TM 9-238

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

DEEPWATER FORDING OF ORDNANCE MATERIEL

HEADQUARTERS, DEPARTMENT OF THE ARMY

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TECHNICAL MANUAL
No. 9-238

HEADQUARTERS
DEPARTMENT OF THE ARMY
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DEEPWATER FORDING OF ORDNANCE MATERIEL

*This manual supersedes TM 9-2853, 7 July 1945, including C1, 7 June 1948.

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

a. This manual contains general information in preparation of Ordnance materiel for deepwater fording operations.

b. This general information covers overall instructions for guidance in connection with the preliminary preparation, prevalent operations, and subsequent maintenance after fording procedures on Ordnance materiel. This information is intended to assist fording personnel to overcome adverse conditions and to apply the preventive measures necessary for successful operation.

c. The appendix contains a list of current references including supply manuals, forms, technical manuals, and other available publications applicable to deepwater fording of Ordnance materiel.

d. Any errors or omissions will be forwarded on DA Form 2028 direct to the Commanding Officer, Raritan Arsenal, ATTN: ORDJR–OPRA, Metuchen, N. J.

e. This manual differs from TM 9–2853, 7 July 1945, as follows:

(1) Revises general information on preparation, operation, and maintenance of Ordnance materiel for deepwater fording or surf landings.

(2) Deletes all detailed instructions for installation of deepwater fording kits on combat and transport vehicles (par. 2).

(3) Deletes all information with reference to instructions for deepwater fording of towed artillery, antiaircraft artillery, and small arms weapons, including mortars and rocket launchers (par. 2).

2. Maintenance Allocation

a. The prescribed maintenance responsibilities will be as reflected in the assigned TM and TM–P portion of the multiple-part, 9-series manual pertinent to the vehicle in the Maintenance echelon allocation for deepwater fording kits for vehicles will be listed in the technical manual pertinent to the vehicle in the Maintenance Allocation Chart (MAC).

b. Supply data for deepwater fording kits for vehicles will be listed in the technical manual pertinent to the vehicle. This data will be detailed in the –20 P and/or –35P portion of the manual according to the lowest echelon authorized to install the kits.

c. Deepwater fording kits for vehicles will be listed in the technical manual pertinent to the vehicle, –20P and/or –35P portion with Federal stock number identification.

d. The technical manual pertinent to the vehicle, –20P and/or –35P portions will also list repair, replacement, or backup support parts with Federal stock number identification for deepwater fording kits for the vehicles.

e. There are no deepwater fording kits authorized for field or antiaircraft artillery at the present time. Wheel bearings, gear housings, trailpins, traversing pintles, and other parts protected by lubricants will be affected by deepwater fording operations as the immersion will destroy the lubricating qualities of the normally protective lubricants and greases. Certain operations peculiar to each weapon must be performed in connection with deepwater fording operations. General preventive maintenance instructions for fording will be provided in the pertinent technical manual for the specific weapon under "Operation Under Unusual Conditions."

f. Small arms, including mortars and rocket launchers do not have special deepwater fording kits, or special waterproofing or protective covers when fording. Waterproof bags or covers for small arms are not used any more. The pertinent weapon technical manual will provide necessary preventive maintenance instructions. Check also pertinent modification work orders (MWO's) pertaining to the equipment. In all cases where the nature of repair, modification, or adjustment is beyond the scope or facilities of the using organization, the supporting Ordnance maintenance unit should be informed in order that trained personnel with suitable tools and equipment may be provided or other proper instructions issued. For example, if the amount of welding required is beyond the capability of the unit, Ordnance maintenance personnel may be called upon to assist.

3. Forms, Records, and Reports

a. General. Responsibility for proper execution of forms, records, and reports rests upon the commanders of all units maintaining equipment. However, the value of accurate records must be fully appreciated by all persons responsible for compilation, maintenance, and use. Records, reports, and authorized forms are normally utilized to indicate the type, quantity, and condition of materiel to be inspected, repaired, or to be used in repair. Properly executed forms convey authorization and serve as records for repair or replacement of materiel in the hands of troops and for delivery of materiel requiring further repair to Ordnance shops in arsenals, depots, etc. The forms, records, and reports establish the work required, the progress of the work within the shops, and the status of the materiel upon completion of its repair.

b. Authorized Forms. The forms generally applicable to units maintaining this materiel are listed in the appendix. For instructions on the use of these forms, refer to TM 9–2810. For a listing of all forms, refer to DA Pam 310–2.

c. Report of Unsatisfactory Equipment or Materials. Any deficiencies detected in the equipment covered herein, which occur under circumstances indicated in AR 700–38, should be immediately reported in accordance with the applicable instructions in cited regulation.

Section II. DEEPWATER FORDING

4. General

a. Fording of military vehicles in deep water became a requirement with the determination to provide logistical and tactical support in all operations and to permit participation in amphibious operations. All tactical and combat vehicles must have deepwater fording capability in order to permit flexibility and obtain maximum utilization.

b. Tactical vehicles are capable of fording shallow water. The capabilities are increased for deepwater fording by the temporary installation of deepwater fording kits.

c. General data for deepwater fording depths for vehicles is as follows:

(1) Special purpose tracked vehicles (open type) tactical wheeled vehicles: maintains a water depth at least 8 inches below the air intake tube attached to the window frame.

(2) Combat tanks: maintains a water depth 1 foot below the turret ventilating blower.

d. Factors affecting the limitations of fording depths are variable as tides, winds, surf conditions, underwater obstacles, holes, composition of underwater ground and sinkage depth, and wave height.

5. Materials

The following items are used in connection with installation of deepwater fording kits.

a. Canvas Cover. Canvas covers are used to seal some air intake vents.

b. Turrent Seal. A synthetic rubber turrent seal is used to seal around the turret race.

c. Stacks. Stacks are used to conduct air into and out of the engine compartment. The stacks are constructed of sheet metal and are of universal design to permit their use with the

maximum number of adapters. The stacks can be conveniently jettisoned upon completion of the landing.

d. Adapters. The adapters are constructed of sheet metal and are designed to conform to the contour of the hull of a specific type of model vehicle. By means of the adapters, the engine compartment is rendered waterproof and through the stacks form watertight air conductors to a level above the anticipated fording depth.

6. Deepwater Fording Kits

a. Deepwater fording kits are available for temporary application on wheeled and tracked vehicles. These kits are issued to oversea theater commanders, port of embarkation commanders, and appropriate schools and training centers. Kits will be supplied to meet the requirements of only these organizations on requisitions through normal channels.

b. Tables II and II contain complete listing of current wheeled vehicles and tracked vehicles with specific kit applicable to prepare the vehicle for deepwater fording operations.

c. Items, miscellaneous supplies, and materials used in connection with the installation of deepwater fording kits are listed in paragraph 5 and table I.

Note. Tables I, II, and III are included herein for information purposes only and are not to be used as a basis for requisitioning.

d. Deepwater fording kits will be installed on vehicles only after full inspection indicates the vehicle to be in first class operating condition, preliminary preparation for deepwater fording has been accomplished, and the kit completely checked and inspected (par. 8*c*).

e. Detailed instructions for installation of deepwater fording kits on vehicles including preliminary preparation, operation, servicing, and fording maintenance procedures will be included in the pertinent 9-series technical manual covering the specific vehicle.

f. Deepwater fording kits installed on vehicles being used for fording training purposes will remain on the vehicle for the duration of the training program. When kits have been used for training operations and are to be removed for return to stock, component parts should be tagged for identification purposes. Tag the parts as they are removed from the vehicles. Use the pertinent TM –20P and/or –35P for identification and approved nomenclature of parts.

g. Deepwater fording kits installed on vehicles being used for a single fording operation may be removed and disposed of in accordance with AR 755–5 or discarded at the discretion of the unit commander.

h. "Long" type deepwater fording kits are complete kits including all items required for initially equipping a vehicle for deepwater fording operations. "Short" type deepwater fording kits consist of those items which replace expendable items that have been jettisoned off the vehicle after fording operations. No further "short" type kits will be procured. The present supply of "short" kits will be issued until supply is exhausted, then only the "long" type kit will be issued.

Note. The U.S. Marine Corps, however, will continue to use both "long" type and "short" type deepwater fording kits.

7. Workmanship

a. All workmanship on Ordnance materiel in connection with fording operations must be meticulously performed in order to be effective. Waterproofing process as prescribed can result in complete failure if the proper treatment of one small part is omitted, overlooked, or otherwise neglected. One faulty seal will cause a vehicle to stall and immobilize succeeding vehicles.

Caution: **Do not spray air-cooled type engines with ignition insulating compound. Air-cooled type engines have waterproof ignition systems and do not require spraying.**

b. The sequence of measures for deepwater fording is standard but not rigid, allowing for ingenuity and discretion according to circumstances. However, certain steps must precede others or difficulty will be encountered. The standard sequence affords a convenient checklist for each vehicle. Careful workmanship in application is imperative. Systematicness and thoroughness in inspection are vital.

Table I. Miscellaneous Material

Federal Stock No.	Specification	Technical service	Federal item name	Application data
8020–242–7266	Fed. H–B–0420	Eng	BRUSH, POINT: flat No. 1–317	Used to apply tape sealing compound coating.
8030–221–1834	Fed. TT–C–520	Eng	COATING, COMPOUND, BITUMINOUS, SOLVENT TYPE	Used to fill cracks and joints where head may be encountered and cover cloth.
8030–264–5114		Eng	SEALING COMPOUND	Sealing compound where heat is not encountered, also used to cover nonhygroscopic tape.
8135–269–8091	Fed. PPP–T–60	QM	TAPE, PRESSURE SENSITIVE ADHESIVE	Used to cover sirens and seal edges of cloth and canvas.
8010–298–3870	*MIL–V–* 13811B	Eng	VARNISH, OIL	Used to spray electrical systems as waterproofing against light spray or moisture.
3439–246–9544	A57–203–3 Type V	Rossford	ELECTRODE, WELDING	Used in certain welding or brazing processed as the filler metal.
----------	----------	----------	OSNABURG, CLOTH	Used to seal around gun shields where no mantlet cover is provided with the vehicles, also used to seal some air intake ventilators.
9150–235–5503	Fed. W–G–632	QM	GREASE, AUTOMOTIVE	
----------	MIL–C–16555A or MIL–B–12121C	----------	Barrier material	
----------	MIL–C–5651	----------	Cord, elastic shock obsorber	
----------	----------	----------	(Tempseal No. 137) Hi-Temp Grease	
----------	----------	----------	*Plastiseal "F"*—Johns-Manville type	
8040–262–9011 :8601	MIL–A–5092	----------	ADHESIVE: synethic rubber cement	
----------	MIL–C–2522	----------	Cord, shock absorber serving	
7920–267–1219		QM	Rags, wiping	General purpose use.

Table II. Deepwater Fording Kits for Tactical Transport Vehicles.

Vehicle	Deepwater fording kit stock No.	Short kit	Long kit	Vehicle serial No. break point
CHASSIS, TRUCK: 5-ton, 6x6, M40 (SNL G-744)	2540-309-8380	(*)	----	Use through IHC-M40-1349; Dia T-M4040-0209.
CHASSIS, TRUCK: 5-ton, 6x6, M40 (SNL G-744)	2540-039-8395	----	(*)	Use after IHC-M40-1349; Dia T-4040-0209.
CHASSIS, TRUCK: 5-ton, 6x6, M63 (SNL G-744)	2540-039-8380	(*)	----	Use through IHC-M63-1349; Dia T-M63-0209.
CHASSIS, TRUCK: 5-ton, 6x6, M63 (SNL G-744)	2540-039-8395	----	(*)	Use after IHC-M63-1349; Dia T-M63-0209.
CHASSIS, TRUCK: 5-ton, 6x6, M139 (SNL G-744)	2540-039-8382	(*)	----	Use through IHC-001849; Dia T-M139-0594.
CHASSIS, TRUCK: 5-ton, 6x6, M139 (SNL G-744)	2540-039-8397	----	(*)	Use after IHC-001849; Dia T-M139-0594.
TRUCK: 2 1/2-ton, 6x6 (all models) (SNL G-742)	2540-039-8376	(*)	----	Use through 118436.
TRUCK: 2 1/2-ton, 6x6 (all models) (SNL G-742)	2540-039-8391	----	(*)	Use after 118436.
TRUCK: 2 1/2-ton, 6x6 (all models) (SNL G-749)	2540-039-8383	----	(*)	One kit.
TRUCK, CARGO: 3/4-ton, 4x4, M37 (SNL G-741)	2540-039-8374	(*)	----	Use through 80039235.
TRUCK, CARGO: 3/4-ton, 4x4, M37 (SNL G-741)	2540-039-8390	----	(*)	Use after 80039235.
TRUCK, CARGO: 5-ton, 6x6, M41 (SNL G-744)	2540-039-8377	(*)	----	Use through IHC-M41-2103.
TRUCK, CARGO: 5-ton, 6x6, M41 (SNL G-744)	2540-039-8392	----	(*)	Use after IHC-M41-2103.
TRUCK, CARGO, 5-ton, 6x6 (SNL G-744)	2540-039-8380	(*)	----	Use through IHC-M55-1349; Dia T-M54-0209.
TRUCK, CARGO, 5-ton, 6x6 (SNL G-744)	2540-039-8395	----	(*)	Use after IHC-M55-1349; Dia T-M54-0209.
TRUCK, CARGO: 5-ton, 6x6, M54 (SNL G-744)	2540-039-8380	(*)	----	Use through IHC-M55-1349; Dia T-M54-0209.
TRUCK, CARGO: 5-ton, 6x6, M54 (SNL G-744)	2540-039-8395	----	(*)	Use after IHC-M55-1349; Dia T-M54-0209.
TRUCK, DUMP: 5-ton, 6x6, M51 (SNL G-744)	2540-039-8378	(*)	----	Use through IHC-M51-3474.
TRUCK, DUMP: 5-ton, 6x6, M51 (SNL G-744)	2540-039-8393	----	(*)	Use after IHC-M51-3474; Dia T-M51-0001; Mack M51-1001.
TRUCK, UTILITY: 1/4-ton, 4x4, M38 (SNL G-740)	2540-039-8375	(*)	----	One kit.
TRUCK, UTILITY: 1/4-ton, 4x4, M38A1 (SNL G-758)	2540-039-8386	(*)	----	Use through 29295.
TRUCK, UTILITY: 1/4-ton, 4x4, M38A1 (SNL G-758)	2540-301-7274	----	(*)	Use after 29295.
TRUCK, WRECKED: medium, 5-ton, 6x6, M62 (SNL G-744)	2540-039-8381	(*)	----	Use through IHC-M62-2079.

See footnote at end of table.

Table II. Deepwater Fording Kits for Tactical Transport Vehicles—Continued.

Vehicle	Deepwater fording kit stock No.	Short kit	Long kit	Vehicle serial No. break point
TRUCK, WRECKER: medium, 5-ton, 6x6, M62 (SNL G-744)	2540-039-8396	----	(*)	Use after IHC-M62-2079; Dia T-M62-0001.
TRUCK TRACTOR: 5-ton, 6x6, M52 (SNL G-744) ------	2540-039-8379	(*)	----	Use through Dia T-M52-4489.
TRUCK TRACTOR: 5-ton, 6x6, M52 (SNL G-744) ------	2540-039-8394	----	(*)	Use after Dia T-M52-4489.
TRUCK TRACTOR: 12-ton, 6x6, M26 and M26A1 (SNL G-160)	2540-692-8891	----	(*)	One kit.
TRUCK TRACTOR, WRECKER: 5-ton, 6x6, M246 (SNL G-744)	2540-039-8381	(*)	----	Use through IHC-M246-2079.
TRUCK TRACTOR, WRECKER: 5-ton, 6x6, M246 (SNL G-744)	2540-039-8396	----	(*)	Use after IHC-M246-2079; Dia T-M246-0001.

*Indicates which type of kit to use.

Table III. Deepwater Fording Kits for Tracked Vehicles

Vehicle	Deepwater fording kit stock No.	Remarks
CARRIER, MISSILE: XM474 (SNL G294).	----------	Maximnm fording depth 42 in. fully loaded.
CARRIER, PERSONNEL, FULL TRACKED, ARMORED: M113 (SNL G–294).	2320–629–1294	Amphibious. (No fording limits)
GUN, SELF-PROPELLED: 90-mm, M56 (SNL G–289).	2540–678–4101	
GUN, SELF-PROPELLED, FULL TRACKED: 155-mm, M53 and M55 (SNL G–259).	2540–039–8385	
GUN, SELF-PROPELLED, FULL TRACKED, TWIN: 40-mm, M42 and M42A1 (SNL G–253).	2350–049–4791	Maximum fording depth 48 in. No deepwater fording kit.
HOWITZER, SELF-PROPELLED, FULL TRACKED: 105-mm, M52 and M52A1 (SNL G–258).	2540–039–8384	
RIFLE, SELF-PROPELLED, FULL TRACKED, MULTIPLE: 106-mm, M50 (SNL G–288).	2590–568–1153	
TANK, COMBAT, FULL TRACKED: 76-mm, M41, M41A1, M41A2, and M41A3 (SNL G–251).	2540–039–8387	TB 9–7610–201–10/1, June 1958. Maximum deepwater fording depth combat loaded 7 feet.
TANK, COMBAT, FULL TRACKED: 90-mm, M48, M481A, M48C, and M67 Flame Thrower (SNL G–254).	2540–637–1437	For M67 tank only.
TANK, COMBAT, FULL TRACKED: 90-mm gun, M48A2 (SNL G–287).	2540–678–4079	
TANK, COMBAT, FULL TRACKED: 105-mm gun, M8A1E1 (SNL G–305).	--------	
TANK, COMBAT, FULL TRACKED: 105-mm gun, M60 (SNL G–292).	2350–678–5773	
TANK, COMBAT, FULL TRACKED: 120-mm gun, M103 and M103A1 (SNL G–356).	2540–663–6698 2540–679–4819	
VEHICLE, HEAVY TANK RECOVERY: M51 (SNL G–274).	2540–690–8070	TB 9–7610–201–10/2, April 1958. Fording depth 60–in.
VEHICLE, RECOVERY, FULL TRACKED, MEDIUM: M88 (SNL G–298).	2320–678–5772	

8. Inspection

a. Make a thorough inspection of the vehicle and its components before preliminary preparation for deepwater fording, to determine the correctness of operation and check for defects or deficiencies. Make certain all assemblies, subassemblies, and accessories are properly assembled, secure, correctly adjusted, and lubricated.

b. Any vehicle which is to be used in a fording operation must be in first-class operating condition.

c. When a new or reconditioned deepwater fording kit is first received, inspect to determine whether the materiel has been properly prepared for service by the supplying unit. Check that all parts are included in the kit and that the kit is in condition to perform its intended function. For this purpose inspect all assemblies, subassemblies, and parts to be sure they are properly assembled, secure, and clean. If any exterior surfaces are coated with rust-preventive compound, remove it with dry-cleaning solvent or mineral spirits paint thinner.

d. Do not under any circumstances install a kit on a vehicle if the kit has not been thoroughly checked and found serviceable in all respects.

e. The term "vehicle" as used herein is applicable to, and includes generally, transport vehicles tracked vehicles, mobile field, antitank, towed, and self-propelled artillery vehicles.

f. The terms "Front" and "Rear" (automotive practice) as used in connection with self-propelled vehicles are referenced with respect to the driver's normal driving position. "Front" indicates the service headlight end and the "Rear" indicates the directly opposite end. "Right" indicates to the right of the driver and "Left" indicates to the left of the driver.

g. The term "Front" and "Rear" (artillery practice) as used in connection with artillery vehicles are referred to with respect to the gunner's position when loading and firing. "Front" indicates the muzzle end and "Rear" indicates the breech end. "Right" indicates to the right of the gunner and "Left" indicates to the left of the gunner when facing from breech to muzzle.

h. Care should be taken to observe between "Right" and "Left" automotive practice and "Right" and "Left" artillery practice when hooking up a towed artillery type vehicle to an automotive type prime mover vehicle.

i. A vehicle that becomes mired, or broaches, or becomes otherwise unmanageable also may tie up disembarking of succeeding vehicles.

j. The beach landing area must be cleared as soon as possible after landing to permit succeeding vehicles and materiel to come ashore.

k. Upon landing, prepare all armament for immediate action.

9. Oversea Shipment

a. If a vehicle prepared for deepwater fording is to be shipped on a voyage exceeding 3 days prior to combat landing, it must also be prepared for oversea shipment in accordance with TB 9–299/1. Do not spray the engine compartment or engine with ignition insulating compound until after the vehicle has also been prepared for oversea shipment.

b. The distance that the processed vehicle travels, after being processed, should be held to a minimum (less than 10 miles) and all waterproofing should be checked after loading. Further waterproofing should be checked periodically during the voyage.

Section III. CLASSIFICATION OF VEHICLES

10. General

Ordnance vehicles capable of fording are of the following types:

a. Shallow water fording vehicles.

b. Deepwater fording vehicles.

c. Amphibious vehicles.

11. Shallow Water Fording Vehicles

Shallow water fording is the ability of a vehicle, with its suspension in contact with the ground, equipped with built-in waterproofing, to negotiate a water obstacle without use of special waterproofing kits.

12. Deepwater Fording Vehicles

Deepwater fording is the ability of a vehicle, with its suspension in contact with the ground, equipped with built-in waterproofing, to negotiate a water obstacle, by the application of special waterproofing kits. Ordnance vehicles prepared for deepwater fording are of the two following types:

a. Those in which the hull must be rendered waterproof, but necessitating no treatment of the individual engine components. This type includes tank and tank-line vehicles.

b. Those in which the water surrounds the individual components of the engine and in which the separate units must be individually rendered waterproof. This type includes trucks, halftracks, tractors, and truck tractors.

c. Openings occurring in either type of vehicle are sealed or vented in accordance with instructions in the TM and/or TM–P manuals of the multiple-part 9-series publications covering the specific vehicle, and by means of the components and materials provided in the deepwater fording kits.

d. Waterproofing of Ordnance vehicles in production requires the sealing of all parts or assemblies which are affected by the entrance

of water and special venting of those components that require atmospheric pressure to operate or that are affected by condensation. Watertight housings are standard on later model vehicles for instruments, switches, starters, regulators, distributors, magnetos, and cables. Tactical vehicles have waterproof ignition systems as standard equipment. Fording kits provide for engine air intake and exhaust above expected water level by extensions or special arrangements, ventings, seals, and sealants.

e. Vent lines must be checked and fording valves must be set prior to fording on vehicles so equipped (M-series vehicles).

13. Amphibious Vehicles

Amphibious vehicles are wheeled or track laying vehicles designed to be fully capable of operating on both land and water without the installation of kits. New model vehicles with complete built-in type waterproofing have fully amphibious watercrossing capabilities.

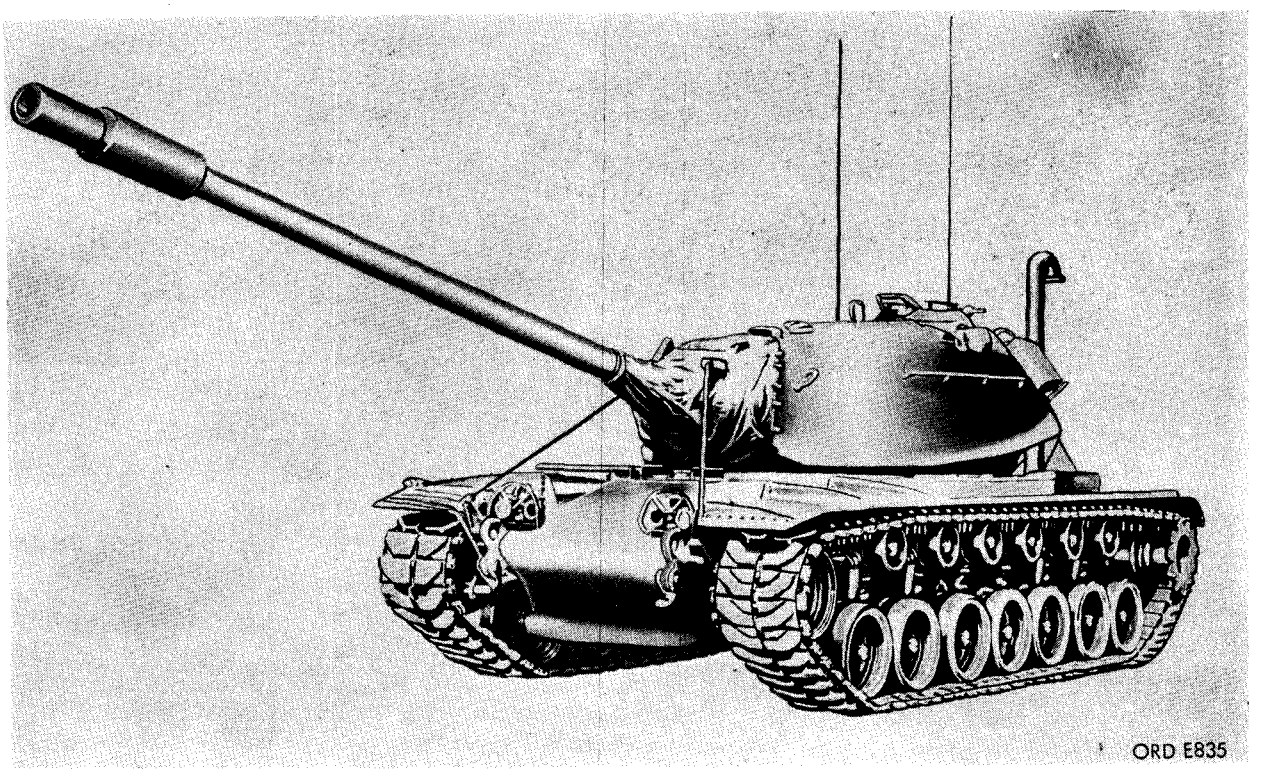


Figure 1. Full-tracked combat tank deepwater fording kit installed—front view.

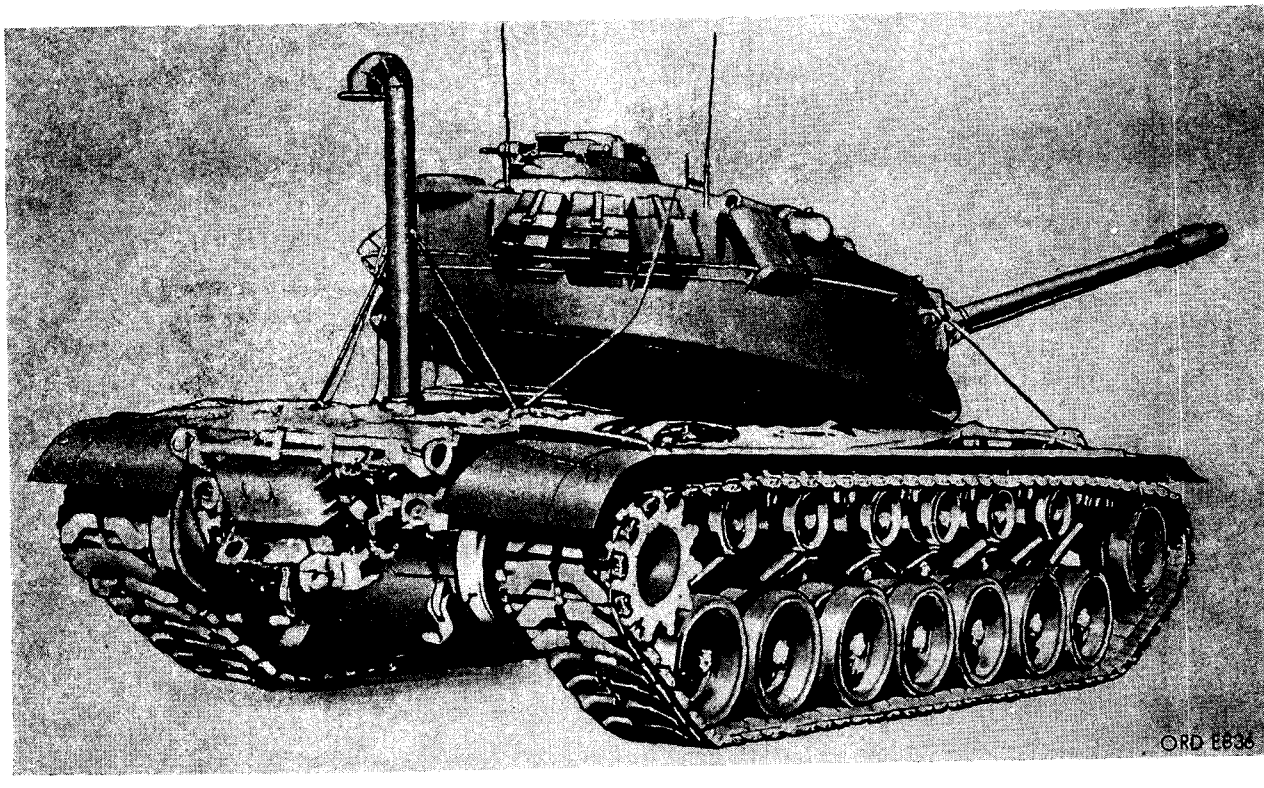


Figure 2. Full-tracked combat tank deepwater fording kit installed—rear view.

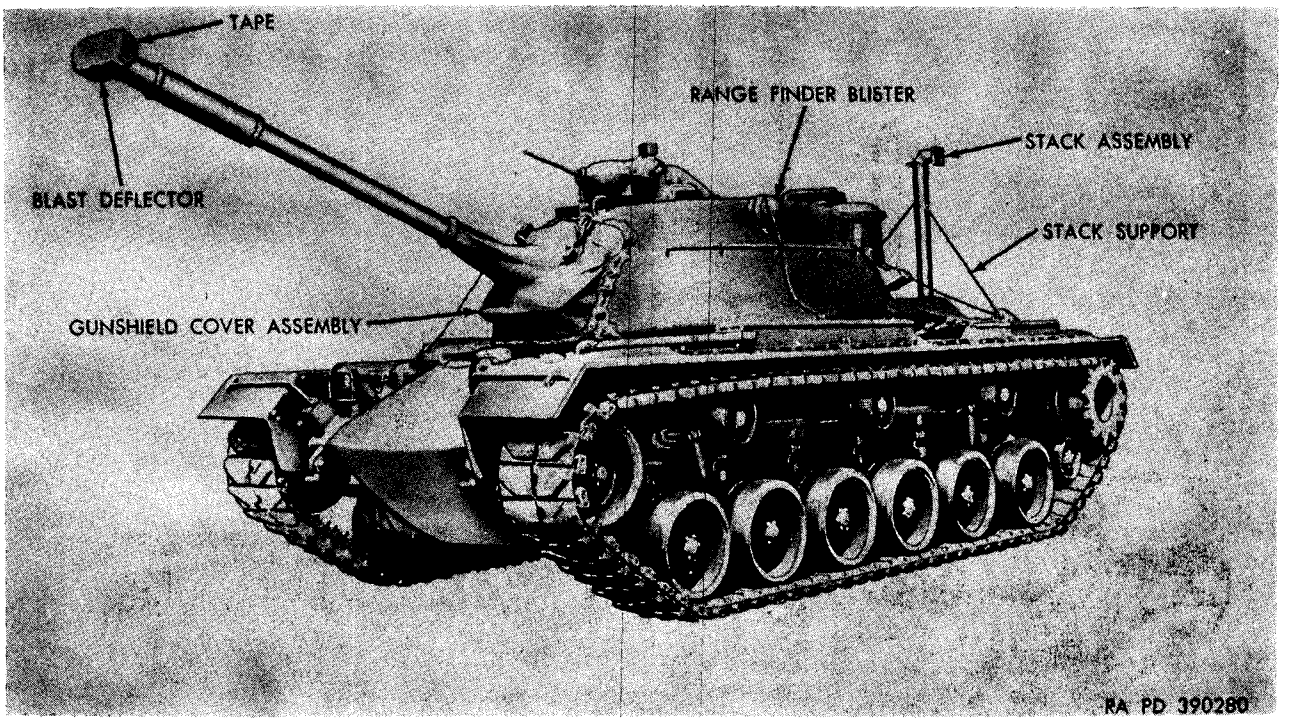


Figure 3. Full-tracked, combat tank deepwater fording kit installed—front view.

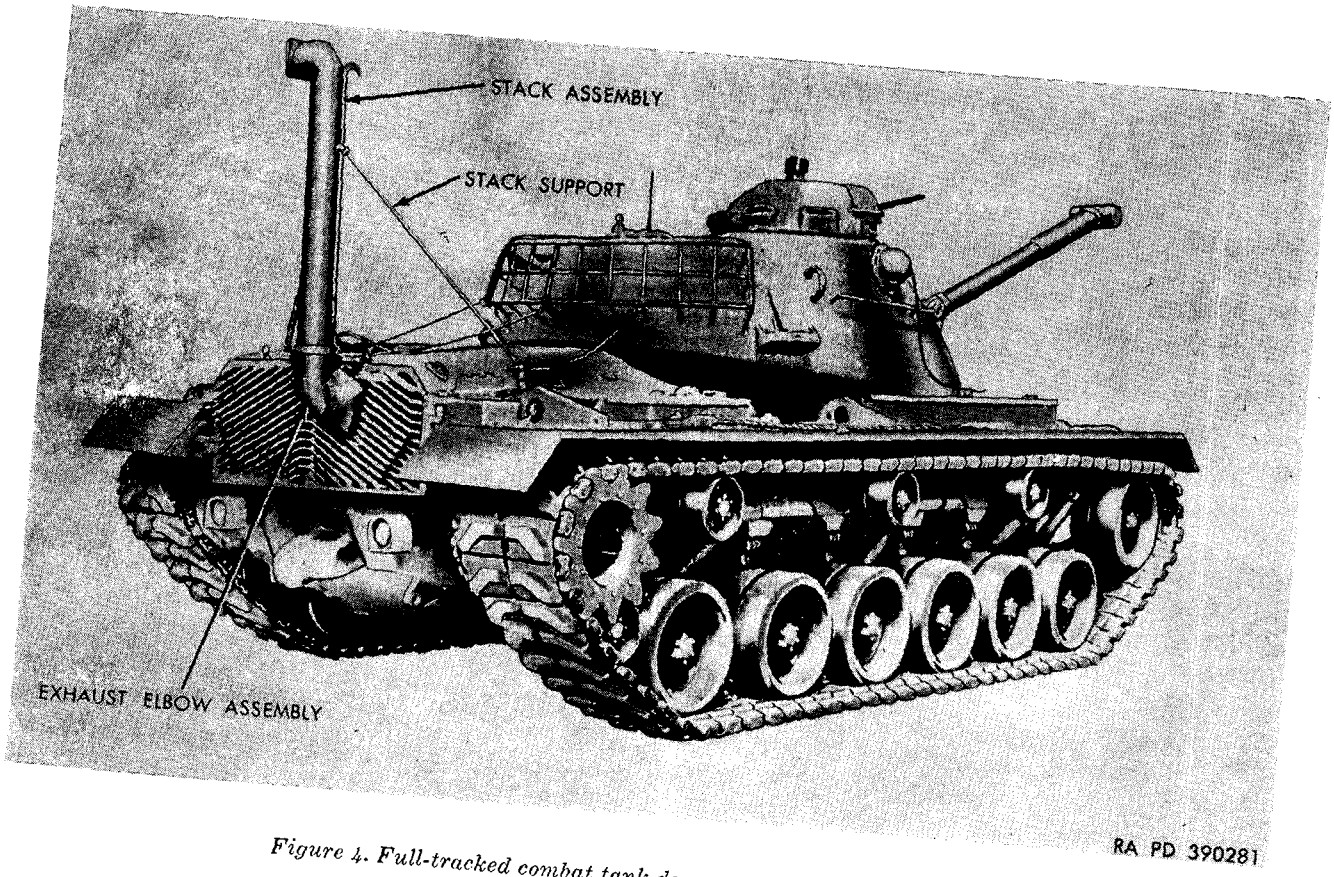


Figure 4. Full-tracked combat tank deepwater fording kit installed—rear view.

CHAPTER 2

TANK AND TANK-LIKE VEHICLES

Section I. GENERAL

14. Introduction

The general protective deepwater fording measures prescribed herein must be taken to prepare a tank or tank-like vehicle (figs. 1–4) so that it will operate satisfactorily, and still keep its armament serviceable while traversing water of a depth greater than that for which vehicle wheel was designed (figs. 5 and 6). After surf landing, the tank or tank-like vehicle must continue to operate satisfactorily until the waterproofing materials can be conveniently removed (figs. 7 and 8).

15. Types of Openings to be Sealed

Openings to be sealed preparatory to deepwater fording operations are of two types:

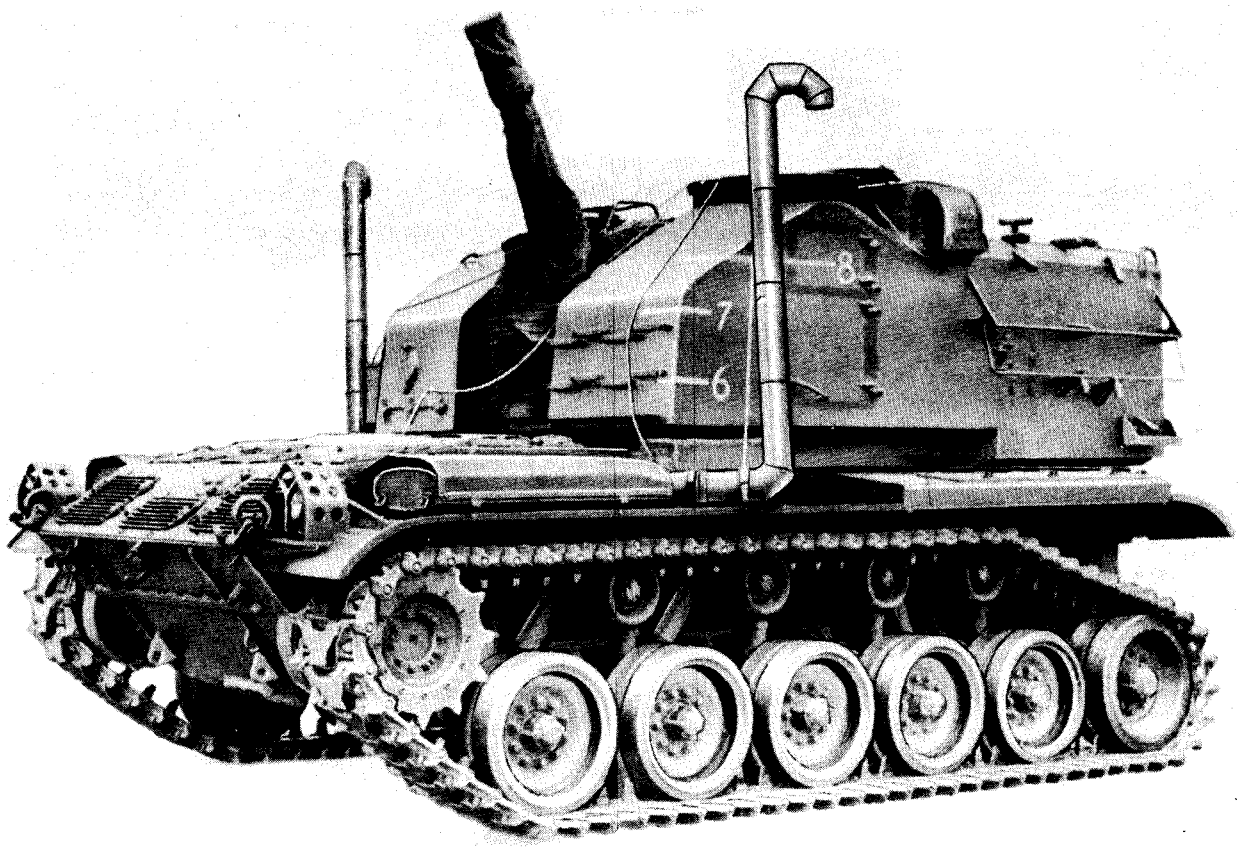


Figure 5. Tank-like vehicle—deepwater fording kit installed.

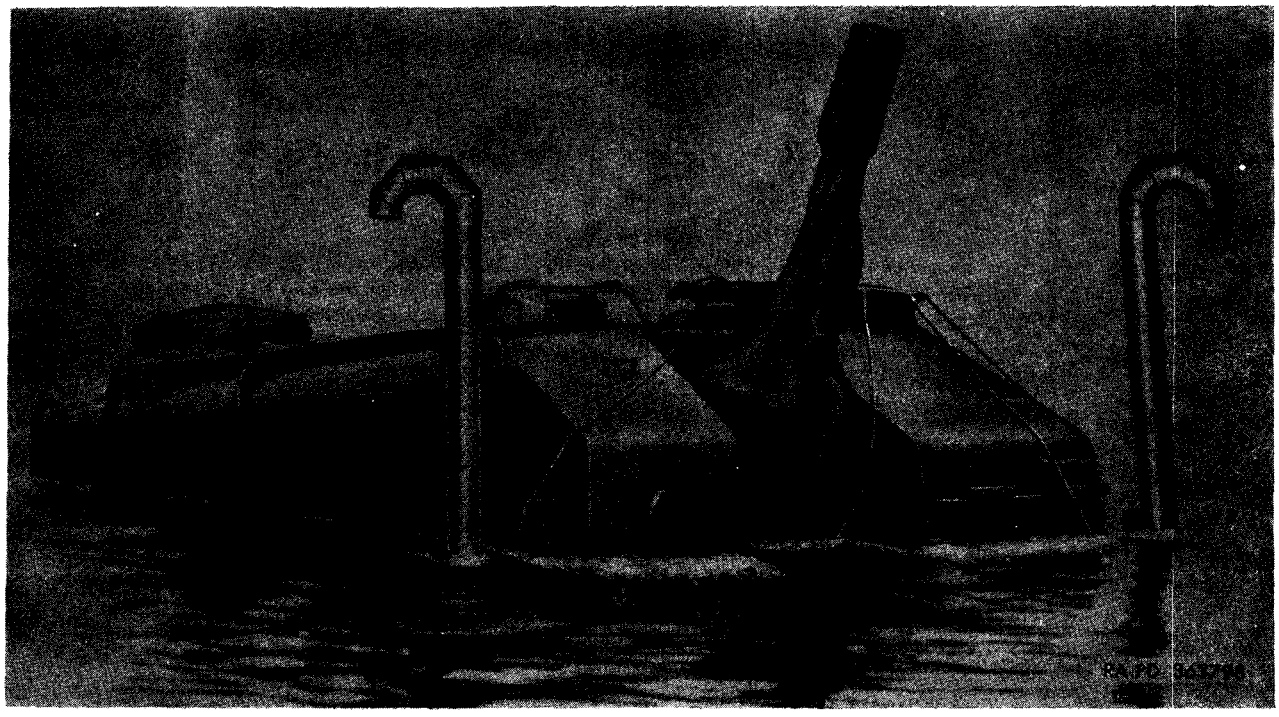


Figure 6. Tank-like vehicle—fording deep water.

a. Normal openings which may be sealed watertight for the short time they will be immersed. Examples of normal type openings are filler caps, machinegun apertures, and hull ventilators.

b. Abnormal openings are not necessarily serious under normal operations. However, they will adversely affect the operation of tank or tank-like vehicles during deepwater fording operations. Leaky seams in tank hulls, missing bolts, and cracks are examples of these types of openings and are the ones that are most commonly overlooked. Careful inspection will insure their disclosure.

16. Sealing Openings

a. Normal openings can generally be sealed with nonhygroscopic adhesive tape and sealing compounds.

b. Seal all unvented openings with nonhygroscopic adhesive tape and sealing compounds to render the hull waterproof. Make extensions of vented openings by use of adapters and stacks.

c. Large cracks or holes must be caulked with pieces of felt or rags to produce a packing for the sealing compounds.

d. A good rule to adopt is "If in doubt seal it."

17. Types of Components

The components of tank and tank-like vehicles to be checked for waterproofing in deepwater fording operations are the turret, power pack, auxiliary engine, primer pump, and the hull.

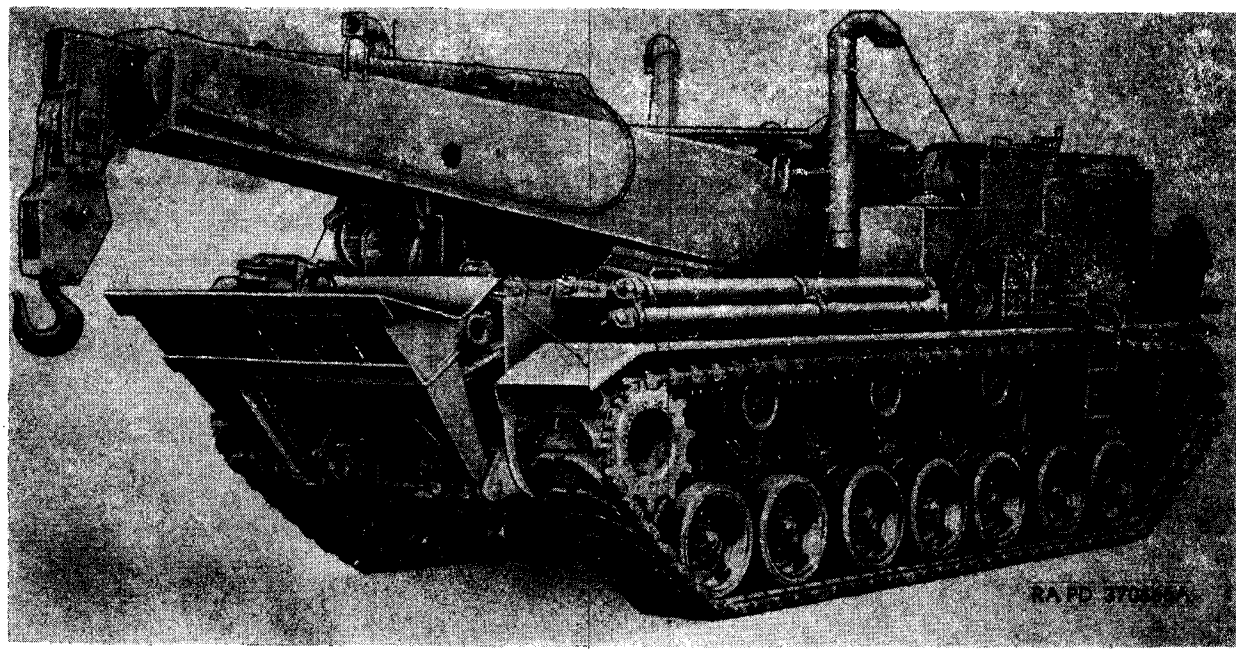


Figure 7. Heavy tank recovery vehicle—deepwater fording kit installed.

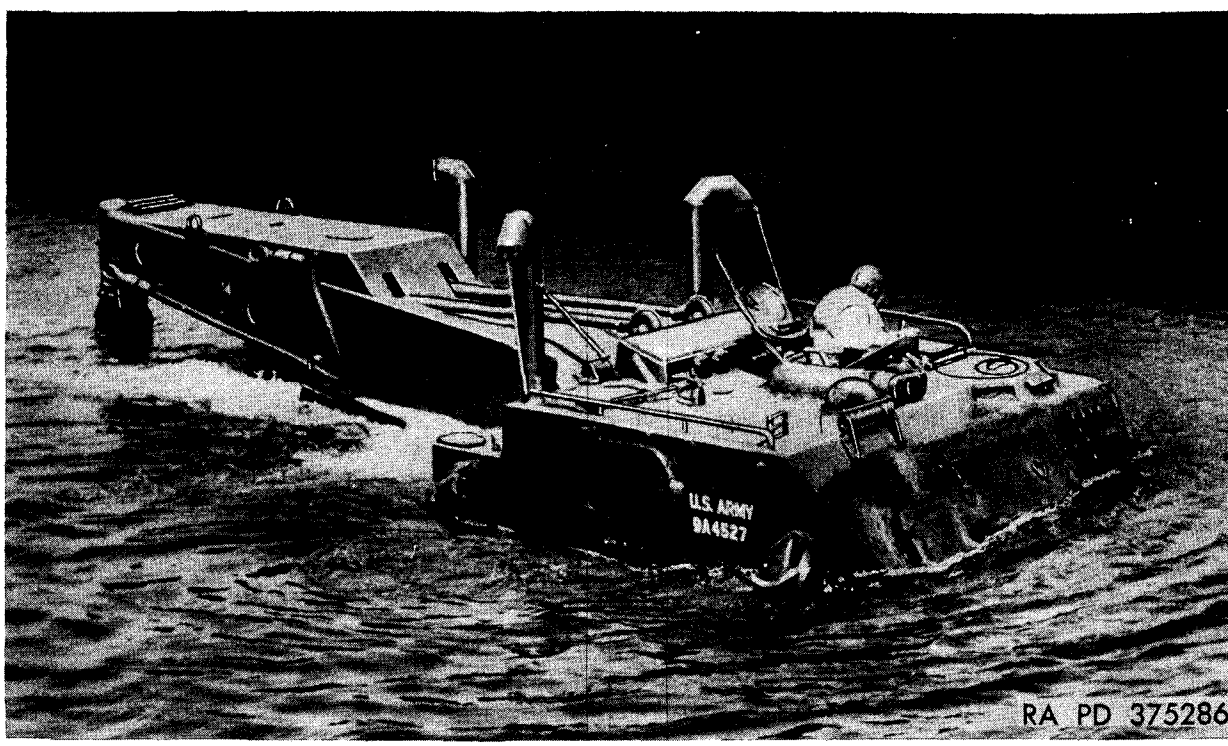


Figure 8. Heavy tank recovery vehicle—fording deep water.

Section II. PRELIMINARY OPERATIONS

18. General

There are certain specific preliminary operations to be performed on tank and tank-line vehicles before proceeding with preliminary preparation associated directly with the installation of the kits for deepwater fording operations.

19. Cleaning

a. Thoroughly clean and dry the vehicle. Refer to TM 9–208–1 on cleaning of Ordnance materiel. Use method C–1, C–3, or C–14 (MIL–P–116) as the tactical situation tools and equipment permit.

Note. Rifle-bore cleaner solvent cleaning compound is not a lubricant. Parts that require lubrication will all condensation has disappeared.

b. Solvents will not readily dissolve the corrosive salts from powder and primer compositions. Rifle-bore cleaner solvent cleaning compound must be used to clean all armament parts which have been exposed to powder fouling during firing.

Note. Rifle-bore cleaner solvent cleaning compound is not a lubricant. Parts that require lubrication will be wiped dry and oiled.

c. All surfaces of the vehicle to which tape or sealing compound is to be applied must be thoroughly clean and dry, otherwise the materials will not adhere or seal properly.

d. General precautions to be observed in cleaning are outlined in (1) through (3) below.

(1) Dry-cleaning solvent and mineral spirits paint thinner are flammable and must not be used near an open flame. Fire extinguishers must be at hand when these materials are used. Use these materials only in well-ventilated places.

(2) Dry-cleaning solvent and mineral spirits paint thinner evaporate quickly and have a drying effect on skin. If used without wearing gloves, it may cause cracks in the skin, and in cases of some individuals, a mild irritation or inflammation will be noted.

Caution: **Always wear synthetic rubber or plastic gloves while using these cleaners.**

(3) Avoid getting petroleum products such as dry-cleaning solvent, mineral spirits paint thinner, engine fuels, or lubricants on rubber parts, as they will deteriorate the rubber.

Warning: **The use of Diesel fuel oil, gasoline, or benzene (benzol) for cleaning purposes is strictly prohibited.**

e. Nameplates, caution plates, and instruction plates made of brass or aluminum should be coated with insulation ignition compound prior to fording in salt water. Such plates made of steel rust rapidly when exposed to salt water. Steel plates should be thoroughly cleaned and coated with an application of lacquer.

20. Lubrication

a. Lubricate all vehicles thoroughly in accordance with the prescribed lubrication order for the vehicle.

b. Maintain a record of changes in grade of lubricant and recoil oil for the weapon on DA Form 9–13 and 9–13–1.

c. Avoid unnecessary operation of the vehicles after waterproofing material has been applied (par. 9*b*).

21. Inspection

a. Pressurize the engine and transmission to disclose defects that cannot be visually located.

b. The engine ignition system should be completely waterproofed including magnetos, distributors, spark plugs, wiring harness, and associated parts.

c. Seal engine air induction system.

d. Seal escape hatch.

e. Waterproof battery terminals and all exposed electrical terminals not connected to vehicle chassis or body, to prevent electrolytic action when wet.

f. If a battery box cannot be made waterproof, less damage will be done to the battery if the battery box is removed.

g. Coat engine mount screws with antiseize compound to prevent seizing.

h. Coat the sight mount controls with grease or other compound to protect them from water splash.

i. Fender box gaskets should be of coated-sponge, not open-sponge material.

j. Upturned exhaust pipes should have flapper type exhaust caps.

k. Make a thorough inspection of each vehicle, including armament, sighting and fire control equipment, and their component parts to determine correctness of operation and to detect defects or deficiencies.

l. Blankets, packs, and other equipment normally stowed outside the vehicle should be placed in the crew compartment and so located as to be secure from seepage water that may enter during fording.

m. All parts removed to facilitate deepwater fording operations must be kept together in a suitable location for installation after fording.

n. Seal muzzles of weapons with thin tape or rubber. These seals must be thin enough to break readily when the weapon is fired.

o. The vehicle should be given a final overall inspection before leaving the landing craft to ascertain that all preparatory operation necessary for deepwater fording have been accomplished.

p. Make standby preparations to assist crews to abandon vehicle if it becomes submerged.

Section III. DEEPWATER FORDING

22. General

During fording operations tank and tank-like vehicles may be subjected to water varying in depth from only a few inches to depths sufficient to completely submerge the vehicle. Factors to be considered are spray-splashing precautions, normal fording capabilities, deepwater fording, and accidental complete submersion.

23. Maximum Fording Depths

The actual maximum fording depths will vary for the different types of vehicles. The maximum practicable shallow water fording depths and deepwater fording depths for vehicles in fresh water and in salt water will be detailed in the pertinent technical manuals.

Section IV. SERVICE AFTER FORDING

24. General

Various protective procedures must be performed after deepwater fording operations. Certain procedures are critical and must be taken immediately after landing. Other procedures are less critical and may be performed as soon as convenient after landing. All procedures are important and failure to service the vehicles properly at this period will result in unsatisfactory operation or complete damage to the equipment.

25. Service

a. All precautions must be taken as soon as practicable to halt deterioration and avoid damage on all vehicles which have been exposed to some depth of water or completely submerged especially in salt water. This must be done before the vehicle is driven extensively in regular service.

b. The sudden cooling of the warm interior air upon submersion may cause condensation of moisture within the cases or instruments. A period of exposure to warm air after fording should repair this condition. Cases that can be opened may be uncovered and dried.

26. Lubrication

Salt water destroys the lubricating qualities of most lubricating greases. Therefore, it is essential that parts having normal lubricants as their only protection be cleaned and lubricated as soon after fording as practicable.

27. Maintenance

After normal beach landings all vehicles should be washed in clean, fresh water as soon

as possible to stop the corrosive actions caused by salt water. If submerged, the vehicle should be recovered as soon as possible, after the beach has been secured, and turned over to Ordnance maintenance personnel for inspection and serviceability check.

CHAPTER 3

WHEELED VEHICLES AND TRUCK TRACTORS

Section I. GENERAL

28. Introduction

The general protective deepwater fording measures prescribed herein must be taken to prepare wheeled vehicles (figs. 9 and 10) and truck tractors so that they will operate satisfactorily and keep their armament (if equipped) serviceable while traversing water of greater depths than that for which they were designed and, after completing the landing, continue to operate satisfactorily until the waterproofing can be conveniently removed (figs. 11 and 12).

Note. Refer to paragraph 9 for overseas shipment.

29. Types of Openings to be Sealed

The following are the types of openings to be sealed preparatory to deepwater fording.

a. The first type consists of normal openings for components which must be vented to operate successfully when the unit is submerged. For this type of opening, venting is provided by the use of auxiliary exhaust pipes, intake and ventilating hoses, and material contained in the fording kits.

b. The second type consists of normal openings which may be sealed watertight for the short time they will be immersed. Vents on gear cases and oil filler caps are examples.

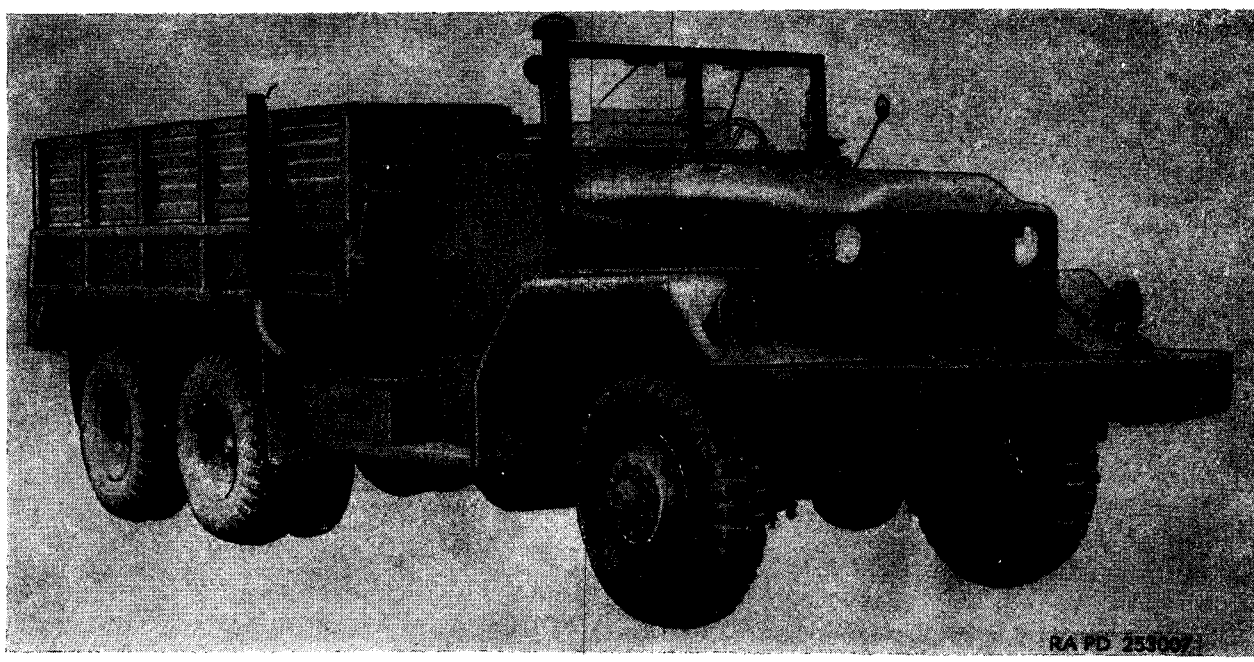


Figure 9. Wheeled vehicle—deepwater fording kit installed.

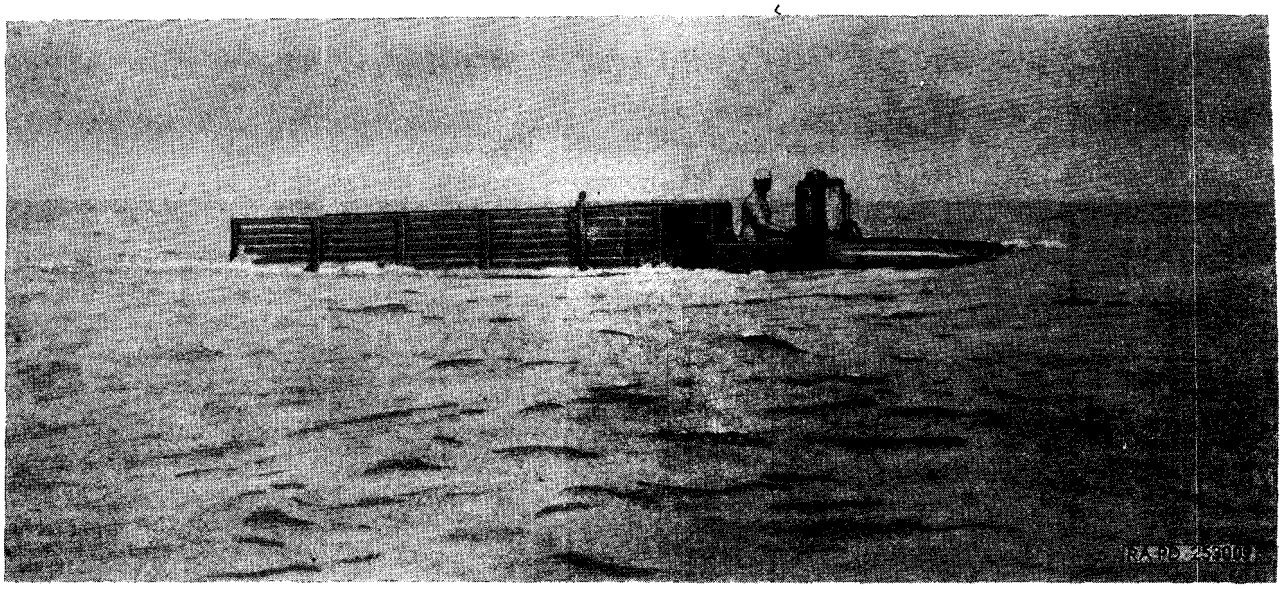
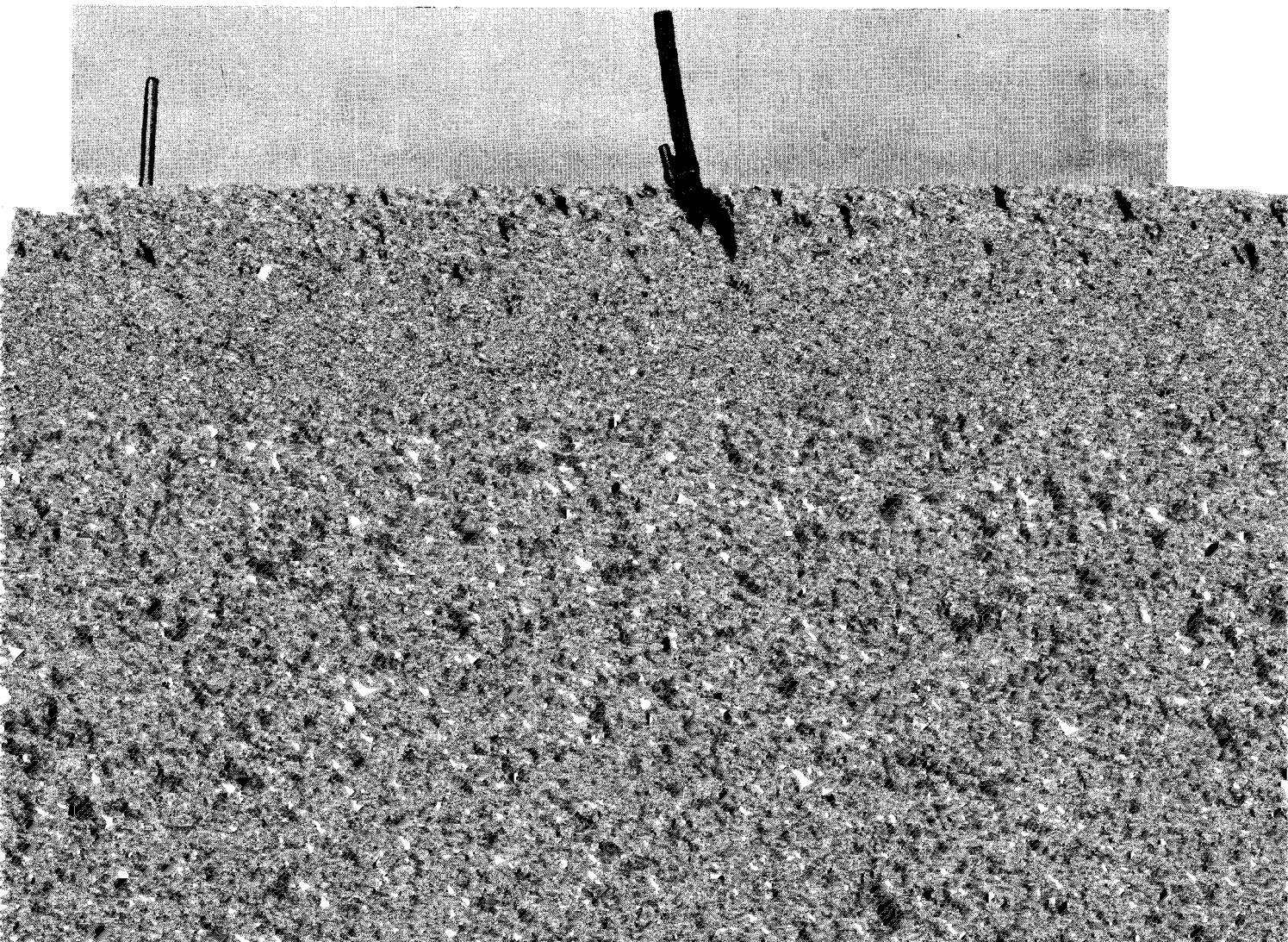


Figure 10. Wheeled vehicle—fording deep water.



These are generally sealed by use of tape and asbestos grease. Tactical vehicle gear cases have spring-loaded pressure vents which do not have to be sealed for fording.

c. All openings in the engine will be sealed or vented. A waterproof exhaust system prevents water from entering the exhaust system and facilitiates restarting engines that have stalled while in the water.

30. Sealing Openings

Asbestos grease is used as a waterproofing seal on all components except the flexible metal exhaust pipe extensions. Due to the heat generated by the exhaust gases the exhaust pipe extensions are treated with a high-temperature cement. In applying asbestos grease care must be taken that there are no air pockets within the grease surrounding the surface of the unit being prepared. Work the asbestos grease with the fingers carefully against all points of the surface being covered in order to fill all cracks and crevices. The asbestos grease must adhere securely to all surfaces.

31. Types of Components

It is recommended that generators and starters which have been corrosion-proofed against salt air, salt water, and high humidity be installed if available on vehicles destined for deepwater fording operations. Where time permits, generators and starters can be corrosion-proofed by Ordnance maintenance personnel prior to the installation of the deepwater fording kits. If the corrosion proofed starters and generators cannot be procured from the direct support unit, all openings and exposed electrical connections should be sealed for the fording operation and the sealing removed as soon as possible after landing.

Figure 12. Wheeled vehicle—fording deep water.

Section II. PRELIMINARY OPERATIONS

32. General

There are certain specific preliminary operations to be performed on wheeled vehicles and truck tractors before proceeding with preliminary preparation associated directly with the installation of the kits for deepwater fording operations.

33. Cleaning

Thoroughly clean and dry all parts. If possible, steam clean the engine and engine compartment. If steam is not available, wash the engine and engine compartment with dry-cleaning solvent or mineral spirits paint thinner. Clean and dry all surfaces to which tape and sealing are to be applied, otherwise these materials will not stick or seal properly. If the engine is steam cleaned, operate engine for 1/2 hour, or until all condensation has disappeared (par. 19).

Warning: **The use of Diesel oil, gasoline, or benzene (benzol) for cleaning purposes is strictly prohibited.**

34. Lubrication

Lubricate all vehicles thoroughly and completely in accordance with pertinent lubrication orders (par. 20).

35. Inspection

Make a thorough inspection of each vehicle including armament and sighting and fire control materiel if so equipped. Check their component parts to determine whether all assemblies, subassemblies, and accessories are properly assembled, secure, correctly adjusted, and lubricated.

a. Carefully test and inspect the entire electrical system.

b. Make certain that the fuel supply is adequate and engine crankcase is filled to proper level. Late type gas caps have vent valve which must be closed for fording.

c. Make a thorough inspection of all seals. Replace defective or questionably defective seals. Tighten all gaskets to insure a snug fit.

d. Avoid unnecessary operation of vehicles after waterproofing has been applied (par. 9*b*).

e. Warm up engine to the proper operating temperature. Do not run the engine to exceed proper operating temperature. This could crack the engine when entering the water.

f. Deflate tires approximately 40 percent of recommended road traveling pressure. This will permit better traction.

g. Check tires, wheels, and wheel bearings to see that they are in good condition.

h. The vehicle should be given a final overall check before leaving the landing craft to make certain that all preventions have been taken.

Section III. DEEPWATER FORDING

36. General

During fording operations wheeled vehicles and truck tractors may be subjected to water varying in depths from only a few inches to depths sufficient to completely submerge the vehicle. Factors to be considered are spray-splashing precautions, normal fording capabilities, deepwater fording, and accidental complete submersion.

37. Maximum Fording Depth

The actual maximum fording depths will vary for the different types of vehicles. The maximum practical shallow water fording depths and deepwater fording depths for vehicles in fresh water and in salt water will be detailed in the pertinent technical manuals.

Section IV. SERVICE AFTER FORDING

38. General

Various protective procedures must be performed after deepwater fording operations. Certain procedures are critical and must be taken immediately after landing. Other procedures are less critical and may be performed as soon as convenient after landing. All procedures are important and failure to service the vehicles properly at this period will result in unsatisfactory operation or complete damage to the equipment.

39. Service

a. All precautions should be taken as soon as practicable to stop deterioration and avoid damage before the vehicle is driven extensively in regular service.

b. When the vehicle leaves the water, intermittently depress the brake pedal for short periods of time, while maintaining a low rate of speed. This action will aid in drying out brake linings.

c. Prepare armament for immediate action.

d. Reinflate tires to regular road operating pressures.

e. Vehicles that have been used for fording operations should be operated at least 3 miles a day to exercise and decrease tendency of moving parts to corrode and stick.

f. If accidental submersion occurs the vehicle will be recovered when tactical conditions permit and temporary preservation applied. The vehicle will then be turned in to the Ordnance maintenance unit as soon as possible for necessary maintenance or overhaul.

40. Lubrication

a. Remove wheels and brake drums, clean them and the mechanism and reassemble them. This should be done as soon as possible, but within 24 hours after leaving the water.

b. Wash the vehicle with fresh water and thoroughly lubricate the entire vehicle in accordance with pertinent lubrication orders.

41. Maintenance

The quarterly preventive-maintenance service, as outlined in the technical manuals, must be performed within the first 5 days after fording operations. (Refer to TM 9–2810.)

CHAPTER 4

TRACTORS

Section I. GENERAL

42. Introduction

The general protective deepwater fording measures prescribed herein must be taken to prepare high-speed tractors so that they will operate satisfactorily while traversing water of greater depths than that for which the vehicle was designed; and after completing the landing, the tractor must continue to operate satisfactorily until the waterproofing materials can be removed.

Note. Refer to paragraph 9 for preparation for overseas shipment.

43. Types of Openings to be Sealed

Following are the types of openings in tractors to be sealed preparatory to deepwater fording operations:

a. Normal openings for components which must be vented to operate successfully when the unit is submerged.

b. Normal openings which may be sealed watertight for a short submerged period such as vents on gear cases and oil filler caps.

c. All openings in the engine will be sealed or vented.

44. Sealing Openings

a. Intake and ventilating hoses and materials provided in the fording kits are used to vent normal openings in components.

b. Tape and asbestos grease are generally used to seal normal openings watertight for a short time while they will be submerged.

45. Types of Components

a. Each component of a tractor will operate in direct contact with the water and must be individually waterproofed.

b. All other components must be able to operate under water successfully without special treatment or may be sealed airtight.

Section II. PRELIMINARY OPERATIONS

46. General

There are certain specific preliminary operations to be performed on tractors before proceeding with preliminary preparation associated directly with the installation of the kits for deepwater fording operations.

47. Cleaning

Thoroughly clean and dry all parts. If possible, steam clean the engine and the engine compartment. If steam is not available, wash the engine compartment with dry-cleaning solvent or mineral spirits paint thinner. Clean and dry all surfaces to which tape and sealing are to be applied; otherwise, these materials will not stick or seal properly.

Warning: **The use of Diesel fuel oil, gasoline, or benzene (benzol) for cleaning purposes is strictly prohibited.**

Note. If engine is steam cleaned, operate engine for at least 1/2 hour or until all condensation has disappeared.

48. Lubrication

Lubricate all vehicles thoroughly and completely in accordance with pertinent lubrication orders.

49. Inspection

a. Make a thorough inspection of each vehicle to determine that all units and assemblies are correctly adjusted, lubricated, and operate efficiently.

b. Carefully test and inspect the entire electrical system.

c. Make certain that the fuel supply is adequate and the engine crankcase is filled to proper level.

d. Check all seals and gaskets. Tighten all gaskets to insure a snug fit. Replace defective seals. Refer to paragraph 8.

Section III. DEEPWATER FORDING

50. General

During fording operations tractors may be subjected to water varying in depths from only a few inches to depths sufficient to completely submerge the vehicle. Factors to be considered are spray-splashing precautions, normal fording capabilities, deepwater fording, and accidental complete submersion.

51. Maximum Fording Depth

The actual maximum fording depth will vary for different types of vehicles. The maximum practical shallow water fording depths and deepwater fording depths in fresh water and in salt water will be detailed in the pertinent technical manuals. Refer to paragraph 8.

Section IV. SERVICE AFTER FORDING

52. General

Various protective procedures must be performed after deepwater fording operations. Certain procedures are critical and must be taken immediately after landing. Other procedures are less critical and may be performed as soon as convenient after landing. All procedures are important and failure to service the vehicles properly at this period will result in unsatisfactory operation or complete damage to the equipment.

53. Service

a. All precautions should be taken as soon as practicable to stop deterioration and avoid damage before the vehicle is driven extensively in regular service.

b. Vehicles that have been used for fording operations should be operated at least 3 miles a day to exercise and decrease tendency of moving parts to corrode and stick.

c. If accidental submersion occurs the vehicle will be recovered when tactical conditions permit and temporary preservation applied. The vehicle will then be turned in to the Ordnance maintenance unit as soon as possible for necessary maintenance or overhaul.

54. Lubrication

Wash the vehicle with fresh water and thoroughly lubricate the entire vehicle in accordance with pertinent lubrication orders.

55. Maintenance

The quarterly preventive-maintenance service, as outlined in the technical manuals, must be performed within the first 5 days after fording operations.

APPENDIX

REFERENCES

1. Publication Indexes

The following indexes should be consulted frequently for latest changes to or revisions of references given in this appendix and for new publications relating to materiel covered in this manual.

Index of Army Motion Pictures, Film Strips, Slides, and Phono-Recordings.	DA Pam 108–1
Military Publications:	
Index of Administrative Publications	DA Pam 310–1
Index of Blank Forms	DA Pam 310–2
Index of Graphic Training Aids and Devices	DA Pam 310–5
Index of Supply Manuals—Chemical Corps	DA Pam 310–23
Index of Supply Manuals—Corps of Engineers	DA Pam 310–25
Index of Supply Manuals—Ordnance Corps	DA Pam 310–29
Index of Supply Manuals—Quartermaster Corps	DA Pam 310–30
Index of Technical Manuals, Technical Bulletins, Supply Bulletins, Lubrication Orders, and Modification Work Orders.	DA Pam 310–4
Index of Training Publications	DA Pam 310–3

2. Supply Manuals

The following supply manual of the Department of the Army supply manual pertains to this materiel:

Introduction	ORD 1

3. Forms

The following forms pertain to this materiel:

DA Form 9–13, Weapons Record Book—Part I.
DA Form 9–13–1, Weapons Record Book—Part II.
DA Form 462, Quarterly Maintenance or Spot Check for Tracked Vehicles-Tracked Trailers.
DA Form 468, Unsatisfactory Equipment Report.
DA Form 2028, Recommended Changes to DA Technical Manual Parts Lists or Supply Manual 7, 8, or 9.
DD Form 6, Report of Damaged or Improper Shipment.

4. Other Publications

The following explanatory publications contain information pertinent to this materiel and associated equipment:

a. Camouflage.

Camouflage, Basic Principles and Field Camouflage	FM 5–20

b. Decontamination.

Decontamination	TM 3–220

Small Unit Procedures in Atomic, Biological, and Chemical Warfare.	FM 21–40
c. Destruction to Prevent Enemy Use.	
Explosives and Demolitions	FM 5–25
d. General.	
Artillery Materiel and Associated Equipment	TM 9–2300
Auxiliary Sighting and Fire Control Equipment	TM 9–575
Cleaning, Drying, and Abrading Equipment for Cleaning Ordnance Materiel.	TM 9–208–2
Cleaning of Ordnance Materiel	TM 9–208–1
Disposal of Supplies and Equipment: Disposition of Excess and Surplus Personal Property Other Than Foreign Excess Personal Property.	AR 755–5
Driver Selection, Training, and Supervision Full-track Vehicles	TM 21–301
General Supply: Deep water Fording Kits for Tank-Automotive Materiel.	SB 9–155
Issue of Supplies and Equipment: Preparation, Processing, and Documentation for Requisitioning, Shipping, and Receiving.	AR 725–5
Logistics (General):	
Malfunctions Involving Ammunition and Explosives (Reports Control Symbol ORD 43).	AR 700–1300–8
Unsatisfactory Equipment Report	AR 700–38
Manual for the Full-track vehicle driver	TM 21–306
Manual for the Wheeled Vehicle Driver	TM 21–305
Military Symbols	FM 21–30/AFM 55–3
Military Terms, Abbreviations, and Symbols:	
Authorized Abbreviations and Brevity Codes	AR 320–50
Dictionary of United States Army Terms	AR 320–5
Military Training	FM 21–5
Ordnance Service in the Field	FM 9–1
Safety:	
Accident Reporting and Records	AR 385–40
Regulations for Firing Ammunition for Training, Target Practice, and Combat.	AR 385–63/ AFR 50–13
Techniques of Military Instruction	FM 21–6
Water-crossing Requirements for Future Combat and Tactical Vehicles.	AR 705–2300–8
e. Maintenance and Repair.	
76-mm Gun Full-Tracked Combat Tanks M41 and M41A1: Installation, Operation, and Maintenance of Deepwater Fording Kits.	TB 9–7610–201–10/1
Heavy Tank Recovery Vehicle M51: Deepwater Fording Kit Installation, Operation, Removal, and Organizational Maintenance.	TB 9–7610–201–10/2
Inspection, Care, and Maintenance of Antifriction Bearings.	TM 9–214
Inspection of Ordnance Material in Hands of Troops	TM 9–1100
Lubrication	TM 9–2835
Painting Instructions for Field Use	TM 9–2851
Preventive Maintenance, Supply, Inspection, and Training Procedures—Tactical Motor Vehicle.	TM 9–2810
Special Operations: River-Crossing Operations	FM 31–60
f. Shipment and Storage.	
Logistics (General): Report of Damaged or Improper Shipment.	AR 700–58
Methods of Preservation	MIL–P–116
Processing of Unboxed Self-Propelled and Towed Class II Ordnance General Supplies and Related Material for Shipment and Storage.	TB 9–299/1

INDEX

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