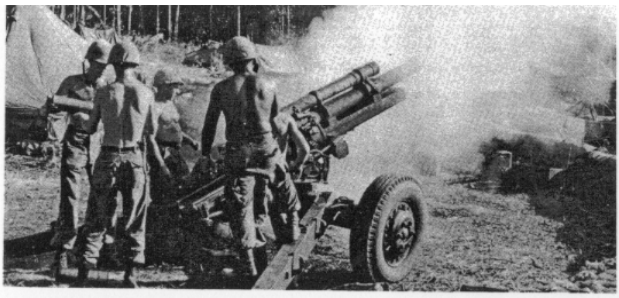
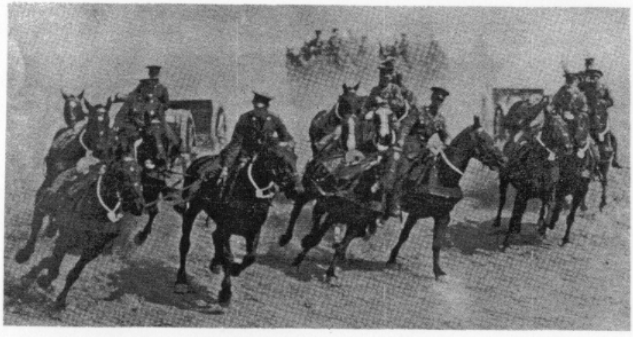
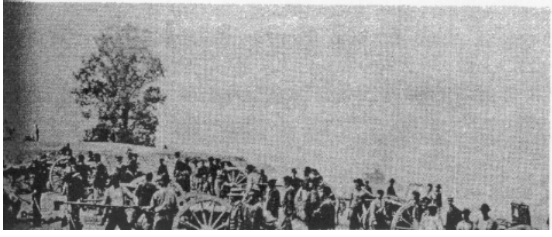
ARTILLERY TRENDS







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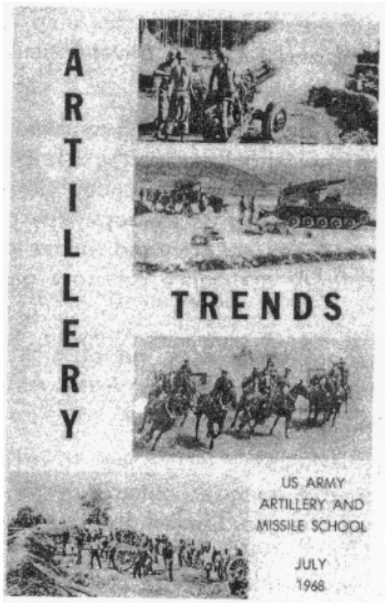
INSIDE THIS ISSUE

INSTRUCTIONAL AID NUMBER 41

ARTILLERY TRENDS is an instructional aid of the United States Army Artillery and Missile School published only when sufficient material of instructional nature can be gathered.

Introduction



● COVER

Field artillery equipment, organization and operations have changed considerably through the years as depicted from bottom to top on the cover. In the first picture, Matthew Brady finds a Union battery lined up in breastworks at the battle of Petersburg, Virginia, in 1864. Horses still served as the artillery's prime mover in World War I and the pre-World War II era. The second picture shows the "Black Horse" battery in full gallop. The Korean conflict revealed further sophistication in the artillery when compared to that used years earlier. In the third picture a 155-mm self-propelled howitzer platoon prepares for action north of Hamhung, Korea, in support of the 32d Infantry Regiment, 7th Division.

The top picture shows one of the first U.S. Artillery units to arrive in Vietnam. Even since then, organization, operations and equipment have changed. This issue is intended to reflect the latest changes in these three areas and to update the July 1966 issue of **ARTILLERY TRENDS.**

Information contained in this issue is a general reference to the present day field artillery weapon systems. However, where research requires the detailed investigation of any particular component of a weapon system, or of any particular phase of its organization or operations, it is recommended that all applicable publications be consulted.

The material contained within this issue represents the best information available at time of publication. All readers and users of the handbook are invited to forward information concerning changes or suggestions for improvement of content and format to:

COMMANDANT
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Artillery Trends

As an instructional aid of the United States Army Artillery and Missile School, **ARTILLERY TRENDS** is published only when sufficient material of an instructional nature can be accumulated. It is designed to keep field artillerymen informed of the latest tactical and technical developments in artillery.

In accordance with AR 310-1, distribution of **TRENDS** will not be made outside the command jurisdicton of the School except for distribution on a gratuitous basis to Army National Guard and USAR schools, Reserve Component staff training and ROTC programs, and as requested by other service schools, ZI armies, U. S. Army Air Defense Command, active army units, major oversea commands, and military assistance advisory groups and missions.

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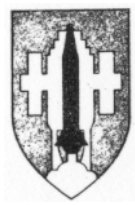
Primarily, articles are prepared by individuals assigned to departments of the School or to artillery units and agencies outside the School. All articles, no matter what the source, are coordinated by appropriate departments in the School and with the U. S. Combat Developments Command Artillery Agency and the U. S. Army Artillery Board collocated with the School at Fort Sill, Oklahoma. This coordination is effected in an effort to arrive at an "Artillery Community" position before publishing the information. The Artillery Community is Fort Sill's term for the center team concept of Continental Army Command, Army Materiel Command, and the Combat Developments Command.



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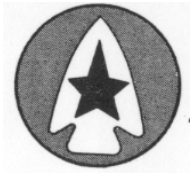


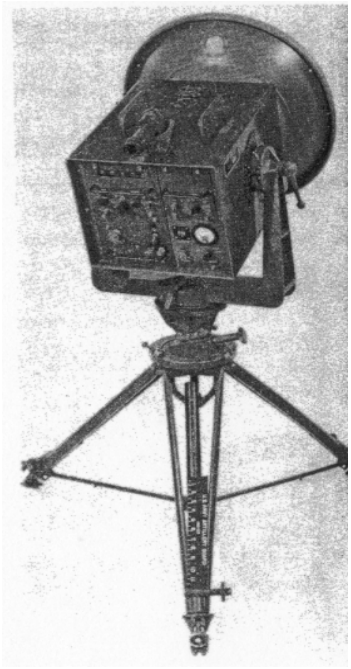
U. S. Army Combat Developments Command Artillery Agency

Commanding Officer	Colonel A. F. Rollins

SECTION I

CHRONOGRAPH, M36

Chronographs, utilizing the radar doppler system, will soon be available as organic items to corps artillery, division artillery and group headquarters. The M36 Chronograph is a 1/4-ton truck and trailer portable electronic instrument which measures weapon projectile velocities ranging from 75 to 1,860 meters per second. It is more flexible than skyscreen equipment and is ideally suited for day or night tactical operations.



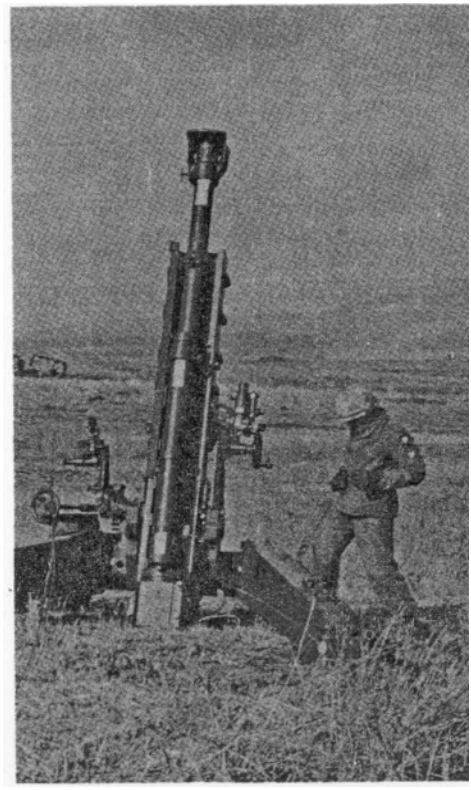
The M36 operates from the vehicle or ground mount at the side of the cannon being calibrated. It is laid parallel to the weapon and follows changes in direction and QE as fast as the piece can be laid. Formal calibration need not be arranged as the chronograph can be used with any firing on a tactical target or during service practice.

After each round fired, the M36 displays a readout which is the indicated velocity of the projectile at some pre-determined point along the trajectory. The indicated velocity is corrected for all nonstandard conditions except those of tube wear and propellant efficiency. The corrected velocity is the muzzle velocity of the weapon, charge and propellant lot used for the calibration.

Given chronograph, survey, and met support, it will no longer be required to register for the purpose of obtaining a velocity error (VE). The muzzle velocity may be used in FADAC or, when converted to a muzzle velocity variation (MVV), it may be used in lieu of a VE.

XM164 105-mm HOWITZER (TOWED)

The U. S. Marine Corps is experimenting with a lightweight towed 105-mm howitzer, the XM164, in a project to develop a lightweight replacement for the M101A1 howitzer. The Marine Corps reports that an accuracy test and service tests conducted on the experimental model proved the weapon to be the equal of the M101A1 howitzer in every regard and its reduced weight of 3,500 pounds is a significant improvement over that of the M101A1.

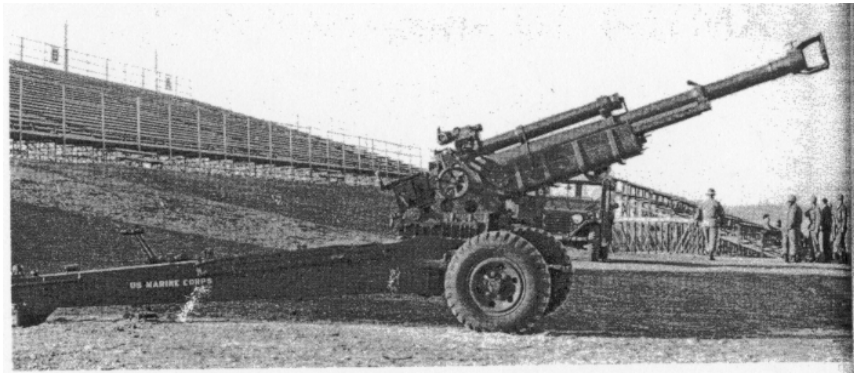


The XM164 fires all current and developmental 105-mm ammunition and has a range capability of 15,000 meters when firing rocket assisted projectiles. The principal innovation on the XM164 is the incorporation of a variable recoil mechanism which eliminates the need for recoil pits during high-angle fire. The mechanism also eliminates the amount of time spent in counter recoil permitting a maximum rate of fire of 7 rounds in 15 seconds.

The fire control equipment is essentially the same as that presently used on the M102 howitzer except that it is removable from the weapon. The fire control equipment will be lighted by luminescent night lighting equipment now under development, thereby eliminating batteries and external wire.

A quick release lock is incorporated to reduce the size of the weapon for internal loads. When released, the lock allows the recoiling parts to slide to the rear where they are secured by a quick release pin. This operation reduces the overall length of the weapon by 52.25 inches.

WEAPONS



CHARACTERISTICS

Weapon System, XM164 Complete

*Weight ..... 3548 lb
Length
Firing Position, Muzzle Brake in Active Position ... 269 in
Traveling Position, Muzzle Brake in Active Position ..... 276.50 in
Cannon Out-of-Battery, Muzzle Brake in Passive Position ..... 218.75 in
Width
Traveling Position ..... 73.25 in
Height
Traveling Position, Lunette at 22 in
Muzzle Brake Active Position ..... 62 in
Firing Position, 0° QE .... 58 in
Road Clearance ..... 11.50 in
Angle of Departure ..... 25°22′
Center of Gravity
(Rear of Centerline Spindle) ..... 13.6 in
(Above Centerline Spindle) 38 in
Lunette Load, Towing at 22 in ..... 250 lb
Elevation Range .... —5° to +75°
Traverse Range (Right and left) ..... 22-1/2°

Cannon, Howitzer, 105-mm, XM165

Weight, Overall ..... 1028 lb
Length, Overall ..... 131.57 in
Length of Bore ..... 108.90 in
Number of Grooves 36
Twist, Right-Hand Progressive 1/35-18
Breech Mechanism Type Horizontal sliding wedge, manual,
Firing Mechanism ..... Internal percussion, mechanical

Recoil Mechanism, XM44

Weight ..... 499 lb
Type ..... Hydropneumatic
Length of Recoil ..... 26 to 50-3/4 in., variable

*The muzzle brake is being eliminated which will reduce the weight by approximately 80 pounds.

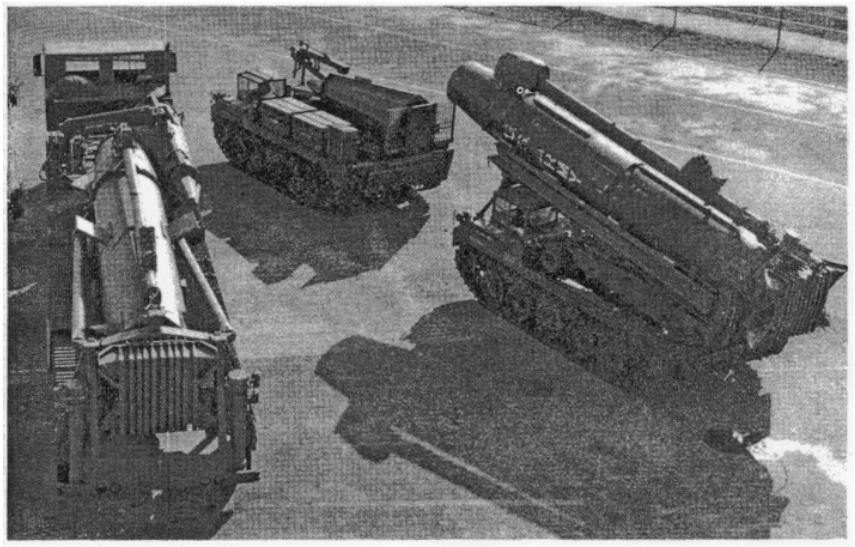
Carriage, XM38

Weight with Equipment ..... 2021 lb
Trail ..... Split trail (aluminum alloy) 45° spread angle
Equilibration ..... Pneumatic type (gas pressurized)
Tires ..... Pneumatic, 7.50 × 15, 10 ply; 40 psi pressure
Traversing Mechanism ..... Screw type system

Fire Control

Direct fire, quadrant, mount, XM14; elbow telescope, XM114 indirect fire, telescope mount, MODIFIED; panoramic telescope XM113 (modified)
Ammunition
Type ..... Semifixed
Projectile ..... Cartridge, HE, M1
Muzzle Velocity, Zone 7 ..... 1621 fps
Chamber Pressure, Average, Zone 7 ..... 36400 psi

Pershing XMGM-31A



The improved erector-launcher, left, is currently under development for the Pershing missile system. The single vehicle, mounted on wheels instead of tracks, will carry the complete missile. The new wheeled version is designed for faster movement and high reliability while at the same time reducing vibration and maintenance costs. The erector-launcher prime mover M757, with eight-wheel drive, has four steerable front wheels and is designed for operation both on rough terrain and roads. The present system, shown at right, and now deployed in Europe, uses tracked vehicles to transport the missile in two sections.

WEAPONS

TABLE IA. CANNON

Weapon	M116 75-mm pack how	M101A1 105-mm how (towed)	M102 105-mm how (towed)	M52A1 105-mm how (SP)
Maximum range (meters)	8,796	11,000	11,500	11,000
Traveling weight (pounds)	1,440	4,980	3,200	53,000
Air transportability	Phase I	Phase I	Phase I	Phase III
Traverse limits (mils)	53 right and left of center	409 right and 400 left of center	6,400	1066 right and left of center
Elevation limits (mils)	-89 to +800	-89 to +1156	-89 to +1333	-178 to +1156
Sustained rate of fire (rd per min)	2.5	3	3	3
Water crossing capability	Floatable	Floatable	Floatable	Fordable (48 inches)
Time to emplace (minutes) (1)	7	3	4	1
Prime mover	1/4-ton truck; helicopter; packs	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	NA	6-155G 6-185G 6-405G 6-705T	6-215G 6-705T	6-345G 6-385G 6-465G
Reference manuals	FM 6-78 TM 9-319 FT 75-I-4 FT 75-I-4 (Abr)	FM 6-75 TM 9-3007 TM 9-325 FT 105-H-6, C 2, 6, 7 FT 105 ADD-B-1, C 3, 4 FT 105 ADD-D-0 (REV) (REV 11) (2)	FM 6-70 TM 9-1015-234-12 FT 105-AS-2, C 1 FT 105 ADD-B-1, C 3, 4, 5 FT 105 ADD-E-0 (REV) (REV 11)	FM 6-77 TM 9-7204 FT 105-H-6 C 2, 6, 7 FT 105 ADD-B-1, C 2, 3, 4 FT 105 ADD-D-0 (REV) (REV 11) (2)

(1) Time to emplace is that time required to emplace and lay single registering piece.
(2) Not an AGO publication. To obtain TFT's write to:

Commanding Officer
Ballistic Research Laboratory
ATTN: AMXBR-CE
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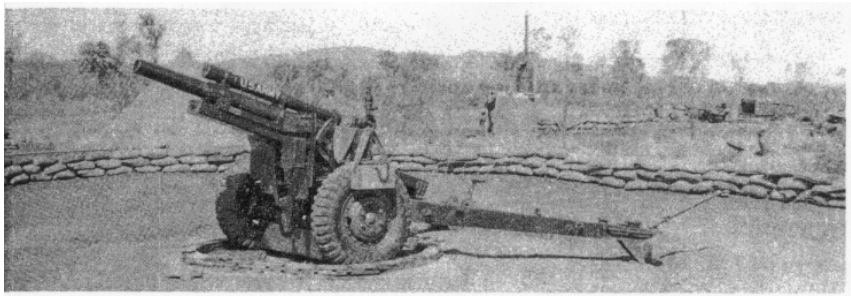

Figure 1. 105-mm How M101A1

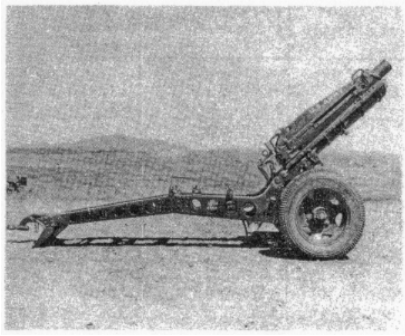

Figure 2. 75-mm How M116

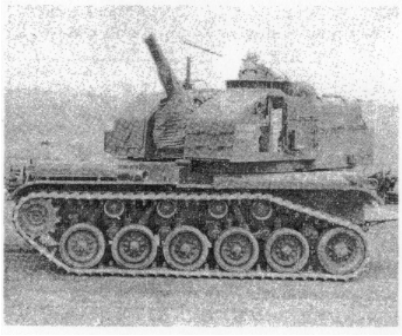

Figure 3. 105-mm How M52A

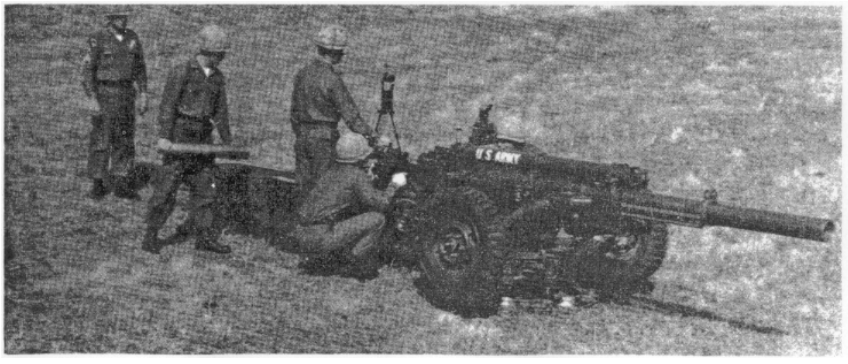

Figure 4. 105-mm How M102

TABLE IA. (Cont)

Weapon	M108 105-mm how (SP)	LVTH6A1 105-mm (SP)	M114A1 155-mm how (towed)	M123A1 155-mm how (aux SP)
Maximum range (meters)	11,500	11,000	14,600	14,600
Traveling weight (pounds)	46,900	86,600 L 84,200 W	12,700	13,540
Air transportability	Phase III	NA	Phase I	Phase I
Traverse limits (mils)	6,400	6,400	448 right and 418 left of center	448 right and 418 left of center
Elevation limits (mils)	-106 to +1333	-73 to +1068	0 to +1156	0 to +1156
Sustained rate of fire (rd per min)	3	3	1	1
Water crossing capability	Amphibious (with kit)	Amphibious	Fordable (30 inches)	Fordable (30 inches)
Time to emplace (minutes) (1)	1	1	5	5
Prime mover	SP	SP	5-ton truck CH-47B CH-47A	5-ton truck; auxiliary CH-47B CH-54A
Using TOE	6-345G 6-385G 6-465G	NA	6-165G 6-425G	
Reference manuals	FM 6-79 TM 9-2350-217-10 FT 105-AS-2 FT 105 ADD-B-1, C 3, 4, 5 FT 105 ADD-E-O (REV) (REV 11) (2)	LI 00512B-10/1 TM 05512C/10/1 FMFM 9-2	FM 6-81 TM 9-1025-200-12 FT 155-Q-4, C 1 FT 155-AI-1, C 1 FT 155 ADD-A-1, C 2, 3, 4, 5 FT 155 ADD-C-1, C 1, 2	FM 6-81 TM 9-1025-200-12 FT 155-Q-4, C 1 FT 155-AI-1, C 1 FT 155 ADD-A-1, C 2, 3 4, 5 FT 155 ADD-C-1, C 1, 2

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

Figure 5. 105-mm How M108

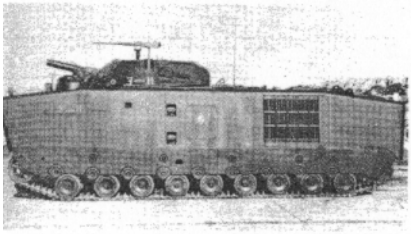

Figure 6. 105-mm How LVTH6A1

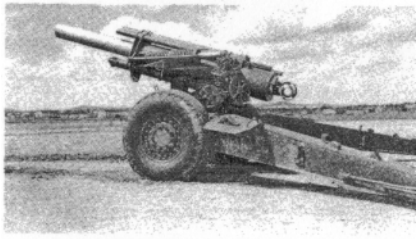

Figure 7. 155-mm How M114A1

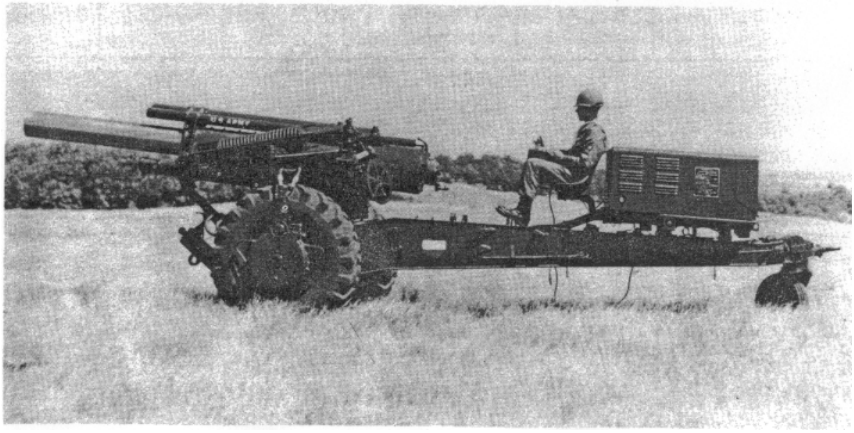

Figure 8. 155-mm How M123A1

WEAPONS

TABLE IA (Cont)

Weapon	M53 155-mm gun (SP)	M44A1 155-mm how (SP)	M109 155-mm how (SP)	M115 8-inch how (towed)	M55 8-inch how (SP)
Maximum range (meters)	23,514	14,600	14,600	16,800	16,800
Traveling weight (pounds)	99,000	64,000	51,100	29,700	98,000
Air transportability	Phase III	Phase III	Phase III	Phase III	Phase III
Traverse limits (mils)	533 right and left of center	533 right and left of center	6400	533 right and left of center	533 right and left of center
Elevation limits (mils)	-89 to +1156	-89 to +1040	-53 to +1333	-36 to +1156	-89 to +1156
Sustained rate of fire (rd per min)	3	1	1	0.5	0.5
Water crossing capability	Fordable (42 inches)	Fordable (42 inches)	Amphibious (with kit)	Fordable (60 inches)	Fordable (48 inches)
Time to emplace (minutes)(1)	1	1	1	20	1
Prime mover	SP	SP	SP	10-ton truck	SP
Using TOE	6-447E	6-355G 6-455G	6-37G 6-355G 6-365G 6-455G 6-375G	6-415G	6-355G 6-445G
Reference manuals	FM 6-93 TM 9-2350-210-12	FM 6-92 TM 9-7004 FT 155-Q-4, C 1 FT 155 ADD-A-1, C 2, 4, 5 FT 155-AI-1, C 1 FT 155-ADD-C-1, C 1, 2	FM 6-88 TM 9-2350-217-10 FT 155-AH-2, C 1, 2, 3 FT 155-AJ-1, C 1 FT 155 ADD-A-1, C 2, 4, 5 FT 155 ADD-B-1 C 1, 2	FM 6-90 TM 9-3004 FT 8-J-4 FT 8-0-4 FT 8 ADD-A, C 1	FM 6-93 TM 9-7220 FT 8-J-4 FT 8-0-4 FT 8 ADD-A-1, C 1

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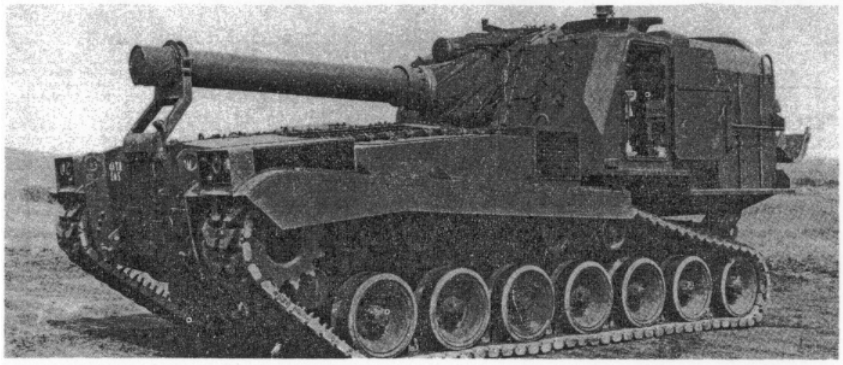


Figure 9. 8-in How M55

Figure 10. 155-mm How M109

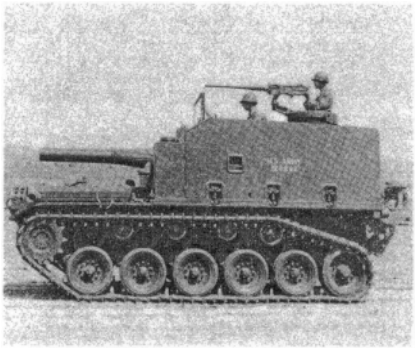


Figure 11. 155-mm How M44A1

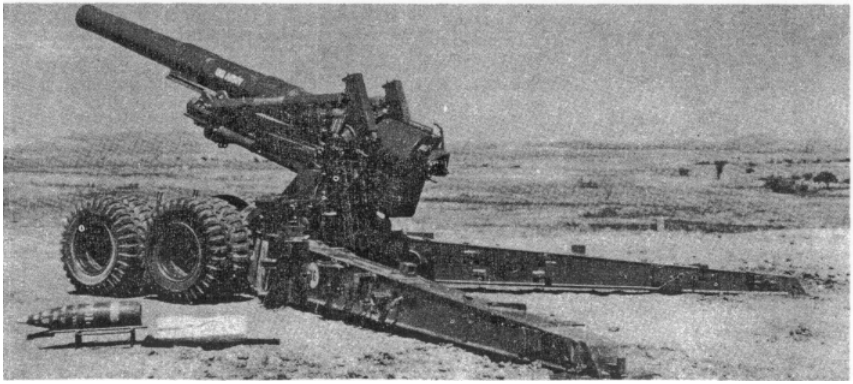


Figure 12. 8-in How M115

TABLE IA. (Cont)

Weapon	M110 8-in how (SP)	M107 175-mm gun (SP)	M3 armament subsystem, helicopter (2.75-in rkt)	M91* 115-mm multiple rkt launcher
Maximum range (meters)	16,800	32,700	2,500	10,600
Traveling weight (pounds)	58,500	62,100	NA	1,200
Air transportability	Phase III	Phase III	Phase I	Phase I
Traverse limits (mils)	533 right and left of center	533 right and left of center	6400	178 right and left of center
Elevation limits (mils)	+35 to +1156	+35 to +1156	NA	+14 to +1067
Sustained rate of fire (rd per min)	0.5	0.5	4 second ripple of 48 rds	15 second ripple of 45 rds
Water crossing capability	Fordable (42 inches)	Fordable (42 inches)	NA	Fordable (30 inches)
Time to emplace (minutes) (1)	2	3	NA	30 (includes loading 45 rds)
Prime mover	SP	SP	UH-1B Helicopter	2 1/2-ton truck
Using TOE	6-355G 6-445G 6-165G	6-435G	6-725T	DS bn TOE, all div artys, and sep bde artys except abn
Reference manuals	FM 6-94 TM 9-2300-216-10 FT 8-J-4 FT 8-O-4 FT 8 ADD-A-1, C 1	FM 6-94 TM 9-2300-216-10 FT 175-A-0 (REV II), C 1 (2)	TM 9-1950	FM 6-54 TM 9-1055-215-12 FTR 115-C-1

*Now shown as a discretionary item in all G-series direct support battalions; mechanized infantry and armored divisions; and separate brigades. Not shown in airborne and airmobile division TOE.

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

(2) Not an AGO publication. To obtain TFT's write to:

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

Figure 13. 2.75-in Folding Fin Aerial Rocket System M3

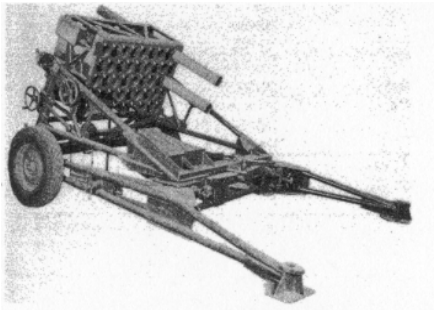


Figure 14. 115-mm Multiple Rocket Launcher M91

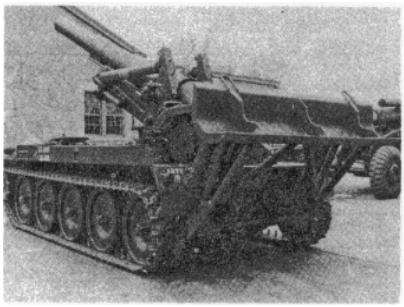


Figure 15. 8-in How M110

Figure 16. 175-mm Gun M107

WEAPONS

TABLE IB. ROCKETS AND MISSILES

Weapon	MGR-3A Little John	MGR-1B Honest John	XMGM-29A Sergeant	XMGM-31A Pershing (P1) (P1A)	XMGM-52B Lance
Min and max range (approx)	3000 m to 20,400 m (max rg)	5000 m to 38,000 m (max rg)	46 km to 140 km	185 km to 740 km (1)	Max rg greater than that of HJ (1)
Water fording capability (inches)	21	30 (wo kit) 60 (w kit)	30	42 (P1) 31 (P1A)	Amphibious
Guidance	Free flight	Free flight	Inertial	Inertial	Modified inertial
Propulsion	Solid propellant	Solid propellant	Solid propellant	Solid propellant	Storable prepackaged liquids
Mobility	Air--phase I Veh--100%	Air--phase II Veh--100%	Air--phase II Veh--100%	Air--phase II (P1) (P1A) Veh-100% (P1) (P1A) Helicopter (P1)	Air--phase I Veh--100%
Prime mover	3/4-ton truck; Helicopter	M139 5-ton truck chassis M386	5-ton tractor M52	XM474E2 (P1) tracked M656 (P1A) wheeled	XM667E1 SP launcher
Field of fire (mils)	267 right and left of center	267 right and left of center	R3111 L3111	R2225 L2225	400 right and left of center
Launch elevation (mils)	0 to +978	72 to +1066	+1333	+1600	25*, 48*, 54*
Length of rkt or msl (meters)	4.36	7.58	10.52	10.55	6.10
Diameter (millimeters)	318	762	787	1016	559
Rkt or msl weight (pounds)	778.6	4,719	10,000	10,275	3,260
Using TOE	6-565T	6-175G 6-525G	6-555G	6-615D (P1) 6-615G (P1A)	6-195T 6-595T
Reference manuals	TM 9-1055-212-12 FM 6-57 FTR 318-A-1 FTR 318 ADD-A-1 FTR 318 ADD-B-1	TM 9-1055-205-10 FM 6-59 FTR 772-G-1 FTR 762-H-1 FTR 762 ADD-C-1, 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 9-1400-375-series (P1) POMM 9-1440-380-19 (P1A) series	POMM 9-1400-485-12

(1) Change from past published instruction.

Figure 17. Pershing Missile XMGM-29A

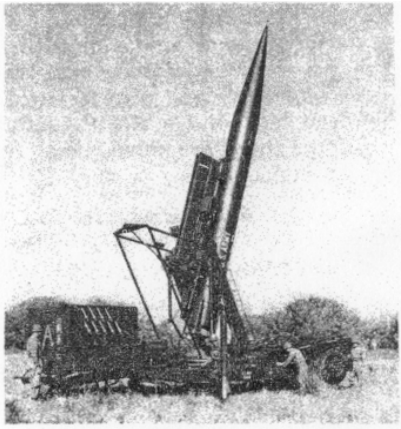


Figure 18. Sergeant Missile XMGM-29A

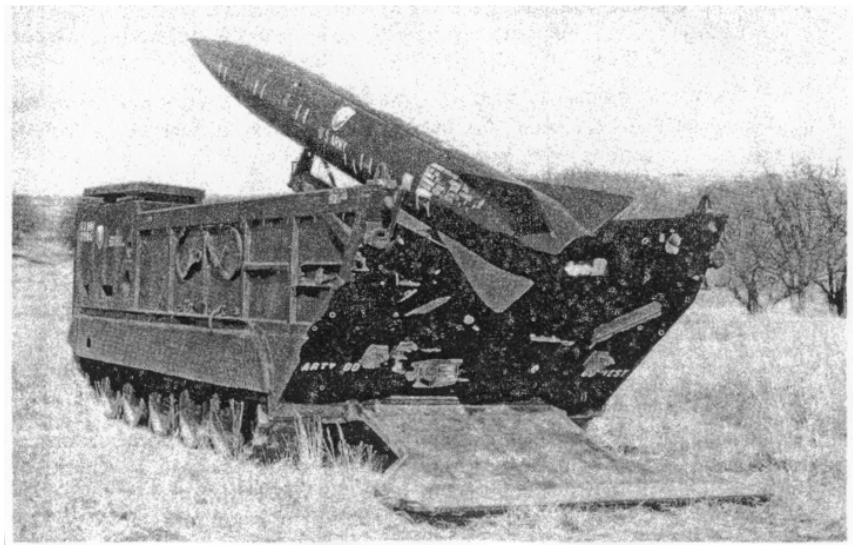


Figure 19. Lance Missile XMGM-52A

AMMUNITION

105-mm HOWITZER PROPELLING CHARGES

Two new propelling charges for the 155-mm howitzer are being manufactured and will soon be available for field use. The propellants are the M3A1 (green bag) and M4A2 (white bag). They will replace the current M3 and M4A1 charges. A detailed discussion of the propellants can be found in TM 9-1300-203.

There are three major differences between the new and old propellants.

- To reduce residue, both the M3A1 and M4A2 have a clean burning igniter instead of the three ounces of black powder in the M3 and M4A1.

- A separate M2 flash reducer is not required for the M4A2 charge. Flash reducer is included in the M4A2 at the time of production.

- The muzzle velocities for charges 3, 4 and 5 of the M3A1 have been adjusted so that they are equal to the M4A1 and M4A2 corresponding charges; i.e., M3A1 charges 3, 4 and 5 have been increased by 6.1, 6.1 and 3.0 meters per second, respectively.

Changes to firing tables will be published and distributed in the near future. These changes will state that the white bag portion of TFT 155-AH-2 and 155-Q-4 are applicable to the M3A1 propellant except for probable error data and that current TFT's are applicable to the M4A2 propellant without change.

Special muzzle velocity corrections need not be applied to selected ammunition or illuminating projectiles for the following reasons:

- If the projectile is fired using corrections determined from high explosive (HE) firings with the M3A1, the velocity difference is included in the HE corrections and need not be applied again.

- If the projectile is fired without corrections, the difference between the firing table and M3A1 velocities is another nonstandard condition which is corrected by the observer in his adjustment.

ADDITIVE JACKET XMI AND BLAST REDUCER XM5

Recent reports from Vietnam indicate that there is some question concerning the use of the XMI additive jacket and the XM5 flash reducer. The use of these items is covered in para 2-118b (6) (7) of TM 9-1300-203 w/changes 3, 4, and 5 and para 95e and 95f of change 8 to TM 9-2300-216-10.

TABLE II

Weapon	Type ammo	Item description	Wt of fuzed proj	Wt of complete round (max chg)	How shipped	Fuze (1)		
						Impact	Time	VT
75-mm pack how M116	HE	Cartridge, HE M48	14.70	18.24	Fuzed or unfuzed	M557 M78A1 (CP)	M520A1	M513 series
115-mm rkt lr	Mltp chemical rocket, chemical M55 M91		58.00 (2) 74.00	58.00 (2) 74.00	Complete	M417		
105-mm how M52A1 M101A1 M102 M108	HE	Cartridge, HE, M1	33.00	42.00	Fuzed or unfuzed	M557 M78A1(CP)	M520A1 M564	M513 series
	HE	Cartridge, HE, M413 M444	33.00	42.00	Fuzed		M548M565	
	HE, Anti-tank	Cartridge, HEAT, M67	29.29	37.06	Fuzed	M62A1 M91A1 (tracer)		
		Cartridge, HEP-T M327	23.38	33.35				
	Gas	Cartridge, gas, persistent, M60 H or HD	33.94	42.94	Fuzed	M557		

TABLE II. AMMUNITION (Cont)

Weapon	Type ammo	Item description	Wt of fuzed proj	Wt of complete round (max chg)	How shipped	Fuze (1)		
						Impact	Time	VT
		Cartridge, gas, non-persistent, GB, M360	35.40	44.40	Fuzed	M508 M557		
		Cartridge, smoke, HC BE, M84 series	32.86	41.86	Fuzed		M501A1	
	Smoke	Cartridge, smoke, WP, M60	34.80	43.80	Fuzed	M557		
	Colored Smoke	Cartridge, smoke, BE, M84 series	Green 31.13	Green 39.13	Fuzed		M501A1	
			Red 30.68	Red 39.68				
			Yellow 30.30	Yellow 39.30				
	Leaflet	Cartridge, leaflet, BE, M84 series	33.00	42.00	Fuzed		M501A1	
		Cartridge, leaflet BE, M488	33.00	42.00				
	Illuminating	Cartridge, illuminating, M314 series	34.90	43.90	Fuzed		M501A1 M565	

	Target Practice	Cartridge, TP-T, M67	28.20 37.06	Complete			
	Blank	Cartridge, blank, M395	6.24				
	HE	Projectile, HE, M107	95.00 100.75GB 108.65WB	Unfuzed	M557	M520A1	M514
		Projectile, HE, M404	95.00 100.75GB 108.65WB	Unfuzed	M78A1(CP)	M564 M565	Series
	Gas	Projectile, gas, nonpersistent, GB, or persistent, VX M121A1	101.80 107.55 GB 115.45 WB	Unfuzed	M508 M557		M514 Series (VX only)
	Dummy	Cartridge, dummy M14	33.06 42.06	Complete	M59 inert	M54 inert	
	Anti-personnel	Cartridge, anti-personnel, XM546	28.50 38.25	Fuzed	XM563 series MTMA (3)		

(1) Fuzes listed are appropriate for peacetime use. Other fuzes also authorized are listed in TM 9-1300-203 and the appropriate firing table.
(2) With shipping and firing container.
(3) Fuze can be set for mechanical time or muzzle action.

TABLE II. AMMUNITION (Cont)

Weapon	Type ammo	Item description	Wt of fuzed proj	Wt of complete round (max chg)	How shipped	Fuze (1)		
						Impact	Time	VT
155-mm how M44A1 M114A1 M1123A1 M109		Projectile, gas, persistent, H or HD, M110	98.49	104.24 GB 112.14 WB	Unfuzed	M508 M557		
	Smoke	Projectile, smoke WP, M110	97.50	103.25 GB 115.15 WB	Unfuzed	M557		
		Projectile, smoke HC, BE, M116 series	94.35	100.10 GB 108.00 WB	Unfuzed		M501A1	
	Colored Smoke	Projectile, smoke (red, yellow, green), BE M116 Series	86.40	92.15 GB 100.05 WB	Unfuzed		M501A1	
	Illuminating	Projectile, illuminating M485 series	95.00	100.75 GB 115.65 WB	Unfuzed		M565	
		Projectile, illuminating, M118 series	100.00	105.75 GB 113.65 WB	Unfuzed		M501A1	

	Nuclear	Projectile, atomic XM454	120.45 136.69	Unfuzed		XM32E1	T361E2
	Dummy	Projectile, dummy, M7	95.00 102.37 M2	Complete			
8-inch how M55 M110 M115	HE	Projectile, HE, M106	200.00 213.30GB 228.30WB	Unfuzed	M557	M520A1	M514 Series
		Projectile, HE, M404	200.00 213.30GB 228.30WB	Unfuzed	M78A1	M564 M565	
	Gas	Projectile, gas, non-persistent, GB, or persistent, VX, M426	200.00 213.30 GB 228.30 WB	Unfuzed	M508 M557		M514 Series (VX only)
	HE Spotting	Projectile, HES, M424	242.00 272.00 M80	Unfuzed		M543	
	Nuclear	Projectile, atomic, M422	242.00 272.00 M80	Unfuzed		M542	
	Dummy	Projectile, dummy, M14	200.00 228.75 M4	Complete			
175-mm gun M107	HE	Projectile, HE, M437	147.00 202.00 M86 series	Unfuzed	M572		M514A1
	Dummy	Projectile, dummy, M458	147.00 202.00 M98	Unfuzed	M73		

(1) Fuzes are appropriate for peacetime use. Other fuzes also authorized are listed in TM 9-1300-303 and the appropriate firing table.

TABLE II (CONT)

Weapon	Type ammo	Item description	Wt of fuzed proj	Wt of complete round (max chg)	How shipped	Fuze (1)		
						Impact	Time	VT
	HE	Whd M299	16.6	28	Fuzed	M423		M429
Armament subsystem	Smoke	Whd, smoke WP, E12	7.00	19.70	Fuzed	M423		
		Whd, smoke WP, M152	10.00	22.70	Fuzed	M423		
Helicopter M3, M16, M21 (2.75-in rocket) and rocket motor, 2.75-in., MK40 mod O	Colored Smoke	Whd, colormarker, Red, XM152	6.90	19.50	Fuzed	M423		
		Whd, colormarker, yellow, XM153	6.90	19.50	Fuzed	M423		
	Practice	Whd, inert, MK1	6.47	19.17	Unfuzed	Inert		
		Whd, inert, MK5	6.47	19.17	Unfuzed	Inert		
	AT	Whd, HEAT, M1	6.47	19.17	Unfuzed	P1M406 MK181		
		Whd, AT, MK5 mod O	6.47	19.17	Unfuzed	MK181		
	Dummy	Whd, inert, MK1	6.47	18.10	Unfuzed	Inert		

TRANSPORTATION

TRANSPORTABILITY

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 705-35.

  Phase I (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 C-123 and C-130.

  Phase II (Initial air-landing). Forces normally moved in this phase are the follow-up elements of the units participating in phase I, 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 air-landing 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.

  Phase III (Heavy air-landing). Forces normally moved in this phase are follow-up elements of the units participating in phases I and II; 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 IIIA. WHEELED VEHICLES

Vehicle	Purpose	Curb weight fully equipped less payload & crew (lbs) (1)	Pay-load (hwy) (lb)	Pay-load (cross country lbs)	Max allow-able speed (MPH)	Cruise range (miles)	Fuel cap (gal)	Fording depth (inches) with kit	Fording depth (inches) without kit	Air trans phase; craft		Ref tech manual
2 1/2-ton M34	Cargo	12, 186	10, 350	5, 000	58	300	50 gas	72	30	I	C-130	TM 9-8022
M35	Cargo	12, 880	10, 350	5, 350	60	350	50 gas	72	30	I	C-130	TM 9-8022
M35A1/2	Cargo	13, 443	10, 000	5, 350	58	500	50 diesel	NA	30	I	C-130	TM 9-2320-205-10
M36	Cargo	13, 915	10, 000	5, 000	58	300	50 gas	72	30	I	C-130	TM 9-2320-205-10
M135	Cargo	12, 500	10, 000	5, 000	58	350	56 gas	78	30	I	C-130	TM 9-8024
M211	Cargo	13, 580	10, 000	5, 000	55	300	56 gas	72	30	I	C-130	TM 9-8024
M49C	Fuel tanker	13, 895	7, 850	5, 000	58	350	50 gas	72	30	I	C-130	TM 9-2320-209-10
M217C	Fuel tanker	14, 805	8, 000	5, 000	55	300	56 gas	80	30	I	C-130	TM 9-8024
M50	Water tanker	15, 594	8, 300	5, 000	58	350	50 gas	72	40	I	C-130	TM 9-2320-209-10
M222	Water tanker	14, 100	8, 500	3, 500	55	300	56 gas	80	30	I	C-130	TM 9-8024
M221	Truck tractor	12, 105	12, 000	7, 000	58	350	50 gas	72	30	I	C-130	TM 9-802 CAA
M275	Truck tractor	11, 590	12, 000	7, 000	58	350	50 gas	72	30	I	C-130	TM 9-8022
M109	Shop van	15, 231	7, 500	5, 000	58	300	50 gas	72	30	III	C-130	TM 9-8023-1
M220	Shop van	15, 085	7, 500	5, 000	55	300	56 gas	80	30	III	C-124A	TM 9-8024
M60	Light wrecker	23, 960	3, 500	1, 500	60	300	50 gas	72	40	I	C-130	TM 9-2320-209-10

M108	Wrecker crane	19,785	3,500	600	62	350	50 gas	72	40	I	C-130	TM 9-2320-209-10
M135	Set, searchlight	12,330	6,695	5,000	58	350	56 gas	78	30	I	C-130	
M292	Van, expansible	20,609	5,000	5,000	58	300	50 gas	72	40	III	C-124A	TM 9-2320-209-10
Truck 1/4-ton M38A1	Utility	2,665	1,200	800	55	280	17 gas	70	37.5	I	C-130	TM 9-8014
M151A1	Utility	2,273	1,200	800	66	300	17.7 gas	60	21	I	C-130	TM 9-2320-218-10
M170	Ambulance	2,963	3 litters or 6 seated patients		60	280	20 gas	70	37.5	I	C-130	TM 9-8014
3/4-ton M37B1	Cargo	5,950	2,000	1,500	55	225	24 gas	84	42	I	C-130	TM 9-8030
M43	Ambulance	7,150	4 litters or 6 seated patients		55	225	24 gas	84	42	I	C-130	TM 9-8030
1/2-ton M274	Carrier, lt wpn	900	1,000	1,000	25	100	8 gas	NA	18	I	C-130	TM 9-2320-213
1/4-ton M715	Cargo	5,252	3,000	2,500	60	225	Unk	60	30	Unk	Unk	TM 9-2320-244-10
1 1/4-ton M725	Ambulance	6,292	2,000	2,000	60	225	Unk	60	30	Unk	Unk	TM 9-2320-244-10
5-ton M41	Cargo	19,835	15,000	10,000	59	280	78 gas	78	30	I	C-130	TM 9-2320-211-10
M54	Cargo	19,945	20,000	10,000	52	214	78 gas	78	30	I	C-130	TM 9-2320-211-10
M54A1	Cargo	19,581	20,000	10,000	54	396	78 diesel	78	30	I	C-130	TM 9-2320-211-10
M55	Cargo	24,064	20,000	10,000	52	214	78 gas	78	30	I	C-130	TM 9-2320-211-10

TABLE IIIA. WHEELED VEHICLES (cont)

Vehicle	Purpose	Curb weight fully equipped less payload & crew (lbs) (1)	Pay-load (hwy) (lb)	Pay-load (cross country lbs)	Max allow-able speed (MPH)	Cruise range (miles)	Fuel cap (gal)	Fording depth (inches) with kit	Fording depth (inches) without kit	Air trans phase; craft		Ref tech manual
M52	Truck tractor	18, 813	25, 000	15, 000	50	300	110 gas	78	30	III	C-124A	TM 9-2320-211-10
M246	Truck tractor	32, 830	16, 000	12, 000	50	230	78 gas	78	30	III	C-124A	TM 9-2320-211-10
M62	Truck wrecker, med	33, 675	12, 000	7, 000	52	214	78 gas	78	30	III	C-124A	TM 9-2320-211-10
M543 10-ton	Wrecker	34, 400	12, 000	7, 000	52	217	78 gas	78	30	III	C-124A	TM 9-2320-211-10
M125	Cargo	30, 000	35, 000	20, 000	43	350	166 gas	78	30	III	C-124A	TM 9-2320-206-10
M123	Tractor	32, 250	35, 000	21, 000	42	300	166 gas	78	30	III	C-124A	TM 9-2320-206-10
M249	Gunlifting	37, 950		53, 675	40	165	140 gas	NA	60	III	C-133A	TM 9-8006
M250	Gunlifting	35, 910		45, 330	40	165	140 gas	NA	60	III	C-133A	TM 9-8006
M656	Cargo	15, 600	10, 000	10, 000	50	300	80 multi-fuel	Swim capability		Unk	Unk	
M520E1	Cargo	23, 900	16, 000	16, 000	32	400	106 diesel	Swim capability		II	C-133A	
M559E1	Tanker	2, 500 (gal)	NA	2, 500	31	400	106 diesel	Swim capability		III	C-133A	

(1) Weight of self-propelled weapons is with full combat load.

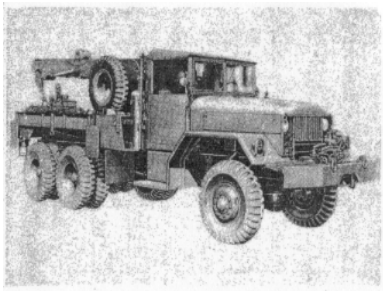


Figure 20. M62

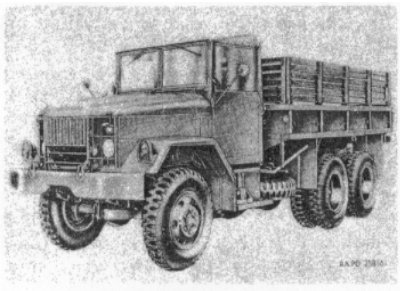


Figure 21. M35

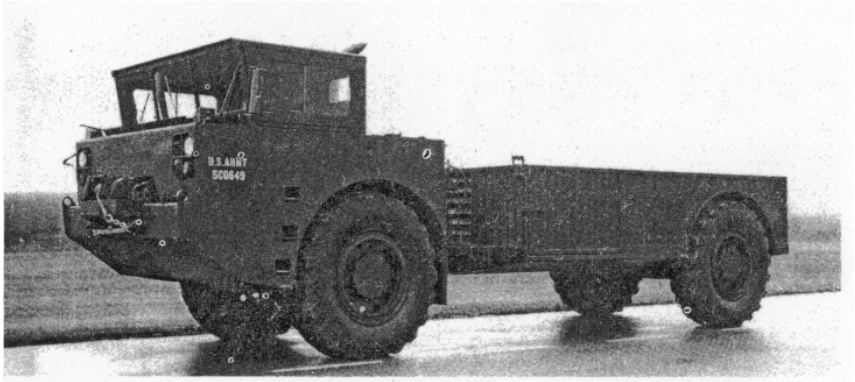


Figure 22. M520

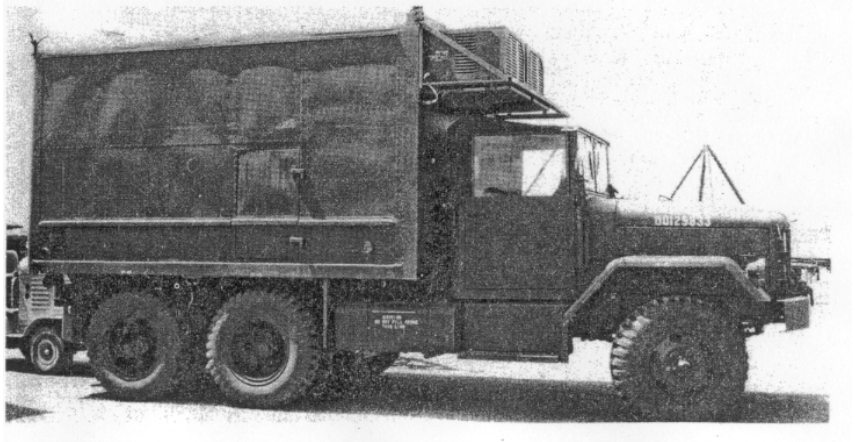


Figure 23. M109

TABLE IIIB. TRACKED VEHICLES

Vehicle	Purpose	Curb weight fully equipped less payload & crew (lbs) (1)	Pay-load (hwy) (lb) (Lift capac)	Pay-load (cross country lbs) (Tow capac)	Max allow-able speed (MPH)	Cruise range (miles)	Fuel cap (gal)	Fording depth (inches) with kit	Fording depth (inches) without kit	Air trans phase; craft		Ref tech manual
M74	Recovery	89,000	50,000	90,000	21	100	168 gas	72	36	III	C-133A	TM 9-7402
M88	Recovery	106,000	50,000	81,000	30	222	445 gas	102	64		NA	TM 9-2320-222-10
M578	Recovery	54,000	30,000	60,000	37	450	320 diesel	72	42	III	C-133A	TM 9-2320-238-10
TABLE IIIC. ARMORED PERSONNEL, CARGO, AND EQUIPMENT CARRIERS												
M59	APC	39,504	NA	3,096	32	120	136 gas	Swim cap w kit		III	C-133A	TM 9-2300-203-12
M113	APC	20,000	NA	3,860	40	200	80 gas	Swim cap w kit		I	C-130	TM 9-2300-224-10
M113A1	APC	20,870	NA	3,450	40	300	95 diesel	Swim cap w kit		I	C-130	TM 9-2399-224-10/2/1
M114	APC-recon	12,900	NA	1,849	36	300	110 gas	Swim cap w kit		I	C-130	TM 9-2320-224-10
M116	Cargo	7,800	NA	3,000	37	300	65 gas	Swim cap w kit		I	C-130	TM 9-2320-223-10
M577	CP-FDC	22,800	NA	1,100	35	200	120 gas	Swim cap w kit		III	C-124A	TM 9-2300-224-10/3/2
M577A1	CP-FDC	23,060	NA	1,200	36	370	120 diesel	Swim cap w kit		III	C-124A	TM 9-2300-224-10/3/2
M548	Cargo/ammo	14,250	NA	12,000	40	300	105 diesel	Swim cap w kit		II	C-130	TM 9-2300-224-10/3/7

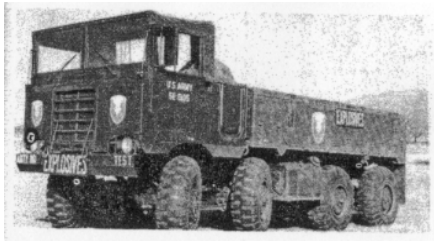


Figure 24. M656

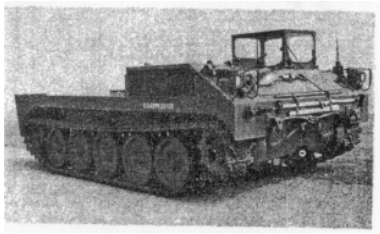


Figure 25. M474E-2

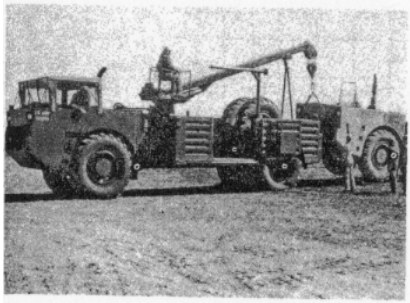


Figure 26. M553

Figure 27. M561

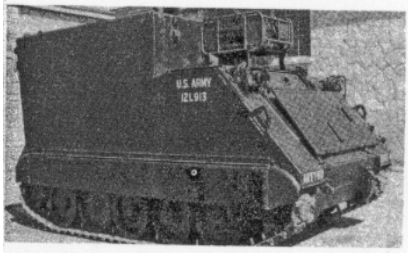


Figure 28. M577

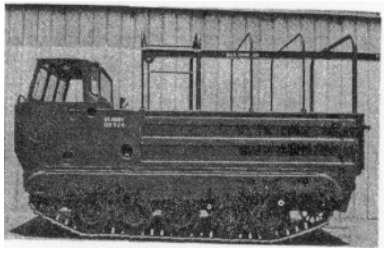


Figure 29. M548

Figure 30. CH-54 Skycrane

TABLE IIID. SELF-PROPELLED WEAPONS

Vehicle	Purpose	Curb weight fully equipped less payload & crew (lbs) (1)	Pay-load (hwy) (lb)	Pay-load (cross country lbs)	Max allow-able speed (MPH)	Cruise range (miles)	Fuel cap (gal)	Fording depth (inches) with kit	Fording depth (inches) without kit	Air trans phase craft		Ref tech manual
M44A1	155mm how	59, 500	NA	NA	35	76	150 gas		42	III	C-133A	TM 9-2350-203-10
M52A1	105mm how	49, 800	NA	NA	42	100	179 gas		48	III	C-133A	TM 9-7204
M107	175mm gun	62, 100	NA	NA	34, 4	450	320 diesel		42	III	C-133A	TM 9-2300-216-10
M108	105mm how	46, 000	NA	NA	35	220	135 diesel	Swim cap w kit		III	C-133A	TM 9-2350-217-10
M109	155mm how	51, 000	NA	NA	35	220	135 diesel	Swim cap w kit		III	C-133A	TM 9-2350-217-10
M110	8-in how	58, 500	NA	NA	34, 4	450	300 diesel		42	III	C-133A	TM 9-2300-216-10
LVTH 6A1	105mm how	79, 800	NA	NA	30L 6W	190L 57W	456 diesel	Amphibious		NA	NA	TM 005-126-10

(1) Weight of self-propelled weapons is with full combat load.

TABLE IIIE. VEHICLES PECULIAR TO ROCKET AND MISSILE UNITS

Vehicle	Purpose	Curb weight (pounds)	Pay-load (pounds)	Max allow speed (mph)	Cruise range (miles)	Fuel capacity (gal) and type	Water crossing cap.		Air transportability phase, craft	
							With kit	Without kit		
XM474E2	Msl equip carrier, PSG	11,739	12,000	40	200	85 gas	NA	42	II	C-115B
Launching Sta XM504	Launcher, Sergeant	17,205	NA	52	NA	NA	NA	30	II	C-130
OMTS or FMTS	Test sta, Sergeant	15,000	NA	58	NA	NA	NA	30	II	C-130
Motor Guidance Transport Trailer	Missile section transporter, Sergeant	4,900	11,000	58	NA	NA	NA	30	II	C-130
XM667E1	Basic vehicle, SP launcher, LT, Lance	13,500	10,500	40	280	85 diesel	Swim cap w kit		I	C-130
M572 2 1/2-ton M36	Rkt hdlg unit, LJ rkt M289	15,155	10,000	58	300	50 gas	72	30	I	C-130
M289, 5-ton Chassis M139D	Launcher HJ rkt M289	41,800	5,913	59	220	70 gas	60	30	III	C-133A
M386, 5-ton Chassis M139	Launcher HJ rkt M386	34,250	5,913	59	224	70 gas	60	30	III	C-130A
M46, 5-ton Chassis M55	Heating & tie-down unit, HJ rkt	24,264	20,000	52.6	214	78 gas	78	30	II	C-130

TABLE IIIF. VEHICLES UNDER DEVELOPMENT

Vehicle	Purpose	Curb weight (pounds)	Pay-load (pounds)	Max allow speed (mph)	Cruise range (miles)	Fuel capacity (gal) and type	Water crossing cap.		Air transportability phase, craft	
							With kit	With-out kit		
XM553 10-ton GOER	Wrecker	38, 844	Tow, 20, 000 Front tow winch 10, 000; rear tow winch, 45, 000; boom cap at 6 ft. radius 20, 000	30. 5	333	74 diesel	Swim cap w kit		III	C-133A
XM705	Truck, utility	6, 000	2, 500	60	300	Unk	60 in	20 in	II	C-123
M561	Cargo, pers wpn carrier	6, 060	NA	2, 900 w/crew	55	440 avg	40 diesel		I	C-130

TABLE IIIG. ROTARY WING

Aircraft	AH-1G Huey Cobra	CH-47C Chinook	CH-47A Chinook	CH-47B Chinook	CH-54A Tarhe	OH-6A Cayuse	OH-13S Sioux	OH-23G Raven	UH-1B/C Iroquois	UH-1D/H Iroquois	CH-34C Choctaw
Purpose	Escort, scout, and aerial artillery	Cargo and personnel transport	Cargo and personnel transport	Cargo and personnel transport	Skycrane heavy lift	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	2	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	1,080	1,715	2,024	4,724	4,954	7,800
Maximum internal fuel capacity (gal/lb)	250/1,625	1,131/7,351	621/4,036	892/4,036	892/5,798	58/382	57/342	46/276	165/1,072	220/1,430	262/1,572
Payload with full fuel (lb)[2]	640	18,000	9,000	15,000	15,400	930	400	400	2,704	3,116	3,500
Maximum allowable gross weight (lb)[3]	9,500	44,800	33,000	40,000	42,000	2,700	2,450	2,700	8,500	9,500	13,600
Maximum recommended external load (lb)	550 pounds per each of four external wings	20,000	16,000	16,000	20,760	NA	NA	NA	4,000	4,000	5,000
Normal cruise speed (knots)[4]	130	120	110	120	100 w pod	118	70	70	90	100	85
Endurance at cruise speed not including 30-minute reserve (hr/min)[5]	2/45	3/00	2/40	2/00	1/45	2/25	2/45	2/30	2/30	3/00	2/50

TABLE IIIG. ROTARY WING (CONT)

Aircraft	AH-1G Huey Cobra	CH-47C Chinook	CH-47A Chinook	CH-47B Chinook	CH-54A Tarhe	OH-6A Cayuse	OH-13S Sioux	OH-23G Raven	UH-1B/C Iroquois	UH-1D/H Iroquois	CH-34C Choctaw
Maximum cargo space (cu ft)	NA	1,487	1,487	1,487	2,680 (pod)	40	NA	NA	140	220	363
Cargo compartment usable length (in)	NA	366	366	366		46	NA	NA	60	92	163.5
Cargo compartment height (clear of obstruction) (in)	NA	78	78	78		48.5	NA	NA	56	52	85
Cargo compartment floor width (in)	NA	90	90	90		50.5	NA	NA	80.5	96	60
Cargo dimensions width plus height (in)	NA	90X78	90X78	90X78		26.5X40.5 and 34.5X40.5	NA	NA	48X48	92X49	53X48
Troop seats	NA	33	33	33	87 passenger pod	3	1	2	7	11	12 or 18
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, 87 passenger pod, light 11-man pod	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	8 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.

TABLE IIIH. 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" U-21A
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 electronical 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 IIIH. FIXED WING (CONT)

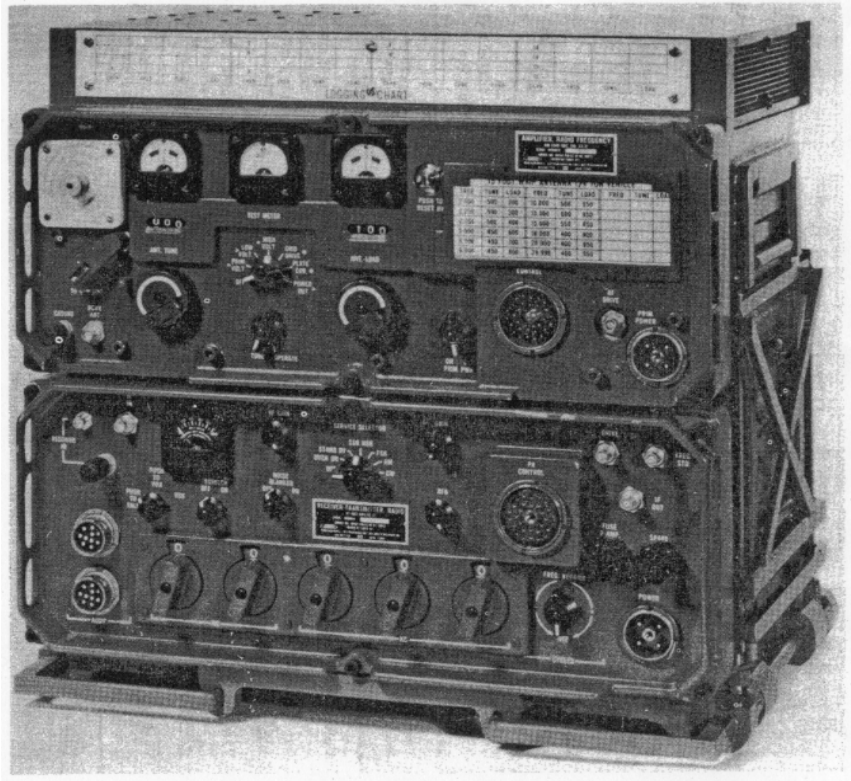
Aircraft	0-1F, 0-1G Bird Dog	OV-1A Mohawk	OV-1B Mohawk	OV-1C Mohawk	U-1A Otter	U-6A Beaver	U-8F Seminole	U-21A "UTE" U-21A
Maximum cargo space (cu ft)	NA	NA	NA	NA	293	125	168.8	272
Cargo compartment usable length (in)	NA	NA	NA	NA	156	92	110.5	150
Cargo compartment height (clear of obstruction (in))	NA	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, infra-red 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

AN/GRC-106



If you are not getting the rated transmission range on the AN/GRC-106, 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 (RF) amplifier, AM 3349, should read just below the gray portion on the (0) lower scale, with the test meter switch in the POWER OUT position (reference paragraph 24n, TM 11-5820-520-12). If this reading is not obtained in the tune position, trouble or improper adjustment is indicated in the RF Amplifier AM 3349.

Paragraphs 41b, 41c, and 44, TM 11-5820-520-12, give the proper procedure for testing and adjusting the driver and power amplifier tubes. It should be noted that these tests and adjustments are made with the "RF DRIVE" and "RCVR ANT" Connectors, **DISCONNECTED.** (Reference paragraph 41c (1) and (6) and paragraph 44a and f). If these adjustments are made with the RF DRIVER cable connected, **VERY LOW POWER** output will result. This will seriously reduce the transmission range of the AN/GRC-106.

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 -5 -7	R-108/RT-66/RT-70 R-109/RT-67/RT-70 R-110/RT-68/RT-70	20.0 - 27.9 27.0 - 38.9 38.0 - 54.9	Voice	16-24	80 120 170	2 2 2	12/24v DC	TM 11-284	3 preset channels on aux receiver; set utilizes AM-65 AF amplifier
AN/GRC-4 -6 -8	RT-66/RT-70 RT-67/RT-70 RT-68/RT-70	20.0 - 27.9 27.0 - 38.9 38.0 - 54.9	Voice	16-24	80 120 170	2 2 2	12/24v DC	TM 11-284	Set utilizes AM-65 AF amplifier
AN/VRC-8 -9 -10	RT-66 RT-67 RT-68	20.0 - 27.9 27.0 - 38.9 38.0 - 54.9	Voice	16-24	80 120 170	2 2 2	12/24v DC	TM 11-286	
AN/VRC-13 -14 -15	RT-66 RT-67 RT-68	20.0 - 27.9 27.0 - 38.9 38.0 - 54.9	Voice	16-24	80 120 170	2 2 2	12/24v DC	TM 11-291	Set utilizes AM-65 AF amplifier
AN/VRC-16 -17 -18	R-108/RT-66 R-109/RT-67 R-110/RT-68	20.0 - 27.9 27.0 - 38.9 38.0 - 54.9	Voice	16-24	80 120 170	2 2 2	12/24v DC	TM 11-611	3 preset channels on aux receiver.
AN/VRC-20 -21 -22	R-108/RT-66 R-109/RT-67 R-110/RT-68	20.0 - 27.9 27.0 - 38.9 38.0 - 54.9	Voice	16, 24	80 120 170	2 2 2	12/24v DC	TM 11-642	3 preset channels on aux receiver; set utilizes AM-65 AF amplifier
AN/VRQ-1 -2 -3	2 RT-66 2 RT-67 2 RT-68	20.0 - 27.9 27.0 - 38.9 38.0 - 54.9	Voice	16-24	80 120 170	2 2 2	12/24v DC	TM 11-287	Provides automatic retransmission capability
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 -9 -10	RT-174/PRC-8 RT-175/PRC-9 RT-176/PRC-10	20.0 - 27.9 27.0 - 38.9 38.0 - 54.9	Voice	5-8	80 120	Continuous tuning	B-279 or 24v DC W/AM 598/U	TM 11-4065	AM 598/U is an amplifier, power supply.

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 11-5820-398-10	Replaces AN/PRC-8, -9, and -10. For man-pack only
AN/PRC-77	RT-841/PRC-77	30.00 - 52.95 53.00 - 75.95	Voice & 150 cps 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/PRC-79	RT-841/PRC-77 +AM-4306/PRC	30.00 - 52.95 53.00 - 75.95	Voice & 150 cps tone	24-32	920	2	BA-386/PRC-25 or BA-398/U	TM 11-5820-667-12	Amplified version of AN/PRC-77. AM-4306 is RF amplifier, using its own battery of same type.
AN/VRC-53	RT-505/PRC-25	30.00 - 52.95 53.00 - 75.95	Voice & 150 cps tone	8	920	2	24v DC vehicular btry	TM 11-5820-398-10	Vehicular configuration of AN/PRC-25
AN/VRC-64	RT-841/PRC-77	30.00 - 52.95 53.00 - 75.95	Voice & 150 cps tone	8	920	2	24v DC vehicular btry	TM 11-5820-667-12	Vehicular configuration of AN/PRC-77
AN/VRC-65	RT-841/PRC-77 + AM-4306/PRC	30.00 - 52.95 53.00 - 75.95	Voice & 150 cps tone	24-32	920	2	24v DC vehicular btry	TM 11-5820-667-12	Vehicular configuration of AN/PRC-79
AN/GRC-125	RT-505/PRC-25	30.00 - 52.95 53.00 - 75.95	Voice & 150 cps tone	8	920	2	Dry Btry or vehicular btry	TM 11-5820-398-10	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 cps tone	8	920	2	Dry Btry or vehicular btry	TM 11-5820-667-12	On/Off vehicular configuration of AN/PRC-77
AN/GRC-161	RT-841/PRC-77 + AM-4306/PRC	30.00 - 52.95 53.00 - 75.95	Voice & 150 cps tone	24-32	920	2	Dry btry or vehicular btry	TM 11-5820 667-12	On/Off vehicular configuration of AN/PRC-79

TABLE II. NEW FM RADIOS

Radio set	Receiver/ transmitter	Frequency (MHz)	Operation modes	Range (km)	Channels		Power requirement	Reference manual	Remarks
					Total	Preset			
AN/GRC-163	1 AN/VRC-47 *1 AN/TCC-70 *Described below	30.00 - 52.95 53.00 - 75.95	Voice & 150 cps tone	15 - 50 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		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
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
Equipment			Purpose & Description						Remarks

*AN/TCC-70 Multiplexer Set		Multiplex Set AN/TCC-70 is a light weight, tactical equipment. 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 has been published in Sep 1967. Expected to be used at battalion level and higher.	
AN/PRC-88 Squad Radio	AN/PRT-4 Transmitter	47.0 - 57.0	Voice & Tone	1.6 .5	200	2	BA-399/U	TM 11-5820-549-12	Compatible with AN/VRC-12 and AN/PRC-25 series. Channel alignment indicator ID-1189/PR is required since radio is crystal-controlled. Has 50 KHz spacing.
	AN/PRR-9 Receiver	47.0 - 57.0		Provided with ear phone H-264/PRR-9	200	1	BA-505/U		
					Usuable channels depend on crystals made available				
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)

Table III. AM RADIOS

Radio Set	Receiver/ Transmitter	Frequency (MHz)	Operation Modes	Range (km)	Channels Total	Channels Preset	Power Requirement	Reference Manual	Remarks
AN/GRC-19	R-392/URR R-195/GRC-19	0.5 - 32.0 1.5 - 20.0	Voice CW	80		7 Manual xmtr	28.0v 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		7 Manual xmtr	28.0v 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).
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	1 fixed	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 - 399.0	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 APC.
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 2/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.

Radio Set	Receiver/ Transmitter	Frequency (MHz)	Operation Modes	Range (km)	Channels Total	Channels Preset	Power Requirement	Reference Manual	Remarks
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 air-droppable version (mounted in ¼ 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 depending on 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. Used for ground to air communication, such as forward air controller. On TOE of airmobile division.

Table IV. SINGLE SIDEBAND RADIOS

Radio Set	Receiver/ Transmitter	Frequency (MHz)	Operation Modes	Range (km)	Channels	Power Requirements	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 11-5820-520-series	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. 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 and 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	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 (when published 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.

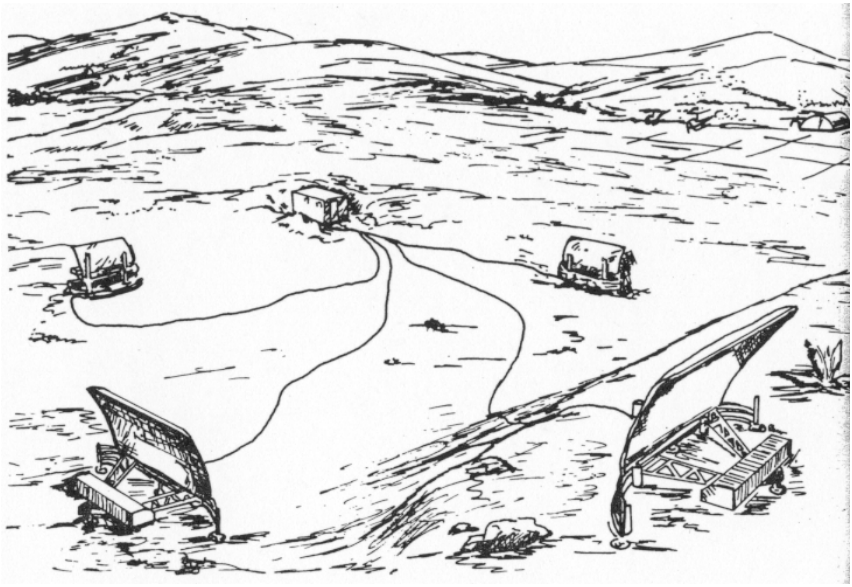
Radio Set	Receiver/ Transmitter	Frequency (MHz)	Operation Modes	Range (km)	Channels	Power Requirements	Reference Manual	Remarks
AN/FRC-93 (KWM-2A Collins)	RT-778/FRC-93	3.4 - 29.999	Voice & CW	80 ground wave	Continuous tuning	115v AC single phase 60 cycles & PP-3990/ FRC-93	TM 11-5820-529-15 (Also Collins Instruction book)	Used in Pershing battalion. Also found in airmobile units. 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 kc 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 11-5820-610-15	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 travelling, 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/USC-2 becomes available.

The following communication tables will appear in future issues of ARTILLERY TRENDS:

Army Aircraft Radios
Communication Security Equipment
Radio Terminal Sets and Associated Equipment
Reeling Equipment
Airborne Command Facilities
Remote Control Devices
Teletypewriter Equipment
Basic Items of Test Equipment
Antenna Equipment
Switchboards
Power Units
Major Components for New Army Area Communication System

TARGET ACQUISITION

OMNIDIRECTIONAL MORTAR LOCATOR RADAR AN/TPQ-28



The Omnidirectional Mortar Locator Radar AN/TPQ-28 consists of four individual antenna/transceivers, plus a central operations and operator shelter, and a power source. Each one of the antennas covers a sector in excess of 1600 mils, so that four of them can be placed together for 6400-mil coverage. The basic technique providing the 6400-mil scanning capability is frequency scanning. All four antennas operate simultaneously, so that at any one time all four are looking in mutually orthogonal directions. The individual antenna transceivers can be remoted up to 75 meters from the central operations shelter. Each antenna/transceiver is mounted on a framework which permits it to be easily adjusted in azimuth approximately 180 mils after initial emplacement.

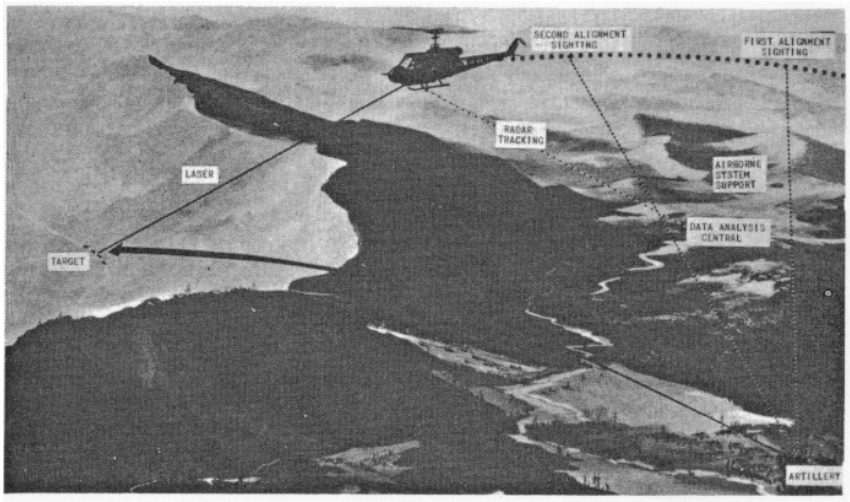
The system does not have to be placed at a single point so that the four radars look in orthogonal directions. For instance, it can provide double coverage in a particular sector by overlapping the coverage. This redundancy can be employed to assure that the destruction of one antenna/transceiver does not eliminate defense from attacks from that sector.

The operations shelter contains a modern digital data processor for the Automatic Target Tracking, Detection, Extrapolation and read out functions. In addition, a display with a 10-inch direct view storage tube

is provided. This display shows the clutter environment within which the radar is operating and is used for monitoring functions. Whenever an actual target appears the target is automatically displayed and located; its location is automatically displayed on the weapon location display and printed out in hard copy X, Y & Z coordinates. The system is capable of storing up to 10 targets in memory.

Although the system is not designed for mobile operations, it can be transported by CH-47 helicopters.

THE VISUAL AIRBORNE TARGET LOCATOR SYSTEM (VATLS)



The AN/UVS-1 (XE-3) visual airborne target locator system consists of both ground and airborne components. The ground station components include a shelter-mounted computer, a tracker, distance-measuring equipment, and a power generator. The airborne components, mounted in a UH-1 series aircraft, include an aircraft-mounted beacon (for tracking), a stabilized variable magnification telescope, a gyroscopic reference, a LASER rangefinder, and the airborne portion of the ranging data entry device and data link.

TARGET ACQUISITION

The airborne equipment can function in either of two modes to complete the target location task. In the first, or single-sight mode, the operator positions the telescope reticle on the target. When the reticle is centered, he presses a MARK button which initiates the following actions:

- Angular information from the attitude reference system and telescope gimbal encoders is transmitted to the ground.
- Slant range from the aircraft to the target is measured by the LASER ranging subsystem and is transmitted to the ground unit. (The attitude reference and telescope data, when transmitted to the ground, enable determination of target angular position with respect to the aircraft. Use of the precision attitude reference subsystem permits computation of target angular position in the ground coordinate system.) Data transmitted from the aircraft is entered into a standard M18 FADAC computer together with the information provided by the angular tracker and distance-measuring equipment. The computer provides the final computation of the target position and presents it to a teletypewriter for printout as target height, target easting, and target northing (UTM coordinates).

In the second, or two-sight mode, operations are somewhat similar except that the LASER rangefinder is not used. Two sightings are made from different helicopter locations, which provide, by triangulation, information establishing the position of the target with reference to the helicopter. Both modes of operation provide information immediately usable for the fire direction center.

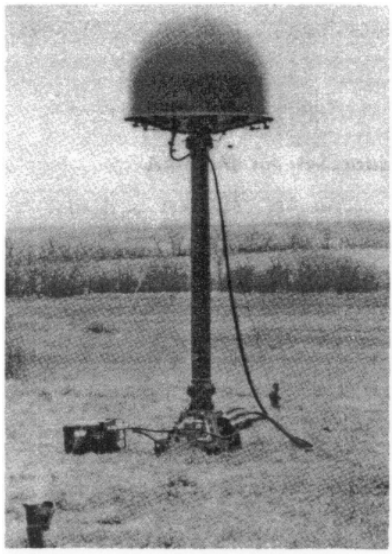
Sound Ranging Set, GR-8

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

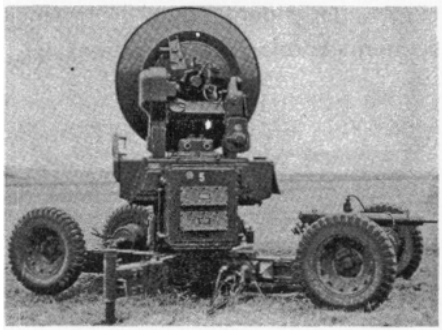
The AN/TPS-25A is a transportable ground surveillance radar capable of detecting moving ground targets at ranges between 450 and 18,280 meters. The set utilizes the doppler principle to provide a means of detection, identification and location of moving targets. The frequency of the amplitude variations 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.



TARGET ACQUISITION

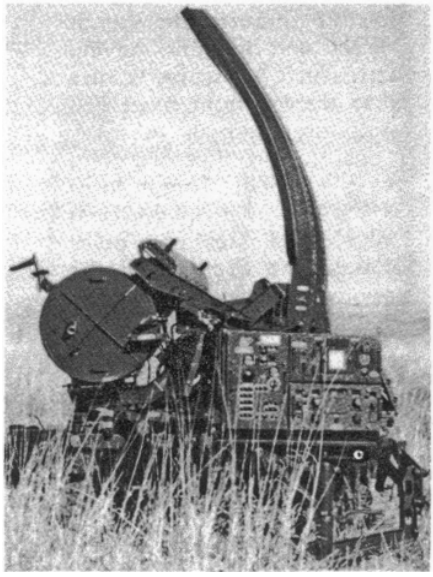
Radar Set An/MPQ-10A

The AN/MPQ-10A is a mobile tracking type radar used in the counterbattery role. It is capable of locating artillery pieces with 0 to 400 meter accuracy at ranges up to 18,000 meters. The set scans a 200- to 800-mil azimuth sector until an artillery projectile is detected. The radar beam then is positioned in range and azimuth to the approximate position in space through which the projectile passed. When a second round is fired by the same weapon, the radar is "locked" on the projectile and tracks it through a portion of its trajectory. From a plot of the projectile height, azimuth, and range, all against time, the operator can determine the origin or location of the weapon that fired the projectile. A 12-man crew can emplace the set in 45 to 60 minutes.



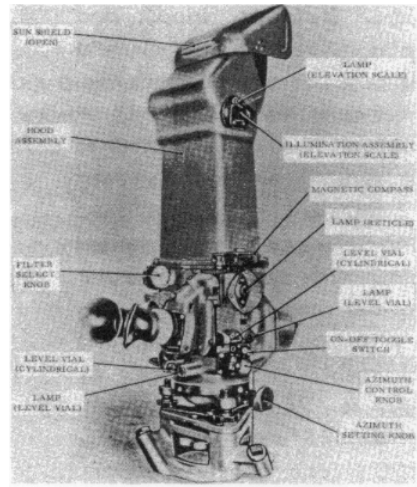
Radar Set An/MPQ-4A

The AN/MPQ-4A is a mobile, short-range, dual-beam-intercept, non-tracking radar used by the artillery to locate mortars and other high-angle weapons. The set has the capability of locating mortars with a 50-meter accuracy at ranges up to 10,000 meters. When a projectile passes through the dual beam, two separate echoes appear on a scope. The operator then positions azimuth and range strobes over the echoes, and an analog computer computes the coordinates of the weapon that fired. The AN/MPQ-4A can be emplaced in 30 to 45 minutes.



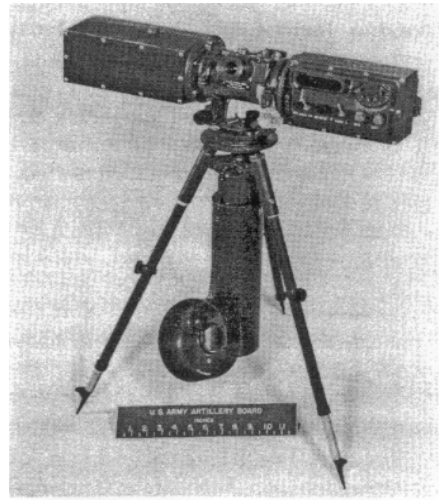
Periscope Battery Command, M43

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 location of friendly artillery fires. Flash ranging techniques are accurate to within 50 meters. The M43 will replace the M65, the current inventory item, as the flash ranging instrument.



Laser XM23

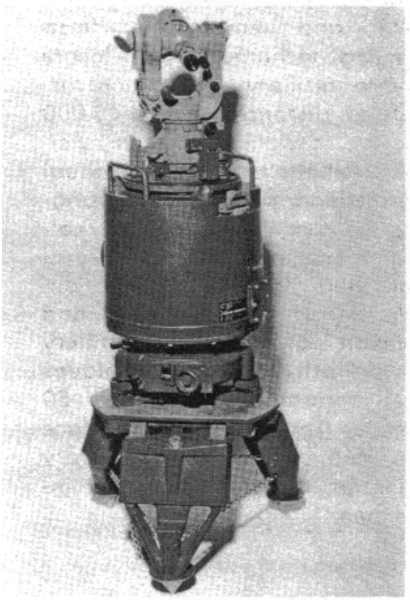
The XM23 Laser (Light Amplification by Stimulated Emission of Radiation) will provide the forward observer with precise polar plot data in the form of direction, vertical angle, and distance. The Laser technique involves the determination of range by measuring the transit time of a ray of light beamed 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."



TARGET ACQUISITION

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

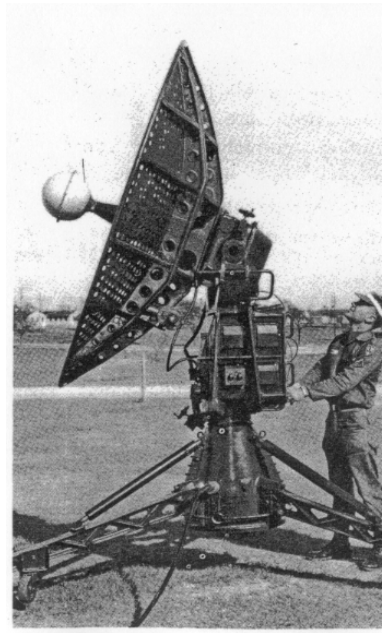
The 0.2 theodolite is used to obtain angular values in artillery surveys executed to fifth-order (1:1000) accuracy. Its scales are readable directly to 0.2 mil and by interpolation to 0.1 mil. Vertical and horizontal scales may be read simultaneously and may be illumined by

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

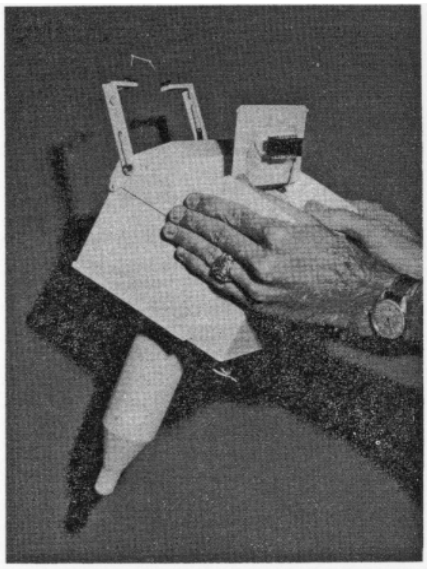
The Rawin set AN/GMD-1 is a transportable radio direction finder which automatically tracks the radiosonde and tunes itself to the transmitted frequency. The control recorder, a component of the Rawin Set, records angles to the radiosonde at a maximum rate of 10 times each minute. Recordings of time 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.



METEOROLOGY

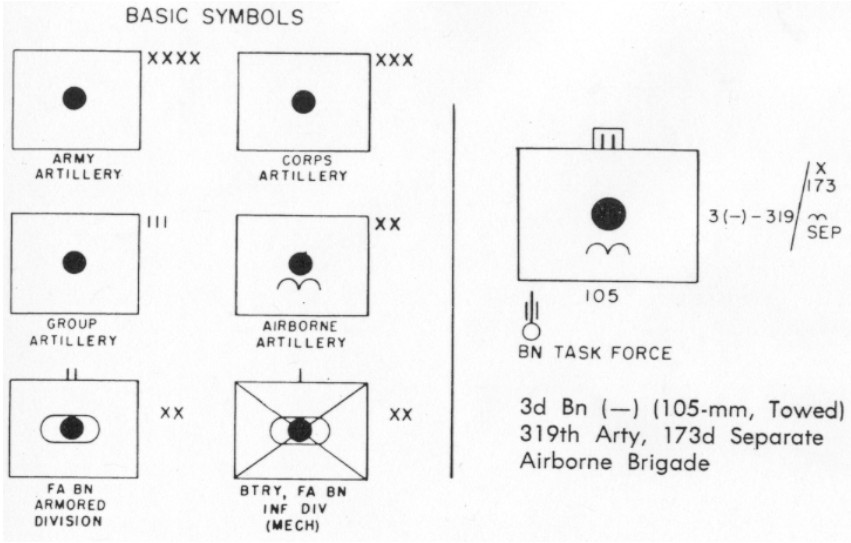
Radiosonde Transmitter AN/AMT-4

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 radiofrequency 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.



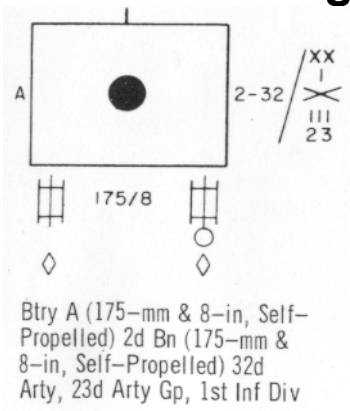
Radiosonde Recorder AN/TMQ-5

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

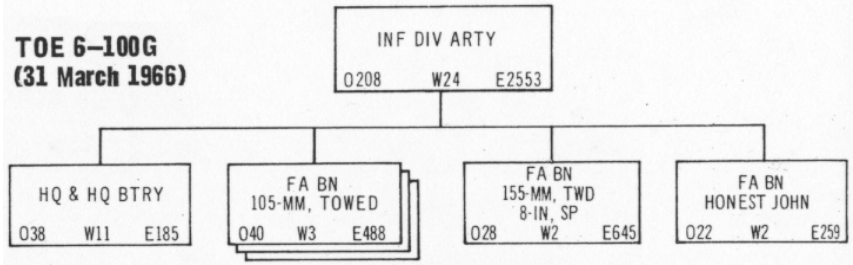
Field Artillery Organizations



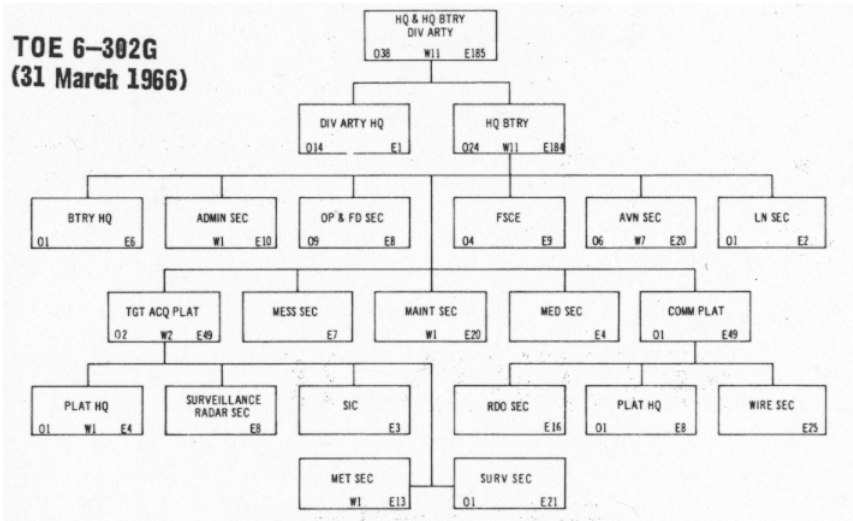
These are examples of unit symbols authorized in FM 21-30, June 1965, with changes 1 and 2.

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, maps, overlays, etc.

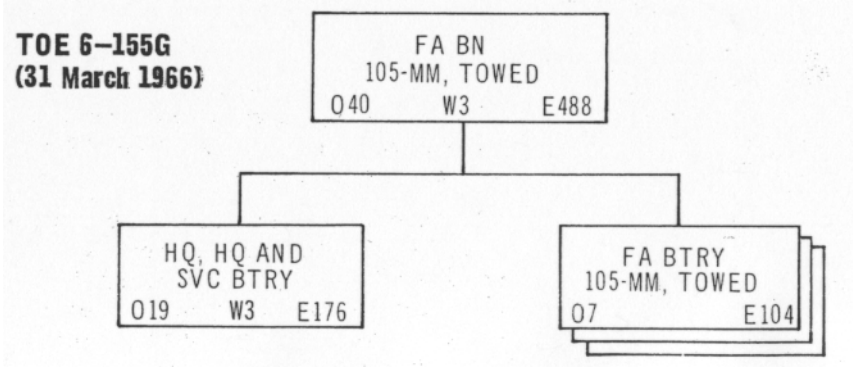
INF ARTY



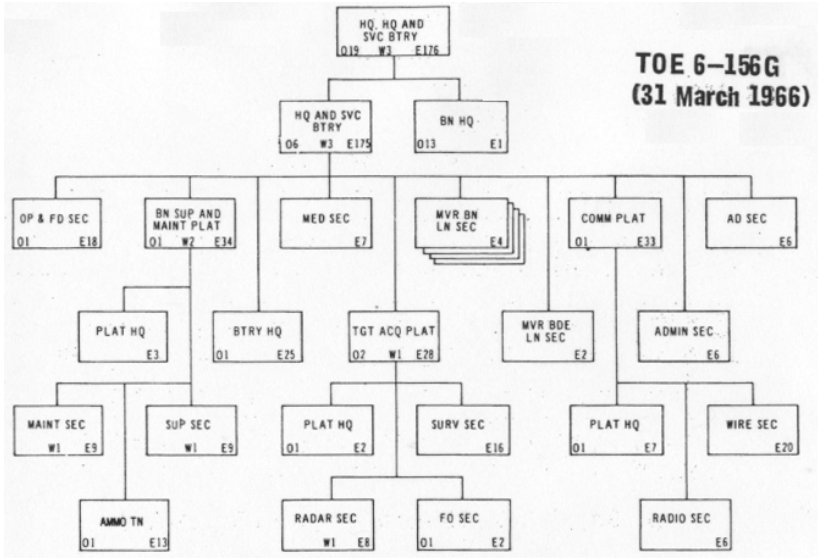
Infantry Division Artillery



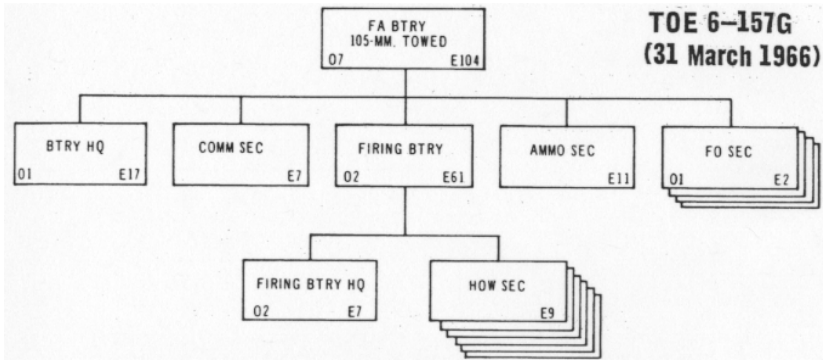
HH Btry, Armd, Mech, or Inf Div Arty



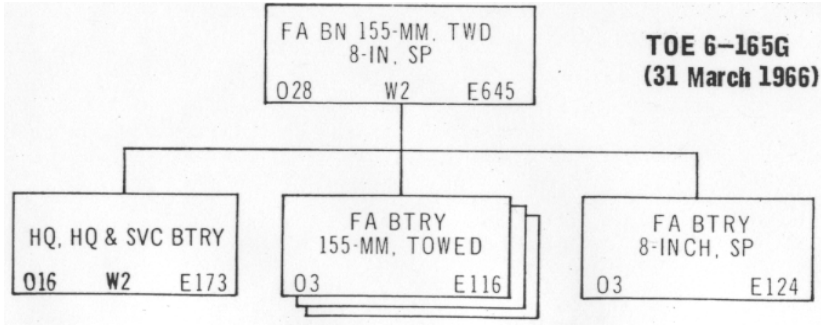
FA Bn, 105-mm Twd, Inf Div



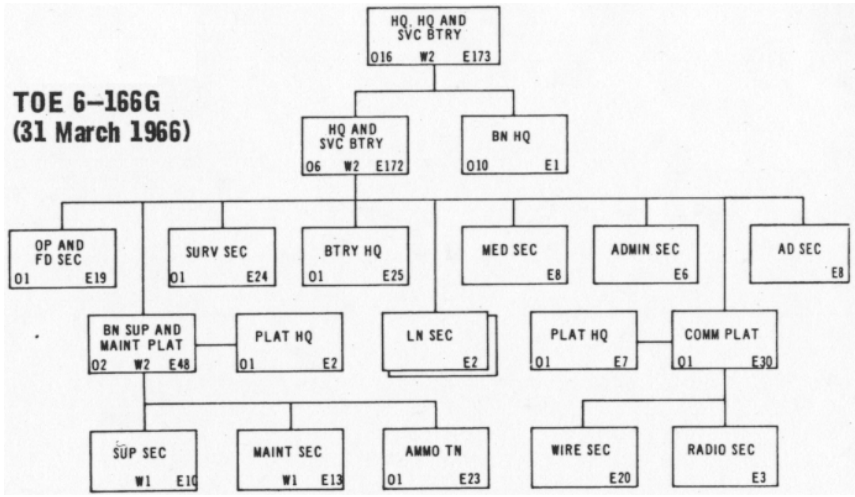
HHS Btry, FA Bn, 105-mm Twd, Inf Div



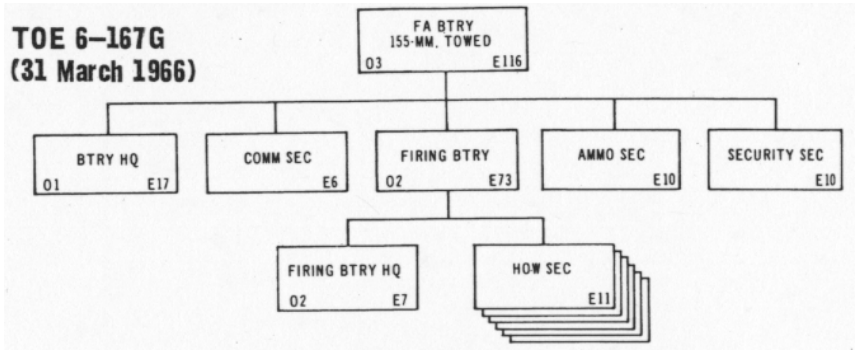
FA Btry, 105-mm Twd, FA Bn, Inf Div or Sep Inf Bde



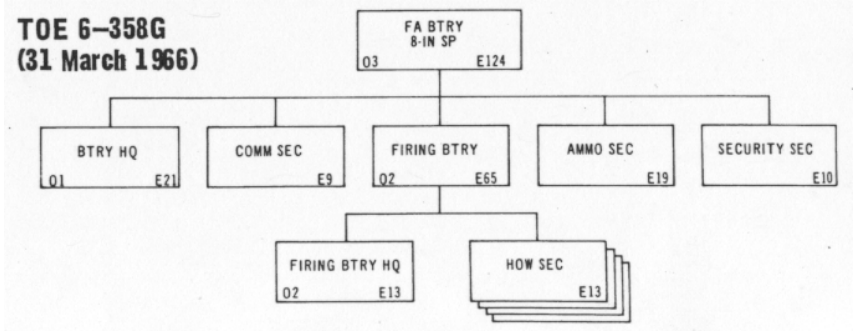
FA Bn, 155-mm, 8-in, Inf Div



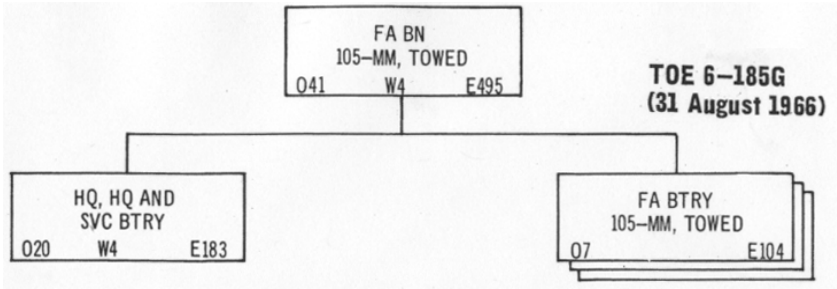
HHS Btry, FA Bn, 155-mm Twd, 8-in SP, Inf Div



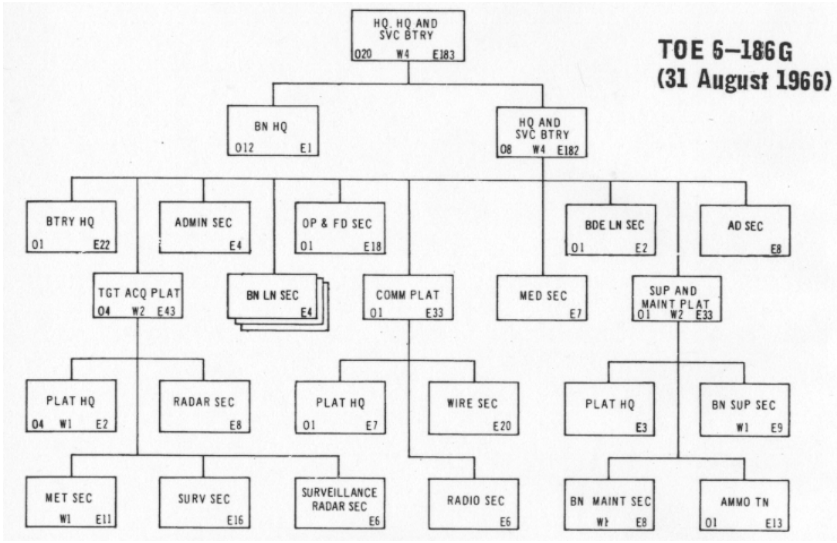
FA Btry, 155-mm Twd, FA Bn, Inf Div



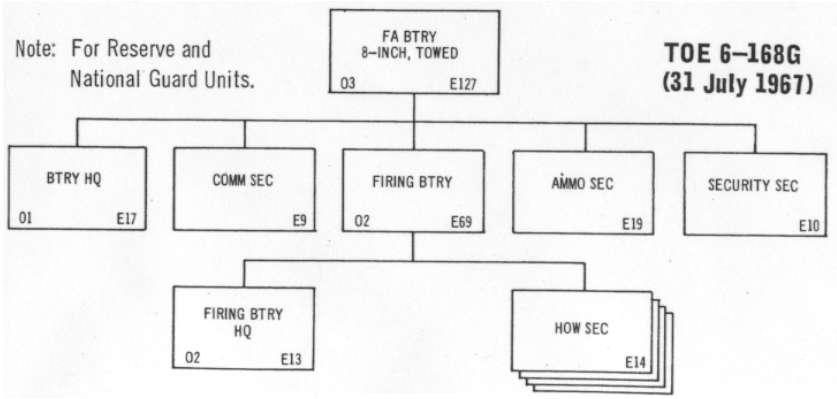
FA Btry, 8-in SP, FA Bn, Armd, Mech, or Inf Div



FA Bn, 105-mm Twd, Sep Inf Bde

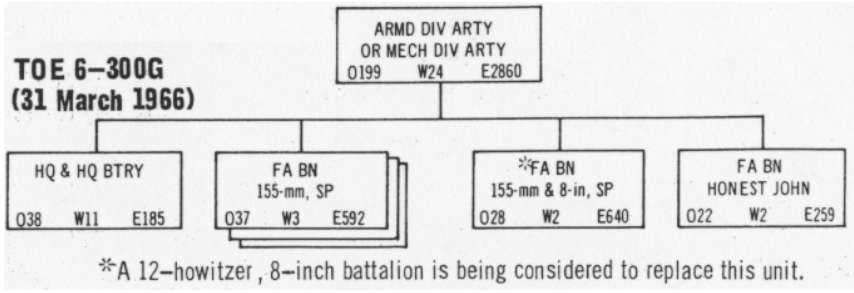


HHS BTRY, FA Bn, 105-mm Twd, Sep Inf Bde

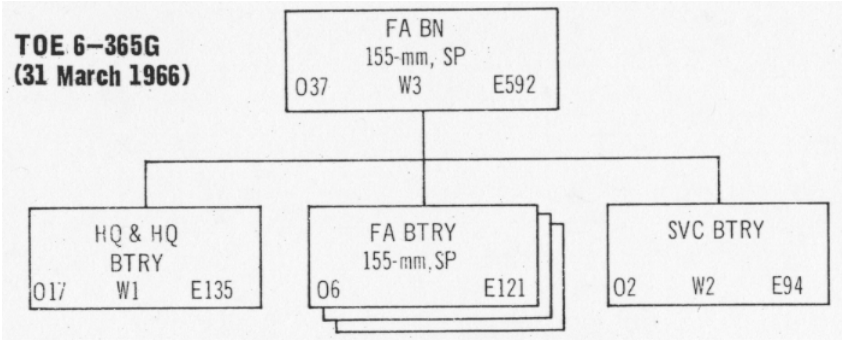


FA Btry, 8-in Twd, FA Bn, Inf Div

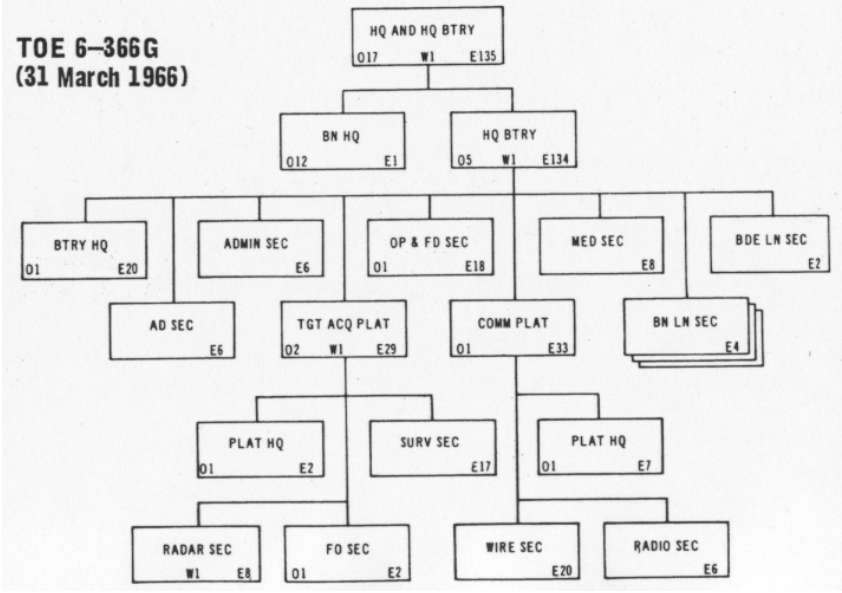
ARMD/MECH ARTY



Armd or Mech Div Arty



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



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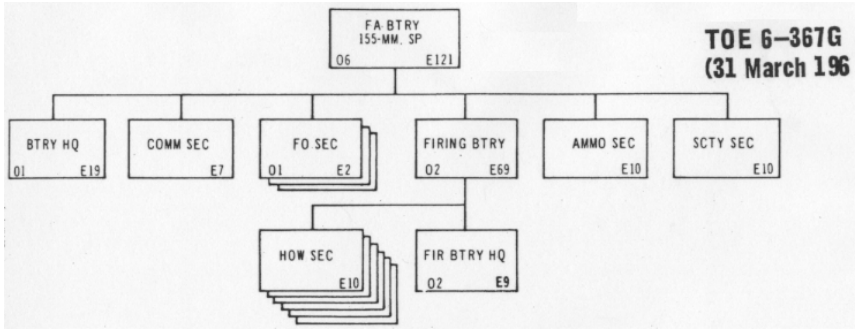
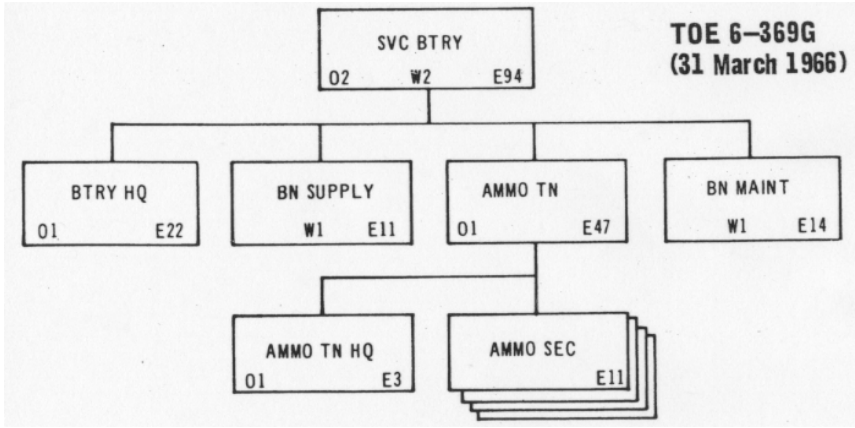
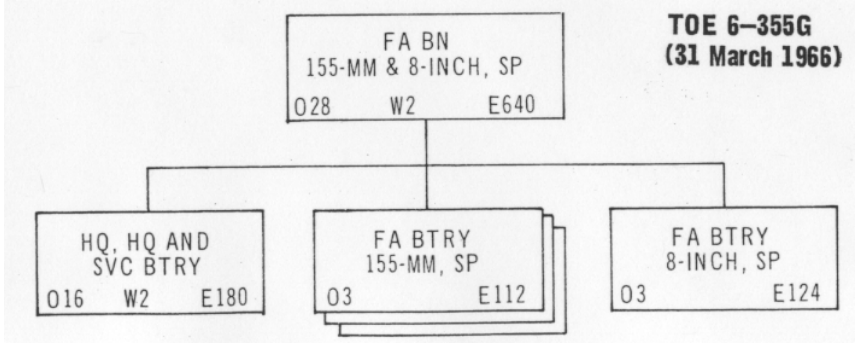


FA Btry, 155-mm SP, FA Bn, Armd or Mech Div

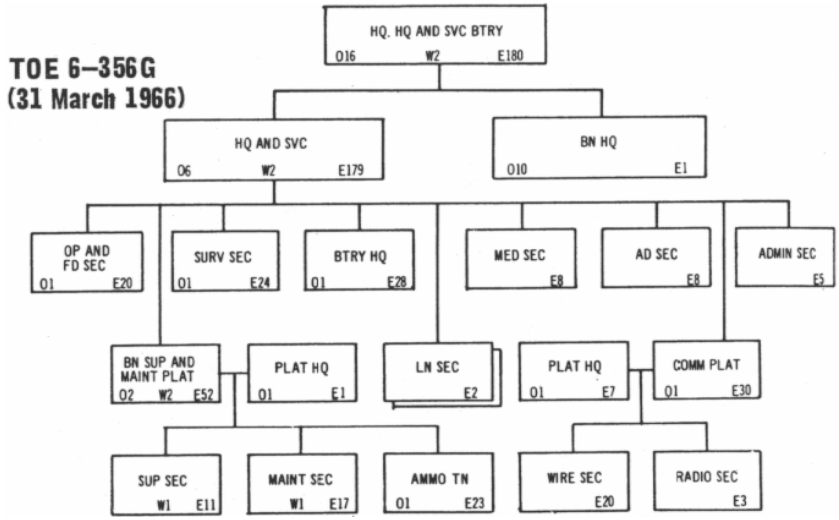


Svc Btry, FA Bn, 155-mm SP, Armd or Mech Div



FA Bn, 155-mm/8-in SP, Armd or Mech Div

ARMD/MECH ARTY



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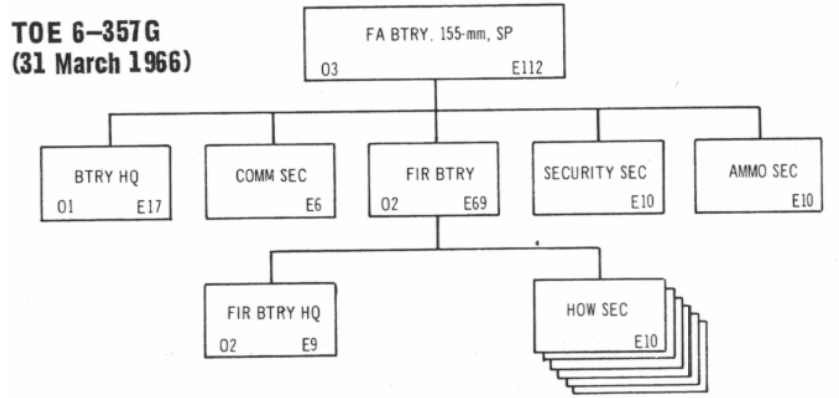
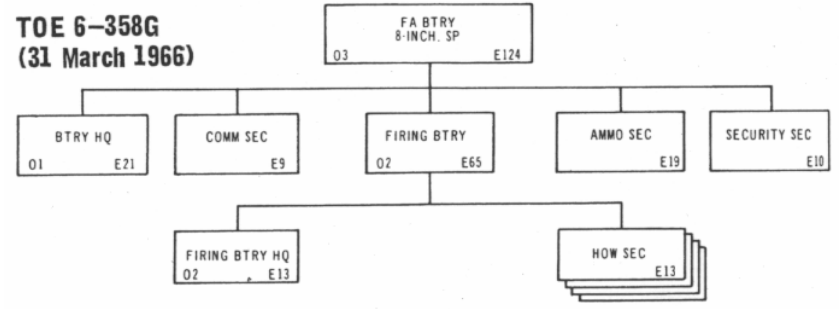
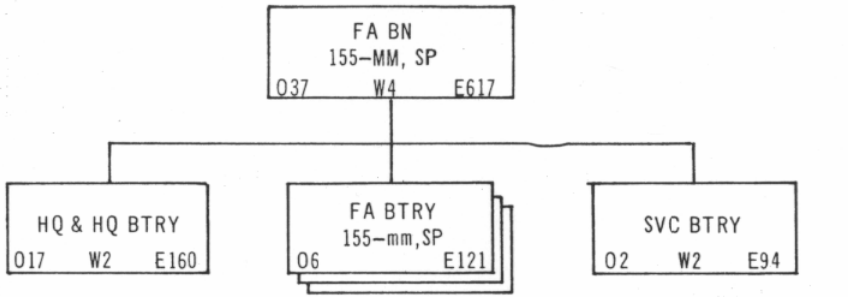


FA Btry, 155-mm SP, FA Bn, Armd or Mech Div



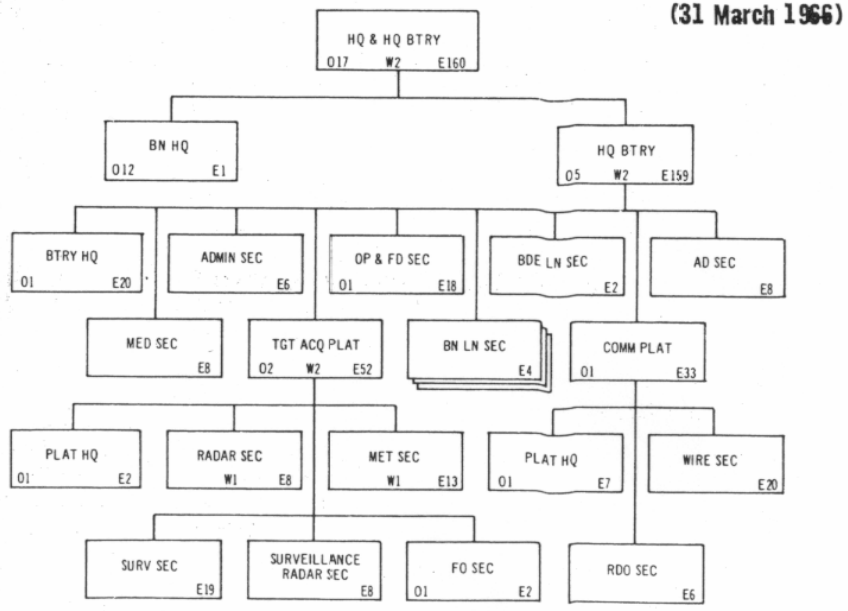
FA Btry, 8-in SP, FA Bn, Armd, Mech, or Inf Div

ARMD/MECH ARTY
TOE 6–375G
(31 August 1966)



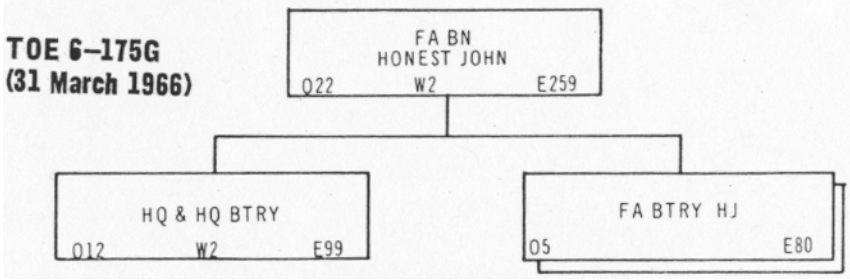
FA Bn, 155-mm SP, Sep Armd or Mech Bde

TOE 6–376G
(31 March 1966)

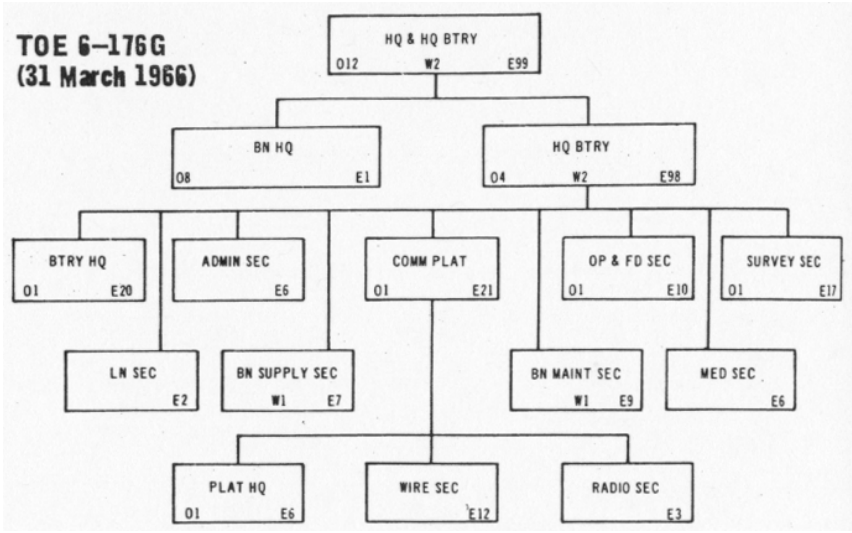


HH Btry, FA Bn, 155-mm SP, Sep Armd or Mech Bde

FA BN, HONEST JOHN



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



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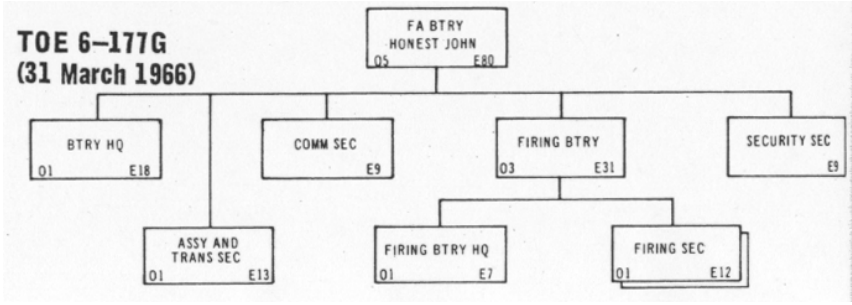
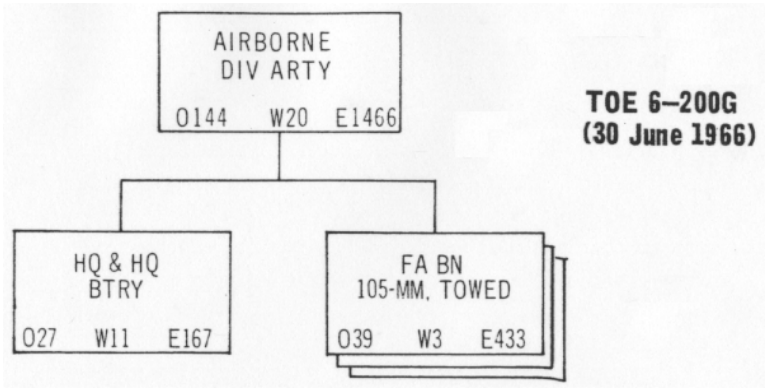
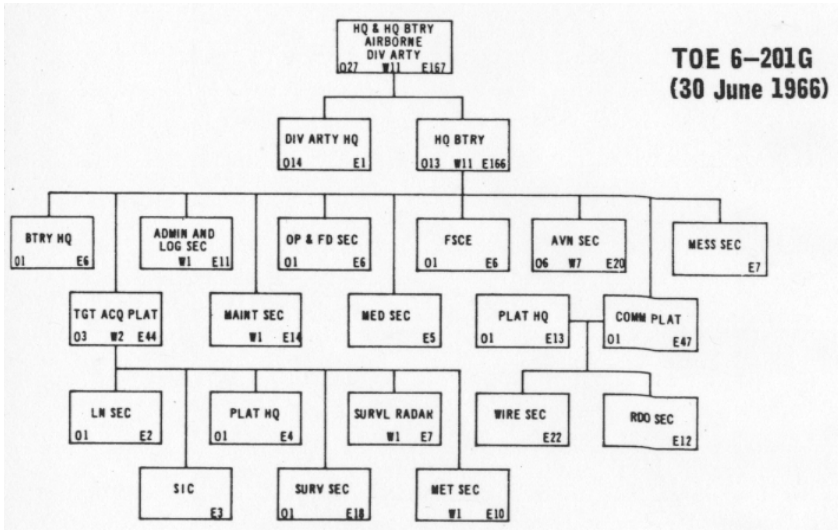


FA Btry, FA Bn, HJ, Armd, Mech, or Inf Div



Abn Div Arty



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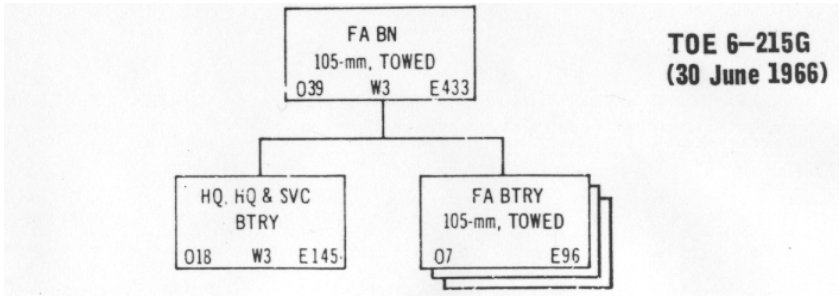
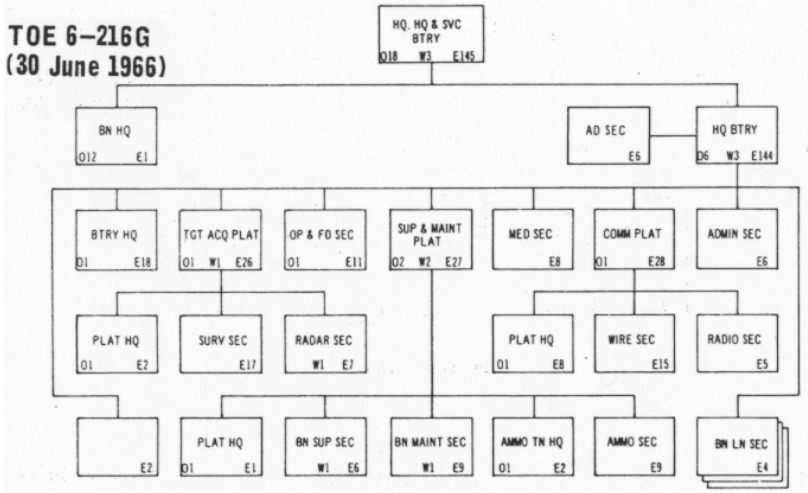
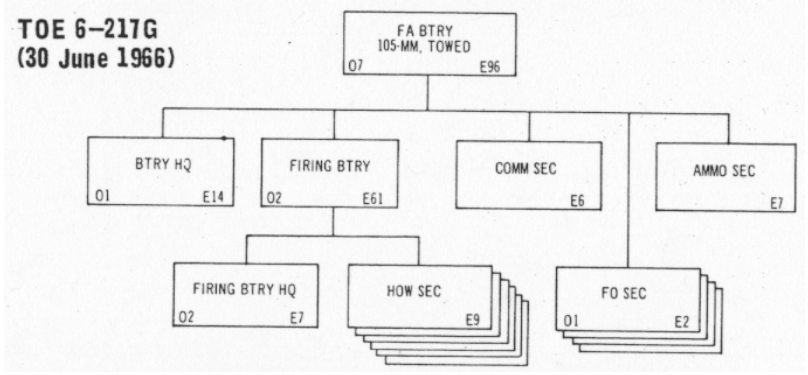


FA Bn, 105-mm Twd, Abn Div or Sep Abn Bde

ABN ARTY

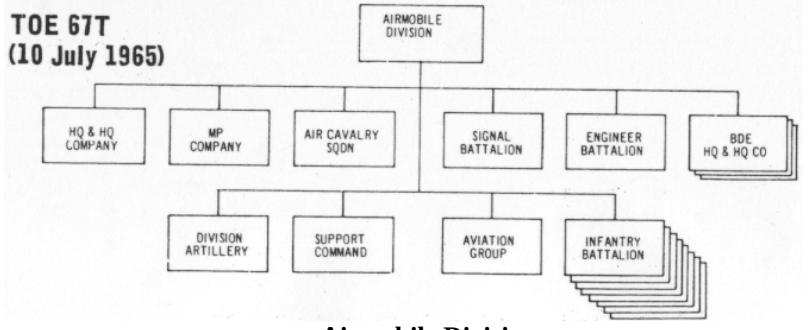


HHS Btry, FA Bn, 105-mm Twd, Abn Div or Sep Abn Bde

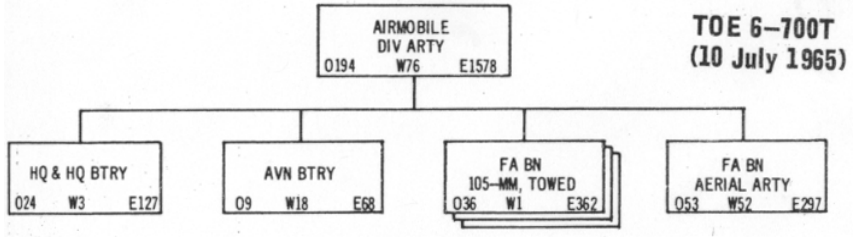


FA Btry, 105-mm Twd, Abn Div or Sep Abn Bde

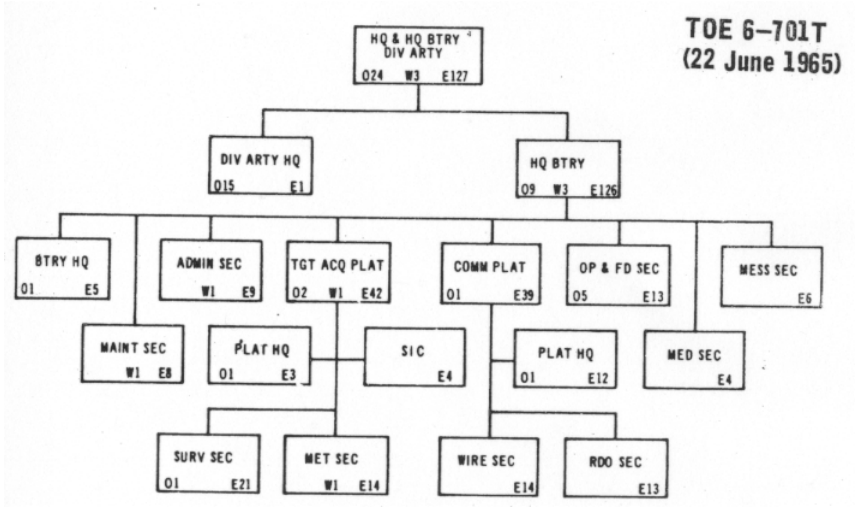
AIRMOBILE ARTY



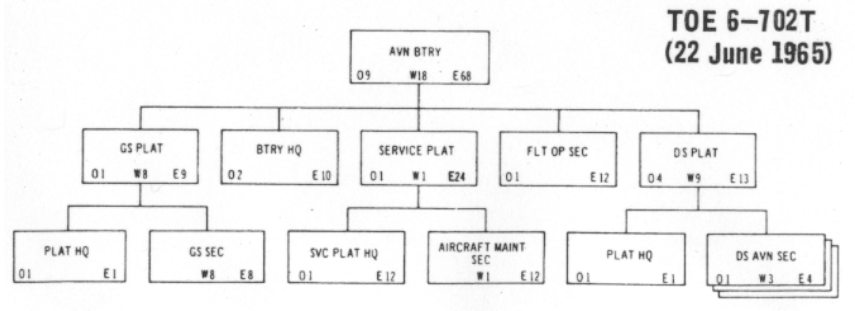
Airmobile Division



Airmobile Div Arty

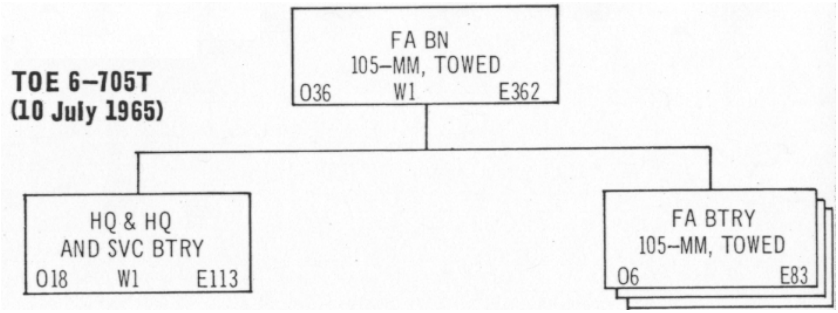


HH Btry, Airmobile Div Arty

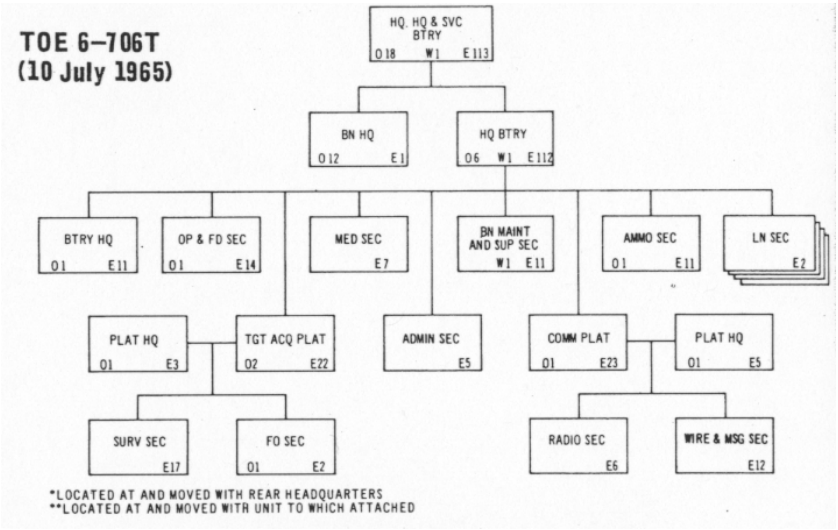


Aviation Btry, Airmobile Div Arty

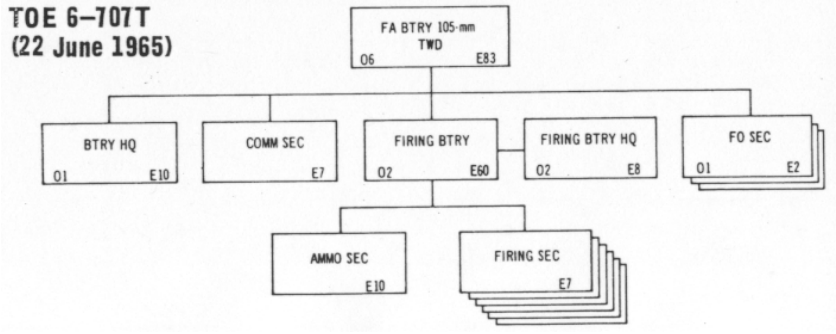
AIRMOBILE ARTY



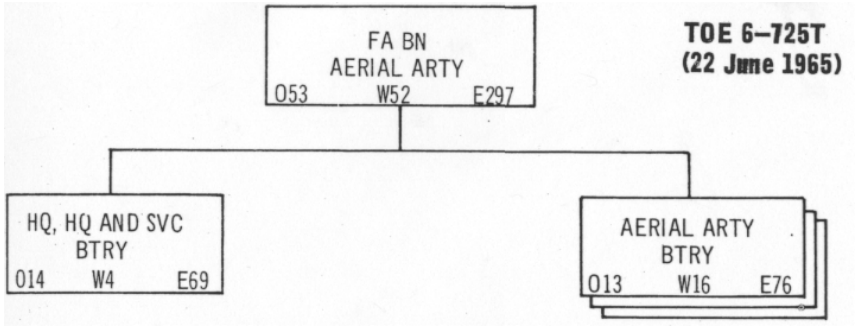
FA Bn, 105-mm, Airmobile Div



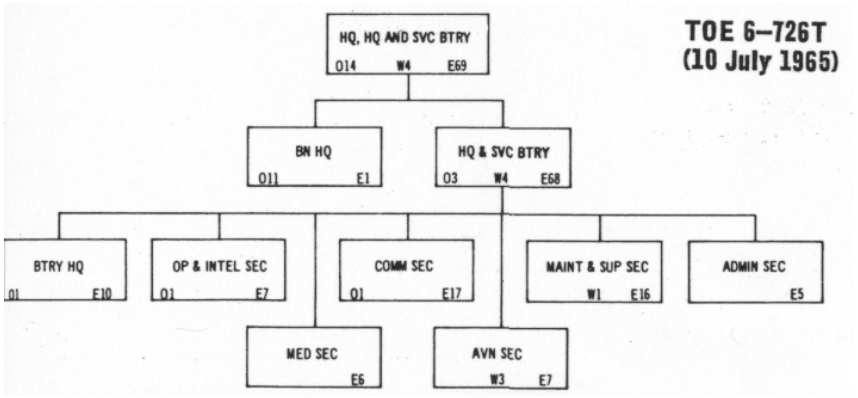
HHS Btry, FA Bn, 105-mm, Airmobile Div



FA Btry, 105-mm, FA Bn, Airmobile Div



FA Bn, Aerial Arty, Airmobile Div



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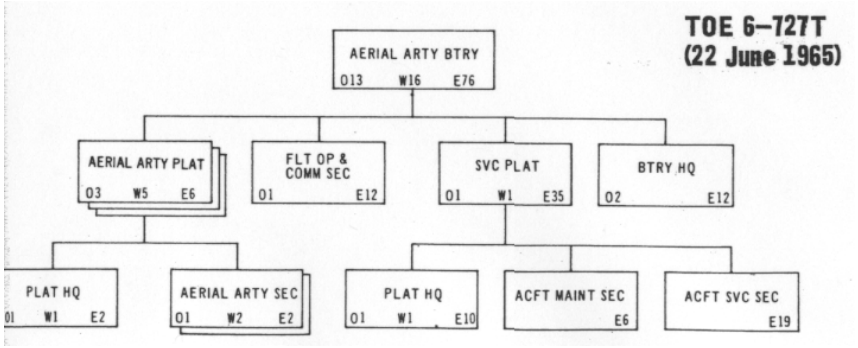
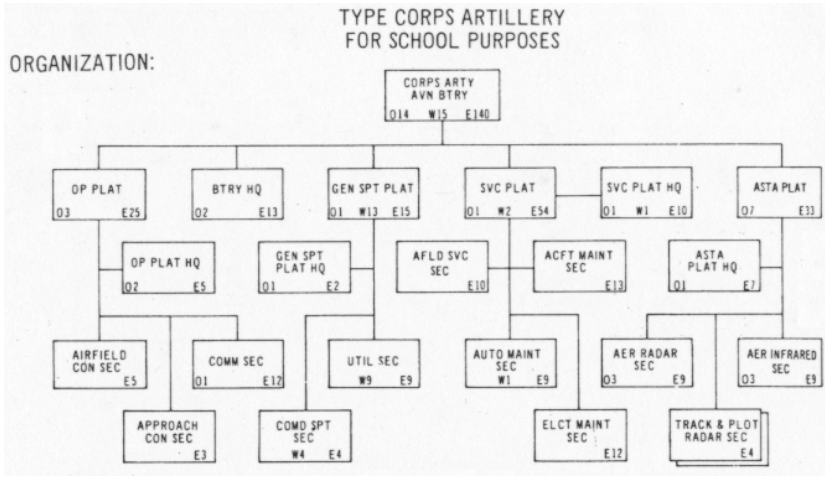
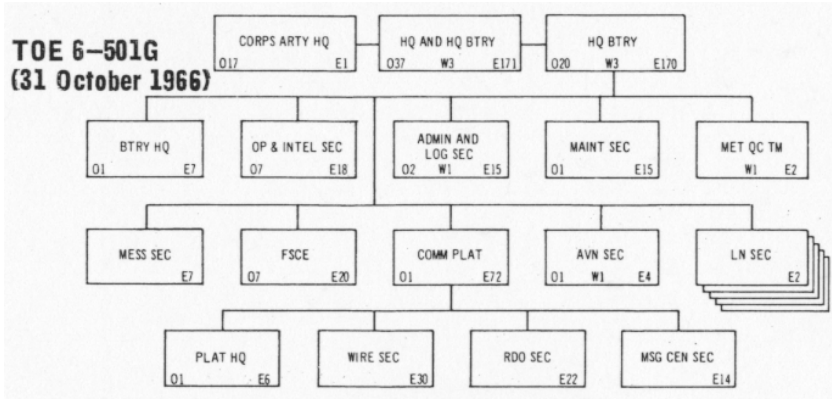


Aerial Arty Btry, FA Bn, Aerial Artillery, Airmobile Div

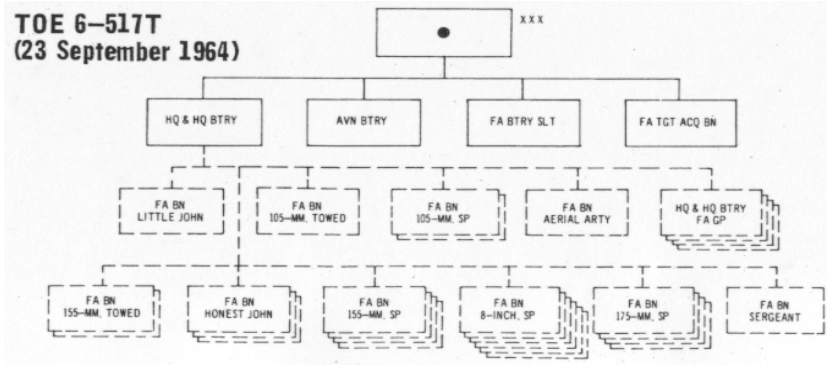
ARMY/CORPS ARTY



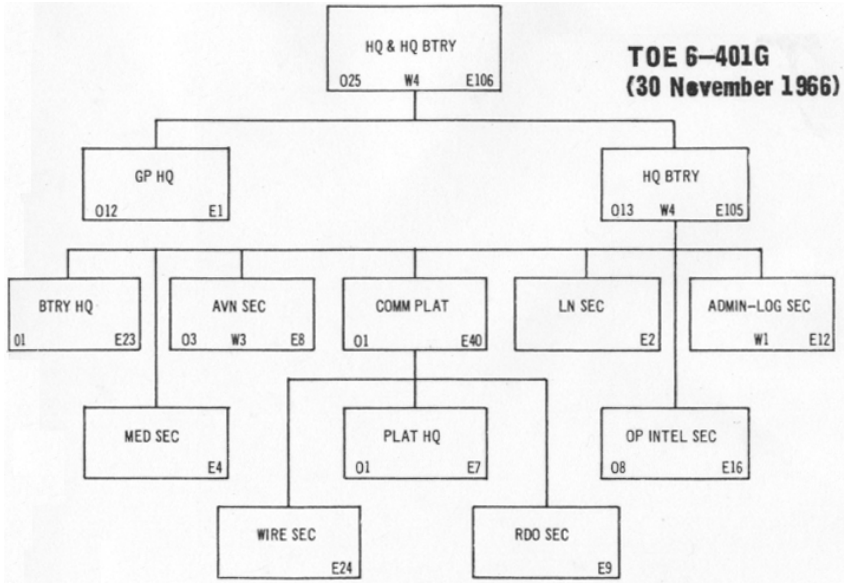
Type Corps Arty



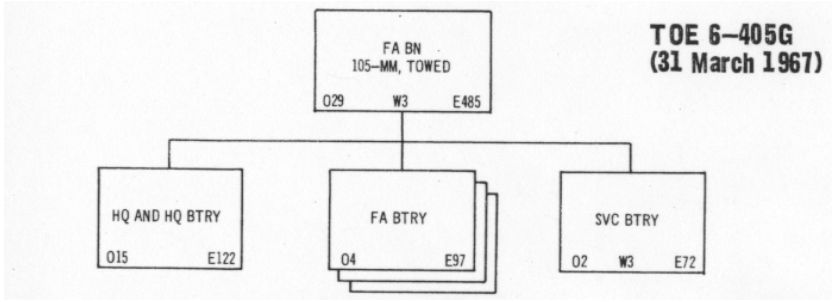
HH Btry Corps Arty



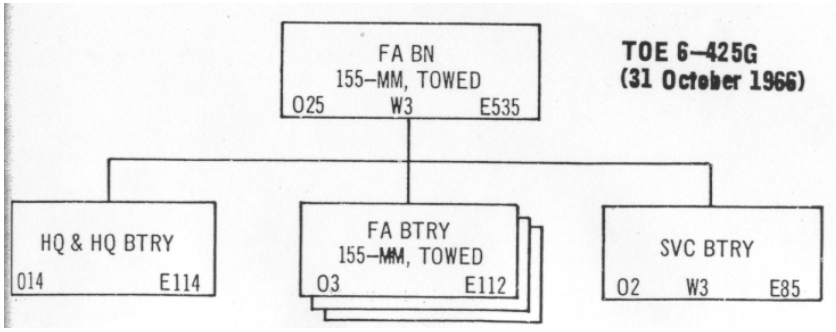
Corps Arty Avn Btry



HH Btry, FA Group

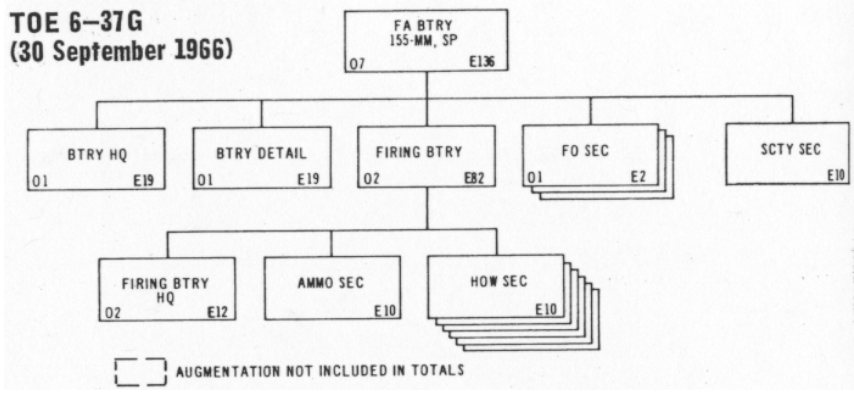


FA Bn, 105-mm Twd

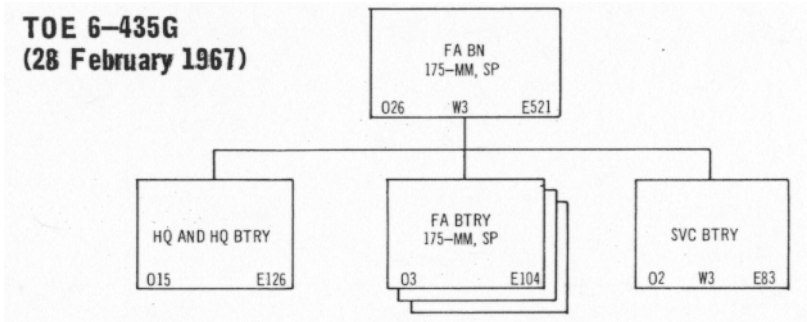


FA Bn, 155-mm Twd

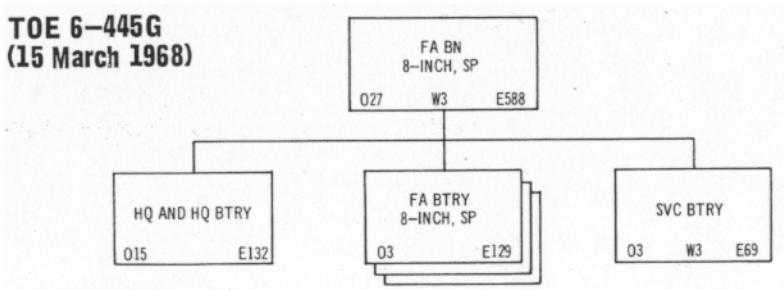
ARMY/CORPS ARTY



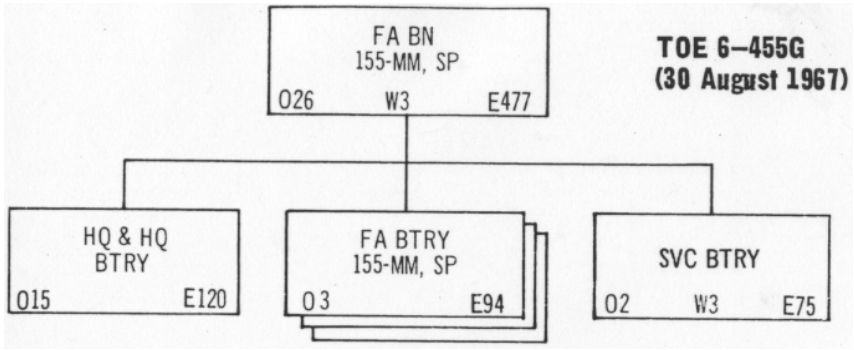
FA Bn, 155-mm SP, Armd Cav Sqdn, Armd Cav Regt



FA Bn, 175-mm SP



FA Bn, 8-in SP



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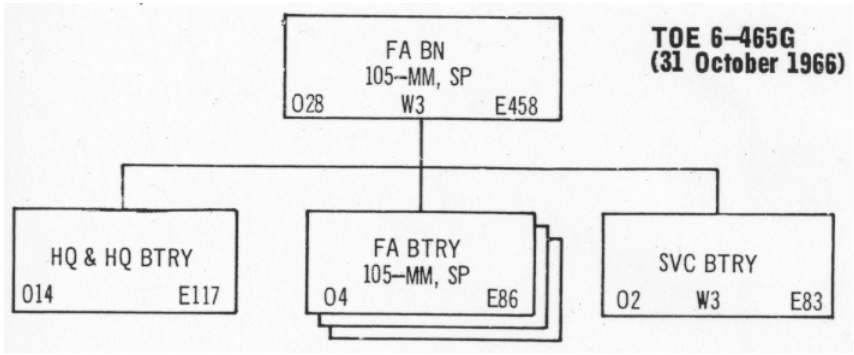

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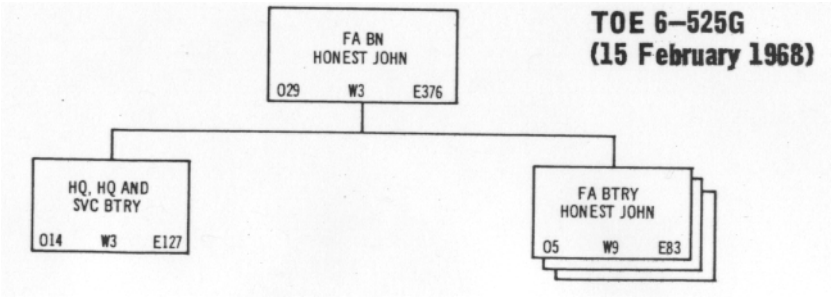
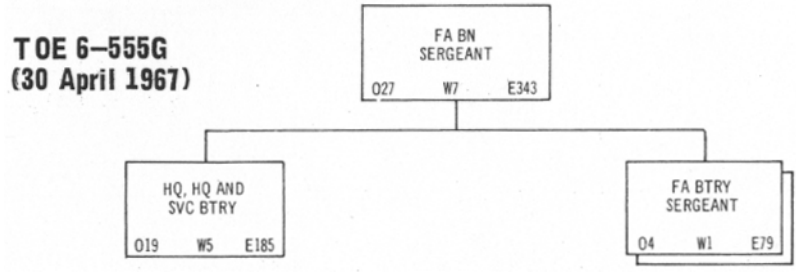
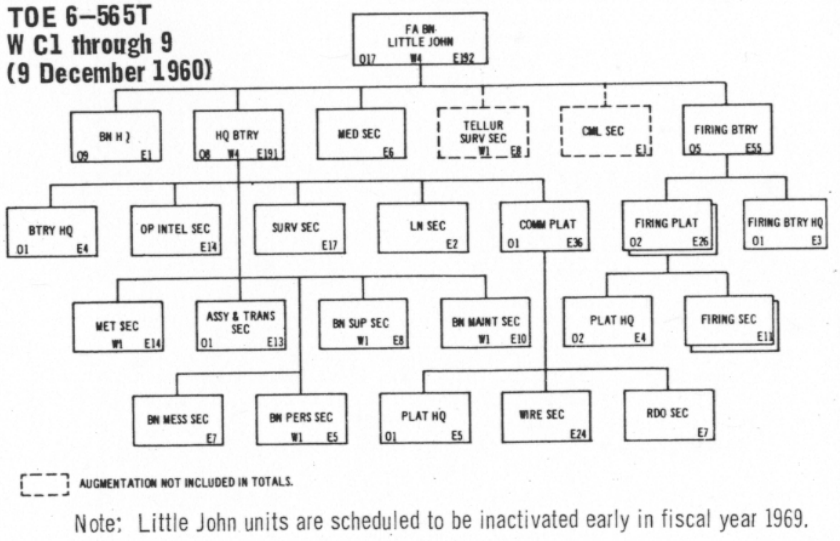


FA Bn, Honest John

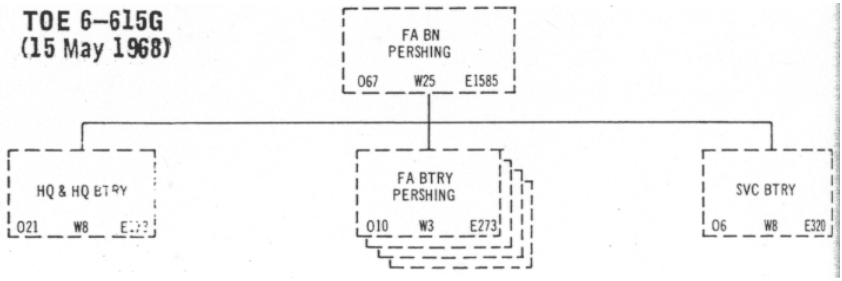
ARMY/CORPS ARTY



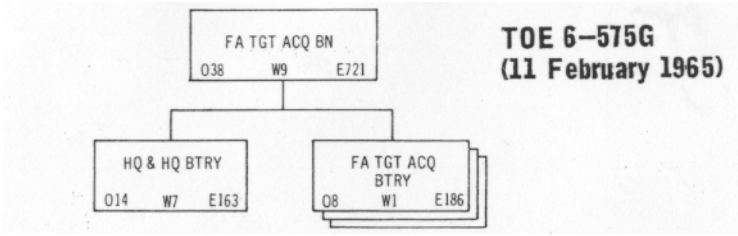
FA Bn, Sergeant



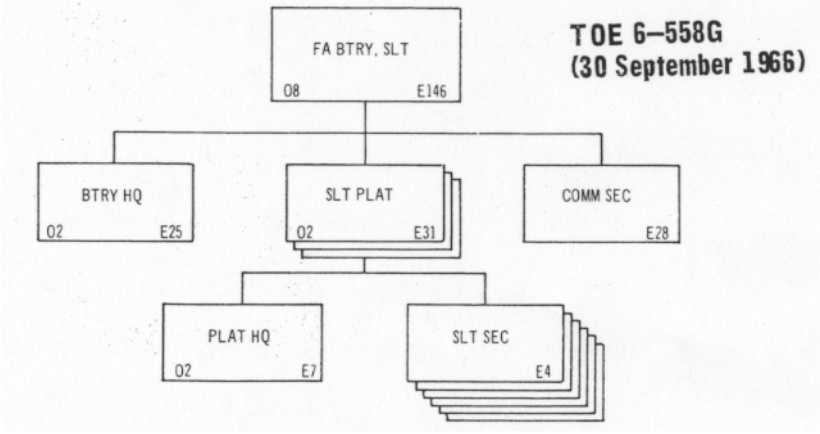
FA Bn, Little John



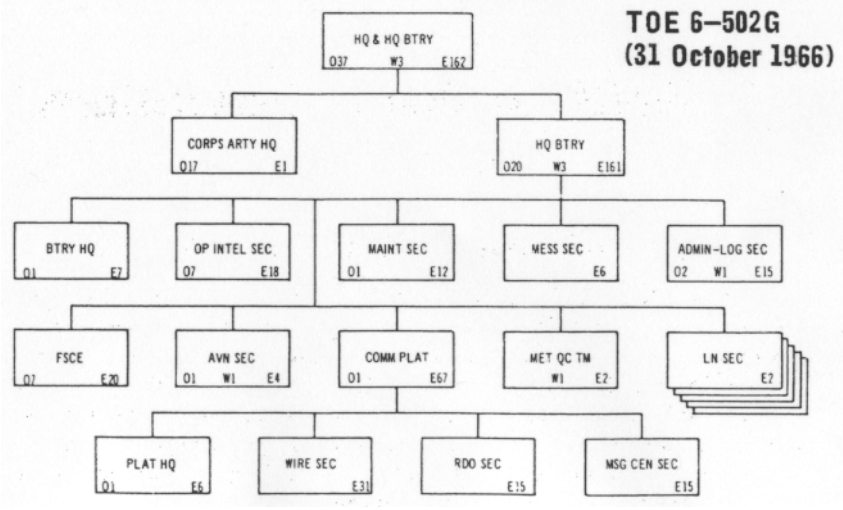
FA Bn, Pershing



FA Target Acquisition Bn



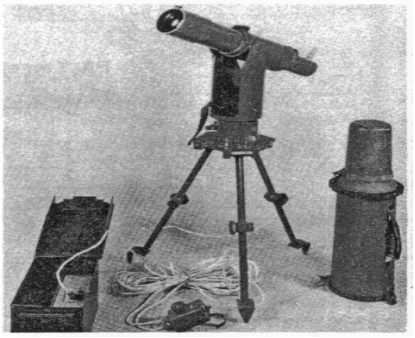
FA Btry, Searchlight



HH Btry, Abn Corps Arty

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.



SECTION III

Field Artillery Operations

FUZE TIME ADJUSTMENT IN AREA FIRE

On 1 May 1968, USAAMS began teaching a revised procedure in the adjustment of height of burst using fuze time in area fire. The new procedure is faster, usually requires fewer adjusting rounds and is simpler for the forward observer (FO) and fire direction center (FDC).

The adjustment of deviation and range is conducted with fuze quick. Upon splitting the appropriate range bracket (usually 100 meters), the adjustment of height of burst is begun and no further corrections to deviation or range are made.

The FDC adds 20/R to the quadrant elevation (QE) determined for the split of the bracket, obtains a fuze setting from the Graphical Firing Table (time gageline or time corresponding to the elevation plus an experience fuze correction) and fires with these data.

The FO spots for height of burst only and determines and announces the correction to the nearest 5 meters to raise or lower the burst to 20 meters above the adjusting point.

The FDC changes the height of burst as announced by the FO, by lengthening or cutting back on the fuze setting. The amount of fuze setting change is obtained from a "change in fuze setting for a 10-meter change in height of burst" scale which has been added to the new, slant-scale GFT's.

Units not having the slant-scale GFT, but wishing to use this procedure, can determine the change in fuze setting for a 10-meter change in height of burst from the TFT, ΔR, ΔH (TIME) table using the zero height of target above gun column. For example, given: FT 155-AH-2, charge 7W, range 10,000. Enter Table L, page 376, and extract ΔH of –135.8 meters for a 1-second change in time of flight. The change in fuze setting, x, for a 10-meter change in height of burst is:

$$\frac{10}{135.8} = \frac{X}{1} = .07$$

The FO adjusts in the normal manner to a 20-meter height of burst above the adjusting point. Continuing the above example, the following events occur (assume initial fuze setting fired as 28.7):

FO Spotting	FO Correction	FDC Command
Graze	UP 40	Ti 28.4 (28.7—(4X.07))
Air	DOWN 15	Ti 28.5 (28.4+(1.5X.07))

NEW GRAPHICAL FIRING SCALES (GFT)

A new family of GFT's will shortly replace the present low angle rules. The scales of the new GFT's are constructed at an angle to the sides of the rule so that when a GFT setting is drawn on the cursor, corrections to range (range K) and time (fuze K) will no longer remain constant as they now do. These constants introduce errors which are presently minimized by the use of transfer limits. The slant scales will provide the ability to apply variable range and fuze K's and thus enlarge transfer limits.

A detailed information letter for each GFT will be supplied to appropriate units and each set of GFT's will also have an information letter packed with it.

New GFT's have been completed for the M107, 175-mm gun and arrangements are being made for their issue. The M109, 155-mm howitzer GFT's are in production and will be followed shortly by GFT's for the M102/M108, M110, M114A1 and M101A1 howitzers.

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 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 two 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 will not 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 AN/GSQ-64 (SDR) and the FADAC Automatic Logic Tester AN/GSM-70 (FALT). The SDR is used by the organizational FADAC radio mechanic to load the various programs into the computer. The FALT is used with the SDR to determine which part of the computer has failed in the event of a malfunction.

FSN FOR FDC EQUIPMENT

Some units in Southeast Asia have experienced difficulties in obtaining fire direction equipment. Following are listed federal stock numbers (FSN) for some of these items which should aid in requisitioning through normal supply channels. The FSN for the graphical firing tables and graphical site tables are the ones used in requisitioning paper ballistic scales for the same items.

Weapon	Firing Table	Nomenclature		Federal Stock No.	No. Rules
105-mm howitzer	FT 105-H-6	GFT		1220-815-6192	2
M101A1		GFT	(I11 M314)	1220-978-9585	2
		GST		1220-815-6190	1
M108/M102	FT 105-AS-1	GFT		1220-764-5419	2
		GFT	(I11 M314)	1220-764-5418	2
		GST		1220-764-5422	1
155-mm howitzer		GFT		1220-789-2985	2
M114A1/M123A1	FT 155-Q-3	GFT	(I11 M118)	1220-898-4212	2
		GST		1220-789-2986	1
M109	FT 155 AH-1	GFT	(GB High A)	1220-764-5423	1
		GFT	(GB Low A)	1220-764-5424	1
		GFT	(WB Low A)	1220-764-5425	1
		GFT	(WB High A)	1220-764-5426	1
		GFT	(I11 M118)	1220-764-5420	2
		GST		1220-764-5421	2
8-inch howitzer	FT 8-J-3	GFT		1220-898-4213	2
M115/M110		GST		1220-898-6786	1
	FT 8-O-3	GFT		1220-876-8572	1
		GST		1220-876-8573	1
Mortar	FT 4.2-F-1	GFT		1220-983-3921	1
	FT 4.2-H-1	GFT		1220-087-2048	1
Howtar (107-mm)	FT 4.2-F-1	GFT		1220-908-9011	1
		SLANT SCALE[1]			
105-mm howitzer M101A1	FT 105-H-6	GFT		1220-937-8279	3
M108/M102	FT 105-AS-2	GFT		1220-937-8280	3
155-mm howitzer M114A1/M123A1	FT 155-O-4	GFT		1220-937-8281	3
M109	FT 155-AH-2	GFT		1220-937-8282	3
8-inch howitzer M115/M110	FT 8-J-4	GFT		1220-937-8283	3
	FT 8-O-4	GFT		1220-937-8284	2
175-mm gun	FT 175-A-O (Rev 2)	GFT		1220-937-8285	2
M107		GST		1220-937-9522	1

[1]Only the slant scale graphical firing and graphical site tables for the 175-mm gun, M107 and 155-mm howitzer, M109 were available for requisitioning at time of printing. They will be followed shortly by GFT's for the M102/M108, M110, M114A1 and M101A1.

GUNNERY

Item	Nomenclature	Federal Stock No.	No.
Grid Sheets (firing charts)	Paper-Aluminum Foil	7530-281-4812	
	Plastic: 1:25,000	7530-656-0813	
	1:50,000	7530-656-0812	
	Paper (used at USAAMS)	7530-281-4811	
Carrying Case	M86 with 15-in rules	1290-765-5870	
	With slant scale rules (contains 4 rules each)	1220-937-8286	
Plotting Pins[2]	Maptack 1 1/8-in long		
	Red	7510-274-5458	
	Green	7510-274-5457	
	Black	7510-274-5454	
	Blue	7510-274-5455	

[2]Previously authorized maptacks are being replaced by the items mentioned above.

M10 Plotting Board		1220-670-2976	
Scale Plotting, Coordinate	Aluminum	6675-283-0018	
	L-shaped, plastic	6675-283-0020	
Graphical Effects Table		1220-855-5922	1
Range Deflection Protractor	Aluminum		
	1:25,000	1290-266-6890 (15,000M)	
	1:25,000	1290-266-6891 (25,000M)	
	1:50,000	1290-580-4441 (50,000M)	
	3,200-mil arc 1:50,000	1290-930-2688 (50,000M)	

If for some reason fire direction equipment cannot be obtained through normal supply channels, the Book Department, United States Army Artillery and Missile School, Fort Sill, Oklahoma, 73503, carries many of these items in stock. Each artillery battalion in Vietnam should have received a copy of the Book Department's price list. If not, a price list catalogue may be obtained by writing the Book Department.

Figure 1. Chinook with piggyback

Rigging Equipment Required for Individual Loads

RIGGING EQUIPMENT

TYPE LOAD	CLEVISES										SLINGS	
	Small	Med	Large	Link Assy	3′	8′	9′	11′	12′	16′	20′	A-22	Remarks
M101A how, piggyback		2		1	1	2		4				2	80 rounds of ammo & fires
M102, piggyback		2		1	1		1	1	2		1	2	80 rounds of ammo & fires
M114A1 (155-mm) how			CH47-6 CH54-7	2	2			4			2		
¼-ton truck	4			1	1		4						
¼-ton trailer				1	1		3						
¾-ton truck				1	3				2	2			or 4 legged adj sling

Cargo nets, paulins and quick release tiedowns may also be used in rigging loads.

NOTES: Substitute items may be used. They should **always** be equal to or better than the items recommended above.

	FSN	Nomenclature
1.	1670-360-0304	Clevis, small, suspension
2.	1670-678-8562	Clevis, medium, suspension
3.	1670-090-5354	Clevis, large, suspension
4.	1670-242-9169	Bag, cargo, aerial del, A-22
5.	4020-240-2146	Cord, Nylon, natural, type III, 550 lb cap
6.	8110-900-8328	Drum, collapsible, water, 250 gal cap
7.	1670-783-5988	Link assembly, (type IV), single, quick-release
8.	1670-753-3789	Sling, cargo, aerial delivery, 13,500 lb. cap, 2 loop, 8′

	FSN	Nomenclature
9.	1670-753-3790	Sling, cargo, aerial delivery, 13,500 lb. cap, 2 loop, 9′
10.	1670-753-3791	Sling, cargo, aerial delivery, 13,500 lb. cap, 2 loop, 11′
11.	1670-753-3792	Sling, cargo, aerial delivery, 13,500 lb. cap, 2 loop, 12′
12.	1670-753-3793	Sling, cargo, aerial delivery, 13,500 lb. cap, 2 loop, 16′
13.	1670-753-3794	Sling, cargo, aerial delivery, 13,500 lb. cap, 2 loop, 20′
14.	1670-753-3788	Sling, cargo, aerial delivery, 20,000 lb. cap, 3 loop, 3′
15.	1670-753-3631	Sling, cargo, aerial delivery, 20,000 lb. cap, 3 loop, 9′
16.	1670-823-5040	Sling, cargo, aerial delivery, 20,000 lb. cap, 3 loop, 11′
17.	1670-823-5041	Sling, cargo, aerial delivery, 20,000 lb. cap, 3 loop, 12′
18.	1670-823-5042	Sling, cargo, aerial delivery, 20,000 lb. cap, 3 loop, 16′
19.	1670-823-5043	Sling, cargo, aerial delivery, 20,000 lb. cap, 3 loop, 20′
20.	1670-823-5044	Sling, cargo, 4-leg, adjustable 10,000 lb. cap
21.	3940-298-3985	Sling, cargo, paulin, ctn duck, 12′ × 12′
22.	3940-892-4375	Sling, cargo net, nylon, 12′ × 12′
23.	1670-725-1437	Strap, aircraft, quick-release
24.	8135-266-5016	Tape, 2-inch, pressure-sensitive

NOTE: Aerial delivery sling capacities have been revised by Technical Message General Number 5-68 (AMSAV-EG3-1360). Sling, Cargo, **2-loop,** capacity is now **6,500 lbs;** sling cargo, 3 loop, capacity is now **10,000 lbs.**

TACTICS

SEARCHLIGHTS

Within the last three years numerous searchlight batteries have been activated and supplied with the 23-inch xenon searchlight. The searchlight has been issued on an interim basis and will eventually be replaced by a 30-inch xenon light.

A searchlight battery consists of a battery headquarters, a communications section, and three searchlight platoons. Two jeep-mounted 23-inch xenon searchlights are provided each section with two sections per platoon.

The light source in the 23-inch searchlight is a short-arc xenon lamp rated at 2.2 kilowatts. Powered by a 180 ampere alternator-rectifier system installed in the jeep engine compartment, the searchlight is capable of operating in both visible and infrared modes. Ignition of the lamp and selection of the mode of operation simply are changed by a selection switch.

Range of the searchlight, using the direct visible, focused beam, is approximately 4,000 meters. Under favorable conditions, however, useful illumination may be obtained at appreciably greater ranges. The range of the spread beam and infrared modes is understandably much less. Operation data for the 23-inch searchlight is listed as follows:

Current requirement	100 amperes dc
Candlepower	125 million
Beam width	
Focused (pencil) beam	10 mils
Spread beam	120 mils
Weight	250 pounds
Range	4,000 meters

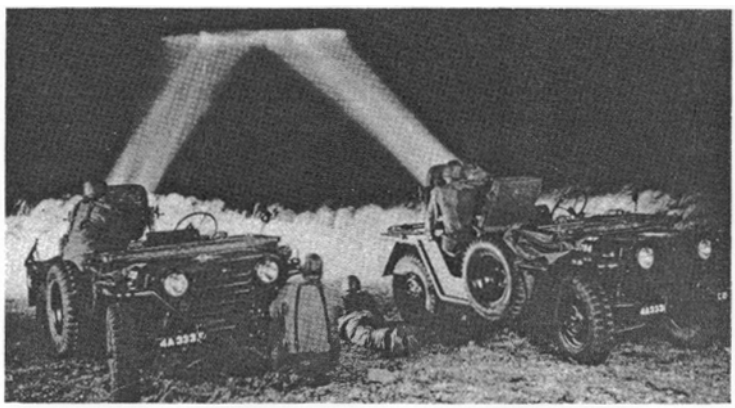


Figure 2. Jeep-mounted 23-inch xenon searchlight.

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.

Spread Beam—A beam 120 mils in width.

Pencil Beam—A beam 10 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 by announcing beam spread corrections; for example, RIGHT 2 BEAMS, UP ½ BEAM.

FIELD ARTILLERY TACTICAL MISSIONS

Recent meetings of a committee representing the Quadripartite (America, Britain, Canada, and Australia) armies resulted in several changes affecting artillerymen the world over. Certain changes in the area of artillery tactical missions were mostly of significance to the other

three nations, since they elected to adopt our concept of four standard tactical missions; however, some changes regarding tactical missions do affect US artillerymen. These changes are discussed below, and the tactical missions are summarized in the table which follows.

First, the word "formation" is to be included, where appropriate, in referring to a maneuver unit (e.g., zone of supported unit/formation). This change was made at the request of the other three nations, who use the term for certain situations.

Second, all references to "higher artillery headquarters" were changed to read "force artillery headquarters." This change was deemed appropriate because all requirements and actions involving the tactical employment of artillery are the responsibility of the artillery headquarters subordinate to a **force** of some size.

The wording of an artillery unit's responsibilities for answering calls for fire was changed to emphasize the priority in which the unit will answer the calls for fire. The heading in the second column of the table of tactical missions was changed from "Answers calls for fire from" to "Answers calls for fire in priority from," and the sources of the calls for fire (requesting agencies) opposite each type of mission are numbered to indicate their priority. The priorities were always understood by US forces; the change now insures that all the Quadripartite forces understand them.

Another change in terminology was made in regard to the positioning of artillery units. Previously, the heading of the seventh column of the table of tactical missions read "Displaces when." The committee felt that a more descriptive phrase should be used—to indicate where, when, and how a unit will move—and changed the heading to read "Is positioned by." The committee also felt, as mentioned above, that since the force headquarters is the control element for all artillery of the force and since all decisions involving the positioning of general support units are implemented through the force artillery headquarters, the term "Ordered by higher artillery headquarters" in respect to the displacement of a general support unit was redundant. Thus, it deleted the latter term from the table of tactical missions.

These changes do not affect the inherent requirements or actual accomplishment of tactical missions, but they do contribute to clarity and precision of meaning and to common understanding of the missions by the nations concerned. The above changes are included in Change 1 (11 Dec 67) to FM 6-20-1, FA Tactics (July 1965).

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

*each is applicable to US only.

TACTICS

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.

Fire planning within the field artillery is continuous and concurrent. It takes place at all levels from the forward observer through the highest echelon, and close coordination between artillerymen and supported commanders is necessary at each level. The forward observers (artillery, 4.2-inch mortar, and 81-mm mortar), using the company's plan of attack, prepare target lists which reflect the fires needed to support the company. After developing targets, the artillery forward observer submits his target list to the artillery liaison officer at the maneuver battalion. Targets suitable for engagement by the 4.2-inch mortar are submitted to the mortar platoon fire direction center. A consolidated list is then forwarded to the artillery liaison officer at the maneuver battalion headquarters. Targets which will be attacked by the 81-mm mortars normally remain at company level. The artillery liaison officer with the 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 developed by the forward observers, resolving any duplications, and adding any targets which he has planned based on information provided him by the maneuver battalion commander and his staff. After this target list is completed and approved by the maneuver battalion commander, it is submitted to the direct support artillery battalion fire direction center, the focal point of fire planning at the brigade level. The artillery battalion S3 consolidates all target information from the liaison officers at maneuver battalion level and the liaison officer at brigade as well as from several other sources to include division artillery, adjacent units, and the organic countermortar radar at the artillery battalion level. An additional requirement, that of planning the fires of the maneuver elements' organic 4.2-inch mortars, may be placed on the direct support battalion by the brigade commander. The plan is then submitted to the brigade commander for approval and, when approved, becomes the artillery fire support appendix. Essentially, the same planning process takes place at the division artillery level, where the division artillery S3 prepares the artillery fire plan for the division. This fire plan includes all the fires of interest to the division as a whole and those fires requested by the division's direct support battalion.

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 fire to support a maneuver phase (series of targets). Both series of targets and program of targets may be fired on call or at a specific time (scheduled) during the operation, whereas a group of targets is fired on-call.

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, and harassing and interdiction fire.

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?

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, and fires beyond the objective.

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, and during the enemy attack and to support the counterattack. These targets are planned in three general areas: in front of our positions, on top of our 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.

TACTICS

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 preparation. 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) of the artillery and mortars. 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 plan 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 a new target numbering system developed at the U. S. Army Artillery and Missile School as a result of new requirements in the field of artillery fire planning. As with all past target numbering systems, the new numbering system must provide for the identification of the planning source of each target and permit a rapid resolution of duplication. In addition, this system must—

- Be compatible with the TACFIRE computerized fire direction system presently under development for the post-1970 time period.

- Implement the changes brought about by the ABCA (American, British, Canadian, and Australian) agreements.

- Differentiate between conventional and special weapon targets as well as counterbattery and toxic chemical targets.

- Conform to security requirements.

The target numbering system consists of two letters and four numbers. The two letters are used to denote the originator of the target and the four numbers are used to designate each specific target as a separate entity. The first of these two letters is assigned by corps to its major subordinate units. 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 coordination 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 coordination element	Z

The four-digit numerical group following the two-letter group designates 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	C—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
Liaison officer at brigade fire support coordination center	1000-1999
Liaison officer with lowest number maneuver battalion	2000-2999
Liaison officer with next higher number maneuver battalion	3000-3999
Liaison officer with next higher number maneuver battalion	4000-4999
Liaison officer with next higher number maneuver battalion	5000-5999
Liaison 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 liaison 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 coordination element (FSCC/FSCE) 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/FSCE 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 four-digit block assigned to that command echelon. For more detailed discussions of all aspects of fire planning, refer to Reference Note T 3304, prepared by the Tactics/Combined Arms Department, USAAMS, which will be used in lieu of FM 6-20-2 presently under revision.

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

COMMUNICATIONS

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.

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.

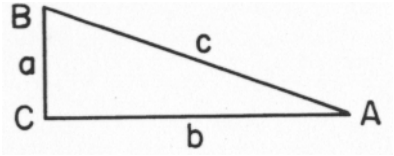
The facilities normally available in a division area communication system are:

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

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.



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

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

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.

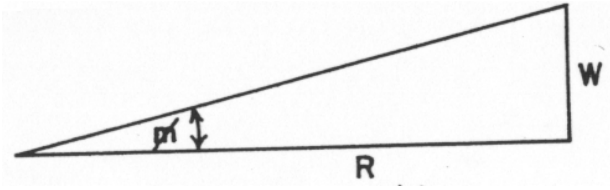
$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

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.

ARTILLERY MATHEMATICS

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* (971-1231)	Feet 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 320-5, Dictionary of United States Army Terms, October 1967.)

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