a defective card, a module test set (MTS) is connected to the failed unit. A hand held tester checks cards in the failed item and indicates a GO/NO-GO condition on each card. The projected time for location and replacement of a failed card is approximately 10 minutes.

TACFIRE is scheduled to undergo service engineer testing in the near future, and will be fielded throughout the Army's field artillery units during the mid-1970's.



Fixed Format Message Entry Device (FFMED)

TABLE 1A. CANNON

Weapon	M101A1 105-mm how (towed)	M102 105-mm how (towed)	M108 105-mm how (SP)
Maximum range (meters)	11,000	11,500	11,500
Traveling weight (pounds)	4,980	3,140	46,921
Air transportability	*	*	***
Traverse limits (mils)	409 right and 400 left of center	6,400	6,400
Elevation limits (mils)	-89 to +1156	-89 to +1333	-106 to +1333
Sustained rate of fire (rd per min)	3	3	3
Water crossing capability	Shallow water	Shallow water	Amphibious (with kit)
Time to emplace (minutes) (†)	3	4	1
Prime mover	2 1/2-ton truck; helicopter; 3/4-ton truck (abn div) CH-47 A/B	3/4-ton truck; helicopter; CH-47 A/B	SP
Using TOE	6-155G 6-185G 6-405G 6-705T	6-215G 6-705T	6-345G 6-385G 6-465G
Reference manuals	FM 6-75 TM 9-3007 TM 9-1015-203-12 FT 105-H-7 FT 105 ADD-B-2, C 1 FT 105 ADD-A-0 (REV), (M413) †† FT 105-H-6 Prov Supp 1 (XM629, CS) †† FT 105-AV-0 (REV 1), (M548 RAP)	FM 6-70 TM 9-1015-234-12 FT 105-AS-2, C 3, 5 FT 105 ADD-F-1, C 1 FT 105-AU-0 (REV 1), (M548 RAP) FT 105-AS-2 Prov Supp 1 (XM629, CS)	FM 6-79 TM 9-2350-217-10 FT 105-AS-2 FT 105 ADD-F-1, C1 FT 105-AU-0 (REV 1), (M548 RAP) FT 105-AS-2 Prov Supp 1 (XM629, CS)

† Time to emplace is that time required to emplace and lay single registering piece.

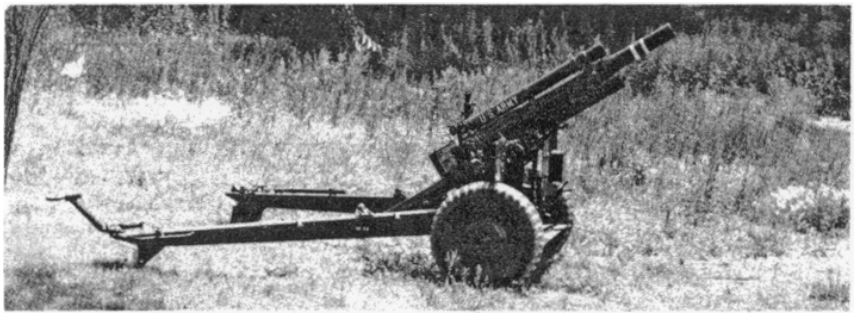
†† Not an AGO publication. To obtain TFT's write to:

Commanding Officer
Ballistic Research Laboratory
ATTN: AMXBR-CE
Aberdeen Proving Ground
Aberdeen, Maryland

*Capable of airdrop and assault landing.

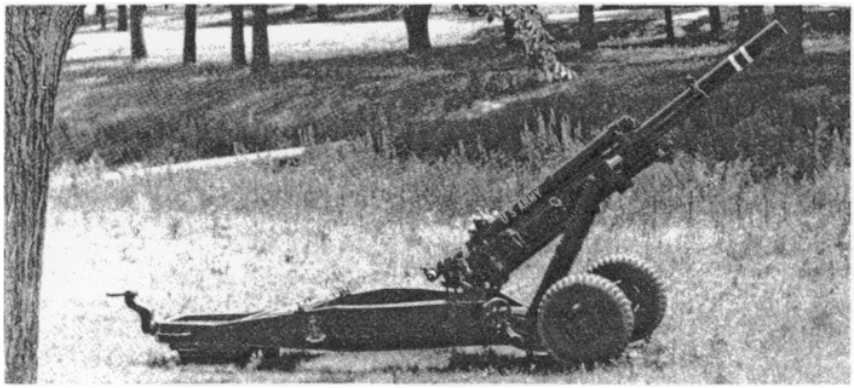
***Capable of transport in heavy transport aircraft.

WEAPONS



105-mm How M101A1

105-mm How M108



105-mm How M102

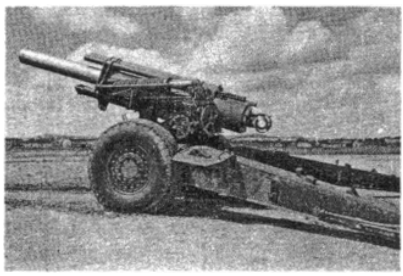
TABLE 1A. CANNON (Cont)

Weapon	M114A1 155-mm how (towed)	M109 155-mm how (SP)	M109A1 155-mm how (SP)	M115 8-inch how (towed)
Maximum range (meters)	14,600	14,600	NA	16,800
Traveling weight (pounds)	12,950	52,461	52,980	29,700
Air transportability	*	***	***	***
Traverse limits (mils)	448 right and 418 left of center	6,400	6,400	533 right and left of center
Elevation limits (mils)	0 to +1156	-53 to +1333	-53 to +1333	-36 to +1156
Sustained rate of fire (rd per min)	1	1	1	0.5
Water crossing capability	Fordable (30 inches)	Amphibious (with kit)	Amphibious (with kit)	Fordable (60 inches)
Time to emplace (minutes) (†)	5	1	1	20
Prime mover	5-ton truck CH-47B CH-47A	SP	SP	10-ton truck
Using TOE	6-165G 6-425G	6-37G 6-355G 6-365G 6-455G 6-375G	6-37G 6-355G 6-365G 6-455G 6-375G	6-415G
Reference manuals	FM 6-81 TM 9-1025-200-12 FT 155-Q-4, C 2 FT 155-AI-2 FT 155 ADD-F-1, C 1	FM 6-88 TM 9-2350-217-10 FT 155-AH-2, C 1, 2, 4 FT 155-AJ-2 FT 155 ADD-E-1, C 1	†† FT 155-AM-1 ††† FT 155-AJ-2, C 1	FM 6-90 TM 9-3004 FT 8-J-4 FT 8-O-4, C 1 FT 8 ADD-A, C 1

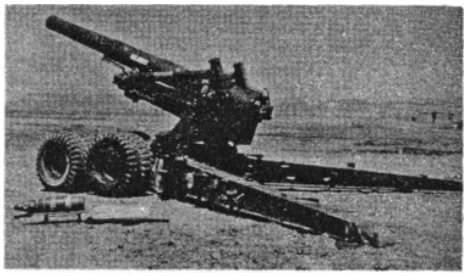
† Time to emplace is that time required to emplace and lay single registering piece.
†† To be published in fourth quarter of FY 72.
††† To be published in third quarter of FY 73.
*Capable of airdrop and assault landing.
***Capable of transport in heavy transport aircraft.

WEAPONS

155-mm How M109A1



155-mm How M114A1



8-in How M115

155-mm How M109

TABLE 1A. CANNON (Cont)

Weapon	M110 8-in how (SP)	M107 175-mm gun (SP)
Maximum range (meters)	16,800	32,700
Traveling weight (pounds)	58,500	62,100
Air transportability	***	***
Traverse limits (mils)	533 right and left of center	533 right and left of center
Elevation limits (mils)	+35 to +1156	+35 to +1156
Sustained rate of fire (rd per min)	0.5	0.5
Water crossing capability	Fordable (42 inches)	Fordable (42 inches)
Time to emplace (minutes) (†)	2	3
Prime mover	SP	SP
Using TOE	6-355G 6-445G 6-165G	6-435G
Reference manuals	FM 6-94 TM 9-2300-216-10 FT 8-J-4 FT 8-O-4, C 1 FT 8 ADD-A-1, C 1	FM 6-94 TM 9-2300-216-10 FT 175-A-1, C 1

Time to emplace is that time required to emplace and lay single registering piece.

***Capable of transport in heavy transport aircraft.

WEAPONS

TABLE 1B. ROCKETS AND MISSILES

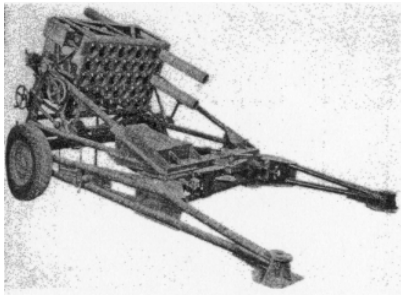
Weapon	XM200 armament, helicopter (2.75 in rkt)	M91* 115-mm multiple rkt launcher
Maximum range (meters)	3,000	10,600
Traveling weight (pounds)	NA	1,200
Air transportability	*	*
Traverse limits (mils)	6,400	178 right and left of center
Elevation limits (mils)	NA	+14 to +1067
Sustained rate of fire (rd per min)	6 second ripple of 76 rds	15 second ripple of 45 rds
Water crossing capability	NA	Fordable (30 inches)
Time to emplace (minutes) ( )	NA	30 (includes loading 45 rds)
Prime mover	AH-1G helicopter	2 1/2-ton truck
Using TOE	6-725H	DS bn TOE, all div artys, and sep bde artys except abn
Reference manuals	TM 9-1340-201	FM 6-54 TM 9-1055-215-12 FTR 115-C-1

† Time to emplace is that time required to emplace and lay single registering piece.

*Capable of airdrop and assault landing.

***Capable of transport in heavy transport aircraft.

2.75-in Rocket System on AH-1G Cobra



155-mm Multiple Rocket Launcher M91

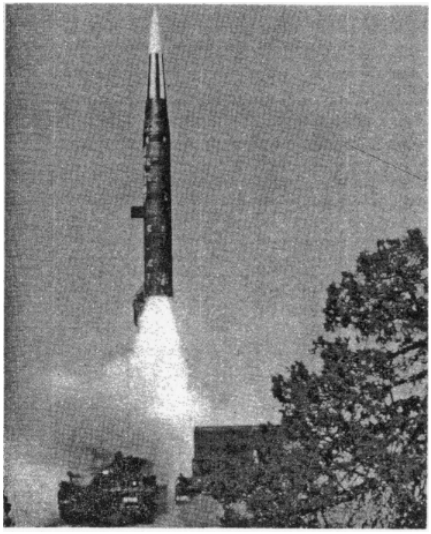
8-in How M110

175-mm Gun M107

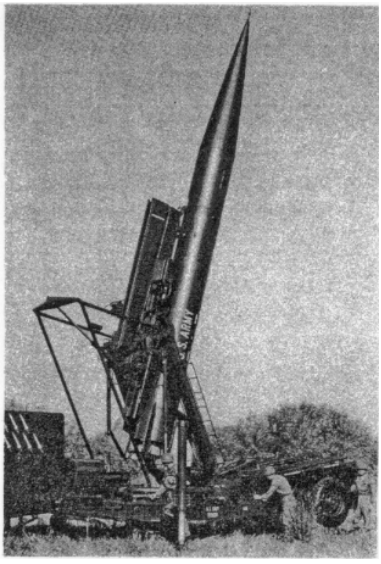
TABLE 1B. ROCKETS AND MISSILES (Cont)

Weapon	MGR-1B Honest John	XMGM-29A Sergeant	XMGM-31A Pershing 1A	XMGM-52 Lance
Min and Max range (approx)	5000 m to 38,000 m (max rg)	46 km to 140 km	185 km to 740 km	Max rg greater than that of HJ
Water fording capability (inches)	30 (wo kit) 60 (w kit)	30	31	Amphibious
Guidance	Free flight	Inertial	Inertial	Modified inertial
Propulsion	Solid propellant	Solid propellant	Solid propellant	Storable prepackaged liquids
Mobility	**	**	**	*
Prime mover	M139 5-ton truck chassis M386	5-ton tractor M52	M757 wheeled vehicle	XM667E1 SP launcher
Field of fire (mils)	267 right and left of center	3111 right and left of center	1532 right and left of center	400 right and left of center
Launch elevation (mils)	+72 to +1244	+1333	+1600	48°, 54°
Length of rkt or msl (meters)	7.58	10.52	10.39	6.17
Diameter (millimeters)	762	787	1016	559
Rkt or msl weight (pounds)	4,719	10,000	10,275	2,900
Using TOE	6-175G 6-525G	6-555G	6-615G	6-595T
Reference manuals	TM 9-1055-205-10 FM 6-59 FTR 762-G-1 FTR 762-H-1 FTR 762 ADD-C-1 FTR 762 ADD-D-1 FTR 762 ADD-E-1	TM 9-1410-302-20 TM 9-1440-301-12 TM 9-4935-303-12	TM 9-1425-380-10	TM 9-1400-485-34 TM 9-1425-485-10-2 TM 9-1425-485-34 TM 9-1450-485-10 TM 9-1450-485-34 TM 9-4935-485-14

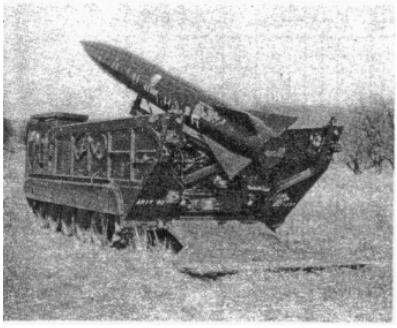
*Capable of airdrop or assault landing.
**Capable of transport in light and medium transport aircraft.



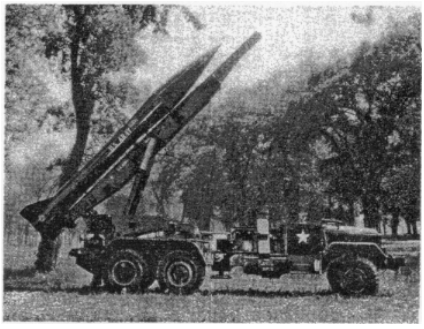
Pershing Missile



Sergeant Missile



Lance Missile



Honest John

TABLE II. AMMUNITION

WEAPON	DESIGNATION	TYPE	FILLER COMPOSITION	WEIGHT OF PROJECTILE AS FIRED (POUNDS)*	WEIGHT OF COMPLETE RD (MAX CHARGE)** (POUNDS)	HOW SHIPPED	FUZES				REFERENCES	REMARKS
							IMPACT	MECH TIME	MECH TIME SUPERQUICK	PROXIMITY (VT)		
115-mm rocket launcher	M55	Chemical rkt		58.00	58.00	Complete	M417					
	M91	Chemical rkt		74.00	74.00	Complete	M417					
105-mm howitzer M102 M101A1 M108	Cartridge, M 1 ***	HE	Comp B	33.0	42.0	Fuzed	M557 M78A1		M564 (Series)	M513 (Series)	TM 9-1300-203 TM 9-1015-203-12 TM 9-7204 TM 9-2350-217-10 FT 105-H-7 FT 105-AS-1 FT 105-ADD-B-1 FT 105-ADD-D-0 (REV II) FT 105-ADD-E-0 (REV II)	Ammunition issued for training may be issued fuzed or unfuzed. When issued, fuzed (HE) will be issued with impact fuze. M548 is normally fired at Chg 7 only, Rocket On or Rocket Off. Chgs 3-6, Rocket Off may be fired in combat emergencies only.
	Cartridge, M 444 ICM	HE	18 M39 Grenades	33.0	42.0	Fuzed		M565 modified				
	Cartridge M 548	HE-RA	Comp B	28.5	37.0	Fuzed	M557		M564 (Series)	M513 (Series)		
	Cartridge, M 314 (Series)	Illum	Illum	34.9	43.9	Fuzed		M565 (New)	M501 (Old)			
	Cartridge, M 60	Gas	H or HD	33.0	42.0	Fuzed	M557		M564			
	Cartridge, M 360	Gas	GB	34.8	43.8	Fuzed	M508					
	Cartridge, M 84 (Series)	Smoke, HC and colored BE	HC	32.9	41.9	Fuzed	M48 (Series)		M501 (Series)			
			Red	30.7	39.7							
			Yellow	30.3	39.3							
			Green	30.5	39.1							
			Violet	30.5	39.1							
	Cartridge, M 60	Smoke	WP	32.9	41.9	Fuzed	M57(Old) M557(New)		M564			
	Cartridge, M 67	HEAT HEAT-T	Comp B	29.3	37.1	Fuzed	M62 (Series) M91 (Series)					Rounds are designated HEAT-T or HEP-T when assembled with fuze M91 or

TABLE II. AMMUNITION (Cont)

WEAPON	DESIGNATION	TYPE	FILLER COMPOSITION	WEIGHT OF PROJECTILE AS FIRED (POUNDS)*	WEIGHT OF COMPLETE RD (MAX CHARGE)** (POUNDS)	HOW SHIPPED	FUZES				REFERENCES	REMARKS (cont)
							IMPACT	MECH TIME	MECH TIME SUPERQUICK	PROXIMITY (VT)		
105-mm howitzer M102 M101A1 M108	Cartridge, M 327	HEP HEP-T	Comp A3	23.4	33.4	Fuzed	M62 (Series) M91 (Series)					M91A1. Designated HEAT or HEP when assembled with fuze M72A1. Fuze comes set for muzzle action and can be set for mechanical time action.
	Cartridge, XM 546	Anti-personnel	8,000 Flechettes	28.5	38.2	Fuzed		XM563 (Series) MAMT				
† 155-mm howitzer M114A1 † M109	Projectile, M107***	HE	TNT	95.0	108.5	Unfuzed	M557		M564	M514 (Series)	TM 9-1300-203 TM 9-331B TM 9-7004 TM 9-2350-217-10 TM 9-1025-200-12 FT 155-Q-4 FT 155-AH-2 FT 155-A1 FT 155-AJ-1 FT 155-ADD-A-1	† Also authorized for use with 155-mm gun using normal charge only. M549 may not be fired at Chg 4 M3 (Series) and M4 (Series).
†	Projectile, M 449 ICM	HE	60 M43 Grenades	95.0	108.5	Unfuzed		M565				
	Projectile, M 549	HE-RA	Comp B	95.8	109.3	Unfuzed	M557			M514 (Series)		
†	Projectile, M 110	GAS	H or HD	95.0	108.5	Unfuzed	M557		M564			
	Projectile, M 121A1	GAS	GB or VX	97.2	110.7	Unfuzed	M508			M514 (Series)		
†	Projectile, M 110	Smoke	WP	96.1	109.6	Unfuzed	M557		M564			
†	Projectile, M 116 (Series)	Smoke, HC, and colored BE	HC	95.0	108.5	Unfuzed	M48 (Series)		M501 (Series)			
			Red	86.4	99.9							
			Yellow	86.4	99.9							
			Green	86.4	99.9							
			Violet	86.4	99.9							

TABLE II. AMMUNITION (Cont)

WEAPON	DESIGNATION	TYPE	FILLER COMPOSITION	WEIGHT OF PROJECTILE AS FIRED (POUNDS)*	WEIGHT OF COMPLETE RD (MAX CHARGE)** (POUNDS)	HOW SHIPPED	FUZES				REFERENCES	REMARKS
							IMPACT	MECH TIME	MECH TIME SUPERQUICK	PROXIMITY		
†	Projectile, M 485 (Series)	Illum	Illum	90.0	103.5	Unfuzed		M565 (Series)				
†	Projectile, M 118 (Series)	Illum	Illum	100.0	113.5	Unfuzed			M501 (Series)			
	Projectile, XM 454	Atomic		120.4	136.7	Unfuzed		XM32E1		T361E2		
175-mm gun M107	Projectile, M 437A1 (3)	HE	TNT	147.8	202.8	Unfuzed	M572			M514 †† (Series)	TM 9-1300-203 TM 9-2300-216-10 FT 175-A-0 (REV II)	†† Designated selected lots to be used for Chg 3 firings.
	Projectile, M 437A2 (3)	HE	Comp B	147.8	202.8	Unfuzed	M572			M514 †† (Series)		
8-in howitzer M110	Projectile, M 106 (3)	HE	TNT	200.0	228.3	Unfuzed	M557		M564	M514 (Series)	TM 9-1300-203 TM 9-3004	
	Projectile, M 404 ICM	HE	104 M43 Grenades	200.0	228.3	Unfuzed		M565			TM 9-2300-250-12	
	Projectile, M 424	HE Spotting	Tritonal	242.0	272.0	Unfuzed		M543			TM 9-2300-216-10	
	Projectile, M 422	Atomic		242.0	272.0	Unfuzed		M542			TM 9-5-1320 FT 8-J-4	
	Projectile, M 426	Gas	Gas GB or VX	200.0	228.3	Unfuzed	M508			M514 (Series)	FT 8-O-4 FT 8-ADD-A-1	

TABLE II. AMMUNITION (Cont)

WEAPON	DESIGNATION	TYPE	FILLER COMPOSITION	WEIGHT OF PROJECTILE AS FIRED (POUNDS)*	WEIGHT OF COMPLETE RD (MAX CHARGE)** (POUNDS)	HOW SHIPPED	FUZES				REFERENCES	REMARKS
							IMPACT	MECH TIME	MECH TIME SUPERQUICK	PROXIMITY (VT)		
2.75-inch rocket	M151	HE	Comp B	8.7	20.6	Unfuzed	M423		XM433	M429		
	WDV4A/A	Flechette		9.3	20.2	Fuzed						
	XM 243	Practice		17	28	Fuzed	Inert					
	M 229	HE	Comp B	17	28	Unfuzed	M423		XM433	M429		
	M156	Smoke	WP	10	21		M427 M423			M429		
	MK 5	Antitank		6.6	18	Unfuzed	MK 181					
	M 230	Practice		8.7	20.6	Fuzed	Inert					
	WTV-1/B	Practice		8.7	20.6	Fuzed	Inert					

NOTES:

*Weight of projectile as fired includes the weight of the fuze. Most weights were taken from the appropriate tabular firing tables and reflect standard weights. See each TFT for any changes.

**Field Artillery rounds of ammunition must be ordered by their Federal Stock Numbers. A complete FSN for each component of a complete round (primers, propellants, projectiles, and fuzes) can be found in Department of the Army Supply Catalogs SC 1305/30-IL and SC 1340/98-IL.

***HE rounds may be normal or deep cavity. In order to use the M513/M514 series of VT fuzes, the deep cavity projectiles must be used and the supplementary charge removed.

TRANSPORTATION

TRANSPORTABILITY

Field Artillery weapons are classified according to methods of transportation which can be used to deliver the weapon to a combat area. All artillery weapons can be transported by air, rail, road, or ship. Classification according to methods of aerial transportation are as follows:

- Helicopter transportable—Weapons which can be transported by helicopter and landed in sufficient assembly to permit immediate employment.
- Air transportable; see paragraph 6, AR 70-39.

  Parachute and assault landing. Forces normally moved in this phase are assault elements of the airborne division and the units which support them initially. These forces must be capable of being air transported into territory not held by friendly forces and delivered by parachute or assault landing. The assault landing aircraft must be capable of landing on unprepared surfaces. All combat and support materiel must be capable of immediate effective employment except for selected construction equipment which, if it cannot meet this requirement, should be capable of employment within 1 hour after delivery. Current Air Force assault type aircraft are the C-7, C-123, and C-130.

  Initial air-landing. Forces normally moved in this phase are the follow-up elements of the units participating in the parachute or assault landing; the initial elements of the infantry division; and the units normally committed in support of them (less those equipment items in excess of the capabilities of assault, light and medium transport-type aircraft). These forces must be air portable in aircraft capable of landing on minimum criteria airlanding facilities held by friendly forces. All materiel should be capable of effective employment within 1 hour after delivery except selected airfield construction equipment which must be available for employment within 2 hours. Materiel to be moved in this phase must be capable of being loaded and transported in light and medium transport or assault-type aircraft.

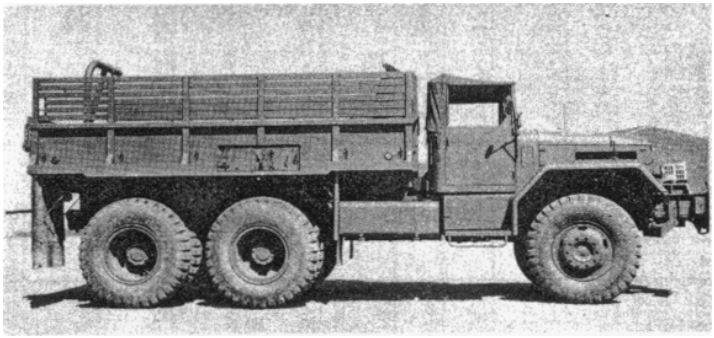
  Heavy air-landing. Forces normally moved in this phase are follow-up elements of the units participating in the two phases listed above; and additional combat and combat support forces and equipment required to insure success of the operation (less those items of equipment in excess of the capabilities of the heavy-transport-type aircraft). These forces must be air portable in aircraft capable of landing at facilities held by friendly forces. It is desirable that all combat materiel to be moved in this phase be capable of being loaded and transported in heavy-transport-type aircraft.

TABLE III A. WHEELED VEHICLES

Vehicle	Purpose	Curb weight (lbs) †	Payload (hiway) (lbs)	Payload (cross-country) (lbs)	Max allow. speed (mph)	Cruising range (miles)	Fuel capac. (gals)	Fording Depth (inches) with kit	Fording Depth (inches) without kit	Air Transportability	Ref tech manual
1/4-ton M718	Ambulance	2,780	2 litter and 2 seated or 3 litter patients		65	300	17 Gasoline	60	21	*	TM 9-2320-218
3/4-ton M43B1	Ambulance	7,150	4 litters or 6 seated patients		55	225	24 Gasoline	84	42	*	TM 9-8030
1 1/4-ton M792	Ambulance	7,300	3 litters & attendant or 2 litters and 3 seated patients		55	384	40 Diesel	Swim Capability		*	TM 9-2320-242
3/4-ton M37B1	Cargo	5,917	2,000	1,500	55	225	24 Gasoline	84	42	*	TM 9-8030
1 1/4-ton M561	Cargo	7,300	2,900	2,900	55	384	40 Diesel	Swim Capability		*	TM 9-2320-242
2 1/2-ton M35A2	Cargo	13,530	10,000	5,000	58	500	50 Multi-Fuel	72	30	*	TM 9-2320-209
2 1/2-ton M35A2C	Cargo	13,530	10,000	5,000	58	500	50 Multi-Fuel	72	30	*	TM 9-2320-209
2 1/2-ton M36A2	Cargo	13,915	10,000	5,000	58	500	50 Multi-Fuel	72	30	*	TM 9-2320-209
5-ton M54A2C	Cargo	19,480	20,000	10,000	52	Approx 390	78 Multi-Fuel	78	30	*	TM 9-2320-211
5-ton M54A2	Cargo	19,480	20,000	10,000	52	Approx 390	78 Multi-Fuel	78	30	*	TM 9-2320-211
5-ton M55A2	Cargo	20,000	20,000	10,000	52	Approx 390	78 Multi-Fuel	78	30	*	TM 9-2320-211

†Fully equipped less payload and crew.
*Capable of airdrop and assault landing.

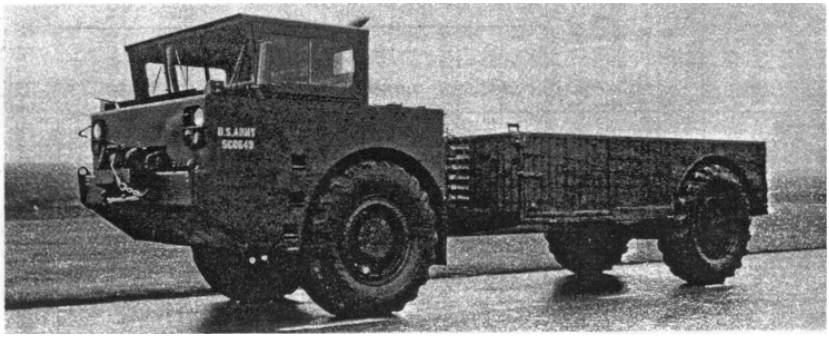
TRANSPORTATION



10-ton, M125

¾-ton, M37B1

1¼-ton, M561



8-ton, M520

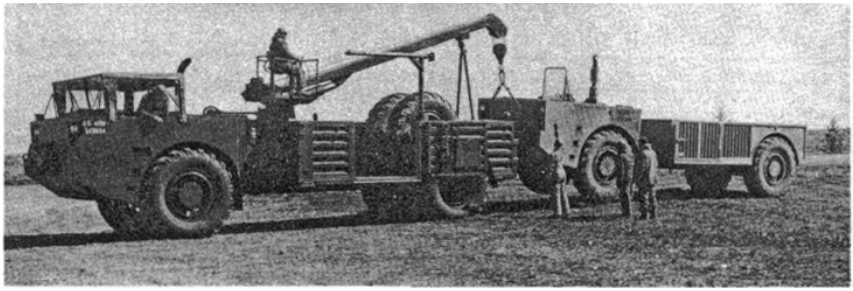
TABLE III A. WHEELED VEHICLES (Cont)

Vehicle	Purpose	Curb Weight (lbs) †	Payload (hiway) (lbs)	Payload (cross-country) (lbs)	Max allow. speed (mph)	Cruising range (miles)	Fuel capac. (gals)	Fording depth (inches) with kit	Fording depth (inches) without kit	Air Trans-portability	Ref tech manual
5-ton M656	Cargo	15,330	10,000	10,000	50	300	80 Multi-Fuel	Swim Capability		*	TM 9-2320-230
8-ton M520	Cargo	23,950	16,000	16,000	30	400	106 Diesel	Swim Capability		NA	UNK
10-ton M125	Cargo	33,789	30,000	20,000	42	300	166 Gasoline	78	30	***	TM 9-2320-206
1/2-ton M274A2	Pltfm Util	900	1,000	1,000	25	151.3 @5 mph	8 Gasoline	NA	18	*	TM 9-2320-213
2 1/2-ton M49A2C	Fuel Tanker	16,107	7,850	5,000	58	500	50 Multi-Fuel	72	40	*	TM 9-2320-209
8-ton M559	Fuel Tanker	30,180	17,155	17,155	30	400	106 Diesel	Swim Capability		*	UNK
2 1/2-ton M50A3	Water Tanker	15,255	8,300	5,000	58	500	50 Multi-Fuel	72	40	*	TM 9-2320-209
2 1/2-ton M275A2	Truck Tractor	12,534	12,000	7,000	58	500	50 Multi-Fuel	NA	30	*	TM 9-2320-209
5-ton M52A2	Truck Tractor	19,063	55,000 ††	15,000 ††	52	Approx 500	110 Multi-Fuel	NA	30	***	TM 9-2320-211
10-ton M123A1C	Truck Tractor	30,230	120,000 ††	80,000 ††	42	300	166 Diesel	NA	30	***	TM 9-2320-206
5-ton M246A2	Truck Tractor Wrecker	31,186	46,000	12,000	52	Approx 390	78 Multi-Fuel	NA	30	***	TM 9-2320-211

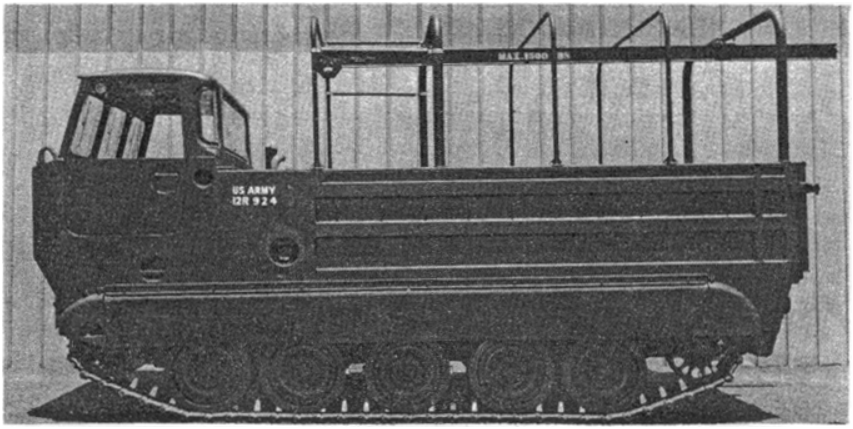
† Fully equipped less payload and crew.
†† Towed load.
*Capable of airdrop and assault landing.
***Capable of transport in heavy transport aircraft.

TRANSPORTATION

5-ton, M656



10-ton, M553



Cargo Carrier, M548

TABLE III A. WHEELED VEHICLES (Cont)

Vehicle	Purpose	Curb weight (lbs) †	Payload (hiway) (lbs)	Payload (cross-country) (lbs)	Max allow. speed (mph)	Cruising range (miles)	Fuel capac. (gals)	Fording depth (inches) with kit	Fording depth (inches) without kit	Air Transportability	Ref tech manual
1/4-ton M151A1	Utility	2,400	1,200	800	65	300	17 Gasoline	60	21	*	TM 9-2320-218
5-ton M291A2	Van Expansible	26,270	15,000	5,000	52	390 Approx	78 Multi-Fuel	78	30	***	TM 9-2320-211
2 1/2-ton M109A3	Shop Van	16,296	7,500	5,000	58	500	50 Multi-Fuel	72	30	***	TM 9-2320-209
5-ton M543A2	Wrecker	34,440	NA	NA	52	Approx 500	133 Multi-Fuel	78	30	***	TM 9-2320-211
10-ton M553	Wrecker	39,150	NA	NA	30	400	106 Diesel	Swim Capability		***	TBP

TABLE III B. RECOVERY VEHICLES

M88	Recovery	106,000	50,000 ††	81,000 †††	31	222	452 Gasoline	102	64	***	TM 9-2320-222
M578	Recovery	54,000	30,000 ††	60,000 †††	37	450	320 Diesel	NA	42	***	TM 9-2320-238

TABLE III C. Armored Personnel, Cargo, and Command/Recon Carriers

M116	Cargo	7,880	NA	3,000	37	200-300	65 Gasoline	Swim Capability	*	TM 9-2320-223
M548	Cargo	15,040	NA	2,000	38	300	105 Diesel	Swim Capability	***	TM 9-2350-247

†Fully equipped less payload and crew.
††Boom capacity.
†††Towed load.
*Capable of airdrop and assault landing.
***Capable of transport in heavy transport aircraft.

TABLE III C. Armored Personnel, Cargo, and Command/Recon Carriers (Cont)

Vehicle	Purpose	Curb weight (lbs) †	Payload (hiway) (lbs)	Payload (cross-country) (lbs)	Max allow. speed (mph)	Cruising range (miles)	Fuel capac. (gals)	Fording depth (inches) with kit	Fording depth (inches) without kit	Air Transportability	Ref tech manual
M114	Command & Recon	12, 900	NA	1, 849	36	300	110 Gasoline	Swim Capability		*	TM 9-2320-224
M577A1	Command Post	23, 060	NA	1, 200	40	300	120 Diesel	Swim Capability		***	TM 9-2300-257
M113A1	Personnel	21, 027	NA	3, 211	40	300	95 Diesel	Swim Capability		*	TM 9-2300-257

TABLE III D. SELF-PROPELLED WEAPONS

M108	105-mm How	46, 921 ††	NA	NA	35	220	135 Diesel	Swim Capability		***	TM 9-2350-217
M109	155-mm How	52, 461 ††	NA	NA	35	220	135 Diesel	Swim Capability		***	TM 9-2350-217-10
M109A1	155-mm How	52, 461 ††	NA	NA	35	220	135 Diesel	Swim Capability		***	TM 9-2350-217
M110	8-in How	58, 500 ††	NA	NA	34	450	320 Diesel	NA	42	***	TM 9-2300-216
M107	175-mm Gun	62, 100 ††	NA	NA	34	450	320 Diesel	NA	42	***	TM 9-2300-216

† Fully equipped less payload and crew.
†† Weight of self-propelled weapons is with full combat load.
*Capable of airdrop and assault landing.
***Capable of transport in heavy transport aircraft.

TABLE III E. Vehicles Peculiar to Rocket and Missile Units

Vehicle	Purpose	Curb weight (lbs)	Pay-load (lbs)	Max allow. speed (mph)	Cruise range (miles)	Fuel capacity (gals)	Fording depth (inches) with kit	Fording depth (inches) without kit	Air trans-portability
M289, 5-ton Chassis M139D	Launcher HJ rkt M289	41, 800	5, 913	59	220	70 gas	60	30	***
M386, 5-ton Chassis M139	Launcher HJ rkt M386	34, 250	5, 913	59	224	70 gas	60	30	***
M46, 5-ton Chassis M55	Heating & tie-down unit, HJ rkt	24, 264	20, 000	52. 6	214	78 gas	78	30	**
Launching Sta XM504	Launcher, Sergeant	17, 205	NA	52	NA	NA	NA	30	**
OMTS or FMTS	Test sta, Sergeant	15, 000	NA	58	NA	NA	NA	30	**
Motor Guidance Transport Trailer	Missile section transporter, Sergeant	4, 900	11, 000	58	NA	NA	NA	30	**
XM667E1	Basic vehicle, SP launcher, LT, Lance	13, 500	10, 500	40	280	85 diesel	Swim Capability with kit		*
M656	Truck, cargo carrier-- Pershing	15, 330	10, 000	50	300	80 multi-fuel	NA	40	*
M757	Truck, tractor transporter-- Pershing	NA	32, 000	50	NA	160 multi-fuel	NA	40	
M791	Expansible van btry control	NA	NA	50	NA	80 multi-fuel	NA	40	

† Fully equipped less payload and crew.
*Capable of airdrop and assault landing.
**Capable of transport in light and medium transport aircraft.
***Capable of transport in heavy transport aircraft.

TABLE III F ROTARY WING

Aircraft	AH-1G Huey Cobra	CH-47C Chinook	CH-47A Chinook	CH-47B Chinook	CH-54A Tarhe	OH-58A Kiowa	OH-6A Cayuse	OH-13S Sioux	OH-23G Raven	UH-1B/C Iroquois	UH-1D/H Iroquois
Purpose	Escort, scout, and aerial artillery	Cargo and personnel transport	Cargo and personnel transport	Cargo and personnel transport	Skycrane heavy lift	Command and control, observation, visual and armed reconnaissance, target acquisition, and utility.	Command control, utility target acquisition, observation, reconnaissance, radiological survey, and wire laying			Utility tactical, weapons aircraft, transport cargo and personnel	
Crew	2	3	3	3	4	1	1	1	1	2	2
Average aircraft operating weight (basic aircraft weight plus oil, trapped fuel, crew and baggage)[1]	Will depend upon configuration	22, 615	19, 964	20, 964	19, 300	2, 060	1, 080	1, 715	2, 024	4, 724	4, 954
Maximum internal fuel capacity (gal/lb)	250/1, 625	1, 131/7, 351	621/4, 036	892/4, 036	1, 342/5, 798	73/455	58/382	57/342	46/276	165/1, 072	220/1, 430
Payload with full fuel (lb)[2]	640	18, 000	9, 000	15, 000	15, 400	865	930	400	400	2, 704	3, 116
Maximum allowable gross weight (lb)[3]	9, 500	44, 800	33, 000	40, 000	42, 000	3, 000	2, 700	2, 450	2, 700	8, 500	9, 500
Maximum recommended external load (lb)	550 pounds per each of four external wings	20, 000	16, 000	16, 000	20, 760	NA	NA	NA	NA	4, 000	4, 000
Normal cruise speed (knots)[4]	130	120	110	120	100 w pod	100	118	70	70	90	100
Endurance at cruise speed not including 30-minute reserve (hr/min)[5]	2/45	3/00	2/40	2/00	2/30	3/15	2/25	2/45	2/30	2/30	3/00

TABLE III F. ROTARY WING (Cont)

Aircraft	AH-1G Huey Cobra	CH-47C Chinook	CH-47A Chinook	CH-47B Chinook	CH-54A Tarhe	OH-58A Kiowa	OH-6A Cayuse	OH-13S Sioux	OH-23G Raven	UH-1B/C Iroquois	UH-1D/H Iroquois
Maximum cargo space (cu ft)	NA	1,487	1,487	1,487	2,680 (pod)	36	40	NA	NA	140	220
Cargo compartment usable length (in)	NA	366	366	366		36	46	NA	NA	60	92
Cargo compartment height (clear of obstruction) (in)	NA	78	78	78		36	48.5	NA	NA	56	52
Cargo compartment floor width (in)	NA	90	90	90		48	50.5	NA	NA	80.5	96
Cargo dimensions width plus height (in)	NA	90X78	90X78	90X78		36x42	26.5X40.5 and 34.5X40.5	NA	NA	48X48	92X49
Troop seats	NA	33	33	33	45 passenger pod	3	3	1	2	7	11
Special equipment available	TA102, XM18, XM20, XM28, XM157, XM159	24 litters	24 litters, M24, XM32, XM33, XM34, rescue hoist w 150-foot cable		48 litters, 45 passenger pod, light 11-man pod	XM27E1	M27 minigun M5 grenade launcher, torso tanks, 2 litters	M2 dual machinegun system, 2 litters		M3, M5, M6, XM16, XM21, M22, 3 litters	M23 6 litters

[1]For individual aircraft operating weights, see Form 365F.
[2]Sea level and standard day conditions.
[3]Maximum allowable gross weight is the maximum total weight of the aircraft prior to takeoff; the "basic weight" of the aircraft plus the crew, personnel equipment, special devices, passengers/cargo, and usable fuel and oil. This is limited by structure, power available, or landing load, based on standard day sea level.
[4]Normal cruise speed is the true airspeed which an aircraft can normally be expected to maintain at some standard power setting below rated military power. This speed will vary with altitude.
[5]Endurance at cruising speed is the time that an aircraft can remain airborne at normal cruising speed with fuel aboard without using the required fuel reserve. The data listed under "operational characteristics" is computed utilizing full fuel minus a 30-minute reserve.

TRANSPORTATION

O-1, Bird Dog

OH-6A, Cayuse

CH-47, Chinook

CH-54, Skycrane

TABLE III G. FIXED WING

Aircraft	0-1F, 0-1G Bird Dog	OV-1A Mohawk	OV-1B Mohawk	OV-1C Mohawk	U-1A Otter	U-6A Beaver	U-8F Seminole	U-21A Ute
Purpose	Reconnaissance, observation, trainer, radio relay, radiological survey, wire laying message drop.	Close combat surveillance.	Close combat surveillance.	Close combat surveillance.	Personnel and cargo transport, reconnaissance.	Personnel and cargo transport, reconnaissance photo duties, resupply, medical evacuation, wire laying.	Command liaison transport.	Command liaison transport, aerial photography, electronic warfare.
Crew	1 (plus obsr)	1 (plus obsr)	1 (plus radar op)	1 (plus IR op)	1 (2 for IFC)	1 (2 for IFC)	1 (2 for IFC)	1 (2 for IFC)
Average aircraft operating weight. (Basic aircraft weight plus crew, oil, trapped fuel, and crew baggage)[1]	1, 502 (0-1F) 1, 614 (0-1G)	Will depend upon configuration			4, 900	3, 100	5, 490	
Maximum fuel capacity (gal/lb)	42/252	Int: 297/1, 930 Ext: 300/1, 950	Int: 297/1, 930 Ext: 300/1, 950	Int: 297/1, 930 Ext: 300/1, 950	213. 5/1, 281	138/828	230/1, 380	378/2, 268
Payload with full fuel (lb)[2]	124 (0-1F) 324 (0-1G)	NA	NA	NA	1, 539	972	728	
Maximum allowable gross weight (lb)[2]	2, 100 (0-1F) 2, 165 (0-1G)	12, 500	13, 318	12, 676	8, 000	5, 100	7, 700	7, 700
Normal cruise speed (kt)[3]	87	185	185	185	104	105	160	
Endurance at cruise speed not including 30-minute reserve (hr/min)[4]	4/00	1/25	1/25	1/25	6/30	6/00	6/00	

TABLE III G. FIXED WING (Cont)

Aircraft	0-1F, 0-1G Bird Dog	OV-1A Mohawk	OV-1B Mohawk	OV-1C Mohawk	U-1A Otter	U-6A Beaver	U-8F Seminole	U-21A Ute
Maximum cargo space (cu ft)	NA	NA	NA	NA	293	125	168.8	272
Cargo compartment usable length (in)	NA	NA	NA	NA	156	92	110.5	150
Cargo compartment height (clear of obstruction (in))	NA	NA	NA	NA	52	51	55	57
Cargo compartment floor width (in)	NA	NA	NA	NA	60	48	55	55
Cargo door dimensions width X height (in)	45X33	NA	NA	NA	46X45 (L) 30X42 (R)	40X40	50.5X26.5	53.5X51.5
Troop seats	1 (obsr)	0	0	0	10	5	5	6
Special equipment available	Camera still picture KA-39A	Camera still picture KA-30A	Camera still picture KA-30A, AN/APS-94 SLAR	Camera still picture KA-30A, infrared detector AN/UAS-4	Camera still picture KA-39A, 6 litters	Camera still picture KA-39A, 2 litters	NA	NA

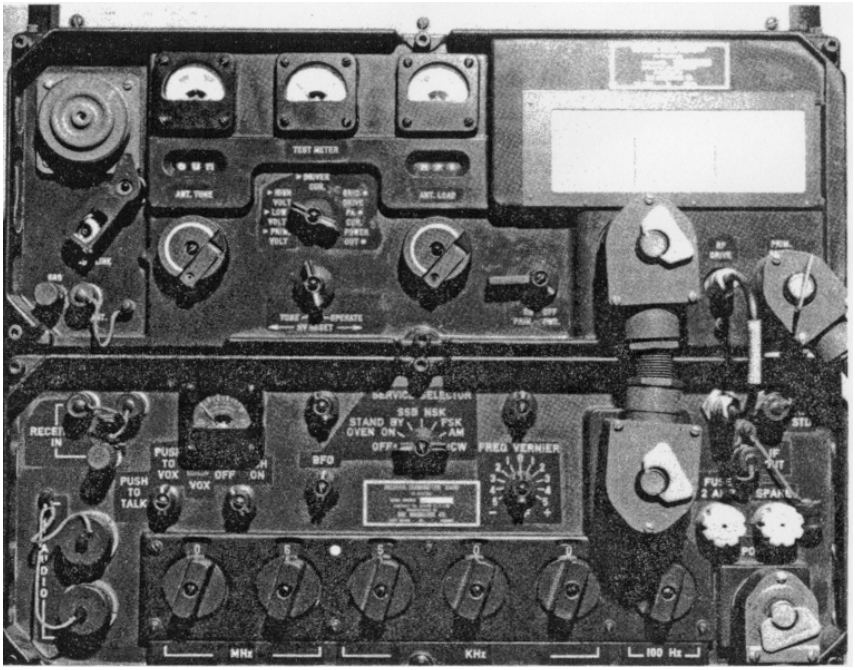
[1]For individual aircraft operating weights, see Form 365F.

[2]Maximum allowable gross weight is the maximum total weight of the aircraft prior to takeoff; the "basic weight" of the aircraft plus crew, personnel equipment, special devices, passengers/cargo, and usable fuel and oil. This is limited by structure, power available, or landing load, based on standard day sea level.

[3]Normal cruise speed is the true airspeed which an aircraft can normally be expected to maintain at some standard power setting below rated military power. This speed will vary with altitude.

[4]Endurance at cruising speed is the time that an aircraft can remain airborne at normal cruising speed with fuel aboard without using the required fuel reserve. The data listed under "operational characteristics" is computed utilizing full fuel minus a 30-minute reserve, except turboprop which requires 20 minutes' reserve.

AN/GRC-106A



If you are not getting the rated transmission range on the AN/GRC-106 or AN/GRC-106A, chances are that you are not getting the proper (rated) power output.

To obtain the rated power output, the TEST METER on the Radio Frequency Amplifier, AM-3349/GRC-106, should read just below the gray portion on the lower scale, with the TEST METER switch in the POWER OUT position. (Reference paragraph 3-6, TM 11-5820-520-12).

If this reading is not obtained in the TUNE position of the TUNE-OPERATE switch, trouble is indicated in the AM-3349/GRC-1 06. Refer to table 4-2, item 6, of TM 11-5820-520-12, FEB 71, to obtain the correcting procedures.

TABLE I. OLD FM RADIOS

Radio set	Receiver/ transmitter	Frequency (MHz)	Operation modes	Range (km)	Channels		Power requirement	Reference manual	Remarks
					Total	Preset			
AN/GRC-3	R-108/RT-66/RT-70	20.0 - 27.9	Voice	16-24	80	2	12/24v DC	TM 11-284	3 preset channels on aux receiver; set utilizes AM-65 AF amplifier.
-5	R-109/RT-67/RT-70	27.0 - 38.9			120	2			
-7	R-110/RT-68/RT-70	38.0 - 54.9			170	2			
AN/GRC-4	RT-66/RT-70	20.0 - 27.9	Voice	16-24	80	2	12/24v DC	TM 11-284	Set utilizes AM-65 AF amplifier.
-6	RT-67/RT-70	27.0 - 38.9			120	2			
-8	RT-68/RT-70	38.0 - 54.9			170	2			
AN/VRC-8	RT-66	20.0 - 27.9	Voice	16-24	80	2	12/24v DC	TM 11-286	
-9	RT-67	27.0 - 38.9			120	2			
-10	RT-68	38.0 - 54.9			170	2			
AN/VRC-13	RT-66	20.0 - 27.9	Voice	16-24	80	2	12/24v DC	TM 11-291	Set utilizes AM-65 AF amplifier.
-14	RT-67	27.0 - 38.9			120	2			
-15	RT-68	38.0 - 54.9			170	2			
AN/VRC-16	R-108/RT-66	20.0 - 27.9	Voice	16-24	80	2	12/24v DC	TM 11-611	3 preset channels on aux receiver.
-17	R-109/RT-67	27.0 - 38.9			120	2			
-18	R-110/RT-68	38.0 - 54.9			170	2			
AN/VRC-20	R-108/RT-66	20.0 - 27.9	Voice	16-24	80	2	12/24v DC	TM 11-642	3 preset channels on aux receiver; set utilizes AM-65 AF amplifier.
-21	R-109/RT-67	27.0 - 38.9			120	2			
-22	R-110/RT-68	38.0 - 54.9			170	2			
AN/VRQ-1	2 RT-66	20.0 - 27.9	Voice	16-24	80	2	12/24v DC	TM 11-287	Provides automatic retransmission capability.
-2	2 RT-67	27.0 - 38.9			120	2			
-3	2 RT-68	38.0 - 54.9			170	2			
AN/VRC-7	RT-70	47.0 - 58.4	Voice	1.6	115	2	6/12/24v DC & 6v PP-448/GR	TM 11-285	Set utilizes AM-65 AF amplifier
AN/PRC-6	RT-196/PRC-6	47.0 - 55.4	Voice	1.6	43	1	BA-270	TM 11-296	
AN/PRC-8	RT-174/PRC-8	20.0 - 27.9	Voice	5-8	80	Contin-	B-279 or	TM 11-4065	AM 598/U is an amplifier,
-9	RT-175/PRC-9	27.0 - 38.9			120	uous	24v DC		power supply.
-10	RT-176/PRC-10	38.0 - 54.9			170	tuning	W/AM 598/U		

TABLE II. NEW FM RADIOS

Radio set	Receiver/ transmitter	Frequency (MHz)	Operation modes	Range (km)	Channels		Power requirement	Reference manual	Remarks
					Total	Preset			
AN/PRC-25	RT-505/PRC-25	30.00 - 52.95 53.00 - 75.95	Voice	8	920	2	Dry btry BA 386/U	TM 11-5820-398-12	Replaces AN/PRC-8, -9, and -10. For manpack only.
AN/PRC-77	RT-841/PRC-77	30.00 - 52.95 53.00 - 75.95	Voice & 150 Hz tone	8	920	2	BA-386/PRC-25 or BA-398/U	TM 11-5820-667-12	X-mode for security device BA-398/U is for arctic operation
AN/VRC-53	RT-505/PRC-25	30.00 - 52.95 53.00 - 75.95	Voice & 150 Hz tone	8	920	2	24v DC vehicular btry	TM 11-5820-398-12	Vehicular configuration of AN/PRC-25
AN/VRC-64	RT-841/PRC-77	30.00 - 52.95 53.00 - 75.95	Voice & 150 Hz tone	8	920	2	24v DC vehicular btry	TM 11-5820-667-12	Vehicular configuration of AN/PRC-77
AN/GRC-125	RT-505/PRC-25	30.00 - 52.95 53.00 - 75.95	Voice & 150 Hz tone	8	920	2	Dry btry or vehicular btry	TM 11-5820-398-12	On/Off vehicular configuration of AN/PRC-25
AN/GRC-160	RT-841/PRC-77	30.00 - 52.95 53.00 - 75.95	Voice & 150 Hz tone	8	920	2	Dry btry or vehicular btry	TM 11-5820-667-12	On/Off vehicular configuration of AN/PRC-77
AN/GRC-163	1 AN/VRC-47 *1 AN/TCC-70 *Described below	30.00 - 52.95 53.00 - 75.95	Voice & 150 Hz tone	15 - 20 Using 2 antennas. Log periodic for long range	920	2	PP-2953/B/U 120v AC to 24v DC & gasoline engine generator 1.5 kw, 120v	TM 11-5820-713-15	This terminal set provides voice and teletype communications by using the multiplexer AN/TCC-70 for point to point communication. Requires two frequencies per link.
AN/VRC-12	RT-246/VRC R-442/VRC	30.00 - 75.95	Voice	24-32	920	10	24v DC	TM 11-5820-401-10	Replaces AN/VRC-16, -17, -18.
AN/VRC-43	RT-246/VRC	30.00 - 75.95	Voice	24-32	920	10	24v DC	TM 11-5820-401-10	Replaces AN/VRC-8, -9, -10.
AN/VRC-44	RT-246/VRC 2R-442/VRC	30.00 - 75.95	Voice	24-32	920	10	24v DC	TM 11-5820-401-10	No previous configuration having this capability.

TABLE II. NEW FM RADIOS (Cont)

Radio set	Receiver/ transmitter	Frequency (MHz)	Operation modes	Range (km)	Channels		Power requirement	Reference manual	Remarks
					Total	Preset			
AN/GRT-13 Radio Transmitting Set (Site marking device)	AN/GRT-13 Development Item	45.0 - 54.8	Tone-modulated omnidirectional signal (on 6 sec, off 4 sec)	NA	50	50 (one at a time)	BA-386/PRC (15 volt)	TM 11-5820-608-15 (when published)	Used in conjunction with organic FM equipment to form a homing system for the purpose of locating air dropped supply bundles. Radio set AN/PRC-10 or AN/PRC-25 equipped with homing loop antenna AT-784/PRC is used.
AN/PRC-47	RT-671/PRC-47	2 to 11.999 in 1 kHz increments	CW & upper sideband voice & FSK	Planning range 80 km	10,000		BB-451/U or vehicular btry	TM 11-5820-509-12	Used in airmobile operations. Portable by rucksack (requiring 2 men) using battery power, or vehicular mounting, using vehicular battery. In fixed station operation can use 115 volts single phase, 400 Hz. Uses antenna AS-1320/PRC-47 (15 ft whip) & AS-1321 (long wire).
AN/VRC-45	2 RT-246/VRC	30.00 - 75.95	Voice	24-32	920	10	24v DC	TM 11-5820-401-10	Replaces AN/VRQ-1, -2, -3.
AN/VRC-46	RT-524/VRC	30.00 - 75.95	Voice	24-32	920	0	24v DC	TM 11-5820-401-10	Replaces AN/VRC-8, -9, -10.
AN/VRC-47	RT-524/VRC R-442/VRC	30.00 - 75.95	Voice	24-32	920	0	24v DC	TM 11-5820-401-10	Replaces AN/VRC-16, -17, -18.
AN/VRC-48	RT-524/VRC 2R-442/VRC	30.00 - 75.95	Voice	24-32	920	0	24v DC	TM 11-5820-401-10	No previous configuration having this capability.
AN/VRC-49	2 RT-524/VRC	30.00 - 75.95	Voice	24-32	920	0	24v DC	TM 11-5820-401-10	Replaces AN/VRQ-1, -2, -3.
AN/TCC-70 Multiplexer Set		Multiplex Set AN/TCC-70 is a light weight, tactical multiplexer. It provides four telephone traffic channels for voice or data, one order wire channel and two telegraph channels. It operates with another distant multiplexer over a four-wire cable or a radio circuit, using radio receiver R-442/VRC and radio receiver-transmitter RT-246/VRC or RT-524/VRC. The telegraph channels are compatible with telegraph terminals TH-5/TG and TH-22/TG.						TM 11-5805-413-12 TM 11-5805-413-34	Expected to be used at brigade level and higher.
Squad Radio	AN/PRT-4 Transmitter*	47.0 - 57.0	Voice & Tone	1.6 0.5	200	2	BA-399/U	TM 11-5820-549-12 SB 11-622	Compatible with AN/VRC-12 and AN/PRC-25 or -77 series. Channel alignment indicator ID-1189/PR is required since radio is crystal-controlled. Has 50 kHz spacing. Transmitter AN/PRT-4 may be operated on either of 2 channels which may be separated up to one MHz in frequency.
	AN/PRR-9 Receiver	47.0 - 57.0		Provided with earphone H-264/PRR-9	200 Usable channels depend on crystals made available	1	BA-505/U		

*AN/PRT-4A has 150 Hz tone added.

TABLE III. AM RADIOS

Radio set	Receiver/ transmitter	Frequency (MHz)	Operation modes	Range (km)	Channels		Power requirement	Reference manual	Remarks
					Total	Preset			
AN/GRC-19	R-392/URR T-195/GRC-19	0.5 - 32.0 1.5 - 20.0	Voice CW	80	Manual	7 xmtr	28v DC 44 amp	TM 11-5820-295-10	Part of AN/GRC-46, AN/VRC-29 and AN/VSC-1. Being replaced by AN/GRC-106.
AN/GRC-46	R-392/URR T-195/GRC-19	0.5 - 32.0 1.5 - 20.0	Voice, CW, FSK simultaneous voice & FSK	80	Manual	7 xmtr	28v DC 100 amp	TM 11-5815-204-10	Mounted in shelter S-89 or S-144. Standard B item, being replaced by AN/GRC-142. Has on-line security capability.
AN/GRC-26 (A, B & C) D	2 R-388/URR 1 BC-610 (A, B, C) 2R-390/URR 1T-368/URT	0.5 - 30.5 2.0 - 18.0 0.5 - 32.0 1.5 - 20.0	Voice CW, FSK simultaneous voice & FSK	160 voice 400 CW & FSK	Continuous Manual Control		115v AC 50-60 Hz 5 kw approx	TM 11-5820-202-10 & TM 11-5820-256-10	Has full duplex capability. Provides on-line secure communication. Extended ranges with doublet antenna.
AN/GRR-5	R-174/URR (Receiver only)	1.5 - 18.0	Voice CW MCW	NA		10	6/12/24v DC w/PP-308, 115 VAC	TM 11-295 & TM 11-5820-284 series	Can operate with dry cells (2 BA-419 & 1 BA-403). Being phased out of Army inventory.
AN/URC-4	RT-159/URC-4	120.0-130.0 & 240.0-260.0	Voice MCW Tone	16/32/64 w/aircraft at 1,000, 5,000 & 10,000 feet	2 fixed	1	BA-1264 (U)	TM 11-510	Emergency aviator's radio for rescue situations, dropped in survival kit or carried on person in a vest.
AN/URC-10	RT-278/URC-10	238.0-263.0	Voice & Tone	56 line of sight	1 fixed		16v dry btry	TM 11-5820-640-15	Replaces AN/URC-4. Personnel rescue radio set.
AN/VRC-24	RT-323/VRC-24	225.0-399.9	Voice	48 at 1000 ft 160 at 10,000 feet	1750	19	24v DC	TM 11-5820-222 series	Ground to air communication. Compatible with AN/ARC-27, AN/ARC-55 or AN/ARC-51.
AN/VRC-29									AN/GRC-46 less shelter. Configuration for mounting in tanks and APCs.
AN/VRC-34	RT-77/GRC-9	2.0 - 12.0	Voice CW MCW	Voice 16-24 CW 24-48	Continuous or 6 crystal freq		6/12v DC w/DY-88/GRC-9 24v DC w/DY-105/GRC-9	TM 11-263	Vehicular version of AN/GRC-9. AN/GRC-87 when not mounted. Uses DC genr GN-43 or GN-58 & battery BA-317/U.
AN/VSC-1	R-392/URR T-195/GRC-19	0.5 - 32.0 1.5 - 20.0	Voice CW FSK	80		7 xmtr	27.5v DC 100 amp	TM 11-5815-204 series	AN/GRC-46 airdroppable version (mounted in $\frac{1}{4}$ ton, less shelter, reperforator teletype and on-line security equipment).
AN/PRC-41 (UHF Receiver/ Transmitter)	RT-695/PRC-41	225.0 to 399.9	Voice (AM)	48 at 1000 ft, 160 at 10,000 ft (also dependent upon antenna)	1750 crystal control (100 kHz channel spacing)		BB-451/U; PP-3700/PRC-41 (Fixed station) or vehicular btry	TM 11-5820-510-12	Can operate from 115 or 230 volts, 50 to 400 Hz. Permits man-pack, fixed station or vehicular operation. Uses either directional antenna AS-1405/PRC-41 or omnidirectional antenna AS-1404/PRC-41.

TABLE IV. SINGLE SIDEBAND RADIOS

Radio set	Receiver/ transmitter	Frequency (MHz)	Operation modes	Range (km)	Channels	Power requirement	Reference manual	Remarks
AN/GRC-106*	RT-662/GRC	2.0 - 29.999	Voice CW	30	28,000	28v DC veh btry or PP-4763/GRC	TM 11-5820 series & TM 11-5820-765-12	Replacement for AN/GRC-19. May be mounted on $\frac{1}{4}$-ton vehicle.
AN/GRC-142*	RT-662/GRC & Modem MD-522A	2.0 - 29.999	Voice, CW FSK, voice & FSK simultaneously	80 ground wave, 2400 sky wave	28,000	28v DC 100 amp high capacity gen or 10kw generator **	TM 11-5820-520 series TM 11-5805-387-15-1 & 2 TM 11-5815-334-12	Replacement for AN/GRC-46. On-line security capability. Half duplex operation. Shelter mounted (S-318) 3/4 ton or $1\frac{1}{4}$ ton vehicle. Can use PP-4763/GRC (28v DC at 50 amp from 115v AC).
AN/GRC-122*	2 RT-662/GRC & Modem MD-522A	2.0 - 29.999	Same as AN/GRC-142	80 ground wave, 2400 sky wave	28,000	28v DC 100 amp high capacity generator or 10KW generator	TM 11-5820-520 series & TM 11-5805-387-15-1 & 2 TM 11-5815-334-12	Same as AN/GRC-142, except for additional RT-662 and auxiliary equipment for full duplex operation. Can use PP-4763/GRC (28v DC at 50 amp from 115v AC)
AN/GRC-108 (Developmental item)	2 RT-662/GRC w/RF amplifier AM-3399 & Modem MD-522A	2.0 - 29.999	Same as AN/GRC-142	160 ground wave, 2400 sky wave	28,000	115 - 230v trailer mtd 10kw gen	None published	Replacement for AN/GRC-26 shelter mtd. Full duplex with on-line security. Initially mounted on $2\frac{1}{2}$-ton truck, but will ultimately be mounted on 3/4-ton truck.
AN/VSC-2	RT-662/GRC & Modem MD-522A	2.0 - 29.999	Same as AN/GRC-142	80 ground wave, 2400 sky wave	28,000	27.5v DC 28 to 115v inverter SS-688 to provide AC for TT operation	TM 11-5820-467-15 & TM 11-5805-387-15-1 & 2 TM 11-5815-331-14	Replacement for AN/VSC-1. Same as AN/GRC-142 less reperforator. Mtd in $\frac{1}{4}$-ton veh for airborne operations.
AN/VSC-3	RT-662/GRC & Modem MD-522A	2.0 - 29.999	Same as AN/GRC-142	80 ground wave, 2400 sky wave	28,000	28v DC high capacity veh generator	TM 11-5815-332-15 TM 11-5805-387-15-1 & 2	Replacement for AN/VRC-29. Mounted in M-577 vehicle.

*PP-4763 is used when commercial power (115v) is utilized.
**Uses PU-620 (5kw) if without air conditioner; uses PU-677 (10kw) if with air conditioner.

TABLE IV. SINGLE SIDEBAND RADIO (Cont)

Radio set	Receiver/ transmitter	Frequency (MHz)	Operation modes	Range (km)	Channels	Power requirement	Reference manual	Remarks
AN/FRC-93 (KWM-2A Collins)	RT-778/FRC-93	3.4 - 29.999	Voice & CW	80 ground wave	Continuous tuning	115v AC single phase 60 Hz & PP-3990/ FRC-93	TM 11-5820-529-15 (Also Collins Instruction book)	Used in Pershing battalion. Commercial off-the-shelf item for SSB communication.
AN/PRC-74B	RT-794/PRC-74	2.0 - 17.999	Voice & CW	40 ground wave	Vernier controlled detent tuning in 1 Hz steps	70 BA 30 or 2 BA 386 or PP-4514/PRC-74	TM 11-5820-590-12-1	Half duplex capability. Can use 12-volt nickel - cadmium wet-cell battery.
AN/TRC-133	5 KWM-2A radio sets (RT-778/FRC-93)	3.4 - 29.999	Voice & CW	80 ground wave	Continuous tuning	Two 5-kw generators w/PP-3990/FRC-93	No TM See POMM 11-5820-610-14-1	5 AN/FRC-93 radio sets mounted in shelter S-141 and trailer w 2/5kw generators, 1 radio set only is capable of mobile communication while traveling, using power supply PP-4151/FRC-93 in conjunction with vehicular electrical system.
AN/MRC-95	RT-698/ARC-102 (Collins type 618T-3)	2.0 - 29.999	Voice, CW, FSK	80 ground wave	28,000	Vehicular power, 28-volt generator system and power converter 770B-1	TM 11-5820-514-12	Mounted in $\frac{1}{4}$-ton vehicle can provide ground to air communication with aircraft using radio set AN/ARC-102 or 29.999 MHz frequency range. Used in airmobile units as an interim item until the AN/VSC-2 becomes available.

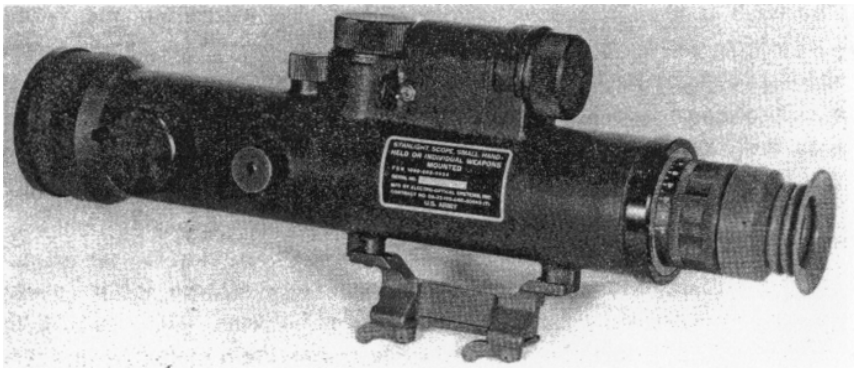
TABLE V. REMOTE CONTROL DEVICES

Equipment	Purpose and description	Distance limitation	Power requirement	Reference manual
Radio set control group AN/GRA-6	Can be used to perform the following functions: 1. Controlling and operating old FM sets from a distance. 2. Controlling AM SSB radio sets and voice portion of AM SSB radio teletypewriter equipment. 3. Two-way telephone communication between remote and local operators. 4. Local control of radio sets.	Approximately 3 km with WD-1/TT wire	4 BA-30, 1 BA-414/U	TM 11-5038
Radio set control group AN/GRA-39	A transistorized, battery operated, remote control system providing duplex telephone operation and two-way signaling for the operation of the AN/VRC-12 and AN/PRC-25 series of FM radio sets from a remote location. Built-in loudspeaker and audio power amplifier. Consists of 1 local and 1 remote unit.	Approximately 3 km with WD-1/TT wire	6 BA-30 for each unit	TM 11-5820-477-12
Radio set control group AN/GSA-7	A small, lightweight, electronic switching unit which can be used as follows: 1. Provides electronic switching for use in integrated radio/wire system. 2. Connects radios with local battery telephone equipment on a push-to-talk basis. 3. Interconnects two push-to-talk radio sets for automatic relay (two sets required). 4. Provides operator facilities for listening, signaling or talking to either or both ends of the circuit.	Approximately 16 km, using WD-1/TT wire	24 VDC 115 or 230 VAC self-contained	TM 11-5135-15
Radio set control group OA-1754/GRC	Radio set control group OA-1754/GRC is designed to permit remote CW operation of the radio set AN/GRC-19 and remote CW and FSK (teletype) operation of the radio teletypewriter sets AN/GRC-46 and AN/VRC-29. This device is used in conjunction with control group AN/GRA-6. The OA-1754/GRC consists of a local unit and a remote unit.	1, 6 km	Furnished by set to which this equipment is connected	TM 11-5820-389-12P, C-1
Oscillator, audio frequency, O-574/GRA	The oscillator, audio frequency, O-574/GRA, is a self-contained 1600 Hz signal generator. It may be used in conjunction with the AN/GSA-7 to permit a radio set operator to signal a telephone that is connected to an unattended AN/GSA-7. When used with the new series radios, a cable CX-7474/U must be used which converts the 10-pin contacts on one end to 5-pins on the other end. Used for radio/wire integration.		4 BA-1312/U	TM 11-5135-15 C-3
Radio control group AN/GRA-74	This equipment is comprised of a local unit, C-4846( )/GRA-74 and a remote unit, C-4847( )/GRA-74. This permits operation of the radio sets from a remote site of 1, 6 km. The units provide a four wire communication link with transmit and receive facilities of SSB, CW and AM between the remote unit and the radio set. Used with AN/GRC-106, 108, 122, and 142, and AN/VSC 2 and 3.	1, 6 km		Developmental item to replace the AN/GRA-6 now used with SSB radio sets.

Note: Cable CX-7474/U must be used to make the AN/GSA-7 compatible with the VRC-12 series of radios. This cable interconnects the 10-pin and 5-pin cable connectors.

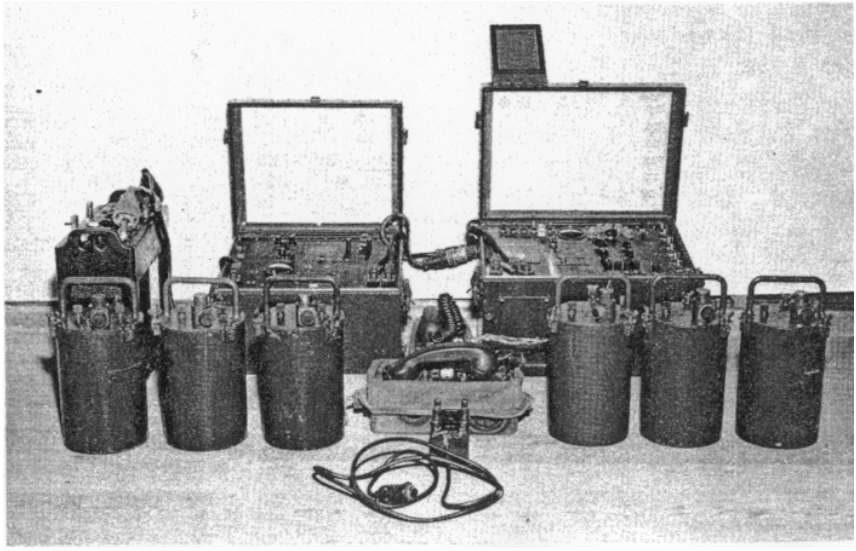
TABLE VI. SWITCHBOARDS

Equipment	Number of lines accommodated	Type of operation	Power requirements	Major components	Reference manual	Remarks
SB-993/GT	6	Manual local battery	None	1 MT-2156/GT 7 U-184/GCT	TM 11-5805-294-15	Emergency switching center, uses visual signaling.
SB-22/PT and SB-22A/PT	12	A portable, local, battery, monocord switchboard, capable of connecting 12 local battery telephone circuits, remote controlled radio circuits, or voice frequency teletypewriter circuits. Uses magneto signaling.	4 BA-30	1 SB-22/PT 1 MX-230/PT (3 spare line packs) (MX-2915/PT for SB-22A)	TM 11-5805-262-12	SB-22A differs from SB-22 in contents of accessory kit. The kit for SB-22A (MX-2915/PT) contains 2 line packs, 1 trunk pack. By stacking 2 or 3 SB-22 switchboards, the number of circuits can be increased to 29 or 46, respectively.
SB-86/P	30, including 2 civilian trunks	A complete, transportable, single-position, nonmultiple, local battery tactical switching central capable of terminating 30 magneto or common battery signaling lines or trunks, two of which may be automatic one-way ring-down trunks to civilian exchanges. Can be used for voice frequency teletypewriter circuits. Includes a switchboard section, jack field switchboard signal assembly TA-207/P, and power supply PP-990/G.	4 BA-30, 10 BA-200/U	1 SB-248/P 1 TA-207/P 1 PP-990/G	TM 11-2134 TM 11-4134	Expansible to 60 lines with the addition of switchboard signal assembly TA-207/P. Cannot be used directly for radio/wire integration; for this purpose a switchboard, SB-22 is used in conjunction with the SB-86.
SB-223/GR (switchboard signal assembly)	12 microphone lines, 6 recorder channels, 4 telephone lines	Manual, no ringing on switchboard.	BB-53 or other source of 12v DC	SB-223/GR	TM 11-2149	Used by sound ranging platoon of target acquisition battery. Connects 2 soundbases to sound ranging set GR-8.
MX-155/GT telephone connecting and switching group	Total of 10 (1 circuit of 2, 1 circuit of 8)	Manual.	None	1 jack panel SB-16/GT, 7 reel brackets, 7 jacks U-17/GT, 15 cords CX-231/GT	TM 11-2546	Provides conference telephone circuits among battery XO, assistant XO, and 6 howitzer or gun sections.



Night Vision Sight (Starlight Scope) AN/PVS-1

The starlight scope is a night vision device, resembling an oversized telescopic rifle sight, designed for use on individual weapons or as a handheld viewer. The night vision device amplifies the dim glow of the moon or stars, or even faint skyglow, and intensifies it within the target area of the scope. Since the system is "passive," the soldier using such equipment does not generate a light source. Thus, he does not risk revealing his position to the enemy.



Sound Ranging Set, GR-8

TARGET ACQUISITION

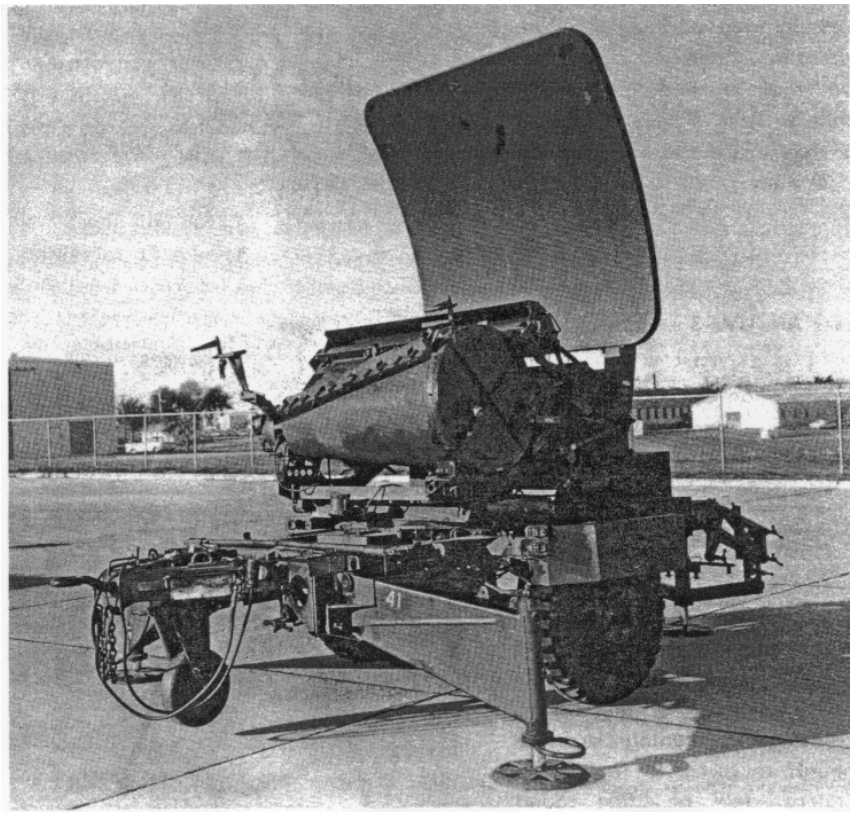
The GR-8 is used to locate hostile artillery by measuring the relative times at which sound waves generated by firings reach accurately located microphone positions on the ground. Targets may be located by sound ranging to accuracies of 0 to 150 meters and to ranges of 20,000 meters, dependent upon the intensities of the sounds they produce, and upon meteorological conditions.

Radar Set AN/TPS-25A

The AN/TPS-25A is a transportable ground surveillance radar capable of detecting moving ground targets at ranges between 450 and 18,280 meters. The set utilizes the doppler principle to provide a means of detection, identification and location of moving targets. The frequency of the amplitude variations of the video pulses, which are proportional to the target velocity, is amplified and applied to earphones and/or a loudspeaker. The operator utilizes the characteristic sounds to detect and identify moving objects. An "A" scope is also used to display both fixed and moving target echoes to assist the operator in detecting and tracking targets. Target locations are presented in the form of map coordinates and polar coordinates on counters at the operator's panel. The location of the target is also indicated by a bright dot of light shining through a map mounted on the radar mapboard. A seven-man crew can emplace the set in 15 minutes, if the antenna is mounted on the transmitter-receiver unit, and in approximately 35 minutes if mounted on three mast sections. The radar control unit and mapboard can be operated within the equipment shelter or it can be remoted up to 225 feet from the antenna.

Radar Set AN/MPQ-4A

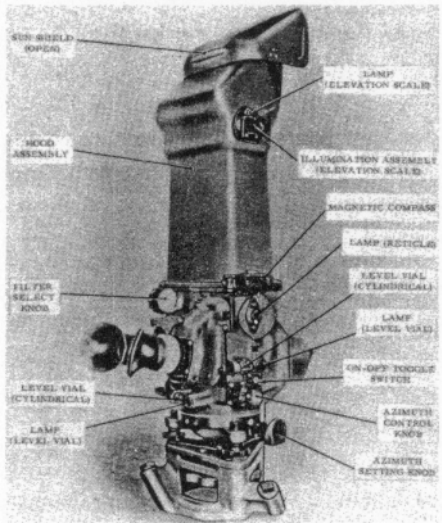
The AN/MPQ-4A is a mobile, short-range, beam intercept, non-tracking radar used by the field artillery to locate high-angle trajectory weapons within a 0 to 50-meter accuracy, and low-angle trajectory weapons within a 0 to 200-meter accuracy at ranges up to 15,000 meters. When a projectile is detected, the operator marks the position on the radar visual display scope. He then positions azimuth and range cursors over the marks, and the analog computer automatically computes the coordinate location of the weapon that fired. The AN/MPQ-4A has the additional capability of adjusting and registering artillery. Emplacement time for the AN/MPQ-4A is 30 to 45 minutes.



TARGET ACQUISITION

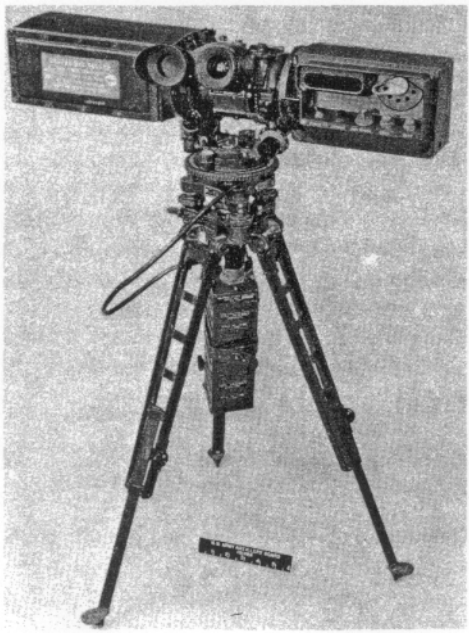
Periscope Battery Command, M43

The M43 periscope is used to locate targets by visual observation and intersection from two or more observation posts (flash ranging). Trained observers using the M43 and employing flash ranging techniques can locate hostile artillery and other targets at distances up to 15,000 meters, depending upon visibility limits from individual observation posts. Flash ranging is also used for the collection of battlefield information and for the calibration, adjustment, registration, and loaction of friendly artillery fires. Flash ranging techniques are accurate to within 50 meters.



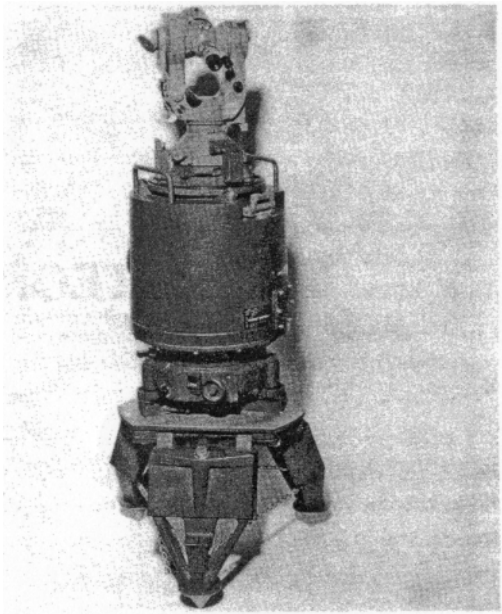
Laser AN/GVS-3

The AN/GVS-3 laser (Light Amplification by Stimulated Emission of Radiation) will provide the forward observer with precise polar plot data in the form of direction, vertical angle, and distance. The laser technique involves the determination of range by measuring the transit time of a ray of light beamed to a target and reflected back to the rangefinder, achieving a reading accurate enough to bring to reality the artillery ideal of "first round fire for effect."



Surveying Instrument, Azimuth Gyro, Artillery (ABLE)

The surveying instrument, azimuth gyro, artillery, is a portable gyrocompass used to establish a true north reference. The instrument consists of a sensing element, control indicator, tripod and cables. The sensing element contains a highly sensitive, single-axis, rate gyroscope. A 0.002-mil theodolite, mated to the sensing element, is used to transfer the established north reference to any desired point. The control indicator provides the controls necessary to operate the gyro. The instrument is powered by either a 24-volt DC battery or a 115 ± 10-volt AC, 50-70 cycle power supply. This instrument is used by artillery survey parties at all echelons.



Surveying Instrument, Distance Measuring, Electronic Microwave

This instrument is a portable, transistorized, electronic distance measuring device which consists basically of an FM transmitter/receiver, power supply, parabolic-reflector antenna, front-panel control facilities and a battery. These components are all incorporated in a single instrument package which is mounted on a tripod and powered by either a self contained 12-volt nickel cadmium battery or from a 12- or 24-volt DC external power source. Two of these instruments, one at each end of the line to be measured, determine by phase comparison distances ranging from 200 to 50,000 meters, with an accuracy of 1:250,000 ± 1.5 centimeters. The instruments are used in artillery survey parties found at division artillery, the target acquisition battalion, and certain cannon and missile units.

Theodolites 0.2 mil and 0.002 mil

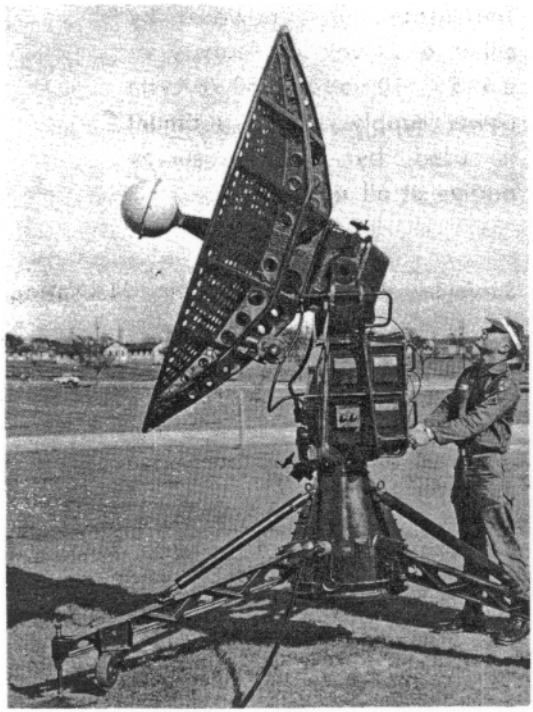
The 0.2 theodolite is used to obtain angular values in artillery surveys executed to fifth-order (1:1000) accuracy. Its scales are readable directly to 0.2 mil and by interpolation to 0.1 mil. Vertical and horizontal scales may

be read simultaneously and may be illumined by either sunlight or self-contained, artificial light. An optical plumb system is provided. The 28-power telescope produces inverted images. The universal field artillery tripod is used to support the instrument. The 0.002 theodolite provides greater accuracy than the 0.2 theodolite, permitting execution of fourth-order (1:3000) surveys. Its scales are readable directly to 0.002 mil and by interpolation to 0.001 mil. Vertical and horizontal scales must be individually viewed by means of a selector knob. Its other characteristics are essentially the same as those of the 0.2 theodolite.

METEOROLOGY

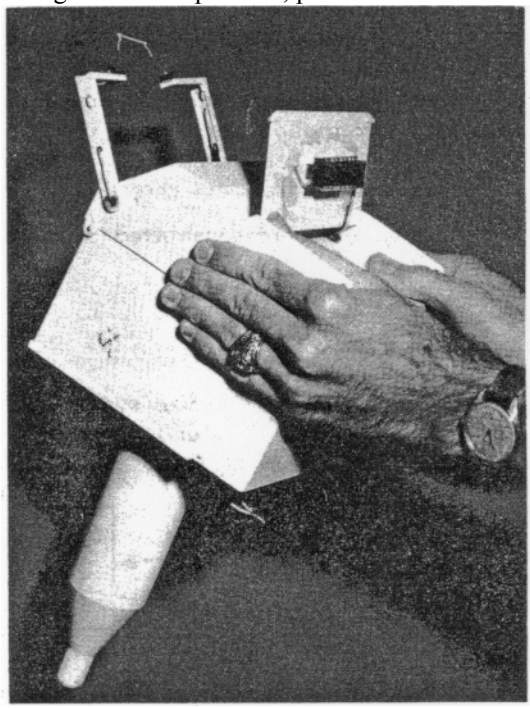
Rawin Set AN/GMD-1

The Rawin set AN/GMD-1 is a transportable radio direction finder which automatically tracks the radiosonde and tunes itself to the transmitted frequency. The control recorder, a component of the Rawin Set, records angles to the radiosonde at a maximum rate of 10 times each minute. Recordings of time versus progressive elevation and azimuth positions are later converted to wind speed and direction. Received radiosonde signals are detected, amplified, and transmitted to a separate piece of equipment, the radiosonde recorder, for conversion to atmospheric values of temperature, humidity and pressure.



Radiosonde Transmitter AN/AMT-4

The radiosonde AN/AMT-4 is a meteorological instrument which is carried aloft by a balloon to obtain soundings of the temperature, pressure and relative humidity of the atmosphere. This instrument automatically transmits radio-frequency signals, amplitude modulated, at a frequency that varies in accordance with the conditions of temperature and humidity of the atmosphere encountered during the flight. A baroswitch connects the circuits of the transmitter successively, so that a repeating sequence of temperature, humidity, and reference signals is transmitted. These data are used in calculating corrections to compensate for the effects of nonstandard meteorological conditions for artillery fire.



Radiosonde Recorder AN/TMQ-5

The radiosonde recorder, AN/TMQ-5, is an assembly of electronic and electromechanical devices which receives meteorological data from the rawin set, AN/GMD-1. The input signal for the recorder consists of audiofrequency pulses that normally range from 10 to 200 cycles per second. These incoming signals are converted to direct current voltages which, by means of a servosystem, position a pen on a calibrated chart. The operation is continuous, so that the pen always marks the chart at a point corresponding to the data received from the balloon borne radiosonde. A preflight calibration establishes the relationship between audiofrequency and both temperature and relative humidity.

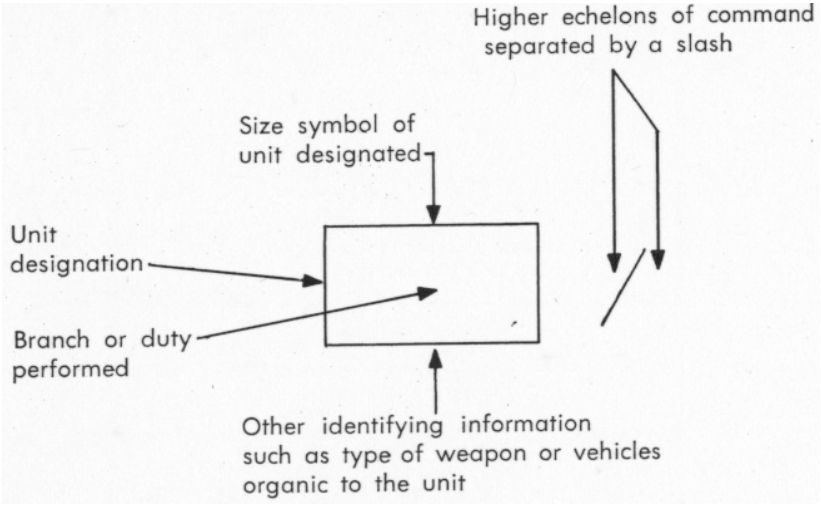
SECTION II

FIELD ARTILLERY ORGANIZATION

UNIT SYMBOLS

These are examples of unit symbols authorized by FM 21-30, May 1970. Developed at Fort Belvoir by the U.S. Army Combat Developments Command Engineer Agency, these symbols are designed to permit the presentation of maximum information concerning units, activities, and items of equipment. The symbols are used on maps, overlays, operation plans, orders, aerial photos, and organizational charts.

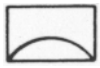
Unit symbols are constructed as shown below:



BASIC SYMBOLS

Branch and Function Symbols

Field Artillery



Air Defense Artillery

Infantry

Size Symbols

● Squad

●● Section or unit larger than a squad but smaller than a platoon

UNIT SYMBOLS

Armor

Engineer

Ordnance

Airborne

Army Aviation

Repair and Maintenance

Supply

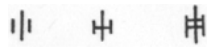
Airmobile

Airmobile with
organic aircraft

• • •	Platoon or detachment
I	Company, battery or troop
II	Battalion or Squadron
III	Group or regiment
X	Brigade or equivalent command
XX	Division
XXX	Corps
XXXX	Army
XXXXX	Army group

Weapon Symbols

Light-Medium-Heavy
Basic Infantry
Weapons



Light-Medium-Heavy
Basic Artillery
Weapons

Light-Medium-Heavy

Missile or Rocket

UNIT SYMBOLS

If a weapon has a high trajectory a O is placed at the base of the shaft. Examples:

Medium Mortar

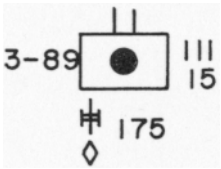
Medium Howitzer

If the weapon is also a tracked, self-propelled vehicle, a ◊ is placed below the weapon symbol. Examples:

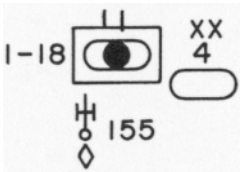
Tracked, Self-Propelled
Medium Howitzer

Tracked, Self-Propelled
Heavy Gun

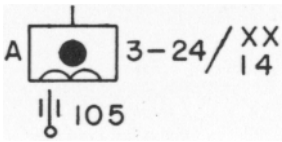
Examples of Unit and Weapon Symbols



3d Battalion (175-mm, SP), 89th Artillery, 15th Field Artillery Group

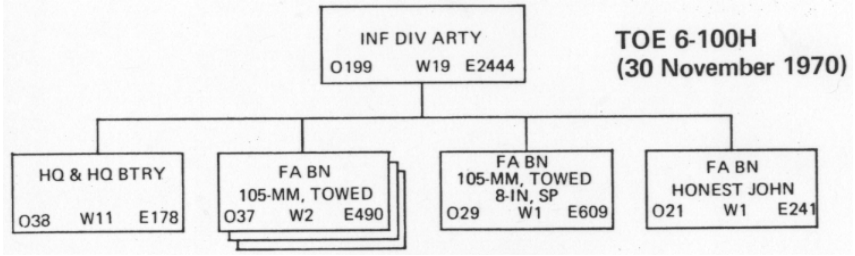


1st Battalion (155-mm, SP), 18th Artillery, 4th Armored Division

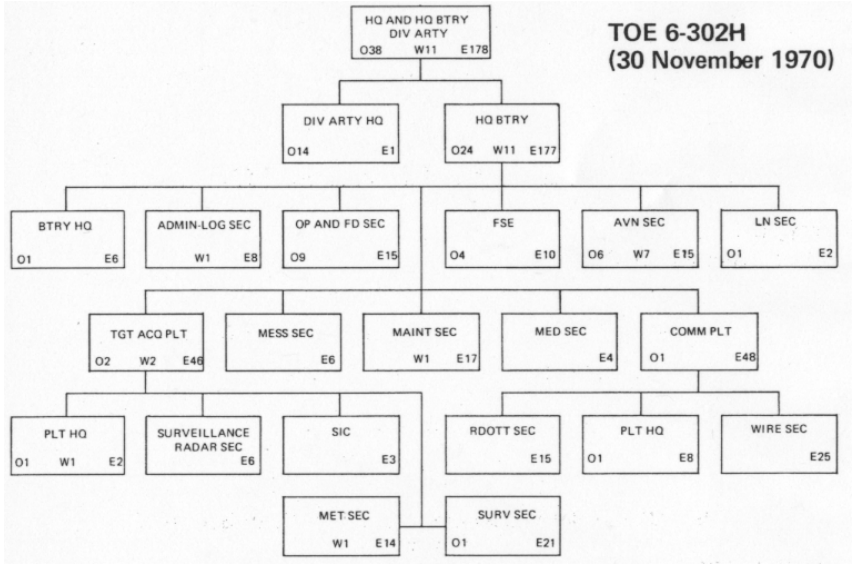


Battery A, 3d Battalion (105-mm, towed), 24th Artillery, 14th Airborne Division

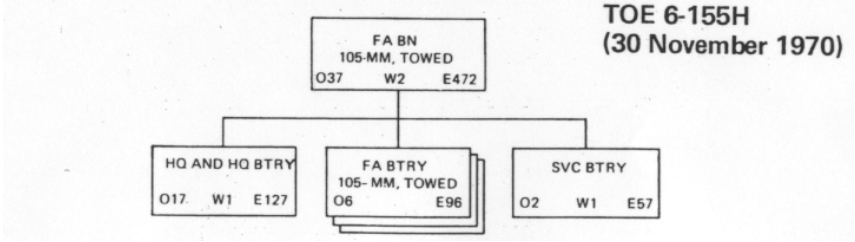
FIELD ARTILLERY ORGANIZATION



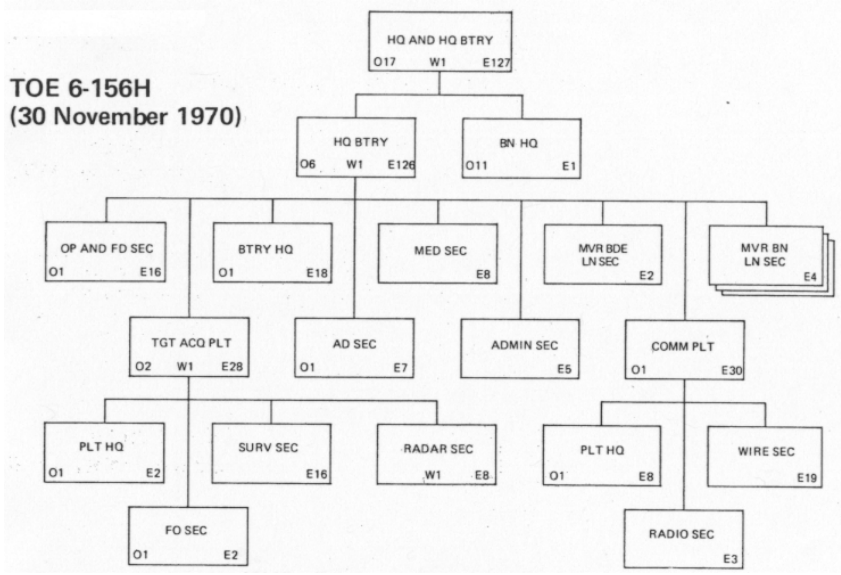
Infantry Division Artillery



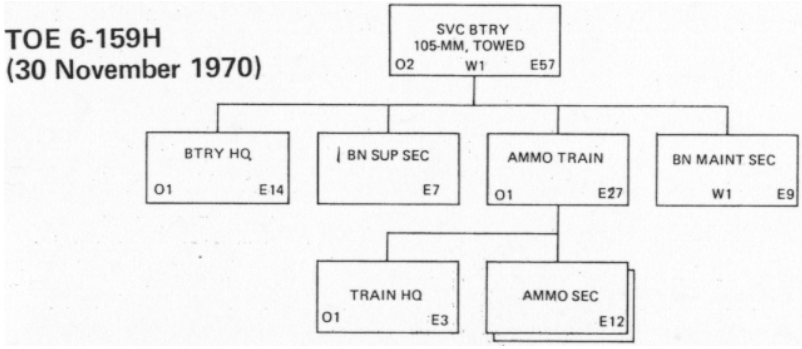
HHB, Armd, Mech, or Inf Div Arty



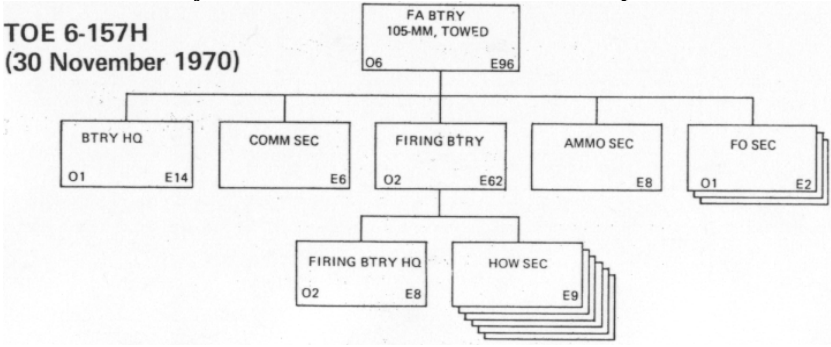
FA Bn, 105-mm, Twd, Inf Div



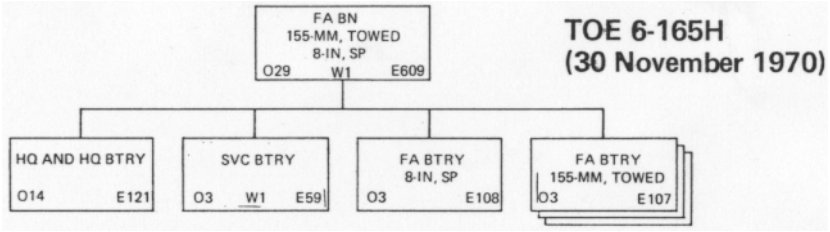
HHB, FA Bn, 105-mm, Twd, Inf Div



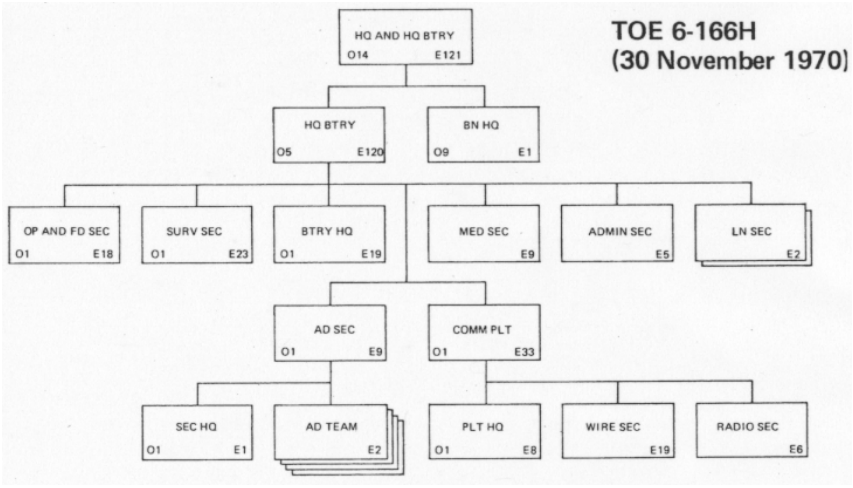
Svc Btry, FA Bn, 105-mm, Twd, Inf Div or Sep Inf Bde



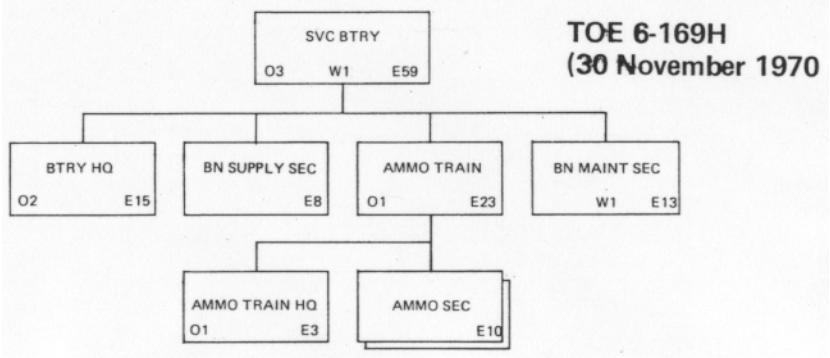
FA Btry, FA Bn, 105-mm, Twd, Inf Div or Sep Inf Bde



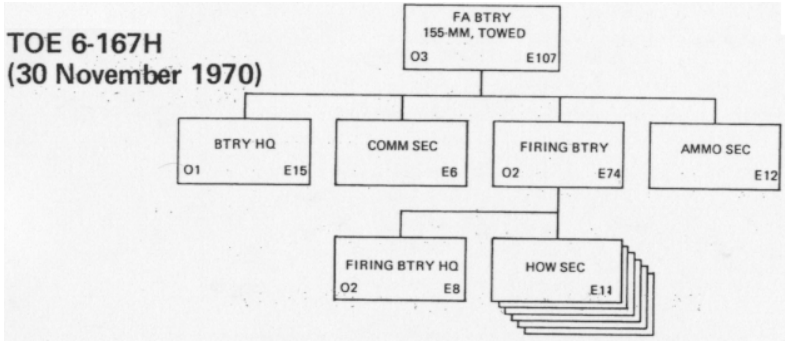
FA Bn, 155-mm, Twd, 8-in, SP, Inf Div



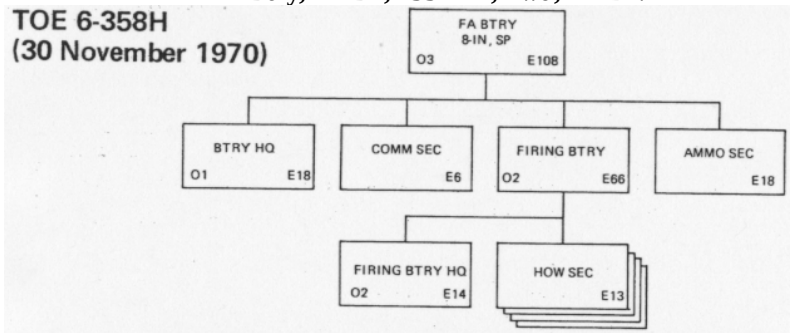
HHB, FA Bn, 155-mm, Twd, 8-in, SP, Inf Div



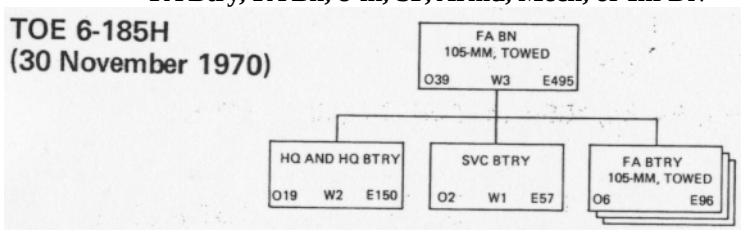
Svc Btry, FA Bn, 155-mm, Twd, 8-in, SP, Inf Div



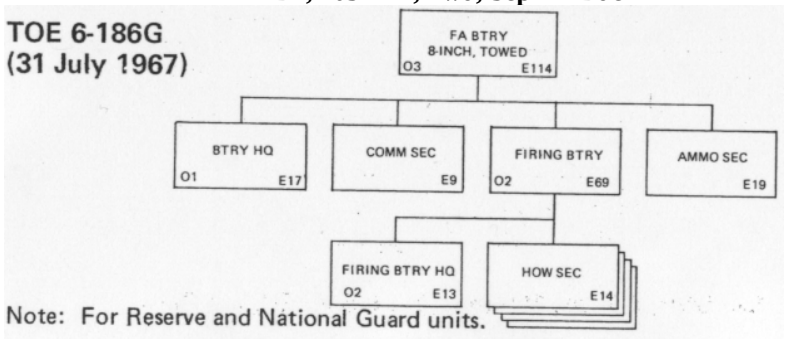
FA Btry, FA Bn, 155-mm, Twd, Inf Div



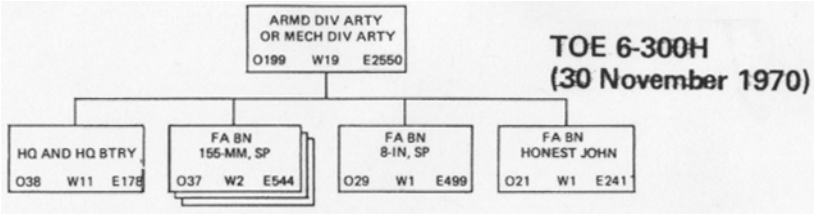
FA Btry, FA Bn, 8-in, SP, Armd, Mech, or Inf Div



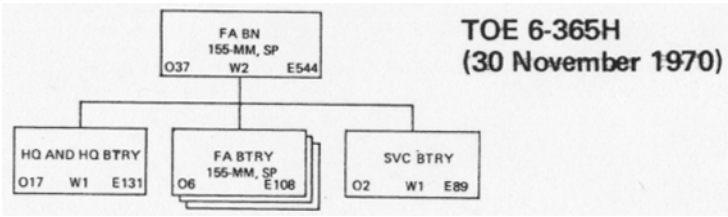
FA Bn, 105-mm, Twd, Sep Inf Bde



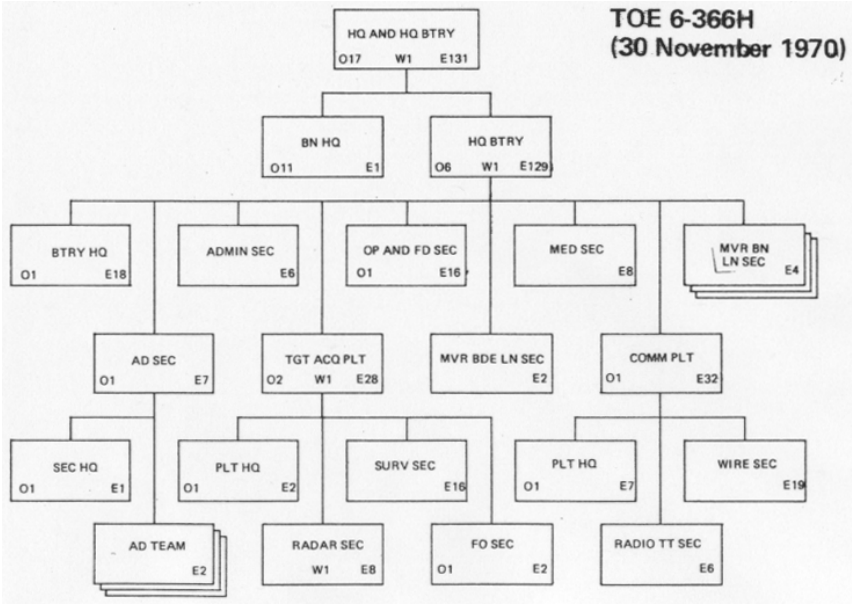
FA Btry, FA Bn, 8-in, Twd, Inf Div



Armd or Mech Div Arty

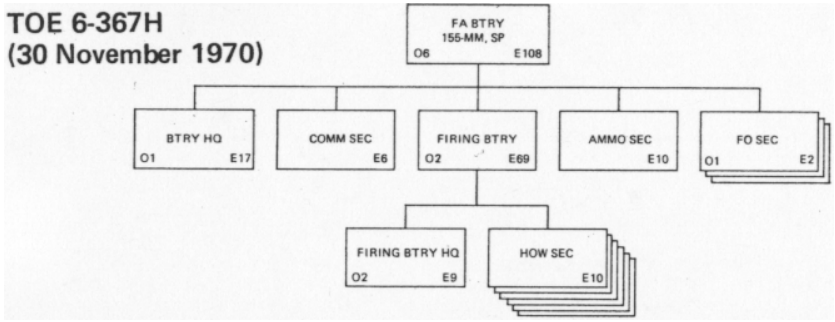


FA Bn, 155-mm, SP, Armd or Mech Div

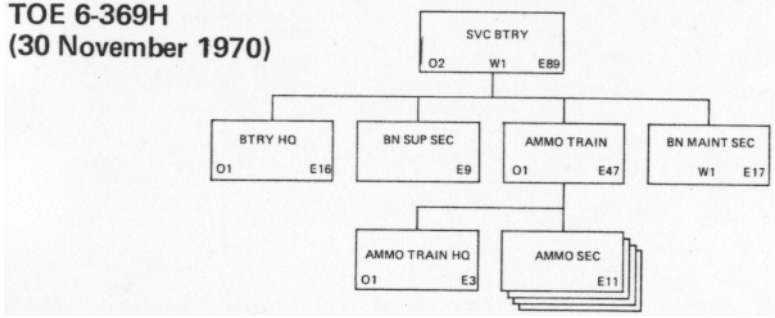


HHB, FA Bn, 155-mm, SP, Armd or Mech Div

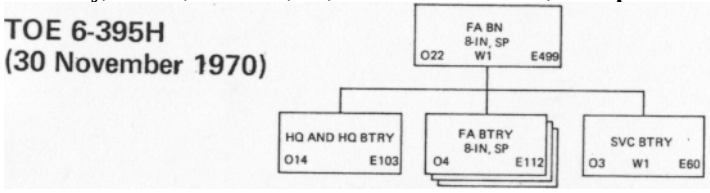
ARMD/MECH ARTY



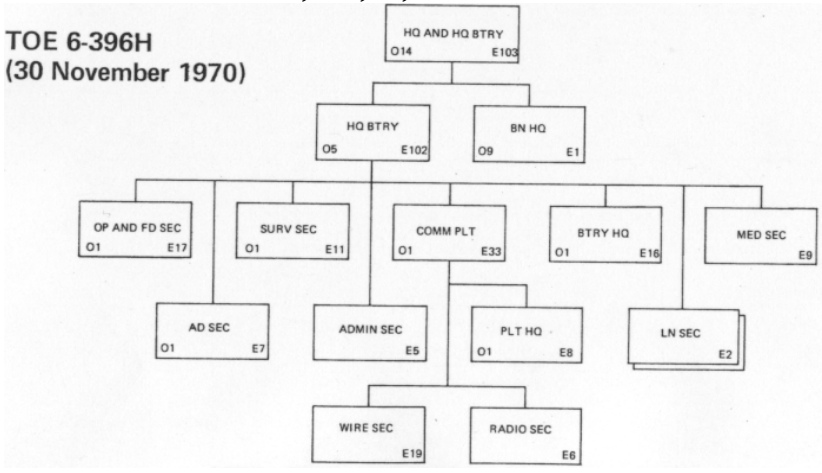
FA Btry, FA Bn, 155-mm, SP, Armd or Mech Div, Sep Armd or Mech Bde



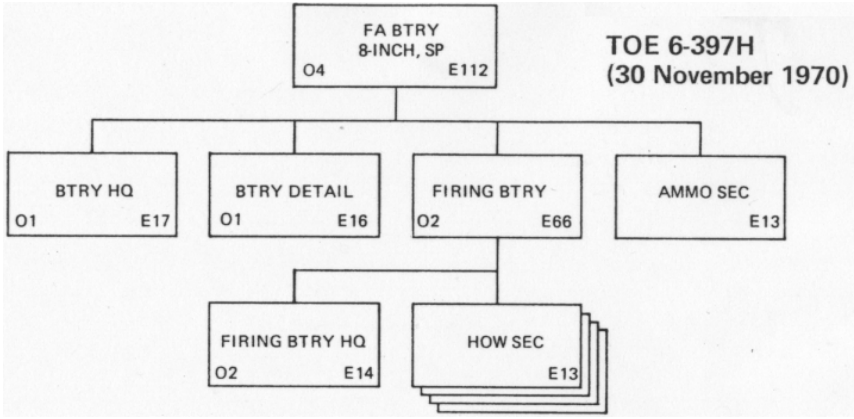
Svc Btry, FA Bn, 155-mm, SP, Armd or Mech Div, or Sep Armd or Mech Bde



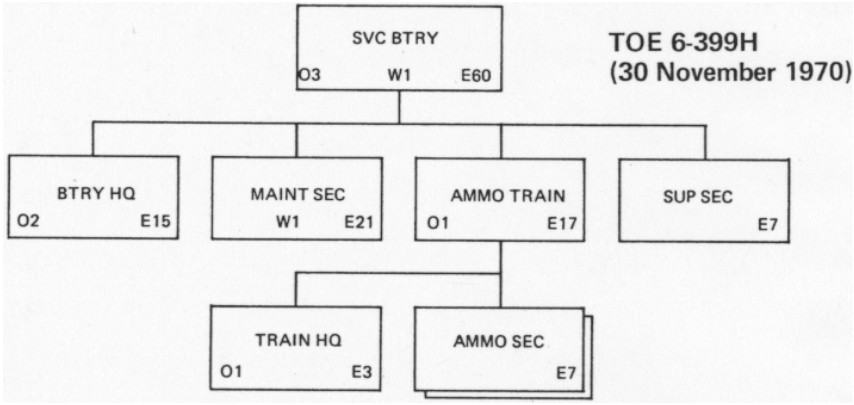
FA BN, 8-in, SP, Armd or Mech Div



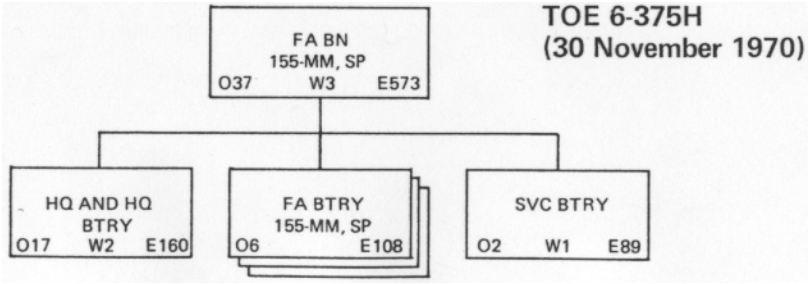
HHB. FA Bn. 8-in. SP. Armd or Mech Div



FA Btry, FA Bn, 8-in, SP, Armd, Mech, or Inf Div

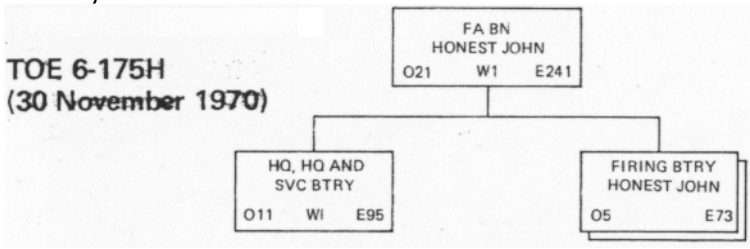


Svc Btry, FA Bn, 8-in, SP, Armd or Mech Div

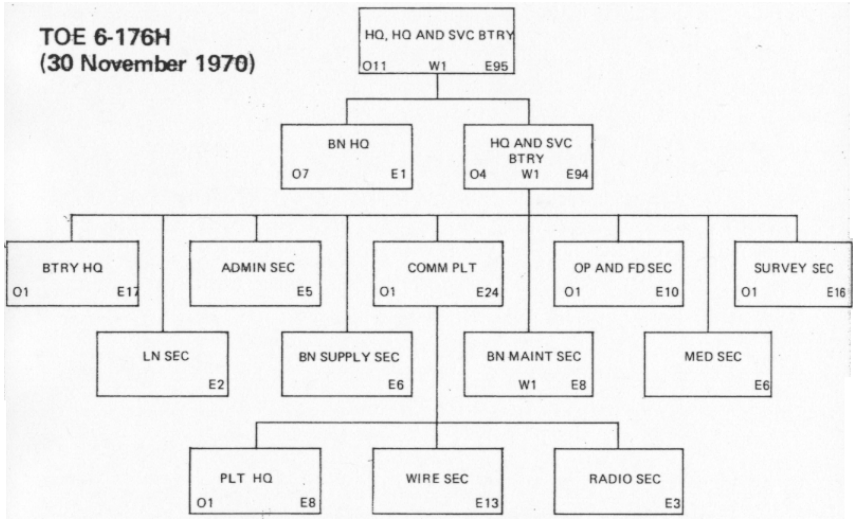


FA Bn, 155-mm, SP, Sep Armd or Mech Bde

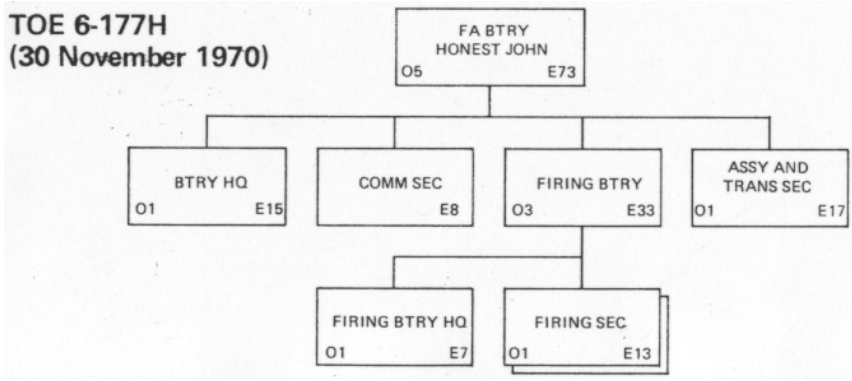
FA BN, HONEST JOHN



FA BN, HJ, Armd, Mech, or Inf Div



HHS Btry, FA BN, HJ, Armd, Mech, or Inf Div



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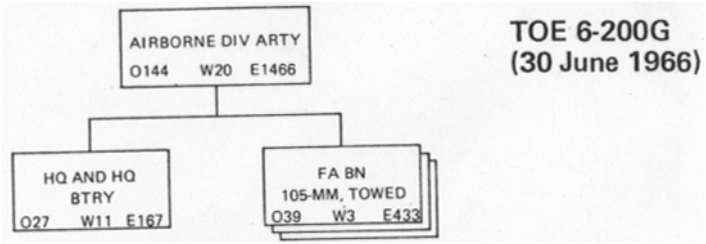

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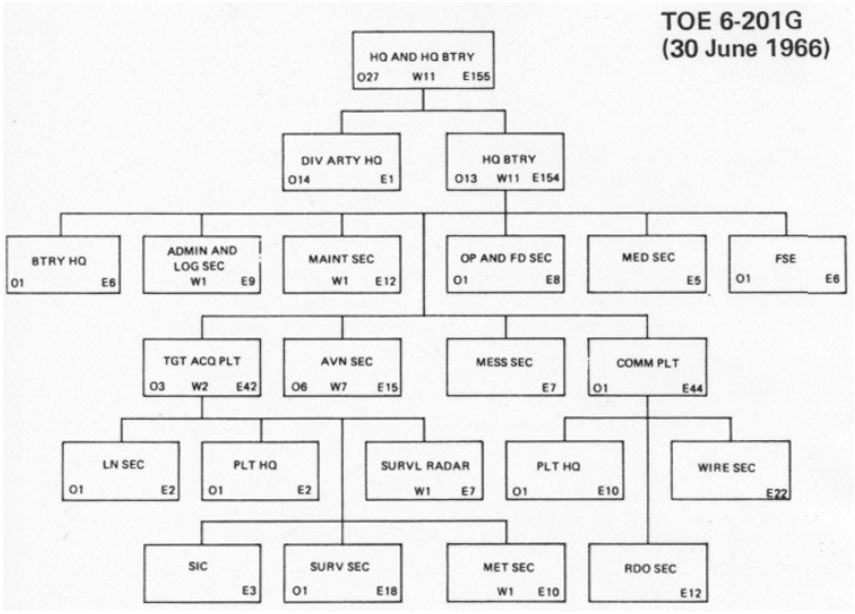

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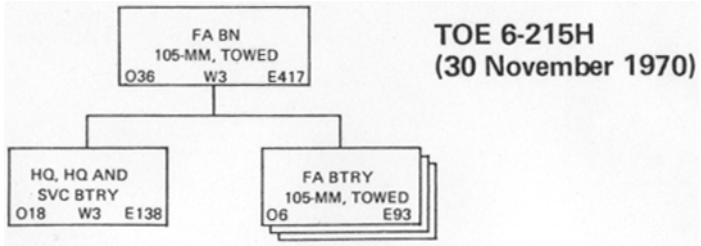

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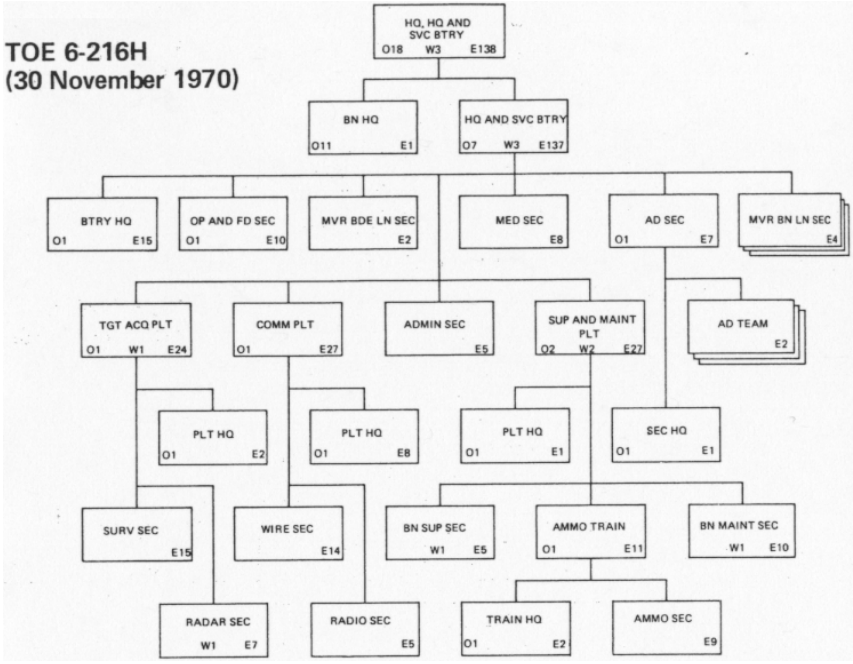

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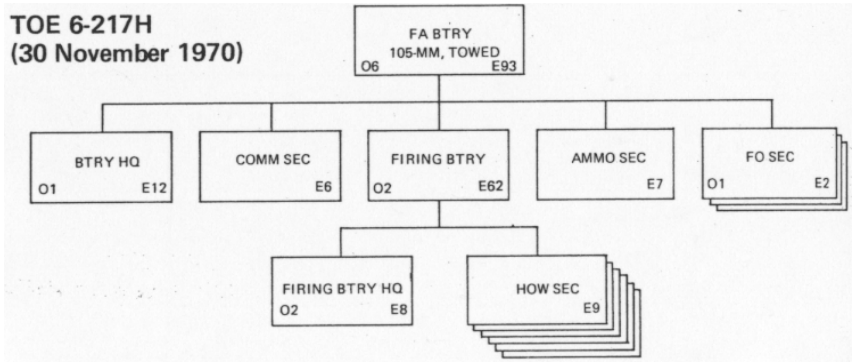

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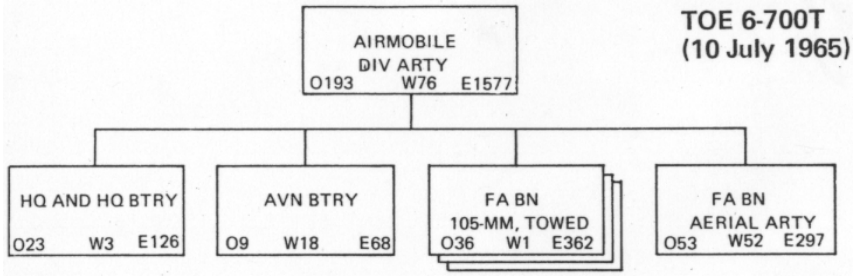
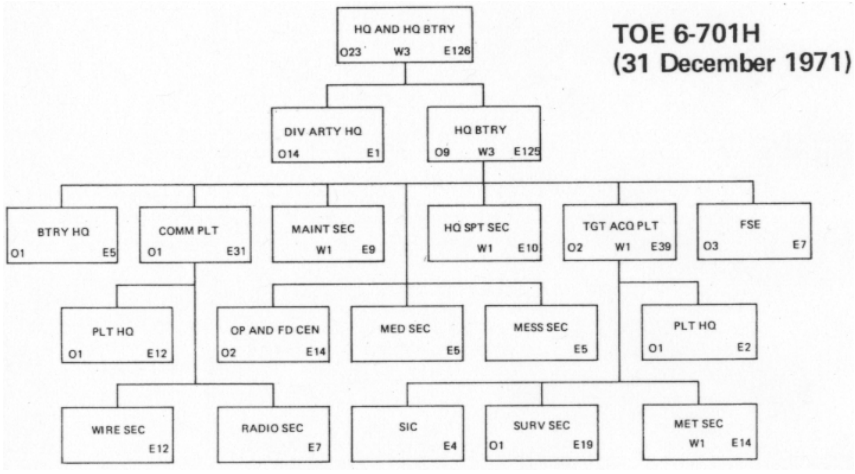


Airmobile Div Arty



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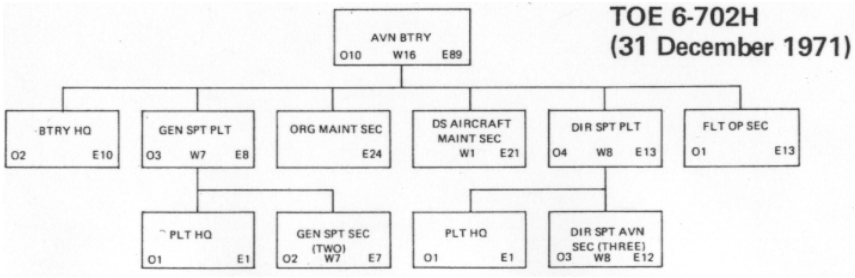
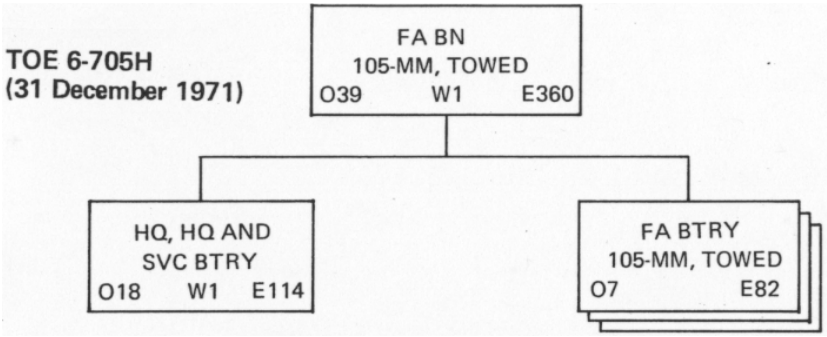


Aviation Btry, Airmobile Div Arty

AIRMOBILE ARTY



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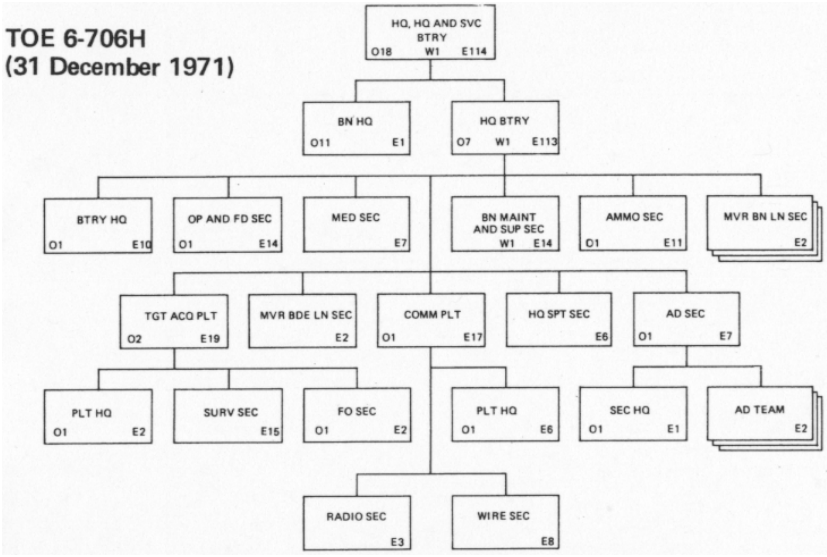

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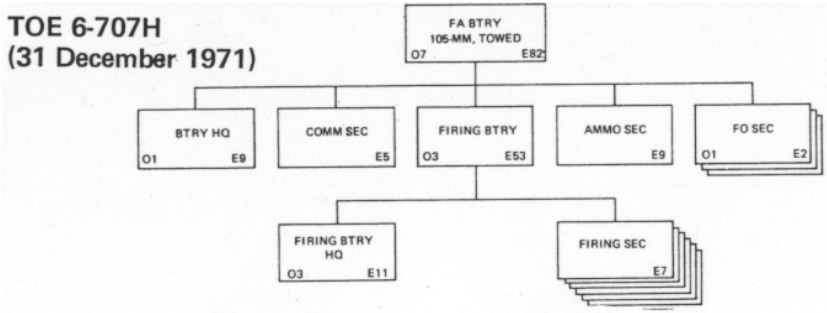

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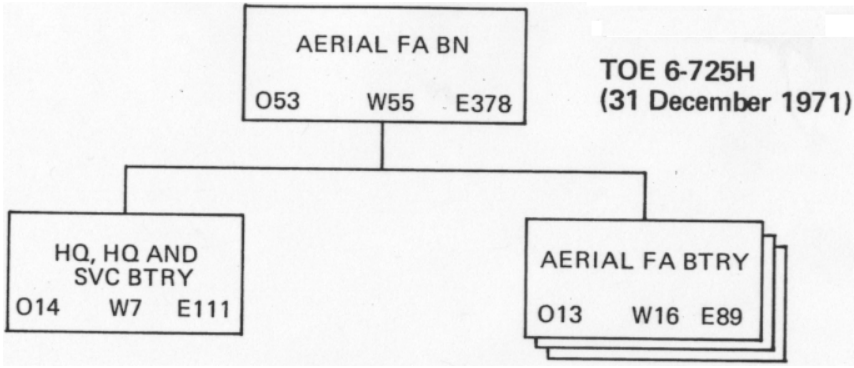

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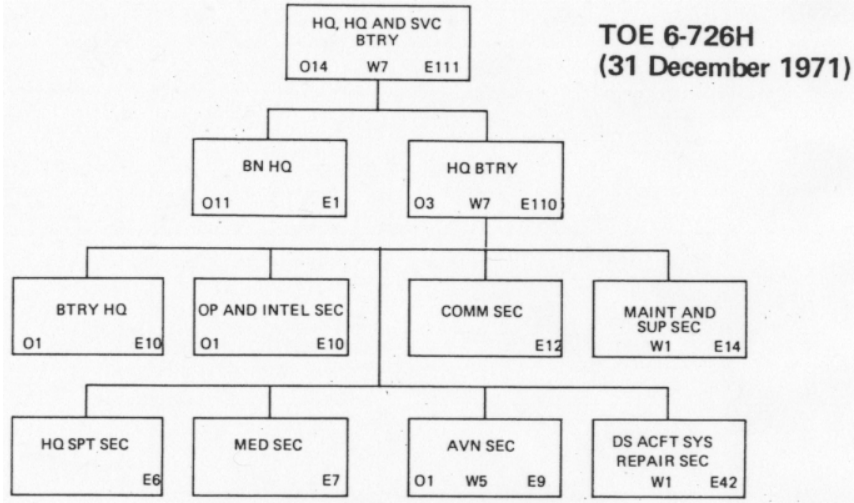

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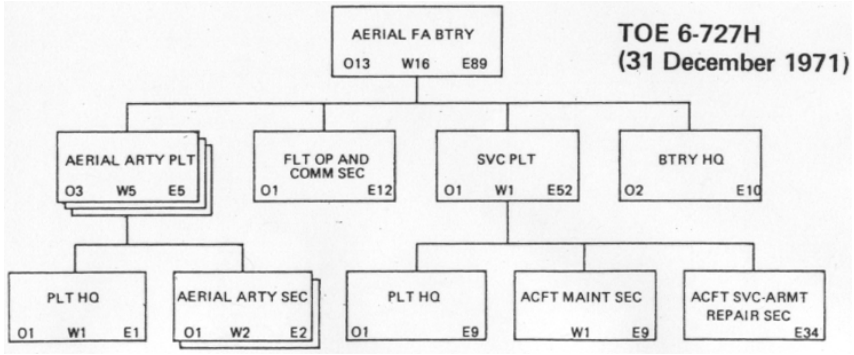
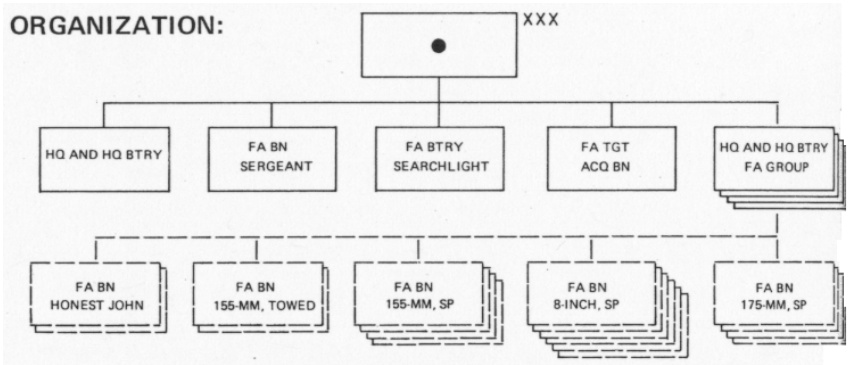
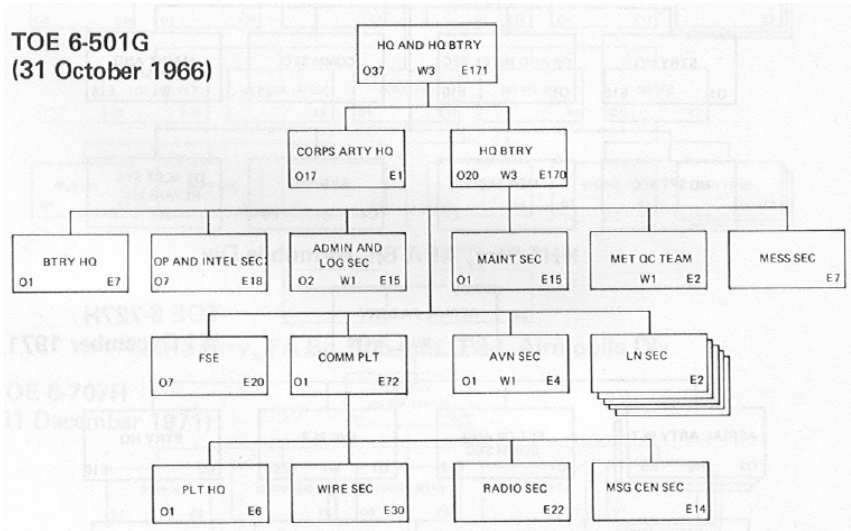


AFA Btry, AFA Bn, Airmobile Div

TYPE CORPS ARTILLERY
FOR INSTRUCTIONAL PURPOSES



Note: This chart conforms to RB 101-1, US Army Command and General Staff College, 1 April 1971.



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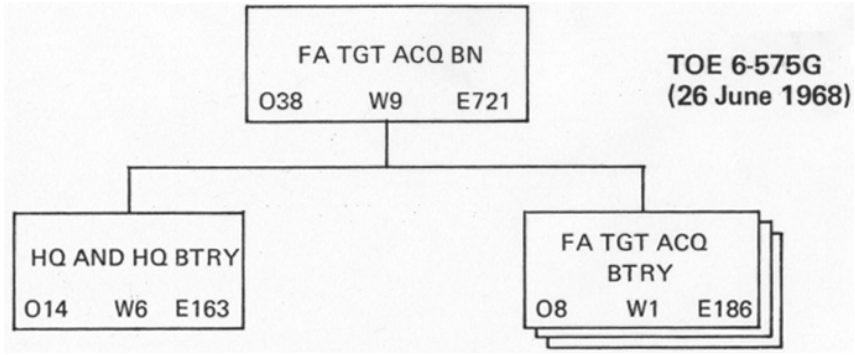

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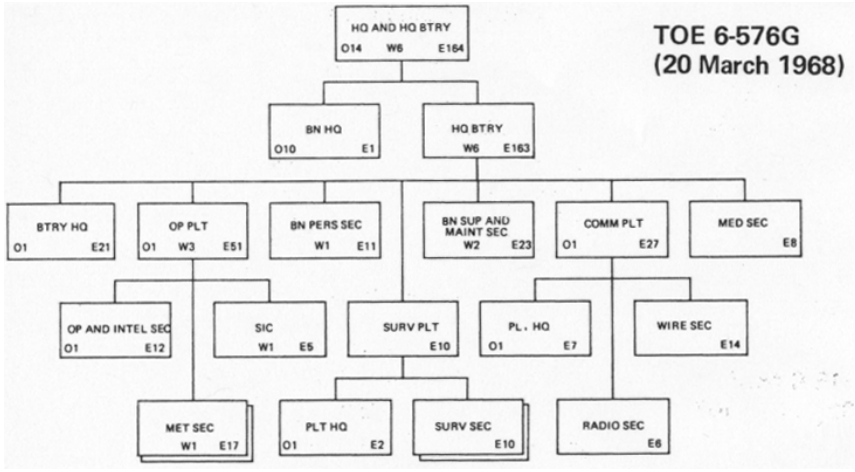

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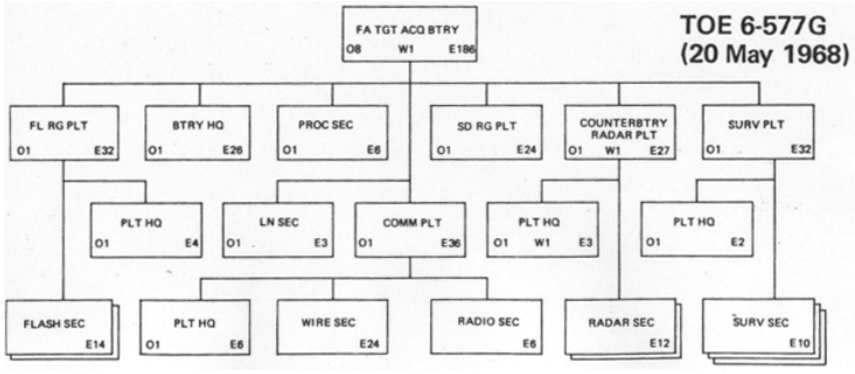

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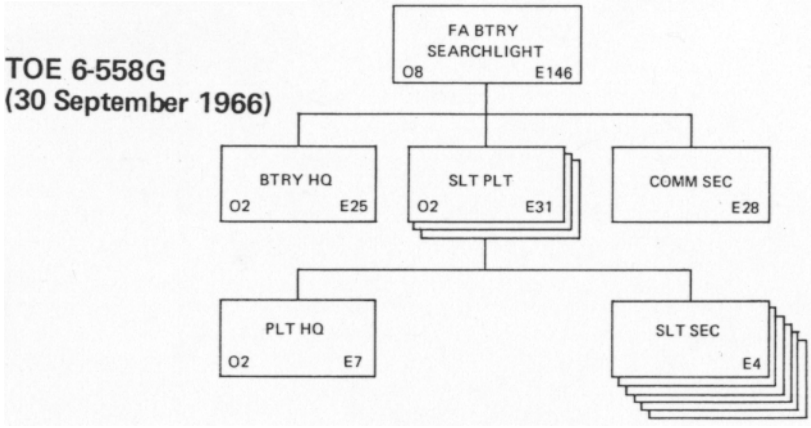
ARMY/CORPS ARTY



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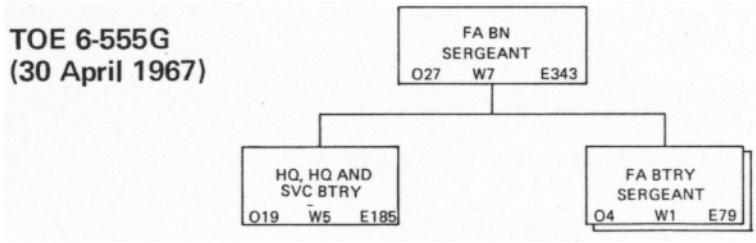

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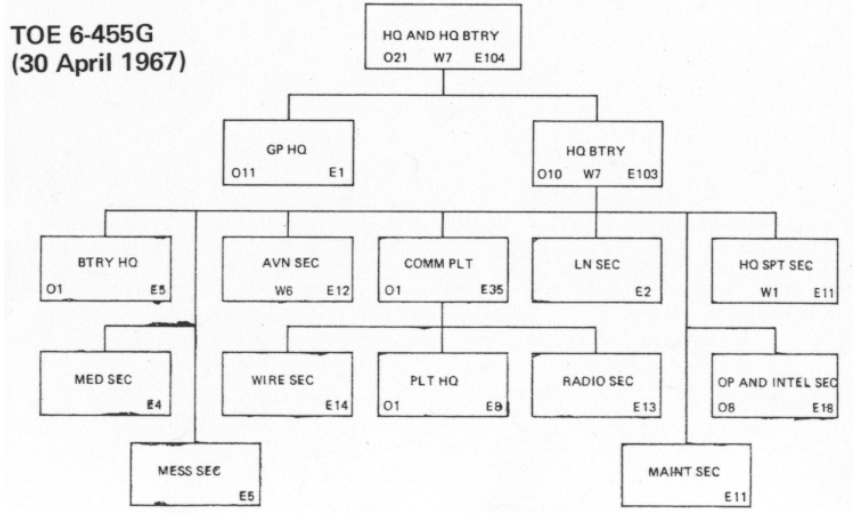

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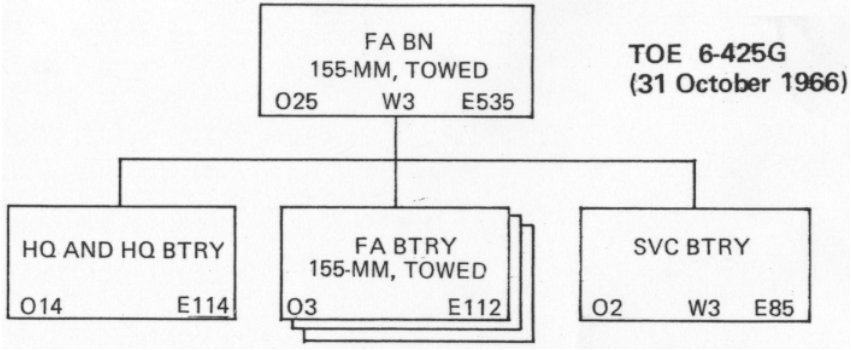

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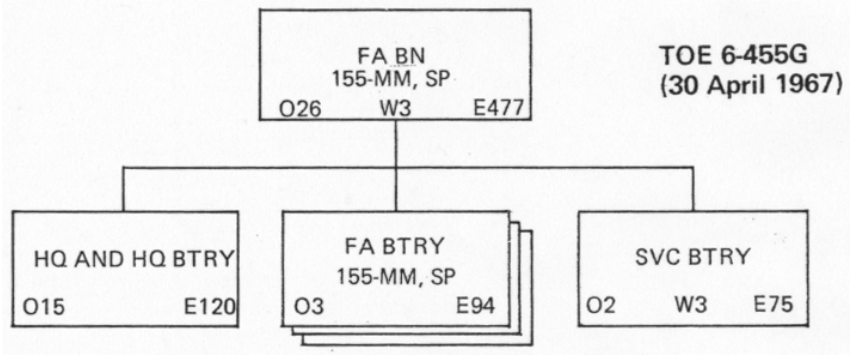

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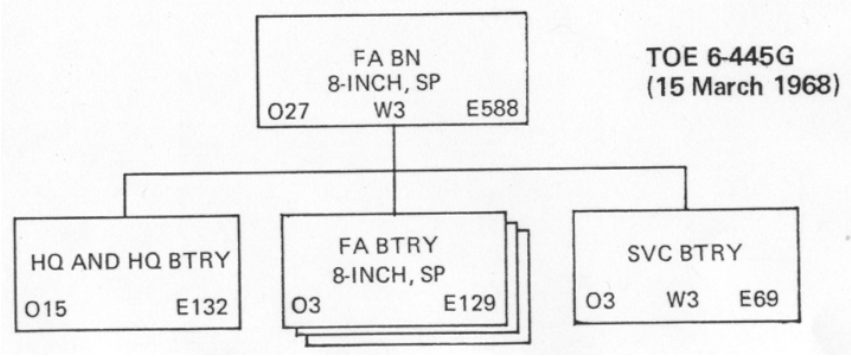
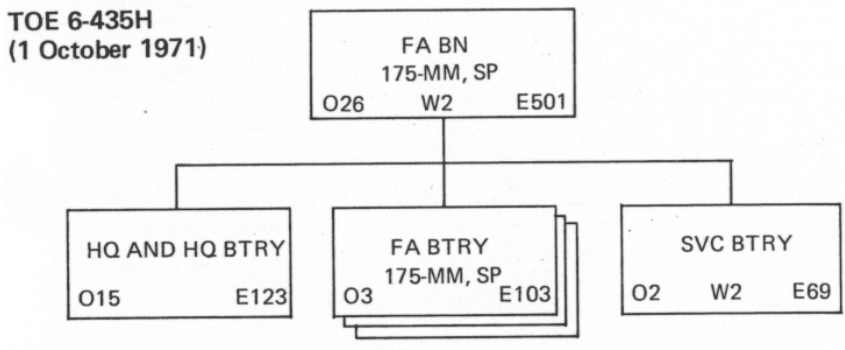


FA Bn, 8-in, SP

ARMY/CORPS ARTY



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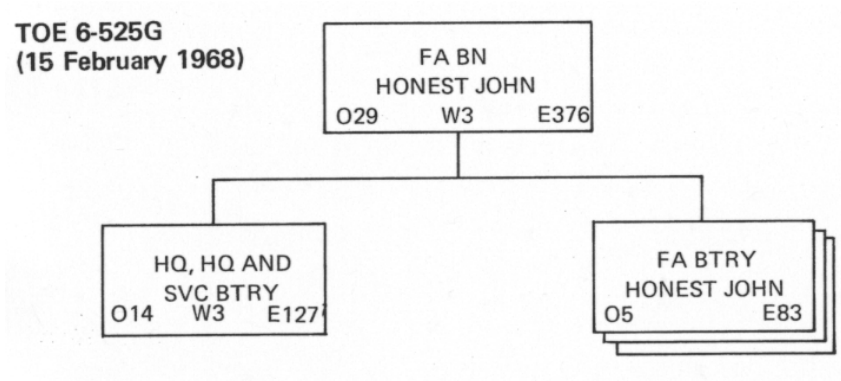

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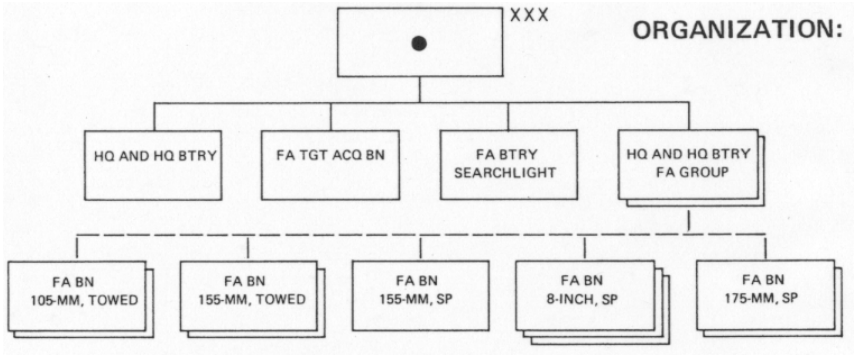
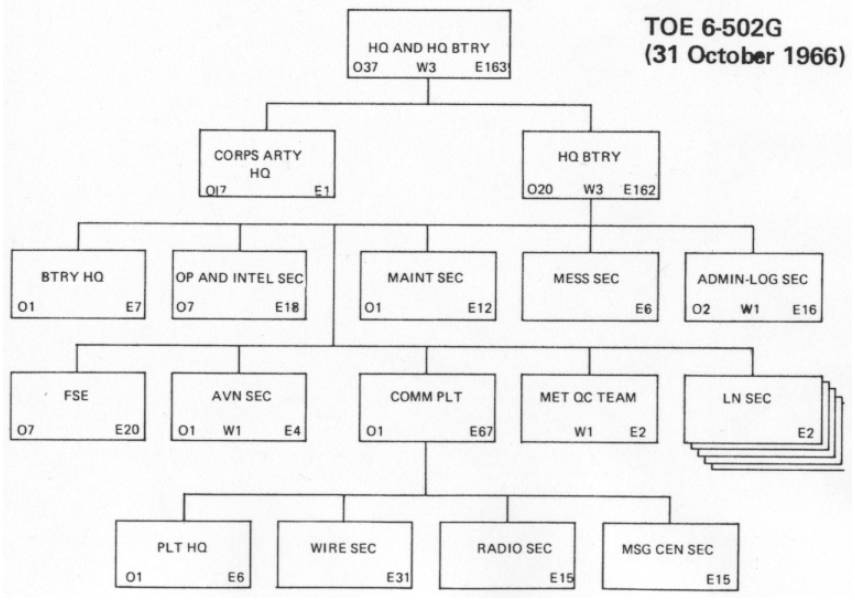
TYPE INDEPENDENT CORPS ARTILLERY FOR INSTRUCTIONAL PURPOSES

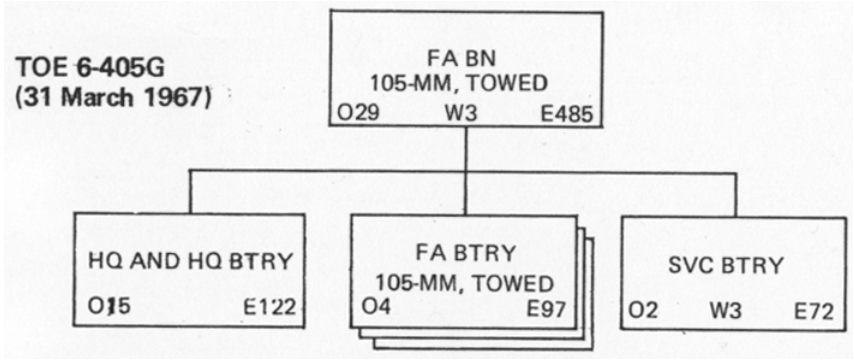


Note: This chart conforms to RB 101-1, US Army Command and General Staff College, 1 April 1971.



HHB, Abn Corps Arty

ARMY/CORPS ARTY



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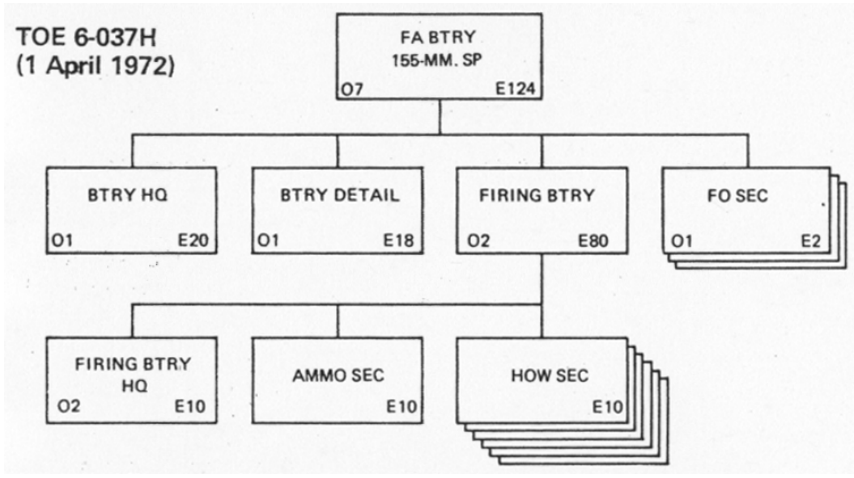
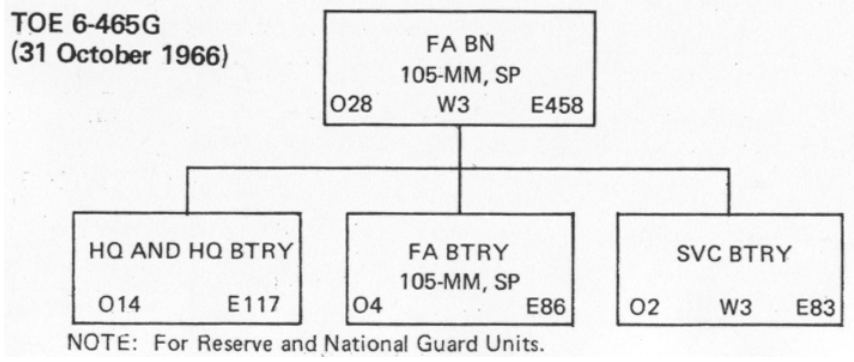
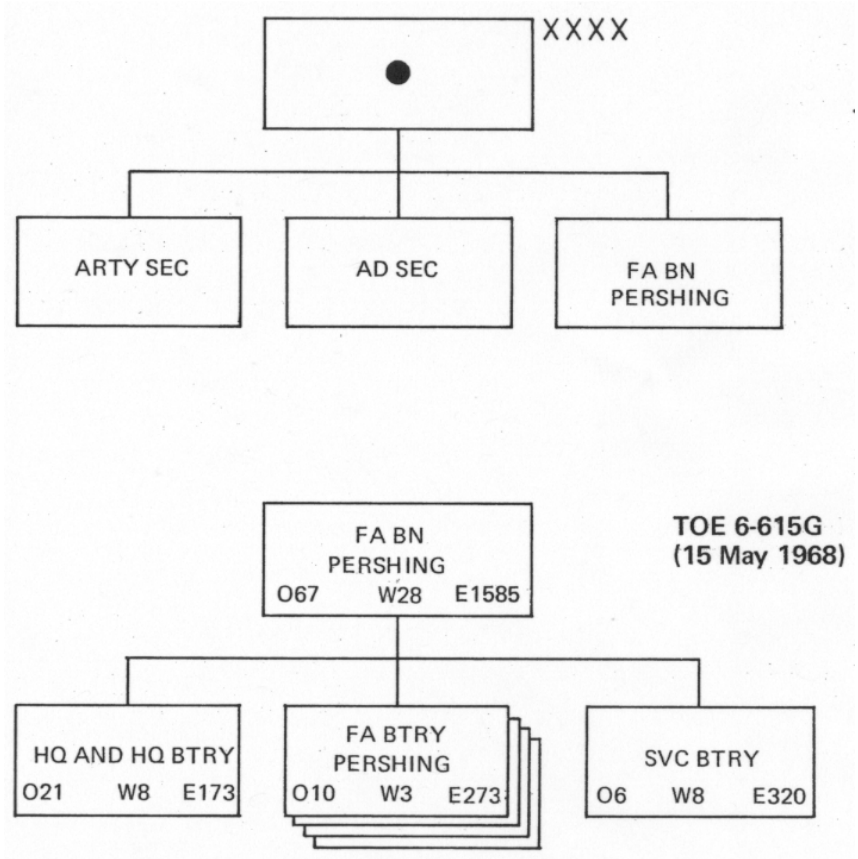


FA Btry, 155-mm, SP, Armd Cav Sqdn, Armd Cav Regt



FA Bn, 105-mm, SP

TYPE ARMY ARTILLERY
FOR INSTRUCTIONAL PURPOSES



FA Bn, Pershing

SECTION III

FIELD ARTILLERY OPERATIONS

FIELD ARTILLERY TACTICAL MISSIONS—INHERENT RESPONSIBILITIES

A field artillery unit with a mission of--	General support	General support-reinforcing	Reinforcing	Direct support
Answers calls for fires in priority from--	1. Force artillery headquarters 2. Own observers	1. Force artillery headquarters 2. Reinforced artillery unit 3. Own observers	1. Reinforced artillery unit 2. Own observers 3. Force artillery headquarters	1. Supported unit 2. Own observers 3. Force artillery headquarters
Establishes liaison with--	No inherent requirement	Reinforced artillery unit	Reinforced artillery unit	Supported unit (down to battalion level)
Establishes communication with--	No inherent requirement (internal communication only)	Reinforced artillery unit	Reinforced artillery unit	Supported unit
Has as its zone of fire--	Zone of supported unit/formation	Zone of supported unit/formation to include zone of fire of reinforced artillery unit	Zone of fire of reinforced artillery unit	Zone of supported unit
Furnishes forward observers--	No inherent requirement	Upon request of reinforced artillery unit, subject to prior approval of force artillery headquarters	Upon request of reinforced artillery unit	To each company-size maneuver element of supported unit
Is positioned by--	Force artillery headquarters	Force artillery headquarters or, subject to prior approval, the reinforced artillery unit	Reinforced artillery unit or ordered by force artillery headquarters	Unit commander as deemed necessary or ordered by force artillery headquarters
Has its fires planned by--	Force artillery headquarters	Force artillery headquarters	Reinforced artillery unit	Develops own fire plan

OPERATIONS

FIRE PLANNING

To accomplish the field artillery's mission of providing close and continuous fire support to the ground-gaining arms, the artilleryman must be prepared not only to provide fire support for current operations but also to plan artillery fire support for future operations in which the force might become engaged.

At the maneuver company level, the company commander briefs the forward observers (field artillery, 4.2-inch mortar, and 81-mm mortar) on the company's mission, plan of maneuver, and plan of fire support. Using data obtained at this briefing as a basis, the forward observers plan fires to support the company. Targets to be attacked by the 81-mm mortars normally remain at company level. Targets suitable for engagement by the 4.2-inch mortars are submitted by the 4.2-inch mortar forward observer to the mortar platoon fire direction center at maneuver battalion. After coordination with the 4.2-inch and 81-mm mortar forward observers and the company commander, the field artillery forward observer forwards his target list to the fire support officer at maneuver battalion. The fire support officer at maneuver battalion is responsible for preparing the target list and fire support requirements of the maneuver battalion. He does this by consolidating the target lists of the field artillery forward observers, adding appropriate targets from the 4.2-inch mortar platoon FDC target list, and adding any targets which he has planned based on information provided by the maneuver battalion commander and his staff. The fire support officer will resolve any target duplication existing on his target list prior to orally submitting the targets to the direct support field artillery battalion fire direction center. Upon approval of the target list by the maneuver battalion commander, the fire support officer submits the list in writing to the direct support field artillery battalion fire direction center to serve as a recapitulation of the targeting requirements submitted orally. He must also notify his forward observers of any changes to their target lists. An information copy of the target list is also submitted to the brigade fire support coordination center for consideration and evaluation by the brigade fire support officer and the brigade commander. The focal point for field artillery fire planning at brigade level is the direct support field artillery battalion fire direction center. The field artillery battalion S3 receives the target lists from the fire support officers at the maneuver battalions and targeting requirements from the fire support officer at brigade, as well as from several other sources including division artillery, adjacent units, and the field artillery battalion organic countermortar radar. The brigade commander may place the requirement for planning the fires of the maneuver battalion heavy mortars on the direct support field artillery battalion fire direction center. The field artillery battalion S3 will prepare the artillery fire support appendix and forward it to the brigade for approval. When approved by the brigade commander, the field artillery battalion S3 sends copies to his organic firing batteries, reinforcing field artillery, and all fire support officers. An information copy is submitted to division artillery along with requests for any additional fires.

Essentially, the same planning process takes place at the division artillery level. The division artillery S3 checks the artillery fire support appendixes submitted by the direct support field artillery battalions to eliminate duplications and to resolve any conflicts. The artillery fire support appendix prepared by the division artillery S3 is developed from the requests of subordinate field artillery units and corps artillery, fire support requirements of the division, and from target information provided by other sources such as counterbattery targets from the division artillery S2 and information from division artilleries with adjacent division. The completed division artillery fire support appendix is submitted to the division fire support element where it is checked against the appendixes of the other fire support means and then forwarded to the division commander for signatory approval.

Artillery fires are planned to support both offensive and defensive combat operations. Areas that should be covered by planned targets are confirmed enemy locations, suspect enemy locations, likely enemy locations, and prominent terrain features. The fire planner has a great deal of flexibility in that he has several techniques with which he may engage targets. He may attack two or more targets simultaneously (group of targets), plan fires on targets of a similar nature (program of targets), or plan fires to support a maneuver phase (series of targets). Both series of targets and program of targets may be fired on-call in accordance with a time sequence during the operation. A group of targets may be fired on-call separately or may be included into series of targets, preparation, or counterpreparation fires.

Fires delivered to assist and protect a unit involved in an offensive action are planned to engage targets before the preparation, during the preparation, and during the attack.

Fires before the preparation include the engagement of targets of opportunity, fires to cover the deployment and movement of attacking troops, registration, and harassing and interdiction fires.

A preparation fire is intense prearranged fire delivered in accordance with a time schedule to support an attack. Preparation fires start prior to, at, or after H-hour and continue until lifted either on a prearranged time schedule or on the request of the assault elements. Preparation fire is designed to destroy or seriously hamper the enemy's ability to resist attack. The decision to fire a preparation and the duration of the fire will be determined by the maneuver force commander ordering the attack. The artilleryman may be called on to advise the force commander in these areas. The primary questions to be resolved about firing the preparation fire are—

- Will the effect gained offset the loss of surprise?
- Have a sufficient number of profitable targets been located?
- Is enough artillery and ammunition available?
- What is the enemy reaction time?

OPERATIONS

Fires during the attack are those fires delivered to assist the advance of the supported unit. They consist of fires between the line of departure (LD) and the objective, fires on the objective, fires beyond the objective, and continuing neutralization fires on enemy indirect fire means.

Fires delivered to support and protect a unit engaged in a defensive action are planned to engage targets before the enemy forms for the attack, after the enemy forms for the attack, during the enemy attack, and to support the counterattack. These targets are planned in three general areas: in front of and on top of defensive positions, and behind the forward edge of the battle area (FEBA).

Fires delivered before the enemy forms for the attack include harassing and interdiction fires, fires that will force the enemy into early deployment, and fires in support of security forces.

Fires delivered after the enemy forms for the attack (counterpreparation) are planned fires designed to disrupt the enemy's attack by breaking up his formations, to disorganize his command and communications systems, and to decrease the effectiveness of his artillery. The counterpreparation is intense prearranged fire delivered when the imminence of the enemy attack is discovered. The counterpreparation is fired on order of the force commander, but again the artilleryman may be called on to make a recommendation.

If the enemy is successful in launching his attack, the artillery must deliver fires during the enemy attack to repel his assault and limit his penetration. Included in these fires are final protective fires (FPF). The precise location of an FPF is the responsibility of the company commander in whose sector it falls. The decision and authority to fire the FPF rests with the company commander and, when called for, will be fired at maximum rate of fire until it is ordered lifted by the supported unit. The forward observer has the following responsibilities concerning final protective fires:

- Relay the FPF locations to the fire direction center.
- Adjust each piece on the location of the FPF if sufficient time and ammunition are available.
- Relay the call for fire.

The final area in which we will plan fire in a defensive operation is to support a counterattack. The fire planning for the counterattack must provide for support of the counterattacking force, stopping or blunting the nose of the penetration, and sealing off the base of the penetrated area to prevent reinforcement by the enemy.

The detailed fire plan necessary to insure success of combat operations is disseminated in the form of the artillery fire support appendix. This appendix will include a written portion, a target overlay, a target list, and several artillery fire support tables. It is coordinated with the plans for the use of other fire support means available, such as tactical air and naval gunfire. Together, these appendices make up the fire support annex of the operation order.

To insure that all areas indicated as targets are clearly designated for future use in artillery fire planning, the field artillery has always had the responsibility of providing a common system of target designation. The system outlined in the following discussion is in accordance with STANAG 2031. This common target numbering system provides for the identification of the planning source of each target and permits a rapid resolution of duplication. In addition, this system—

- Is compatible with the TACFIRE computerized fire direction system under development and test for the post-1972 time period.
- Implements the ABCA (American, British, Canadian, and Australian) agreements.
- Differentiates between conventional, counter-battery, and toxic chemical targets.
- Conforms to security requirements
- Does not provide numbers for nuclear targets.

The target numbering system consists of two letters and four numbers. The two letters are used to denote the originating unit of the target and the four numbers are used to designate the planning individual and the specific target as a separate entity. The first of these two letters is assigned by corps to its major subordinate units. The system does not use the letters I and 0. Letter designations within a type corps are allotted as follows:

Units	Letters
Retained by corps	X
Attached divisions in numerical order	A through G
Armored cavalry regiments	H
Additional separate regiments, brigades, and as desired	J through W
Artillery groups of corps artillery	XA through XE
Additional corps, artillery groups, separate battalions, and as desired	XF through XX

Units	Letters
Corps artillery fire direction center	XY
Corps fire support element	XZ
Not used as first letters	YZ

The second letter is assigned by the division to its major subordinate units. Letter designations are allotted as follows:

Units	Letters
Brigades in numerical order	A through E
Organic artillery battalions in numerical order	F through L
Attached artillery or as desired	M through W
Not used	X
Division artillery fire direction center	Y
Division fire support element	Z

The four-digit numerical group following the two-letter group designates a specific target as a separate entity. Units assigned a two-letter group assign numbers as shown below:

Brigades of the divisions

Units	Numbers
Lowest numbered maneuver battalion attached	0001 through 0199
Units	**Numbers**
Next higher numbered maneuver battalion attached	0200 through 0399
Next higher numbered maneuver battalion attached	0400 through 0599
Next higher numbered maneuver battalion attached	0600 through 0799
Next higher numbered maneuver battalion attached	0800 through 0999

The block of 200 numbers assigned to a maneuver battalion may be further assigned to subordinate units as shown below:

Units	Numbers
Battalion headquarters, as desired	0—01 through 0—49
Heavy mortar platoon	0—50 through 0—99
Company A	0—00 through 0—24
Company B	0—25 through 0—49
Company C	0—50 through 0—74
Company D	0—75 through 0—99

Direct support battalion of division artillery

Most of the target planning is accomplished by the artillery representatives located at maneuver battalion and company. Therefore, the bulk of the target numbers are allocated to these units. A breakdown of these target numbers is shown below:

Units	Numbers
Fire support officer at brigade fire support center	1000-1999
Fire support officer with lowest number maneuver battalion	2000-2999
Fire support officer with next higher number maneuver battalion	3000-3999
Fire support officer with next higher number maneuver battalion	4000-4999
Fire support officer with next higher number maneuver battalion	5000-5999
Fire support officer with next higher number maneuver battalion	6000-6999
Artillery battalion fire direction center, as desired	7000-7999
Counterbattery targets	8000-8999
Toxic chemical targets	9000-9999

Targets planned by the artillery forward observer are assigned numbers by the artillery fire support officer with the maneuver battalion or task force from his block of allotted numbers.

Targets which are to be engaged by conventional ammunition delivered by aircraft will be assigned a number from the fire support coordination center/fire support element (FSCC/FSE) block numbers. Any targets to be engaged with air-delivered toxic chemical weapons are designated by a number from the 9000-9999 block as assigned to that command echelon.

When naval gunfire is available to Army units, the naval gunfire spotter teams and liaison officers will obtain target numbers from the FSCC/FSE block of numbers. A naval ship assigned a tactical mission is assigned a two-letter group in the same manner as attached artillery.

All nuclear targets, to include air-delivered weapons, are designated by a number from the classified target number list assigned to that command echelon. For more detailed discussions of all aspects of fire planning, refer to FM 6-20-2 or FM 6-20 when published.

FM 3-10B provides classified data on chemical agents and on the capabilities and effects of chemical munitions. This manual is classified CONFIDENTIAL.

AREA COMMUNICATION SYSTEM

The division employs an area communication system designed to insure rapid and responsive communication to meet the requirements of command control. The division signal officer, who is also the signal battalion commander, is responsible for the establishment, operation and supervision of all phases of communication within the division. The division signal battalion provides the necessary personnel and equipment to establish, operate, and maintain the division area communication system and various internal and external radio systems.

OPERATIONS

Composition of the Division Area Communication System

The area communication system consists of command and area signal centers linked together by a multichannel, multiaxis network of radio relay and carrier systems. In addition to the radio relay and carrier equipment available at each signal center, there are various combinations of other facilities.

The facilities normally available in a division area communication system are:

a. Radio relay and cable systems.
b. Patching and switching facilities.
c. Message center service.
d. Messenger service.
e. Radio/Wire Integration facilities.

SEARCHLIGHT EMPLOYMENT

The 30-inch Xenon searchlight is the standard field artillery searchlight. It is employed by a searchlight battery (TOE 6-558G) which consists of a battery headquarters, communications section, and three searchlight platoons. Each platoon consists of a platoon headquarters, six searchlight sections, and a light direction center.

The searchlight is capable of providing visible and infrared light. The beam can be changed manually to provide a pencil (focused), diffused (defocused), and spread beam.

The mission of the field artillery searchlight battery is to furnish direct or indirect illumination in support of tactical night operations within the division and corps area. The battery or any of its platoons or sections may be assigned the tactical mission of general support, direct support, or a modified mission.

TECHNICAL CHARACTERISTICS AND OPERATION DATA:

Light Source	Short-arc Xenon lamp, rated at 10, 15, or 20 KW (depending upon generator used).
Power Requirements	120/208-volt, 400 Hz, 3 phase, 15, 20, or 25 KW generator (15 KW generator presently issued)
Candlepower	800 million to 1.5 billion depending upon power source.
Focused or Pencil Beam Width	30 mils in diameter.
Defocused Beam Width	160 mils in diameter.
Spread Beam Width	180 mils in diameter.
Range (Visible Light)	7500 meters plus, depending upon weather conditions.
Range (Infrared Light)	2500 meters plus, depending upon weather conditions.

As in normal target location, an observer requests illumination by grid reference, target number, or shift from a known point. However, searchlight illumination requests involve the use of vocabulary which varies somewhat from that of the normal fire mission. Following is listed special terminology used for conduct of an illumination mission.

ACTION COMPLETE—Report of compliance with last command.

FLICK—Command to turn on the searchlight; corresponds to the command FIRE.

HOLD—Command to keep the searchlight on the same elevation; corresponds to the command REPEAT.

CUT—Command to turn off the searchlight; corresponds to the command CHECK FIRING.

FOCUSED OR PENCIL BEAM—A beam 30 mils in width.

DEFOCUSED BEAM—A beam 160 mils in width.

SPREAD BEAM—A beam 180 mils in width.

The elements and sequence of a request for illumination and adjustment are illustrated below:

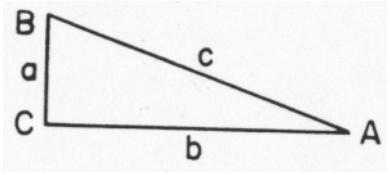
ELEMENT	EXAMPLE
Identification of observer	FRANKSCOTT 30, THIS IS FOXTROT 41
Warning	ILLUMINATION MISSION
Target Location	GRID 419631, Direction 1680
Description of target	SUSPECTED ENEMY PLATOON
Method of engagement	
Number of lights	LIGHTS—Adjustment is usually made with one light
Type of Illumination	INDIRECT—Type of illumination omitted when direct illumination is desired.
Beam Spread	SPREAD BEAM—Beam spread is omitted when pencil beam is desired.
Control	ADJUST LIGHT, FLICK WHEN READY

NOTE: Adjustment is made along the Searchlight target line by announcing beam spread corrections; for example, RIGHT 2 BEAMS, UP ½ BEAM.

ARTILLERY MATHEMATICS

Trigonometric Functions

In any right triangle, the ratio of one side to either of the other two sides depends directly on the size of the angle. As long as the angle remains the same, the sides, no matter how long, will maintain the same ratio.



$$\text{sine (sin) A} = \frac{\text{side opposite}}{\text{hypotenuse}} = \frac{a}{c} \qquad \text{tangent (tan) A} = \frac{\text{side opposite}}{\text{side adjacent}} = \frac{a}{b}$$

$$\text{cosine (cos) A} = \frac{\text{side adjacent}}{\text{hypotenuse}} = \frac{b}{c} \qquad \text{cotangent (cot) A} = \frac{\text{side adjacent}}{\text{side apposite}} = \frac{b}{a}$$

The Law of Sines

If any side and the angle opposite that side and any other side or angle are known in any triangle, the triangle can be solved by using the law of sines below.

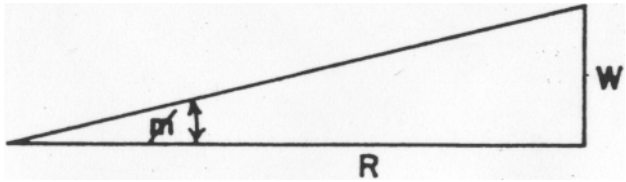
$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\text{Sin } C}$$

Mil Relation

A mil is that angle subtended by an arc which is one 6400th of the circumference of a circle.

The mil relation is frequently used in field artillery computations for approximations of ranges and widths. For example, the forward observer uses the relation in conjunction with the mil scale on his binoculars, to adjust artillery fires. Since the distance so measured represents a width across two equal radii rather than a perpendicular to the observer-target line, the mil relation becomes inaccurate for large deviations, and rough sine factors (normally used with angles 600 mils or greater) should be used. The mil relation is depicted below.

$$mils = \frac{W}{R}$$



mils = angular measurement in mils between two points.
W = the lateral distance in meters between the points.
R = the mean distance to the points in thousands of meters.

CONVERSION FACTORS

Multiply To Obtain	By	To Obtain Divide
Distance		
Inches	25.4	Millimeters
	2.54	Centimeters
	0.0254	Meters
	0.0833	Feet
	0.0278	Yards
Feet	12.0	Inches
	0.3333	Yards
	304.8	Millimeters
	30.48	Centimeters
	0.3048	Meters
Yards	3.0	Feet
	36.0	Inches
	914.4	Millimeters
	91.44	Centimeters
	0.9144	Meters
Statute Miles	5280.0	Feet
	1760.0	Yards
	1609.3	Meters
	1.6093	Kilometers
Nautical Miles	1.1508	Statute Miles
	1.852	Kilometers
	1852.0	Meters
	6076.0	Feet
Knots	1.1508	Miles per hour
	1.6878	Feet per second
	0.5144	Meters per second
Kilometers	1093.6	Yards
	3280.84	Feet
Miles per hour	1.4667	Feet per second
	0.447	Meters per second
Feet per second	0.3048	Meters per second
mach number	1100.0*	Feet per second
mach number	340.294*	Meters per second
Angular		
Degrees	17.78	Mils
Minutes	0.296	Mils
Seconds	0.00494	Mils
Weight		
Ounces	0.0625	Pounds
Kilograms	2.205	Pounds
Tons (long)	2240.0	Pounds
Tons (short)	2000.0	Pounds
Tons (metric)	1.1023	Tons (short)
Volume		
Gallons (US liquid)	3.785	Liters
Cubic inches	0.01639	Liters

* Variable dependent upon meteorological conditions

NOTE: MEASUREMENT TON is a measure of cubic volume of cargo expressed in units of 40 cubic feet (AR 320-25, Dictionary of United States Army Terms, March, 1969.)

ALPHABETICAL INDEX TO THE FIELD ARTILLERYMAN

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