FM 25-10

DEPARTMENT OF THE ARMY FIELD MANUAL

MOTOR TRANSPORTATION, OPERATIONS

DEPARTMENT OF THE ARMY • FEBRUARY 1953

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This manual supersedes FM 25-10, 12 March 1942, including C 1, 27 July 1942, C 2, 21 September 1942, and C 3, 10 November 1942

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PART ONE

GENERAL

CHAPTER 1

INTRODUCTION

Section I. PURPOSE AND SCOPE

1. PURPOSE

This manual is a guide for the conduct of movements by motor vehicles on highways and in off-road operations. Its purpose is to enable all concerned to understand the organization, principles of operation, and requirements of discipline and control essential to the smooth and effective conduct of convoys and march units.

2. SCOPE

a. The manual covers the conduct of march units and motor columns of combat troops, supply and personnel convoys of service troops, and related casual movements necessary to all military operations. It sets forth the differences in technique of each type of operation. It shows the relationship of individual movements to the general highway traffic plan. It emphasizes the importance of, but does not go into detail as to, such closely related subjects as driver selection, driver training, and preventive maintenance.

b. The manual is so organized as to cover first those basic subjects of general application and later those subjects dealing with particular types of movement or conditions.

(1) Part one deals briefly with the basic factors of motor movements such as the driver, the vehicle, and preventive maintenance.

(2) Part two outlines the principles of march organization and planning.

(3) Part three deals generally with the conduct of all marches.

(4) Part four outlines the fundamentals of highway traffic management.

(5) Part five gives the distinctive characteristics of supply and personnel movements.

(6) Part six deals with highway transportation under various conditions of operation.

(7) The appendixes supplement the text by giving references, charts, and data helpful to the march planner.

3. MOTOR TRANSPORT'S RELATIONSHIP TO THE OVER-ALL MOVEMENT FUNCTION

Motor transportation has a common purpose with all modes of transportation in the accomplishment of the uninterrupted flow of troops and supplies from source to final destination. Motor transport's relationship to the over-all transportation function lies in that common purpose of movement.

a. *Movement*. Movement is basically the change of location of persons and things in time and space.

This means the transfer of troops and supplies from one place to another, often over long distances, and as expeditiously as possible.

b. Transportation. Transportation is the movement of persons and things over land, by water, or through the air, and the means used to accomplish this movement.

c. Organic Transportation. Organic transportation is that transport which is a regularly assigned part of a military unit as contrasted with that temporarily furnished by other units or by a service supporting that unit.

Section II. MOTOR TRANSPORT'S ROLE IN MODERN WARFARE

4. NEED FOR MOTOR TRANSPORT

a. Modern wars are wars of movement. After armies are mobilized, trained, and equipped, they must be transported to a place where they can meet and defeat the enemy. After reaching that place, they must be supplied with ammunition, food, equipment, and replacements. If armies are victorious and advance rapidly, supplies must be moved fast enough to keep up with them. The striking power and the mobility of an army are dependent on the efficiency of the military motor transport system and its ability to get war materials to the places where they are needed and get them there on time.

b. Time and again it has been shown that highway transportation is one form of movement without which armies cannot function. With the increasing effectiveness of long range aerial attack and vulnerability of fixed forms of transportation, it is probable that highway transportation will become increasingly important.

5. TYPES OF MOTOR MOVEMENT

a. Broadly, all movements may be classified as casual, organized, or unorganized, depending on whether the elements are moving separately and under no close supervision, or moving together and under adequate control. Military movements may be either casual or organized to varying degrees.

b. The various types of movement and traffic over wartime highways include combinations of the following:

(1) *Casual military movements.* Casual military movements consist of individual elements proceeding more or less at will in the performance of routine administrative, evacuation, staff, command, and supply functions of units.

(2) *Organized military movements.* Organized military movements of combat and supporting units consist of elements on foot, mounted, or in vehicles, grouped together for purposes of control. These are the marches and convoys to be dealt with in detail in this manual.

(3) *Unorganized traffic.* Unorganized traffic includes refugee and disorganized military traffic fleeing from destroyed cities or before the advance of an opponent force. This condition occurs only in event of disaster or defeat or when effective control breaks

down. Emergency plans for controlling traffic should be made so that these conditions can be avoided or mitigated to a large degree.

Section III. CONDITIONS AFFECTING MILITARY MOTOR MOVEMENTS

6. VARIED CONDITIONS

a. Military motor movements must be made under a wide variety of conditions over which the personnel of the movement may have little or no direct control, but by which they must govern their actions. Among these conditions are effects of location, weather, and terrain, and of the tactical situation, as existing—

(1) In the zone of interior.
(2) In the communications zone.
(3) In the combat zone.
(4) In friendly territory.
(5) In enemy territory.
(6) When enemy aerial attack is or is not probable.
(7) When enemy ground attack is or is not probable.
(8) On open, supervised, dispatch, or reserved routes.
(9) In areas of good or adverse weather and terrain.

b. It is important that officers appreciate the conditions under which their movement is made, and know how to select the methods which are appropriate to the particular conditions with which they are faced.

7. EFFECT OF CONDITIONS ON MOVEMENTS

Examples of the effect of conditions include the following:

a. Location. Highway movements in the continental United States which, by reason of number or unusual size or weight may cause trouble, should have clearance from state and/or local civil authorities. In territory of a friendly nation this may or may not be true. In enemy territory no clearance from civil authorities is required.

b. Terrain and Climate. Conditions of terrain and climate may require special issue of equipment and special training to meet those conditions.

c. Reconnaissance. When a movement is made over a route on which all traffic is regulated, reconnaissance by the moving unit may require only a study of a map, but if a movement is made over roads which are not regulated and on which little information is available, or over unknown terrain, personal reconnaissance is usually necessary.

d. Organization. A combat unit, expecting contact with the enemy, must march in the order which is best for tactical deployment. The movements of service troops will be influenced by their different functions and the special purposes of their equipment. For example, Medical, Engineer, and Quartermaster perform services requiring the use of specialized motor transport and special methods of operation. Each may require special procedures in the movement of its convoys.

e. Command. When a unit moves by its own or attached transportation, there is no question as to command. However, when a troop unit is moved by an unattached transportation truck unit, there are certain command responsibilities which fall upon the commander of the truck unit, and others upon the commander of the troop unit being moved. This command responsibility may be altered, however, by the tactical situation (par. 164).

f. Defense. In a tactical situation not only passive defense such as camouflage, deception, and blackout may have to be employed but also active defensive measures. If the advantage is with the friendly forces, many defense measures may be relaxed to allow more complete freedom of action.

g. Protective Forces. Advance, flank, and rear guards are usually not required in the zone of interior, communications zone, or in well-held rear areas of the combat zone, but they may be needed when a movement is being made in territory which may contain enemy troops. A supply convoy normally has no troops available to use for advance, rear, or flank guards, and when such protection is required, it must be furnished by other troops. A personnel convoy, however, may use part of the personnel being moved where such protection is needed.

h. Tactical Motor Movements. Since it will not always be possible to attach sufficient motor transportation to a command to enable it to move entirely in one trip, the ability of a command to concentrate superior forces at the desired place and time will often depend upon the use of motor transportation to move by echelon. Units which are not completely mobile can move tactical groupings by augmenting their organic transportation with transportation obtained from higher headquarters, or they can accomplish the move in two or more trips, using their organic transportation only.

CHAPTER 2

BASIC FACTORS INVOLVED IN MOTORIZED OPERATIONS

Section I. COMBINATION OF FACTORS

8. BASIC FACTORS

The methods of operation of motor marches and convoys treated in this manual are not in themselves sufficient to secure good highway transportation. They can be applied with full effectiveness only by a combination of related factors.

9. DRIVER SELECTION AND UTILIZATION

Commanders or personnel concerned with driver selection should constantly strive to make sure that only men with proper qualifications are selected to be trained as drivers, and that men who are obviously unfitted are transferred to other duties. Men with low intelligence, low physical ability, slow reaction, little education, or little sense of responsibility cannot be trained to become good drivers. The military motor vehicle is an expensive piece of mechanical equipment which is easily damaged by poor driving. Poor drivers can cause costly damage. They cause excessive vehicle deadlining, which overburdens maintenance facilities and impairs the effectiveness of highway transportation. Drivers must know not only how to drive properly and how to perform first echelon maintenance (TM 21–300, TM 21–305, and TM 37–2810), but they must be skilled therein. They must learn to appreciate the value of, and necessity for, good driving and good first echelon maintenance. They must *want* to drive properly and to perform their maintenance function thoroughly. Selection of personnel of sufficiently high standard for drivers will not suffice. Training of drivers must be thorough, and it must be continued throughout their assignment to organizations. They must learn to apply "defensive driving," which means they must keep alert to what others do and keep their vehicle under such control at all times that even if the other drivers do the wrong thing they can avoid an accident.

10. POINTS COVERED IN BRIEFING THE DRIVER

The fact that the driver is operating in column does not lessen the need for him to be alert and careful. Rather it increases his responsibility. Driving in column requires that he keep his position and maintain the pace. The tendency to become lax in habits in column driving and merely to "follow the vehicle ahead" must be avoided. This fact cannot be overemphasized and should be impressed upon the driver at all times. The following are particularly important points in the conduct of motor marches and convoys, and march commanders should brief all drivers concerning them before movement of convoy.

a. Start engine on the proper signal and keep alert for the command to move out.

b. Move out slowly and allow the vehicle ahead to gain its proper distance before normal speed is reached.

c. Keep within the lane of the column unless required to give way to or pass other traffic.

d. Maintain an even driving pace, increasing and decreasing speed gradually. Never speed unnecessarily to catch up; never lag behind.

e. Maintain proper distance from the vehicle ahead by opening gradually as speed increases, closing gradually as speed decreases. Never get too close; never carelessly lose the vehicle ahead.

f. Keep alert and watch the vehicle ahead for changes in direction, traffic hazards, column signals, etc.

g. Repeat the appropriate signals passed back along the column and observe them at the proper time for changing direction, slowing down, or stopping.

h. Use horn only when necessary.

i. Keep position in the column unless ordered or signalled to pass other elements.

j. Shift into proper gear on climbs or slow stretches of road; never coast down hills with the clutch disengaged or transmission in neutral; use same gear that would be used to ascend the hill.

k. Obey traffic signals, signs, and markers except when otherwise instructed as, for example, when the way has been cleared for the column to pass intersections by traffic personnel.

l. If vehicle is disabled, move it to the side of the road and signal the succeeding vehicles to pass and be prepared to inform maintenance personnel of the trouble.

m. Move as far as possible off the road or to the right side of the roadway before halting.

n. Stop engine on proper signal or if vehicle is to stand longer than a few minutes.

o. After the column halts, wait for the command before dismounting; when hauling troops, dismount on proper order and open tailgate for the troops.

p. When dismounted, keep to the off-road side of the vehicles, and off the traveled part of the road.

q. Perform the prescribed inspection and maintenance functions during operation and at halt, giving special attention to items which might be taken for granted, such as checking the fuel supply for the rest of the march.

r. Be alert for signal to remount and resume march, and move out promptly.

s. Under blackout or other conditions requiring security, conform strictly to all restrictions.

11. FULL USE OF AVAILABLE VEHICLES

a. The utmost use must be made of all available highway transport. The requirements for such transportation are not presented in an average demand, day after day. For example, an infantry division on occasion has need for more than its organic highway transportation to increase its mobility.

b. It is impossible to provide each unit and installation with all the highway transportation needed to meet peak requirements. Thus, it is a basic principle that a unit or installation should be provided only with such motor transport as it will constantly employ day after day. Motor transport vehicles, for the purpose of meeting peak loads, should be pooled and allocated to meet requirements as they occur. Every effort should be made to minimize the movement of empty or partially loaded vehicles.

c. A requirement of full utilization is an organized system for providing information on forward and return loads. This is accomplished by cooperation between troop unit, movement control, and highway staff personnel. Movement control officers furnish highway transport staff officers with information as to pending cargo or personnel to be moved by highway, and highway transport staff officers, having this information, employ their vehicles for maximum utilization. When diversions are necessary, the movement control staff must coordinate the changes with highway transport staff personnel. It is important that the commanding officers of units and installations cooperate to the fullest extent in the maximum utilization of all transportation.

d. The return load program provides a method of utilizing cargo space of vehicles which would otherwise travel entirely or partially empty, but should not result in such vehicles being required to make excessive detours, or to be unduly delayed in returning to their proper station. The bad practice of officers seizing truck units or trucks seriously disrupts the supply program, and, when resorted to by senior commanders, is an indication that such commanders have failed to take proper steps to meet their truck requirements.

12. HIGHWAY CAPABILITIES

a. The term "highway" in its broadest sense means any specified line of travel, any common or open way or course. In like manner, the term "highway network" includes all ground surface routes of travel other than rail.

b. The characteristics of highways are diversified. Their differences require planning and proper use. There are two main factors which limit the use of the highway network. These are—

(1) *Highway capacity* (*vehicle*). This is the maximum traffic flow obtainable on a given roadway using all available lanes. It is usually expressed as the number of vehicles per hour.

(2) *Highway capability* (*tonnage*). This is the number of vehicles (highway vehicle capability) or the number of short tons pay load which can be moved over a highway within a given time, with reasonable road maintenance and proper consideration of the type of roadway, mountains, hills, curves, weather, other traffic, types of vehicles employed, etc. Thus, the highway tonnage capability indicates the practical tonnage support that can be moved over a highway.

c. With the exception of the best modern highways, the tonnage capability rather than the vehicle capability is the more important limiting factor. The tonnage capability of a road may be exceeded for short periods. However, if the full vehicular capacity of a road is used without consideration of its tonnage capability, the road may break down and become impassable. Therefore, road capabilities may necessarily restrict freedom of movement. Commanders must consider both vehicle and tonnage capability in scheduling and routing highway movements. They must consider the highway tonnage capability in planning road maintenance and new construction. They must take road capability into consideration when making tactical or logistical plans.

d. In estimating the capability of a highway, it must be realized that any military force not only creates definite requirements for supply movement, but, in addition, generates other traffic. This includes the traffic involved in administrative operations, casual movement of messengers, staff officers, etc. In some areas such casual traffic may be several times the volume generated by hauling of cargo. Furthermore, the limitations of terrain, bridges, feeder and egress routes, cross traffic, and similar variable factors, make it impractical to maintain a volume of traffic equal to the full capability of the highway for other than very short periods of time. Capability of a highway must, therefore, be computed on the basis of these various limitations on the realization of full capacity.

13. THE HIGHWAY TRAFFIC PLAN

a. There must be a highway traffic plan. Normally the general plan originates in theater or similar headquarters. It may prescribe the main supply roads (MSR) through various sections of the communications zone and combat zone. It may prescribe procedures as to blackouts, camouflage, and other passive defense measures. It may prescribe traffic rules and regulations applicable throughout the command. It usually includes circulation maps depicting the through routes, direction of traffic flow, and extent of area road networks as described in the text of the plan.

b. Successive subordinate commands promulgate plans which conform to the plan of higher authority, and supplement it by regulations as to use of highways within their control and not covered by the higher plan. It is important to stress the fact that lower commanders implement the larger, over-all plan, but do not change it.

14. CARRYING OUT THE PLAN

a. So much of the highway traffic plan as deals with highway regulation is carried out by the transport service or transportation staff of the appropriate command (par. 152).

b. Regulation of highway traffic is imposed only to the degree necessary to prevent congestion and to make sure that all movement is constantly in hand, so that any moving unit can be reached almost instantly and its orders changed whenever the tactical situation requires.

c. If highway regulation is to prevent congestion and efficiently perform its mission, it must be the responsibility of a single agency. Therefore, a staff is organized in the office of the appropriate transportation officer to regulate traffic on dispatch routes. In the case of routes reserved for the operation of a particular unit, highway regulation is a proper function of the staff of the command charged with the operation.

d. This office prepares the schedules of and records the progress of all serials whether they be march units, convoys, or individual vehicles traveling over the routes which it controls. Convoys and march units using such routes must adhere to highway regulation. When doubts arise, or information regarding schedules or routes of travel is desired, they contact the nearest highway regulation point (HRP) along the route of march.

15. ENFORCING THE PLAN

a. The regulations as to speed, rules of the road, etc., are enforced by officers and noncommissioned officers of marching units and by military police traffic control (FM 19–25).

b. Military police traffic control is exercised to enforce speed regulations and rules of the road, and to keep unauthorized movements off dispatch or reserved routes.

Section II. THE MOTOR VEHICLE—CHARACTERISTICS AND USES

16. MILITARY MOTOR VEHICLES

(fig. 1)

a. A motor vehicle is any vehicle propelled by a self-contained power unit, except vehicles designed for use on railways and materials handling equipment. For practical purposes, the term is expanded to include vehicles designed to be towed by a motor vehicle, that is, trailers and semitrailers.

b. A military force is normally equipped with vehicles suited to the conditions under which the force will operate, or with vehicles designed for the specialized tasks to be performed. For example, some combat units have tanks or other vehicles equipped with armor and armament which are

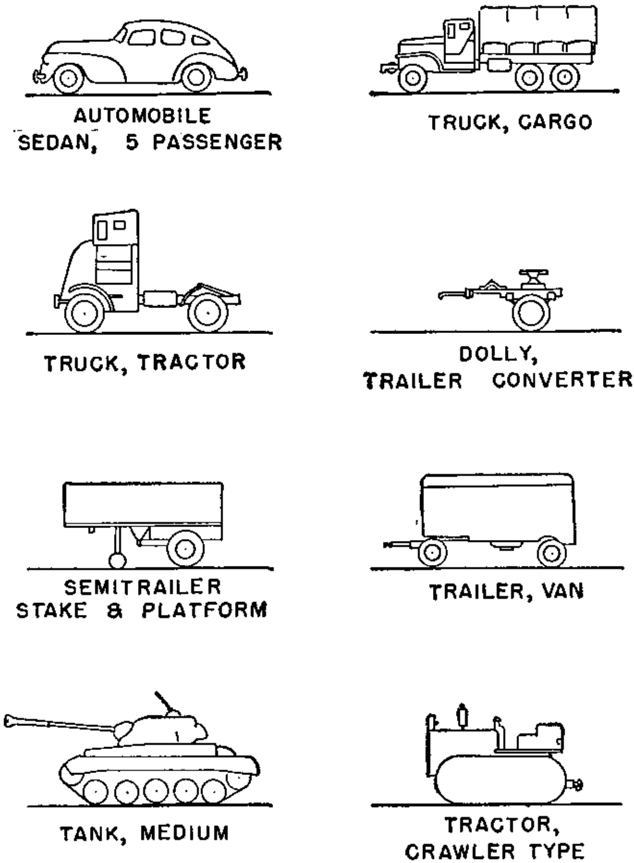


Figure 1. Motor vehicles—examples of major types.

designed for combat; artillery units have self-propelled guns or prime movers which tow the guns to firing positions; and tactical units which may operate over difficult or hazardous terrain have vehicles with cross-country capabilities. Vehicles with strictly military characteristics have tended to set the standard for all military vehicles. However, transportation truck companies which operate long distances over improved routes get more efficient service from vehicles similar to those in general commercial use; such vehicles are designed to transport a large volume of cargo at maximum speed, with minimum use of personnel, fuel, and equipment.

c. There are two general classes of military vehicles according to the use for which they are intended. These are the following:

(1) *Administrative vehicles.* Vehicles, normally of commercial type, suitable for routine purposes in connection with the transportation of supplies, personnel, or equipment at installations. Administrative use of a vehicle is any use not directly connected with combat, tactical, or service unit field operations or the simulation of such operations for training purposes.

(2) *Tactical vehicles.* Vehicles designed primarily to meet field requirements in direct connection with combat tactical operations and the training of troops for combat are tactical vehicles.

d. Tactical vehicles are, in general, those most often used for strictly military purposes, and insofar as practicable, administrative vehicles are those used for purposes closely paralleling civilian usage. In this sense, the $2\frac{1}{2}$-ton, 6 x 6 truck, because of its all-wheel drive for operations over difficult terrain, is generally termed a tactical vehicle and the common 4 x 2 pick-up truck is termed an administrative vehicle. This, however, does not preclude use of the $2\frac{1}{2}$-ton, 6 x 6 truck administratively, nor use of the pick-up truck tactically.

17. PURPOSES FOR WHICH DESIGNED (fig. 2)

Vehicles are further grouped according to the purpose for which they were designed:

a. General Purpose Vehicles. These are motor vehicles designed to be used interchangeably for movement of personnel, supplies, or equipment, without modification to body or chassis to satisfy general automotive transport needs. These include such items as passenger cars and buses, and cargo trucks, trailers, and semitrailers.

b. Special Equipment Vehicles. These are motor vehicles, the chassis of which are identical, except for minor alterations, to those used in general purpose vehicles, but which have a special body or special equipment mounted thereon. These include such items as wreckers, repair and shop trucks, and others modified to perform special functions or services.

c. Special Purpose Vehicles. These are motor vehicles designed for a specialized requirement for which no general purpose vehicle chassis can be adapted. This category includes items that are specified from time to time by technical services such

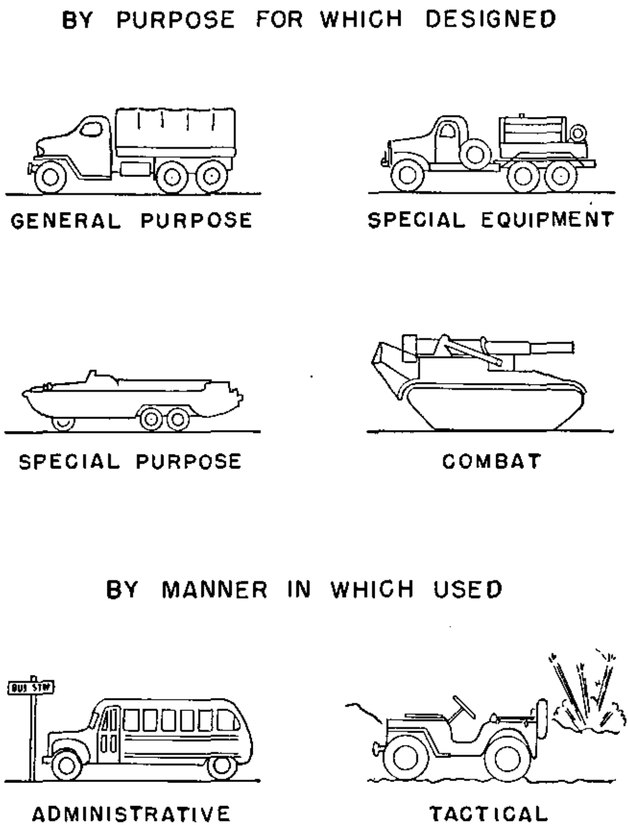


Figure 2. Classification of vehicles.

as fire trucks, engineer road equipment, tractors, amphibious trucks, and combat vehicles.

d. Combat Vehicles. These are special purpose vehicles, with or without armor and/or armament, which are designed for specific fighting functions.

They include scout cars, armored cars, half-track and full-track carriers or carriages, and tanks. Limited armor protection and/or armament mounted or installed on vehicles of otherwise noncombat type do not operate to change the classification of such vehicles to combat vehicles.

18. CHARACTERISTICS OF VEHICLES
(fig. 3)

Military vehicles are designed with characteristics which will insure acceptable performance under many varied conditions. The ability of a motor vehicle to negotiate difficult terrain depends upon its design specifications and performance characteristics resulting therefrom. A proper appreciation of these related factors will assist military personnel in proper use of vehicles under various conditions.

a. Gradability. This is the ability of a vehicle to negotiate a slope while carrying the pay load for which it is designated and with transmission in lowest forward gear.

b. Traction. This is the ability of the wheels or track of an automotive vehicle to adhere to the road.

c. Fordability. This is the ability of a vehicle to negotiate a depth of water without stalling the engine.

d. Momentum. This is the energy stored up by the weight of the vehicle in motion. It increases with the speed of the vehicle and weight of the vehicle and load.

e. Flotation. This is the ability of a wheel or track to resist sinking into the surface supporting it.

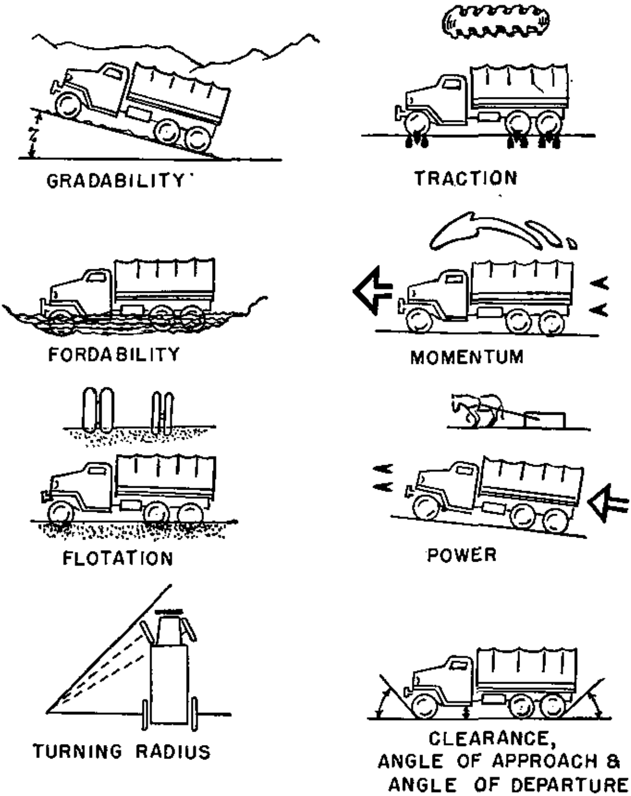


Figure 3. Vehicle performance characteristics.

It increases if the area of ground contact afforded, per pound of weight, is increased. Flotation varies inversely with ground pressure, which is measured in pounds per square inch.

f. Power. This is the force built up in the engine of a vehicle and transmitted to the wheels or tracks to produce motion. Power in any gasoline-propelled vehicle depends primarily upon maintaining proper engine speed. A shift to a lower gear gives more effective application of power, but with a loss of speed.

g. Other Characteristics. Other characteristics which limit or extend the use of vehicles under various conditions include: ground clearance, angle of approach, angle of departure, turning radius, gross weight distribution, etc.

19. CARE OF VEHICLES AND SAFETY PRECAUTIONS

a. Prevention of Vehicle Abuse. Vehicle abuse is the chief cause of mechanical failures, excessive operating and maintenance costs, general unsatisfactory performance of the motor vehicle and its component parts, and consequent impairment of mobility. Prevention of abuse of vehicles is of the utmost importance and is the responsibility of each commanding officer. Evidence of abuse of vehicles will be investigated and will be cause for disciplinary action. Mechanical failures which are not the result of fair wear and tear or defective material or workmanship will be considered evidence of vehicle abuse and will be reported to the appropriate commanding officer by maintenance personnel making the discovery. The following forms of vehicle abuse are among those which should be prevented.

(1) Improper use of manual controls, particularly gear shift, clutch, brakes, and choke.

(2) Racing or overloading engine before normal oil pressure or operating temperature is established.

(3) Excessive speeds (for the gear being used), particularly over rough roads and across country, on turns and down grades.

(4) Lack of lubrication or use of improper lubricants.

(5) Deferred maintenance, including lack of proper servicing and adjustments.

(6) Lack of systematic maintenance inspection and follow-up.

(7) Unauthorized loading beyond rated (highway or cross-country) capacity, and improper loading.

(8) Unsafe driving practices, failure to observe regulations as to speed, etc.

(9) Continued operation of malfunctioning vehicle which will result in more serious damage.

(10) Lack of proper care of vehicles in storage.

(11) Driving with front axle engaged, under conditions when front wheel drive is not needed.

b. Safety Precautions. Commanding officers are responsible for enforcement of safe driving rules and will cooperate fully with civilian and/or military authorities in the enforcement of traffic regulations. They are responsible for seeing that adequate precautions against fire and accident are maintained. These precautions include the following:

(1) Proper selection and training of drivers and the maintaining of qualified personnel.

(2) Training of personnel in *defensive driving* and in the respect for the rights of others.

(3) Assuring the observance of the rules of the road.

(4) Maintaining proper march discipline in convoy.

(5) Insuring the security of loads being hauled by—

(*a*) Proper loading and lashing.

(*b*) Clear marking of explosives and dangerous cargo, and safe distribution in column.

(6) Taking necessary measures to prevent fires especially in regard to the use of fuels, and smoking limitations.

(7) Taking necessary parking precautions, including posting of warning devices when vehicles are parked along an open way.

(8) Prescribing necessary precautions in shops or in connection with maintenance activities such as regarding the proper disposal of combustible waste and the careful use of tools.

c. Speed Limits. The caution plate mounted on each vehicle indicates the maximum safe speed, in each gear, for which the vehicle is designed. It will not be exceeded in any gear except in case of extreme emergency.

(1) Speeds will not exceed those prescribed by competent authority or the limits set by local laws or regulations, except in cases of emergency or where prior arrangements have been made for release from such regulations.

(2) Regardless of allowable speeds, vehicles will be operated within the limits required by

road and traffic conditions to assure safe operation.

(3) On all vehicles regulated by governors, governors will be set and sealed at a speed not to exceed the maximum speed indicated on the caution plate.

20. RESPONSIBILITY AND USE OF VEHICLES

a. Responsibility. Each commanding officer is responsible for the vehicles under his jurisdiction—for their proper operation, utilization, and maintenance.

b. Use. Regulations prescribe certain limitations and restrictions on the use of motor vehicles. Except for weight, design, and loading restrictions, these are generally:

(1) The commanding officer of an installation or organization will prohibit operation of any vehicle under his command which is not in safe operating condition or where further operation will cause additional damage to the vehicle.

(2) Motor vehicles will be used only for official business, including special uses prescribed by regulations.

(3) Motor vehicles will not be assigned to exclusive use of individuals except as specifically authorized by Army Regulations.

(4) Motor vehicles will not be assigned for uses not properly part of, or connected with, an official task.

(5) Motor vehicles, when available without detriment to other official business, and subject to restrictions, may be used by special

direction of a commanding officer for authorized and supervised recreational, welfare, and morale-building activities.

(6) Motor transportation should be furnished only after every effort has been made to consolidate and coordinate trips.

Section III. MOTOR VEHICLE ADMINISTRATION

21. DEFINITION

Motor vehicle administration seeks to attain efficient utilization of vehicles by consolidating and coordinating their assignments. It includes the following:

a. Allocation and Commitment.

(1) Allocation by assignment is the assignment or attachment of vehicles or units to various installations or commands based on the requirements of the using installation or organization and in accordance with availability of equipment. It is exercised by major commands or responsible services.

(2) Commitment for a particular lift or hauling job is the temporary allotment of vehicles to work on a job without assignment or attachment to the using installation or organization.

b. Dispatch. The process by which a motor pool, organization, or unit directs and supervises the use and movement of vehicles under its control so as to prevent improper use and attain maximum utilization is dispatch. Dispatch is normally exercised through the scheduling and recording of driver and vehicle assignments and by the issuance of a ticket covering each trip of a vehicle or group of vehicles.

22. HIGHWAY TRANSPORT UNIT POOLS

a. In a theater of operations, requirements for highway transportation will usually be so great that maximum utilization must be made of all truck companies and the vehicles organic thereto. This precludes the assignment or attachment to depots, ports, and other installations of sufficient units to meet peak loads. It requires such assignment to be kept down to the minimum required for regular daily needs.

b. Highway transport service pools are unit pools consisting of Transportation Corps units such as truck or car companies, battalions, or other units which provide a general hauling service for a theater, communications zone, army, corps, division, etc. Under this type of pooling, units perform specific hauling jobs as required by the command they serve, but they are not assigned or attached to any organization or installation within or subordinate to such command. The general highway transport service pool operation is normally controlled by the theater army, communications zone, or other appropriate highway transport service.

Section IV. MOTOR POOLS

23. GENERAL

The localized pooling of available motor transportation will, under most conditions, give the most efficient and economical results, so that a given number of vehicles can transport more cargo or personnel in a given time. The common terms used in referring to vehicle pools follow:

a. Motor Pool. A group of vehicles under central control, that is available for common use of several agencies or individuals is called a motor pool.

b. Motor Park. An area where vehicles are stored or parked when not in use, or where repairs can be made when necessary is called a motor park. It is also called a vehicle park.

24. TYPES OF MOTOR POOLS

a. In distinguishing between the physical grouping of vehicles and the centralization of the dispatch function without the physical pooling, the following terms are used:

(1) *Functional pool.* A functional motor pool consists of vehicles which are garaged or parked with their own or different organizations, but which are under a central control.

(2) *Physical pool.* A physical motor pool is one in which the vehicles are assembled in one place and available for use as needed by different organizations or individuals.

b. The general types of motor pools normally set up for routine use at installations and in metropolitan areas are as follows:

(1) *Post motor pool.* A pool of vehicles normally employed at an installation for overhead and routine housekeeping purposes is called a post motor pool.

(2) *Subpool.* A group of administrative vehicles suballocated to a particular activity

but which remains under central control is called a subpool.

25. OPERATION OF VEHICLE MOTOR POOLS

a. The conditions surrounding the operation of motor pools in cities, of highway transport units in the field, and of organic vehicles, may vary materially; but the general principles set forth below, with minor modifications to meet each type of condition, are applicable to the operation of all pools of motor vehicles.

b. Motor pools may be operated by one of the following types of dispatch control:

(1) *Central dispatch.* Dispatch control performed from a central office over a number of scattered motor pools, or subpools, is central dispatch.

(2) *Local dispatch.* Dispatch located and performed at one motor pool, or at subpools, is local dispatch.

(3) *Job dispatch.* A temporary dispatch system set up over vehicles performing short hauls, or shuttle tasks, as part of a job assignment for which they have already been dispatched by their organization is job dispatch.

c. The factors of time, distance, and tasks largely determine the type of motor pool operation, for example:

(1) If the distance between the main pool and loading or discharge points is short, it is normally desirable to assemble all vehicles

at one motor pool and control them from that point.

(2) If the distance between the main motor pool and pick-up or discharge points is great, physical pooling at one point might require vehicles to travel unnecessarily long distances per trip. Under such circumstances, it is generally advisable to establish subpools near major outlying loading or unloading points. Even on small posts it may be desirable to establish a subpool at one or more distant points where vehicles are frequently required.

(3) Subpools may also be desirable on the basis of the special use of certain vehicles, such as those which are constantly loaded with tools or equipment of a particular technical service, or ambulances to be used in emergencies.

(4) A surge-type pool may be required on the basis of particular tasks to be performed such as port or beach clearance, airlift operations, etc.

d. When the vehicles are not physically assembled in one pool, a functional pool should be established with an experienced motor transport officer supervising the operation of the main pool and all subpools. Training and discipline of personnel, preventive maintenance of vehicles, and general administrative control of all activities should be under one motor officer. Such an administrative organization should have a central dispatching system so that all requests for vehicles may be coordinated and cleared by a single office.

26. DUTIES AND RESPONSIBILITIES OF PERSONNEL (fig. 4)

a. Commanding Officer. The commanding officer under whose jurisdiction a motor pool is established is responsible for its operation. The transportation officer acts for the commander in supervision of motor pools.

b. Motor Pool Officer. The motor pool officer is in direct command of the motor pool and is charged with direct responsibility for all phases of its operation. He represents the commanding officer in the approval and disapproval of requests for transportation referred to him by the dispatcher. Under the supervision of the motor officer, the clerical staff maintain all files and records and prepare all reports and correspondence pertaining to the motor pool.

c. Motor Maintenance Officer. The motor maintenance officer, as the shop superintendent, is charged with the organizational maintenance of all motor vehicles in the pool. His duties include the proper training of personnel, the scheduling of maintenance and emergency repair of vehicles, and the care of shop equipment.

d. Truckmaster. The truckmaster, as assistant to the motor officer, is charged with supervision of policies and procedures of the trucking unit.

e. Dispatcher. The dispatcher, upon receipt of an authorized request, selects the most appropriate piece of equipment available with operator and accomplishes the following:

(1) Fills in the following entries on DD Form 110 (① and ② of fig. 5): "Date," "Type,"

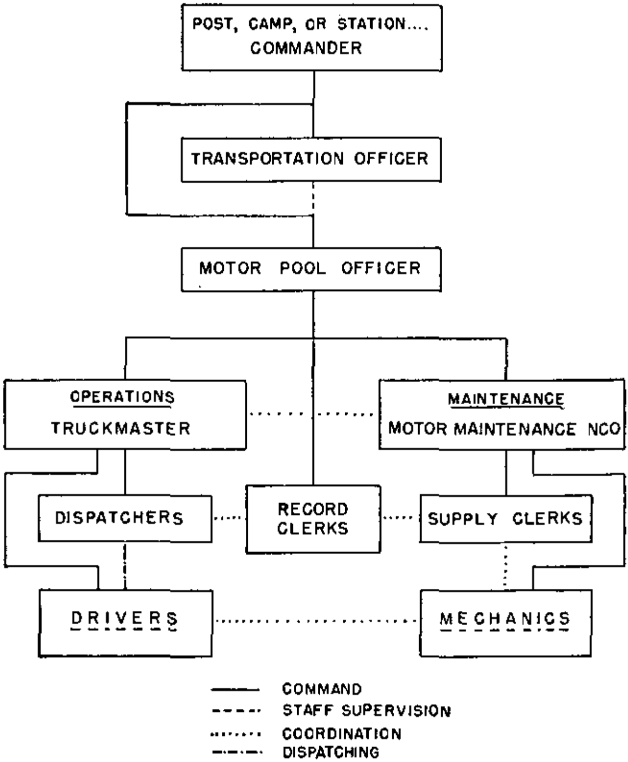


Figure 4. Typical organization for motor pools at an installation.

"Registration No.," "Time out," "Operator (name and grade)," "Requested by," "Dispatcher (signature and grade)," and "Dispatching organization."

(2) Coordinates and effects consolidation of routine and extended trips.

VEHICLE AND EQUIPMENT OPERATIONAL RECORD

DATE	TYPE	REGISTRATION NO.
2 Feb 1952	2½-ton Dump	7843912

AUTHORIZED DESTINATION: Hq Co A to Bldg T-2871

REQUESTED BY: Capt J.N. Jones

OPERATOR (*Name, grade*): N.J. Smith, Pfc

ACTION	TIME	MILES
IN	0945	5670
OUT	0730	5640
TOTAL	1:15	30

FUEL (*Gallons*)	OIL (*Quarts*)
5	0

DISPATCHER (*Signature, grade*): P.A. Brown, Cpl

DISPATCHING ORGANIZATION: Bn Hq 116th Engr Bn

DESTINATION	TIME ARRIVAL	TIME DEPARTURE	ARRIVAL MILEAGE	LOAD	RELEASED BY (*Initial*)
FROM Motor Pool		0730	5640		
TO Hq Co A	0745	0800	5645	1 ton	
TO Bldg T-2871	0830	0900	5655		
TO Hq Co A.	0910	0930	5665		JNJ
TO Motor Pool	0945		5670		
TO					
TO					
TO					
TO					
TO					
TO					
TO					
TO					
TO					
TO					
TO					

REMARKS

Windshield wiper not working.

I have noted all entries on this form and have taken the necessary action, including arrangements for correction of deficiencies noted by operator.

P.A. Brown, Cpl

Signature and grade of dispatcher.

DD FORM 1 DEC 49 110 Replaces NME Form 110, 1 Nov 1948, which may be used. 16—61344-1

① Front.

Figure 5. DD Form 110, Vehicle and Equipment Operational Record.

OPERATOR'S DAILY AND WEEKLY PREVENTIVE MAINTENANCE SERVICES			
1. DAILY OPERATIONS	O. K.	ADJUST	NEEDS REPAIR
FUEL, OIL, WATER, (*Antifreeze*)	✓		
TIRES	✓		
LEAKS, GENERAL	✓		
VEHICLE EQUIPMENT windshield wiper blade			✓
~~STANDARD FORM 91, ACCIDENT REPORT~~			
2. DURING OPERATIONS			
INSTRUMENTS, BRAKES, STEERING, POWER DRIVEN UNITS	✓		
3. AT HALT			
CHECK DEFICIENCIES NOTED DURING OPERATION	✓		
4. AFTER OPERATION SERVICES			
CLEAN EQUIPMENT	✓		
FUEL FILTERS	✓		
~~AIR BRAKES AND TANKS~~			
5. WEEKLY SERVICES			
~~CLEAN EQUIPMENT~~			
~~BATTERY~~			
~~ASSEMBLIES AND BELTS~~			
~~TOOLS AND EQUIPMENT~~			
~~VISUAL INSPECTION OF VEHICLE~~			
REMARKS Windshield wiper not working.			
OPERATOR'S SIGNATURE N.J. Smith Pfc			

☆ U. S. GOVERNMENT PRINTING OFFICE 16—61344-1

② Back.

Figure 5.—Continued.

(3) Posts all requests for transportation when received, and operational records at time of issue on the Daily Dispatching Record of Motor Vehicles (DA Form 9–75) (fig. 6).

(4) Receives operational records from operators upon their return and records necessary data on DA Form 9–75. Examines both sides of each operational record to insure completeness of action by all concerned. Refers equipment requiring repair to shop. Initials operational record in space provided and files tickets by registration number and date, pending disposition.

f. Operator (*AR 700–105*). DD Form 313 (① and ② of fig. 7) will be issued by commanders to all operators of motor vehicles who are qualified to operate the particular vehicles noted on the permit. The validity of the permit with or without glasses will be indicated on the reverse side of the permit in the space marked restrictions. Authentication of vehicles the operator is qualified to drive will be indicated by the signature of the qualifying official, a commissioned officer, and the permit will be certified by the signature of the issuing official, the commanding officer or the supervising commissioned officer. The operator is responsible for the following:

(1) Performs the daily and weekly preventive maintenance services and certifies their performance by signing in the space provided. When the commanding officer specifically relieves a driver or operator from responsibility for daily and weekly maintenance, a responsible designated person in the

motor pool garage, preventive line maintenance system, or other agency that performs the required maintenance will certify that performance by initialing in the space provided for the operator on DD Form 110.

(2) Fills in the following:

(*a*) On DD Form 110, the operator makes the following entries: "Time in," "Miles in," "Miles out," "Total," "Fuel," "Oil," "Destination," "Arrival time," "Departure time," "Arrival mileage," "Load" (when applicable—passengers and/or tons), as applicable, for each trip or subtrip, obtaining the initials and further instructions from the official user.

(*b*) In case of an accident resulting in injury or property damage, Standard Form 91 (① and ② of fig. 8) will be filled out by the driver on the spot or as promptly as possible thereafter. The driver will also execute DD Form 518, Accident-Identification Card, (fig. 9), and submit it to the persons directly involved. The driver will refrain from making a statement, oral or written, to claimants or their agents.

(3) In the absence of further instructions, the operator automatically returns to the motor pool by the most direct or usual route.

(4) Carefully notes and records all equipment deficiencies under "Remarks" on DD Form 110.

NOTE—Entries shown in bold face type to be filled in by dispatcher when transportation is requested.

DAILY DISPATCHING RECORD OF MOTOR VEHICLES

DATE | DISPATCHER | PAGE NO.

Adm. No.	Registration No.	Driver's Name and Rank	Type Vehicle	Requested By	Report To	Unit or Section	Phone Ext. No.	Reporting Point Address or Unit	Load or Number in Party	Destination	Time to Report	Expect Time of Return	Time Out	Time In	Miles	Remarks
55	456789	Smith, J.J. Pfc	2½T	Capt R.A. Jones	Sgt Able	16th Engr	781	Bldg T2931 7th Ave & 4th St	2 tons	Warehouse #4	1315	1600	1300	1610		Check hydraulic hoist
83	435531	Moore, T.M. Pvt	2½T	Major J.P. Williams	Major Williams	22nd QMC Bn	149	Bldg T704	1 ton	Station Hospital	0800	1730	0745	1700		
194	2237545	Miller, J.H. Pfc	Automobile	Major Downs	Major Downs	7th Regt Hq	762	7th Regt Hq	4	Fort Story	0745	1730	0730	1730		Accident
16	2198731	Harvey, Wm. Pfc	¼T	Lt Col L.D. Barr	Lt. Ware	7th Regt Hq	480	7th Regt Hq	2	Messenger	0745	1730	0730	1720		
48	2147631	Black, W.W. Cpl	10T Semi	Capt P.O. Field	Capt Harvey	7th Regt Hq	311	7th Regt Supply Office	4 tons	Parade ground	0800	1730	0730	1530		
195	437232	Brown, J.R. Pfc	2½T Dump	Capt I.D. Baker	Capt I.D. Baker	Post Hq	187	Bldg 1401	3 tons	QM Depot	0800	1530	0730	1530		

DA Form 9-75 Previous editions of this form are obsolete.

Figure 6.. DA Form 9–75, Daily Dispatching Record of Motor Vehicles.

U. S. GOVERNMENT OPERATOR'S PERMIT DEPARTMENT OF DEFENSE							PERMIT NO. 68807757
NAME OF OPERATOR Norman J. Smith				DATE ISSUED 4 Feb 52			EXPIRATION DATE 4 Feb 53
SEX M	RACE W	AGE 27	HEIGHT 5'10"	WEIGHT 160		COLOR OF HAIR Black	COLOR OF EYES Blue
The holder of this permit is qualified to operate U. S. Government vehicles and/or equipment specified subject to the restrictions set forth on the reverse hereof.							
SIGNATURE OF ISSUING OFFICIAL J. B. Moore				TITLE Capt TC Chief Hwy Branch NYPE			
NAME AND LOCATION OF ISSUING UNIT New York Port of Embarkation, Brooklyn, N. Y.							
NOT TRANSFERABLE *Permit must be carried at all times when operating Government vehicles.*	SIGNATURE OF OPERATOR (*Not valid until signed*) Norman J. Smith						

DD FORM 313, 1 AUG 50 REPLACES WD AGO FORM 9-74, 1 AUG 48, WHICH MAY BE USED.

① Front.

Figure 7. DD Form 313, U. S. Government Operator's Permit.

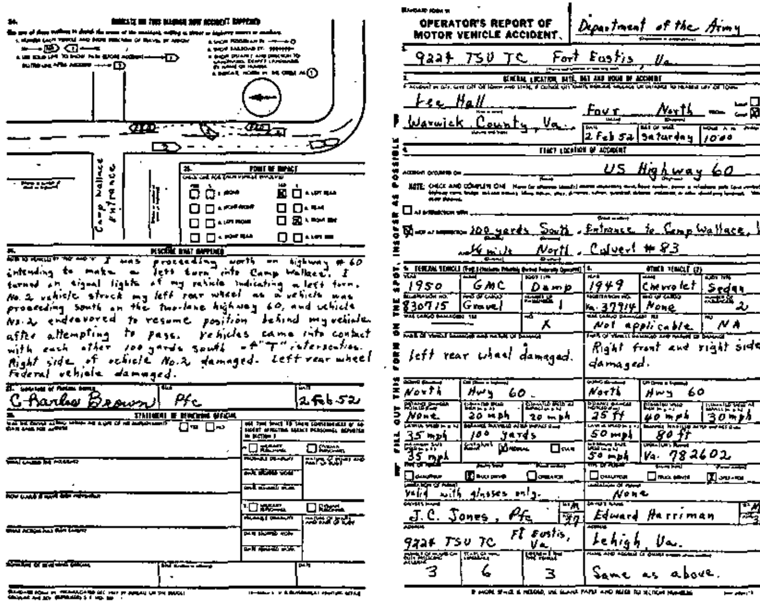
RESTRICTIONS Valid with glasses.		
QUALIFIED TO OPERATE		
TYPE VEHICLE AND/OR EQUIPMENT	CAPACITY	QUALIFYING OFFICIAL
Automobile	5 Pass.	L B Robinson, Capt. T.C
Trucks, cargo	1/4, 3/4 ton	L B Robinson, Capt. T.C

ACCIDENT OR TRAFFIC VIOLATION RECORD		
DATE	NATURE	OFFICIAL

GPO—O—939287 16—62352-1

② Back.

Figure 7.—Continued.


OPERATOR'S REPORT OF MOTOR VEHICLE ACCIDENT.

Department of the Army

9224 TSU TC Fort Eustis, Va.

Lee Hall

Warwick County, Va.

Four North

2 Feb 52 | Saturday | 1000

US Highway 60

100 yards South, Entrance to Camp Wallace, Va.

1/4 mile North, Culvert # 83

1950	GMC	Dump	1949	Chevrolet	Sedan
830715	Gravel	1	Va. 37914	None	2
		X	Not applicable.		NA
Left rear wheel damaged.			Right front and right side damaged.		
North	Hwy 60		North	Hwy 60	
None	20 mph	20 mph	25 ft	40 mph	30 mph
35 mph	100 yards		50 mph	80 ft	
35 mph			50 mph	Va. 782602	
Valid with glasses only.			None		
J.C. Jones, Pfc			Edward Harriman		
9224 TSU TC	Ft Eustis, Va.		Lehigh, Va.		
3	6	3	Same as above.		

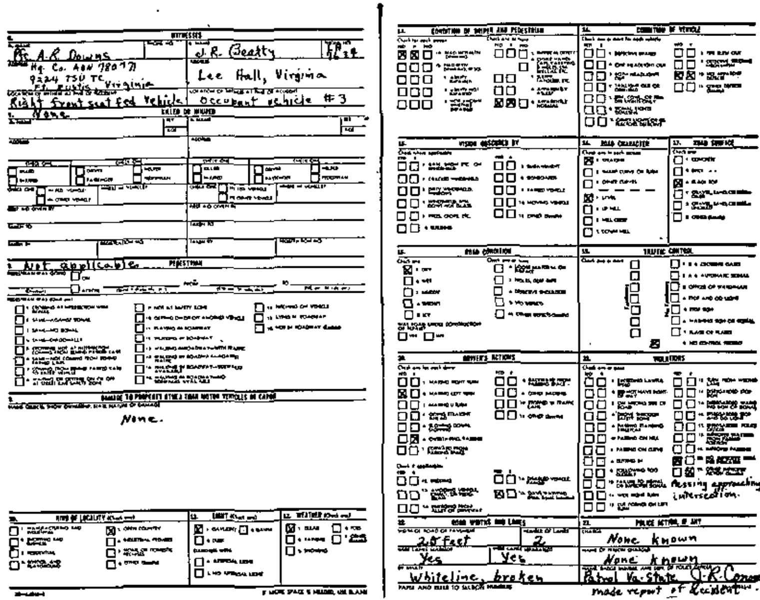
Camp Wallace Entrance

I was proceeding north on highway #60 intending to make a left turn into Camp Wallace. I turned on signal lights of my vehicle indicating a left turn. No. 2 vehicle struck my left rear wheel as a vehicle was proceeding South on the two-lane highway 60, and vehicle No. 2 endeavored to resume position behind my vehicle after attempting to pass. Vehicles came into contact with each other 100 yards south of "T" intersection. Right side of vehicle No. 2 damaged. Left rear wheel Federal vehicle damaged.

Charles Brown | Pfc | 2 Feb 52

① Front.

Figure 8. Standard Form 91, Operator's Report of Motor Vehicle Accident.


WITNESSES

Pfc A.R. Downs
Hq. Co. ASN 780771
9224 TSU TC
Ft. Eustis Virginia
Right front seat Fed Vehicle

J.R. Beatty
Lee Hall, Virginia
Occupant vehicle #3

KILLED OR INJURED

None.

PEDESTRIAN

Not applicable

DAMAGE TO PROPERTY OTHER THAN MOTOR VEHICLES IN CAUSE

None.

KIND OF LOCALITY

LIGHT

WEATHER

CONDITION OF DRIVER AND PEDESTRIAN

CONDITION OF VEHICLE

VISION OBSCURED BY

ROAD CHARACTER

ROAD SURFACE

ROAD CONDITION

TRAFFIC CONTROL

DRIVER'S ACTIONS

VIOLATIONS

Passing approaching intersection.

ROAD WIDTHS AND LANES

20 Feet

2

Yes

Yes

Whiteline, broken

POLICE ACTION, IF ANY

None known

None known

Patrol Va. State J.R. Conner

made report of accident.

② Back.

Figure 8.—Continued.

(5) Upon returning to the pool and after completion of required services, signs the certificate and personally delivers the completed operational record to the dispatching office.

ACCIDENT-IDENTIFICATION CARD

Any correspondence regarding accident should be addressed to:

Commanding Officer
Fort Eustis, Virginia
Attn: Claims Officer

MAKE REFERENCE TO

DATE OF ACCIDENT
2 Feb 52

MAKE AND TYPE OF VEHICLE
1950 $2\frac{1}{2}$-ton GMC Dump

REGISTRATION NO.
830715

DRIVER (*Last name—first name—initial*)
Jones, James C.

SERVICE NO.	GRADE
1387812	Pfc

ORGANIZATION
9224 TSUTC

16—64591-1 GPO

DD FORM 1 MAY 51 518 REPLACES WD AGO FORM 614, WHICH MAY BE USED.

Figure 9. DD Form 518, Accident-Identification Card.

g. Official User. The official user has the following responsibilities:

(1) Directs the operator to record any deficiencies noted.

(2) Secures efficient utilization of the vehicle and assures that it is promptly released upon completion of the job for which dispatched.

(3) Releases driver and equipment and certifies the official nature of his trip by initialing in that part of the "Released by" space which corresponds to the last trip or subtrip accomplished for him.

h. Mechanic. Mechanic performs the second echelon maintenance of motor vehicles and allied equipment operated by the motor pool.

27. REQUESTS FOR TRANSPORTATION

a. All agencies of the Department of Defense will be permitted to use the facilities of Army motor pools under such regulations as may be prescribed.

b. So far as practicable, requests should be submitted in writing, 24 hours in advance, to the dispatch office. Requests for vehicles should contain the following information:

(1) Agency or officer submitting request.

(2) Cargo or passenger transportation desired.

(3) Description, weight, and cube of load, or number of passengers. Unusual shapes or dimensions of cargo should be noted.

(4) Date and time the vehicle(s) should report.

(5) Point at which the driver should report.

238658°—53——4

(6) Name and rank (or position) of person to whom the driver should report; and/or person in charge of the trip.
(7) Purpose of the trip.
(8) Place(s) to and from which the vehicle will be required to travel.
(9) Date, estimated hour, and place at which the vehicle will be released.
(10) Other information which may be pertinent to the trip such as reference to travel orders; whether user-driver will be furnished; reason government transportation is necessary in place of commercial transportation; etc.

c. Requests for specific types of vehicles should not be made. The dispatcher should determine the number and type of vehicles required after consideration of the type of cargo, its weight and cube, or shape, vehicle maneuvering conditions at loading and unloading points, and terrain over which the vehicles will operate. Where there is any doubt the dispatcher will refer the matter to the motor officer.

28. OPERATING METHODS

a. Planning Dispatch.

(1) Whatever the type of motor pool, all dispatching should be planned at one central office. Priority should be given to requests as follows:
   (*a*) To emergency or important requests.
   (*b*) To those requests which are received 24 hours in advance.
   (*c*) To other requirements in accordance with the time of the request.

(2) It usually will not be practicable to anticipate all requirements for transportation 24 hours in advance. Hence, in dispatch planning the entire fleet should not be used, but a reserve of vehicles of various types should be held to meet important requirements which cannot be anticipated. The size of this reserve can be determined only by experience at the particular pool. Vehicles should be held for reserve in rotation, and full advantage taken of waiting time to perform any maintenance which will not interfere with the vehicles' readiness to roll.

(3) As requests for transportation come in they are consolidated so that the greatest practicable degree of utilization is attained. For example, if two individuals request transportation to the railroad station in a nearby town, it will frequently be practicable for one vehicle to take both at the same time and also meet any incoming personnel at the station.

(4) If a vehicle is sent to a distant point at which it will discharge its load, an attempt should be made to secure a return load from that point. This should be carried to the extent of cooperation between motor officers at various posts, to avoid the possibility that a vehicle will be dispatched with a load from Post A to Post B and return empty, while at the same approximate time another vehicle is bringing a load from Post B to Post A and returning empty. One vehicle

from either post can do both jobs, thus realizing 100 percent utilization for one vehicle rather than 50 percent for two. Vehicles of one post arriving at any other post should clear through the transportation officer before returning. "Return load" programs should be instituted in all commands, and transportation officers should have authority to use any available vehicles to transport return loads. However, judgment should be used in each instance in seeing that vehicles are not sent too far off their route in returning to the posts from which originally dispatched.

(5) When a vehicle is sent to a point at which its load (passengers or cargo) will be discharged and no return load has been arranged in advance, the driver should be instructed to telephone the central dispatching office when his mission is complete. He may then be sent on another job without returning to the motor pool.

(6) The nature of the load and the need for the trip should be carefully considered. Whenever a vehicle of a different type from that requested, or a lesser number of vehicles, will be suited for the work, or whenever the need for the trip is not apparent, the dispatcher should report the facts to the motor officer for decision.

(7) Except for tactical purposes and local hauling, army vehicles will not be dispatched for off-post transportation when suitable commercial means are available.

b. Vehicle and Equipment Operational Record DD Form 110.

(1) One vehicle and equipment operational record form should be made out each time a vehicle is dispatched from a pool or subpool. It is not satisfactory to make just one such ticket per vehicle per day.

(2) These vehicle equipment and operational record forms should be completely filled in as prescribed by TM 37–2810. They must be made out by the dispatcher at the pool or subpool from which the vehicles are physically dispatched regardless of the type of organization of the pool. If dispatched from a subpool, necessary data is transmitted by the subpool to the central dispatching office by available means of communication.

c. Daily Dispatch of Vehicles. No vehicles should be dispatched to one person or agency as daily procedure without approved written request justifying such daily dispatch. Approval of daily dispatch should be for a limited period only and subject to revocation. The motor pool officer is responsible for carefully investigating the need for daily dispatch of vehicles to any person or agency, and for permitting the daily dispatch of no vehicle beyond the requirements of sound utilization.

d. Trip Routing. Orders posted at each pool and subpool should include instructions to the effect that the shortest suitable route will be followed to and from a destination. Such routes should be established by the motor pool officer, making due allowance for the traffic conditions when necessary. This practice makes it possible to check trip ticket mileage to ascertain whether or not vehicles are taken off their course on matters other than for which dispatched and makes it easier to locate a vehicle which fails to return within a reasonable time.

29. BUS OPERATOR

The same general principles of good driving, safety, and proper maintenance that are applicable to other vehicles are equally applicable to the operation of buses. Buses are part of the general pool and will be operated under the motor officer as are other vehicles. However, when desirable, buses may be considered separately and constituted a subpool. Legal and administrative procedures in connection with the operation of buses are covered in AR 55–90.

Section V. AUTOMOTIVE MAINTENANCE

30. MAINTENANCE DEFINED

a. Maintenance. Maintenance is the care taken and the work done, including minor repairs, to keep vehicles and equipment in serviceable condition. It includes the systematic servicing and inspection of vehicles to prevent vehicle failure; the modification, repair, rebuilding, and reclamation of major items, units, and parts; and the evacuation and recovery of major items.

b. Preventive Maintenance. This is the care and servicing by using personnel for the purpose of maintaining equipment in satisfactory operating condition by providing systematic inspection, detection and correction of incipient failures either before they occur or before they develop into major defects. Preventive maintenance includes correct operation. DA Form 460 (Preventive Maintenance Roster) provides a simple method for scheduling the periodic services within organizations. When vehicles are to be away from their organizational maintenance facilities for some time, there should be kept with each vehicle a running record or log which will indicate when the vehicle received its last scheduled service with its unit and which will have blank spaces for the same information to be filled in by the mechanic who accomplished the next scheduled service away from the unit. Upon return of the vehicles to their parent unit, the information on the form may be transferred to DA Form 460.

31. INSPECTIONS

a. The unit commander is responsible for the maintenance of his motor vehicles, motor vehicle equipment, and tools. He may delegate maintenance functions to his motor officer and other personnel but must assure himself of their proper performance.

b. In addition to regular inspections and supervision, higher commanders should see that spot check inspections are made at irregular intervals but as often as prescribed by AR 750–5.

32. ORGANIZATION OF THE MAINTENANCE FUNCTION

The motor maintenance prescribed for the military service is a flexible system that can be adapted to various operating conditions. This organization is based on the agency (person or unit) responsible for the maintenance function at various echelons rather than on the type of work done by each echelon. Maintenance operations are divided into three main categories—organizational, field, and depot—with subdivisions as indicated:

a. Organizational Maintenance. Organizational maintenance is that maintenance (including first and second echelons) which is performed within the using organization by personnel of the unit on its own vehicles. The mileage that a vehicle travels is the principal criterion for the frequency of preventive maintenance services.

(1) *First echelon maintenance.* First echelon maintenance is that part of organizational maintenance which is assigned to the driver or crew of the vehicle.

(2) *Second echelon maintenance.* Second echelon maintenance is that part of organizational maintenance which is assigned to unit (company, battalion, or regimental) mechanics. It normally includes inspections, servicing, adjusting, minor repair, and replacement of minor parts. Second echelon personnel act upon drivers' reports of mechanical failures. The maintenance functions of this echelon are—

(*a*) Scheduled maintenance based on time and mileage as set forth in TM 37–2810.

(*b*) Seasonal maintenance, such as spring or fall, when vehicles are prepared to meet the operating conditions of summer and winter.

(*c*) March maintenance, which includes emergency service performed during the march and the repair of organizational vehicles necessary to keep transportation on the road.

b. Field Maintenance. Field maintenance incorporates the third and fourth echelons of maintenance and is the work exclusive of rebuild or overhaul performed by maintenance organizations (ordnance) on equipment for return to using organizations.

(1) *Third echelon maintenance.* Third echelon maintenance is that field maintenance performed by maintenance and supply organizations in direct support of using troops. Third echelon organizations may, for example, overhaul and replace specified subassemblies and repair the overflow from lower echelons. They also support the lower echelons by furnishing technical advice, supplying units and spare parts, performing unit replacements and repairs beyond the scope of using organizations, etc.

(2) *Fourth echelon maintenance.* Fourth echelon maintenance is that field maintenance performed by an established pool of variable members and types of maintenance and

supply units formed as a semifixed shop serving a geographical area. It serves all forward echelons with a higher degree of skill and a larger stock of parts, subassemblies, and assemblies. It sends forward contact parties or reinforcing elements when required. It includes overflow work from the third echelon of maintenance; repair of major items for return to utility stock; and the reconditioning of assemblies, subassemblies, and parts, either generated during repair operations or received from ordnance collecting points.

c. Depot Maintenance. Depot maintenance (fifth echelon) is that required for the repair of material which requires a major overhaul or complete rebuild of parts, subassemblies, assemblies, and/or end item as required. Such maintenance is intended to augment stocks of serviceable equipment or to support lower levels of maintenance by the use of more extensive shop equipment and personnel of higher technical skill than are available in organizational or field maintenance activities.

33. ORGANIZATIONAL MAINTENANCE SYSTEMS OF PERFORMANCE

a. Unit System Maintenance. This is the conventional system whereby one mechanic or a team of mechanics gives the entire service to a vehicle; it is simultaneous maintenance of a number of vehicles by separate mechanics or teams assigned to each. Unit system maintenance normally requires a high degree of general mechanical knowledge and the ability of individual mechanics to perform all necessary inspections and services.

b. Production Line Maintenance. This is the system for performing maintenance by accomplishing individual items of service or repair in specialized work stations. This system normally requires a high degree of specialized skill, and a careful selection of mechanics to perform individual items of maintenance.

34. DRIVER'S MAINTENANCE RESPONSIBILITY

a. The driver is the most important single factor in preventive maintenance. Improper driving and neglect of preventive maintenance service are the major factors in mechanical failures of motor vehicles. Inexperienced and careless drivers can nullify all efforts to maintain vehicles properly.

b. Driver-maintenance duties include correct loading and driving; servicing with fuel, lubricants, coolants, and air; inspecting; cleaning; tightening; and the care of tools and accessories. The driver *must not* perform maintenance that involves an adjustment which should be made by a mechanic.

c. Preventive maintenance services normally performed by the driver, are contained in TM 21–305, TM 37–2810, and appropriate vehicle technical manuals. Briefly, they are as follows:

(1) *Before-operation check.* This is a check to make sure that no change has occurred since the performance of the after-operation service (see (4) below).

(2) *During-operation check.* This is a continuing check to observe the actual func-

tioning of the vehicle while rolling and to take note of improper performance, so that it can be given attention at the first opportunity.

(3) *At-halt check.* This check consists of investigating any deficiencies noted during operation and locating deficiencies which cannot conveniently be observed while the vehicle is in motion.

(4) *After-operation service.* This is the main daily preventive service. Its purpose is to make sure that the vehicle is in condition to roll again on a moment's notice.

(5) *Weekly-service.* This service consists of those items of the daily after-operation service plus certain other items which require weekly attention to all vehicles.

d. Normally the driver performs the after operation service. If time does not permit a full service, the unit SOP can modify the service by deleting items not deemed essential. When vehicles are being operated on around-the-clock basis or under other conditions which make it impracticable to have the driver perform the after-operation and weekly-maintenance services, second echelon maintenance augmentation should be provided to relieve the driver of these services. However, under any circumstances, the irreducible minimum of driver maintenance is the during-operation and at-halt services. The driver should also be taught that, when others perform the after-operation service, if he fails to make his before-operation check he has no protection against being charged with deficiencies which were due to faulty after-operation maintenance.

35. REPAIR PROCEDURE

a. During marches, roadside repairs to disabled vehicles are frequently temporary in character. When a vehicle in column becomes disabled, the maintenance personnel from the trail should attempt to diagnose and correct the trouble.

b. If the diagnosis shows that the vehicle needs only a minor repair, a mechanic with a kit of tools and needed parts may be dropped off with the vehicle.

c. When the vehicle is carrying supplies or troops, or towing a gun or trailer, and doubt exists as to its probable repair in a reasonable time, its cargo or tow may be removed and loaded on or attached to another vehicle.

d. The driver should remain with a disabled vehicle, unless ordered by competent authority to abandon it.

e. When a vehicle is disabled, it should be driven, pushed, or towed well off the road, so that other vehicles may pass around without halting.

f. When a disabled vehicle is repaired without prohibitive delay, it resumes the march at the maximum authorized speed and rejoins the rear of the last unit of the column, remaining there until the next halt when it resumes its proper position; or, when properly instructed it passes along the column and resumes its position with its organization. The trail maintenance officer of an organization may have a disabled vehicle towed a reasonable distance. When towing is impractical repairs may have to be attempted on the spot.

g. When repair personnel are working on or by the side of the road, guards, flags, or signs should be put out as a warning to passing traffic. At night, security permitting, red lanterns or flares may be used. Lighted warning signals should not be used when blackout light restrictious are in effect.

36. EMERGENCY ROADSIDE REPAIRS

a. In the absence of maintenance personnel, limited emergency roadside repairs may be performed by the driver. These are limited by the ability of the driver and the time, tools, and parts available for his use.

b. The driver should not attempt repair unless he is reasonably certain that he has properly diagnosed the trouble and is capable of correcting it. Unnecessary tampering with mechanisms is prohibited. At the first opportunity after an emergency repair has been effected, the driver should report the facts to his squad or section chief in order that proper action may be taken. The following are examples of emergency roadside repairs which a driver may perform if he has received proper training:

(1) Change tires. Put cold patches on tubes.
(2) Tighten nuts.
(3) Remove, clean, reset, and install spark plugs.
(4) Adjust fan belt.
(5) Remove, blow out, and install gas lines.

(6) Tape leaks in gas or oil lines and tighten connections.
(7) Drain and clean the sediment bowl of the fuel pump.
(8) Drain and clean the fuel filter.
(9) Reconnect and tape electrical lines.
(10) Plug leaks in the cooling system and tighten waterpump connections.
(11) Adjust dragging brakes.

PART TWO

PRINCIPLES OF THE MARCH

CHAPTER 3

ORGANIZED MILITARY MOTOR MOVEMENTS

Section I. CLASSIFICATION OF HIGHWAY MOVEMENTS

37. GENERAL

a. Organized military movements, as opposed to casual movements, are made by groups of elements (troops and/or vehicles) over planned routes under supervision.

b. Military movements are organized to keep the troop organization intact; for purposes of leadership, discipline, and march control; to provide for group messing and quartering; to prevent pilferage and loss of cargo or equipment; to control the movement of supplies and personnel being transported; to regulate the flow of traffic over the highways; to make it possible to meet priorities according to prescribed schedules; to make it easy to change plans to meet the tactical situation.

c. The organized movements of troops are usually classified as foot marches and motor marches or a combination of the two. While on the road, elements of a foot march are referred to as the foot column; elements of a motor march, as the motor column or convoy.

38. CLASSIFICATION OF CONVOYS AND MARCHES

The following defines fundamental terms.

a. Motor March. The controlled movement of troops in motor vehicles is a motor march.

b. Convoy. A group of two or more vehicles organized for the purpose of control and orderly movement with or without escort protection is a convoy.

c. Tactical Movement. Movements are classified as tactical when made under combat conditions. Tactical convoys are organized to facilitate offensive or defensive action against the enemy.

d. Administrative Movements. Movements of units or supplies other than tactical movements against the enemy are called administrative movements. Administrative convoys are organized to facilitate movement and control of the vehicles and/or personnel.

Section II. ORGANIZATION OF MARCHES

39. GENERAL

a. Good organization is essential to good march discipline, good convoy control, and compliance with the regulations imposed by higher authority.

b. The organization of a motor column is affected by the type of transportation used, whether it consist of organically assigned vehicles or vehicles temporarily detailed to the particular task, and by the type of troops or supplies being hauled. It is affected by the condition of the highway, by the traffic conditions over the route being traveled, and by orders of higher authority. Organization may further depend on the demands of the tactical situation and the requirements of administration.

c. Military troop unit organization does not always meet requirements in planning for highway movement; in preparing schedules, march graphs, and march tables; and in reporting the progress of columns on the traveled route. The larger units are too unwieldy to be treated as a whole. Furthermore, there are so many kinds of units that it has been found desirable to set up a temporary organization for the purpose of regulating and controlling motor marches and convoys, which is sufficiently flexible to meet the various conditions arising in connection with the planning of movements, and which permits grouping of elements under single designations delineating their respective march functions.

40. FUNDAMENTAL TERMS OF ORGANIZATION

a. Before march organization can be explained, certain terms and their relationships and distinctions must be understood.

(1) *March*. A march is the movement of troops in a steady, regular manner; in a given order; and by their own means, whether on foot, mounted, or in vehicles.

(2) *March unit*. A march unit is a unit which moves or halts at the order of a single commander.

(3) *Column*. A column is a formation in which the elements are arranged one behind the other. When the elements of a column consist solely of vehicles one behind the other

on the same route they are often termed a "motor column."

(4) *March column.* A march column consists of all elements using the same route for a single movement of troops.

(5) *Serial.* A serial is an element, or group of elements, within a series which is given a numerical or alphabetical designation for convenience in planning, scheduling or control of movements by land, water or air.

b. These terms are variously employed in defining the manner in which movements are formed. For example, in tactical troop movements, the march may consist of elements of one organization using many different routes and subdivided into serials and march units. On the other hand, in highway regulation all elements moving over specific routes may be designated as serials in accordance with their scheduled passing times over the routes.

41. THE MARCH UNIT

a. A march unit operates under a unit commander who can control it directly by voice or signal. A company may operate as a march unit, and in some tactical movements, the march unit may be as large as a battalion; but in many movements—such as truck unit hauls—the march unit is normally of platoon section, or smaller size.

b. Unless the tactical situation makes it unwise, march units should have similar march characteristics throughout. For example, it is obvious that foot elements and motor elements should not normally be included in the same march unit. The placing of vehicles of different characteristics and different efficient speeds in the same march unit should be avoided when practicable.

42. THE MARCH COLUMN

a. A march column usually consists of a troop unit (company, battalion, combat team, etc.) or a temporary organization of march units for a single purpose or mission. The march column should consist, so far as practicable, of elements capable of maintaining the same rate of march. Unlike the march unit, march columns may consist of *complementary* rather than similar elements. For example, the tactical march column should be a team organization of the various march units necessary to accomplish a combat mission.

b. In administrative movements, primary considerations in the arrangement of the motor column are ease of march control, distribution of supplies, and the comfort and convenience of troops.

43. THE SERIAL

a. A serial may consist of any element such as a march unit or column, or any part or combination thereof, which is given a temporary numerical, alphabetical, or other designation and treated as a unit for convenience in preparing march graphs, march tables, and schedules or orders, and in reporting the progress of the march.

b. So far as possible, serials should consist of elements having the same rate of march so as to simplify the scheduling and reporting of the movement.

There are three methods of serialization which may be used advantageously either singly or in combination under different circumstances.

(1) *Organizational serials.* Organizational serials conform generally to the troop organization. This system has the advantage of ready unit identification and easy remembrance.

(*a*) The march column of a company could be serialized by platoons, sections, or squads.

(*b*) The march column of an infantry division organized for tactical movement may be serialized by combat teams and trains.

(2) *Time sequence serials.* Time sequence serials conform generally to the schedule of units past a point as shown on a march graph or table. The system gives definite information regarding the sequence of the march.

(*a*) It may be used by the tactical troop commander in planning. For example:

		Arrival time	*Clearance time*
Serial 1.	Foot troops, 31st Inf Div.	2312	0006
Serial 2.	Motor elements, 31st Inf Div.	0052	0110
Serial 3.	Div trains, 31st Inf Div.	0125	0155

(*b*) In scheduling successive movements of mixed elements over a dispatch route, time sequence serialization is used by the highway regulation office. An example might be:

	Arrival time	Clearance time
Serial 1. 1st platoon, 345th Trk Co.	0620	0630
Serial 2. 125th Artillery Battalion.	0646	0702
Serial 3. Foot elements, 31st Inf.	0723	0901

(3) *Route designation serials.* Route designation serials are determined by the routes to be taken. This system can usually be used in conjunction with one of the above.

(*a*) For example, the commander of a tactical unit in planning a march of his command over various routes may fix the serial designation by route each element is to take.

Serial 1 (A). Foot troops, 31st Inf. Route A.

Serial 2 (B). Motor elements, 31st Inf. Route B.

Serial 3 (A). 31st Div, trains, hq units. Route A.

(*b*) Another example of route designation is found in the case of highway regulation personnel regulating movements over different dispatch routes of a highway network, as follows:

Serial A–1. Route A. Truck Plätoon, 345th Truck Company.

Serial A–2. Route A. 125th Artillery Battalion.

Serial A–3. Route A. Foot elements, 31st Inf.

Serial B–1. Route B. 345th Truck Company (less one truck platoon).

c. The method for using serial designations in connection with the preparing of march graphs and tables is covered in paragraph 62.

Section III. ELEMENTS OF MOTOR COLUMNS

44. THE MAIN COLUMN

a. Every motor column is made up of three internal parts: a head, a main body, and a trail. In the case of a small column, including small march units within a column, the functions of the three parts may be combined, but are nevertheless present. For example, a convoy may be as small as two vehicles moving together under one commander. In such small movements, both vehicles are usually task vehicles carrying loads and constitute the main body, but the first vehicle driver or commander performs the functions of the head, and the second vehicle driver or commander, those of the trail.

(1) *The head.* The first element of the column in order of march or advance is the head. The column commander or his representative controls from the head.

(2) *The main body.* The principal element of the column is the main body. In a motor column it consists of all vehicles exclusive of the column head, trail and control ve-

hicles consisting primarily of the task vehicles carrying the bulk of the cargo or troops within the column.

(3) *The trail.* The last element of the column is the trail. It consists of aid, maintenance and trail control vehicles.

(4) *Detached parties* (*advance and follow-up*). Though detached parties are not a part of the main column and operate apart from it, they are detailed to meet special duties such as quartering or reconnaissance (pars. 90 and 91). These parties are provided only when the situation requires them. In some tactical situations, advance, flank, or rear guards may be required.

b. The simplest type of column will consist of only a head, main body, and trail with the functions of advance parties and follow-up parties falling to the head and trail respectively; whereas, in large and more complex columns, the main body may be broken down into smaller elements containing their own head, main body, and trail functions, and the detached parties may be grouped for performing separate and distinct functions.

c. The commander of a motor column should be free to go wherever he may be required to supervise the proper movement of his unit, but he should have supervisory officer and/or noncommissioned officer personnel so located within the column as to best assist him in march control.

(1) *Command.* Command may be located anywhere.

(2) *Control.* Control extends throughout the column, including every officer and noncommissioned officer.

45. THE HEAD

A lead vehicle will contain the commander or an officer or noncommissioned officer who represents the commander of the marching unit for the purpose of meeting such problems as occur at the head of the column—for example, correctly following the prescribed route, checking in at scheduled points, receiving any orders or changes in orders, and issuing such instructions as may be required. A lead vehicle should also contain a pace setter who sets the speed of the column so as to assure conformity with prescribed rates of march. The pace setter normally rides in the slowest vehicle in the column. He may ride in a vehicle which is not the slowest, but in such case he sets the pace according to that of the slowest vehicle.

46. THE MAIN BODY

The main body is that portion of the column intended to perform the basic mission of the unit. It includes the bulk of the task vehicles, that is, those vehicles actually carrying or intended to carry troops or supplies. In large movements the main body may be subdivided into two or more march units, each having its own organization of head, main body, and trail and moving under the orders of a subordinate commander.

47. THE TRAIL

The last vehicle, or vehicles, of the main column contains one or more officers or noncommissioned officers who represent the commander of the marching unit for the purpose of meeting such problems as occur at the trail of the column; for example, prevention of straggling, maintenance of discipline, checking final clearance of the column with scheduled points, march maintenance, medical aid, and various other functions. The trail officer is in a position to observe anything that has gone wrong with the column and to take such action as may be required.

CHAPTER 4

MARCH PLANNING AND PLANNING AIDS

Section I. RECONNAISSANCE AND PLANNING

48. RECONNAISSANCE

a. Reconnaissance is a directed effort for useful information in the field. Reconnaissance is characterized by the type of information sought, as in engineer reconnaissance, and by the method of seeking it, as in photographic or air reconnaissance.

b. Reconnaissance in connection with motor movements is undertaken for the purpose of gathering information on which to base plans or, during the course of movements, to assure their safe and successful completion. Reconnaissance is always required before planning a march but in many cases will have been accomplished by others and need not be done by personnel of the marching unit. Basic information on which to plan a march is usually available from maps, prior knowledge, and information furnished. In the zone of interior, in the communications zone, and often in the rear areas of the combat zone, routes will be found to be well-signed and traffic personnel will be available to give directions and other information regarding the route and conditions to be encountered thereon, but even then limited personal reconnaissance may be desirable.

49. PLANNING

a. Every motor march and convoy should be organized along a previously prepared plan. In some cases, such a plan may merely tell where to go, what vehicles to use, the route to take, and when to start. Such simple plans may require only a moment's thought and an oral order. In other cases, extended study and detailed written orders from different echelons of command are necessary to assure an efficient movement. In every case the planning should be limited to that needed for efficient accomplishment of the mission. Overplanning and oversimplification of plans should be avoided.

b. When highway movements are regulated, the coordination and most of the planning are performed by the appropriate staff. In such cases, planning by convoy and march unit commanders is normally confined to that necessary to assure that the unit complies with orders issued and that it marches in an orderly, systematic manner under the instructions received.

c. However, if a unit is given an order to move and a plan has not been furnished by higher command, details as to the move must be worked out by the unit command. When there is any possibility of producing serious conflicts with other traffic, organization commanders making a march on their own initiative should give advance notice of time of movement and routes to be used in order to obtain proper authority.

50. PLANNING AIDS

a. An adequate background for plans for marches and convoys requires a knowledge of appropriate intelligence, maps, and symbols; the preparation and use of march graphs; the recording on march tables, of appropriate data as required, all of which must result in the promulgation of clear, concise, and complete orders.

b. The march graph is an important aid in preplanning and to recording marches in progress. It is explained in detail in paragraphs 57–63 and applied to various types of marches throughout the manual.

51. PRELIMINARY MARCH DATA

a. The march planner, having certain basic data, may determine by simple arithmetic additional information which he may desire in regard to a movement.

b. Normally, the planner will know the number and types of vehicles in the column; from where to where the convoy must travel; and when it should arrive. He can determine from his map the number of miles it must travel, and from his schedule the number of hours it should require. By dividing miles by hours he can determine the rate of march vehicles must maintain to meet the schedule. If he knows something of the road conditions and the skill of his drivers he can make a reasonable estimate as to safe driving distances, the positions vehicles should maintain within the column, and how his march units will be formed.

c. However, march conditions vary, and the information available and that which the planner must determine will also vary. The planner should, first of all, list the available information, for example:

(1) *What?* The task or mission to be accomplished.

(2) *Where?* From where to where the movement must be made.

(3) *When?* By when the task or mission must be completed.

(4) *How?* The equipment that will be required.

d. The commander of a small march unit might answer the above questions as in the following example:

(1) *What?* To move a platoon to a new station.

(2) *Where?* From point A to point B.

(3) *When?* To arrive at B before 1800 hours this date.

(4) *How?* In 3 trucks organized in convoy formation.

e. In such a small movement very little additional information may be needed and, even if required, factors are easily derived by asking, for example:

(1) *How soon?* Immediately. It is now 1300 hours.

(2) *How far?* Point B is 100 miles away. (*Road distance.*)

(3) *How long?* By 1800 hours gives the unit 5 hours to complete the movement. (*Time distance.*)

(4) *How fast?* The convoy must maintain an average of 20 miles per hour in order to

complete the move within the prescribed time. (*Rate of march.*)

f. The larger and more complex the movement the more complete and detailed must be the planning. If the movement is scheduled over a dispatch route, exact data as to road space allocated, the time space allowed, and the other factors of lead, gap, length, in both time and space may be required to be known. The rate of movement necessary to meet the point by point schedule, within the limitations of the other factors, and as limiting them, must be determined. For example, the planner may begin by asking the following questions:

(1) *In regard to the mission.*

(*a*) What is the tactical or administrative purpose of the march?

(*b*) What special measures or arrangements are necessary to assure the accomplishment of the mission or task?

(*c*) What is the load the movement must transport either in troops or cargo or both?

(2) *In regard to the march formation.*

(*a*) How many vehicles or units, and of what types, will be needed?

(*b*) How should they be dispatched or grouped for movement? What should be their relative positions in the column, their spacings both in time and distance.

(*c*) How fast can the move be accomplished after consideration of maximum allowable speeds of vehicles and their average running times? How will this rate of movement affect the march organization?

(3) *In regard to the route to be traveled.*

(*a*) Where will the convoy load; where will it assemble; what will be the exact route it should follow; and to where should it move and, if necessary, disperse? How far must the convoy move to its ultimate destination?

(*b*) When should the march begin and when should each subordinate element enter the route and pass each important point on the route in order to arrive at the prescribed time? How often will halts have to be made and what effect will they have on the rate of march.

(*c*) How will traffic or roadway conditions possibly affect or alter the plans while the march is in progress?

g. Normally, the march planner will have or be supplied information with which to answer such questions. March formulas are the means by which he applies the known data to secure other information. However, march formulas are only one aid to the march planner in evaluating his mission and in gathering information which the commander may desire in regard to the march. They should be used together with march graphs and other aids suggested herein.

Section II. RATE, TIME, AND DISTANCE FACTORS

52. TIME AND DISTANCE FACTORS IN MOVEMENT (fig. 10)

a. Before movements can be effectively planned and executed, commanders must understand time and distance factors and their relationship to each other.

b. The relationship between distance (space) and time is the basis for all march planning. Examples of corresponding factors are as follows:

(1) Those pertaining generally to elements within columns:

Length	*Time length*
Gap (*distance*)	*Time gap* (*time interval*)
Lead	*Time lead* (*headway*)

(2) Those pertaining generally to the column on the route:

Road space	*Time space*
Road distance	*Time distance*
Road clearance distance	*Road clearance time*

53. DISTANCE FACTORS

The distance factors of a march are usually expressed in miles, yards or feet.

a. The length of any column or element of a column is the length of roadway which it occupies, measured from front to rear inclusive.

b. Road space is the total length of roadway occupied by a column, or element thereof plus any space in addition to the length, which may be required as safety factor or to maintain flexibility.

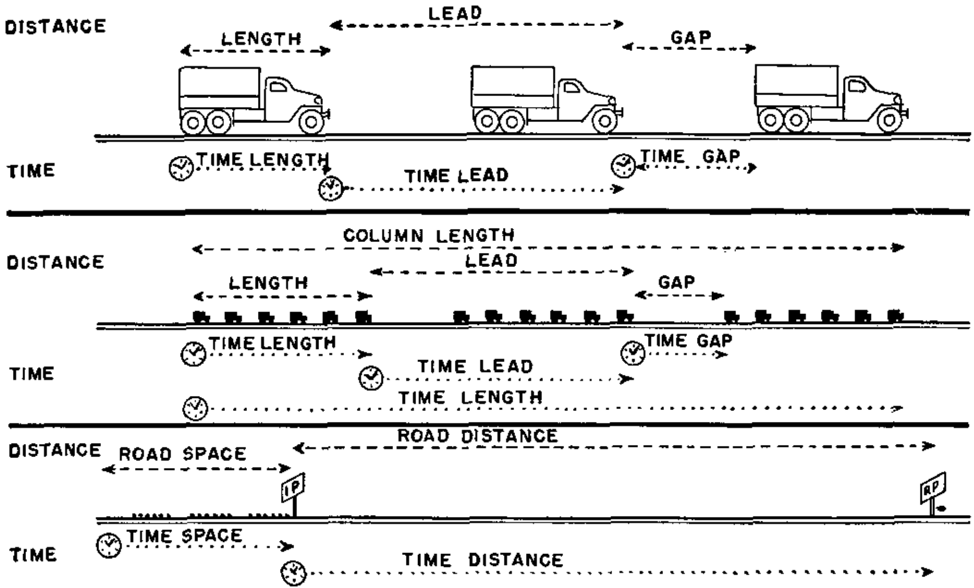


Figure 10. Space and time factors illustrated.

This extra distance allows for a safety factor and for mobility in planning marches. For example, a column of three serials, each 1 mile in length, with one-half mile gaps between serials, and a one-half mile gap to the next column would have a *length* of 4 miles but a road space of 4½ miles.

c. Gap is a term used to designate distance between successive vehicles or elements in a column or between successive columns as measured from the rear of one element to the front of the following element.

d. Lead in highway operations is the linear spacing between the heads of elements in a column or between successive heads of successive vehicles, serials, march units or columns.

e. Road distance is the distance from point to point by road, usually expressed in miles.

f. Road clearance distance is the total distance the head of a column must travel for the entire column to clear a given section of a road.

54. TIME FACTORS

a. Time factors are used to clock the relative positions and passage of elements of a march and are expressed in seconds, minutes, or hours.

b. It is easier to understand and appreciate the value of time factors if it is kept in mind that each is related to a corresponding factor of distance.

(1) Time length is the time required for a column, or element thereof, to pass a given point.

(2) Time gap is the period of time measured from rear to front between successive vehicles or elements as they move past any

given point. This time is measured from the instant the rear of one unit clears the point to the instant the front of the next unit reaches it.

(3) Time lead (headway) is the period of time between individual vehicles or elements in a march measured from head to head as they pass a given point.

(4) Time distance is the time required to move from one point to another at a given rate of speed.

(5) Time space is the time consumed by a column, or element thereof, while proceeding past any point en route. It includes the time gaps between subordinate elements and additional time necessary for safety and to maintain flexibility.

(6) Road clearance time is the total time a column or element thereof requires to travel over and clear a section of road. It is usually clocked between the time at which the head of a column enters a given stretch of road and the time at which the tail of the column clears that stretch. Road clearance time equals time distance plus the time length of the column; and is the road clearance distance of a moving element expressed in minutes or hours.

55. RATE OF MOVEMENT

a. Movement is measured by a ratio of distance and time generally expressed as miles per hour.

b. Often no exact distinction is made between terms expressing rate of movement; however, the following distinctions are helpful to march planners:

(1) Speed is the actual rate at which a vehicle, or vehicles, is moving at a given time, normally expressed in miles per hour according to the speedometer reading.

(2) Pace is the regulated speed of a column or element as set by a lead vehicle (the pace setter). It undergoes constant adjustments due to terrain and road conditions as different sections of road are passed over.

(3) Rate of march is the average number of miles traveled in any given period of time, including short periodic halts and other short delays. This rate is expressed as miles in the hour.

c. An example of how these speed factors differ is illustrated thus:

(1) A convoy is traveling at a maximum speed of 40 miles per hour.

(2) Its pace is adjusted by the pace setter between 20 and 40 miles per hour for an average pace of 30 miles per hour.

(3) During the first 5 hours of travel, it makes short halts totaling 1 hour, which reduces its rate of march for the entire trip to 24 miles in the hour.

56. BASIC MARCH FORMULAS

a. *General*. There are three basic march factors: distance (D) rate (R), and time (T). When two of the three factors are known, the third can be found by simple arithmetical equation expressed by the formulas:

(1) $R = \frac{D}{T}$ (*rate* equals *distance* divided by *time*).

(2) $T = \frac{D}{R}$ (*time* equals *distance* divided by *rate*).

(3) D=R x T (*distance* equals *rate* multiplied by *time*).

Any of the distance factors—length, gap, lead, or road distance—may be substituted in the equation if the corresponding time factors are also substituted. Corresponding units of measure must be used throughout.

b. Determining Rate Factors. Examples:

(1) Rate (yards per minute) = length (yards) ÷ time length (minutes).

(2) Rate (miles per hour) = road distance (miles) ÷ time distance (hours).

c. Determining Time Factors. Examples:

(1) Time length (minutes) = length (yards) ÷ rate (yards per minute).

(2) Time lead (minutes) = lead (yards) ÷ rate (yards per minute).

(3) Time space (hours) = road space (miles) ÷ rate (miles per hour).

(4) Time distance (hours) = road distance (miles) ÷ rate (miles in the hour).

d. Determining Distance Factors. Examples:

(1) Gap (yards) = rate (yards per minute) × time gap (minutes).

(2) Lead (yards) = rate (yards per minute) × time lead (minutes).

(3) Distance (miles) = rate (miles in the hour $\times$ time distance (hours).

e. Conversions. Factors may be converted into others of the same class (distance, rate or time) by arithmetic.

(1) Length + gap = lead.

(2) Time length + time gap = time lead.

(3) Distance (miles) $\times$ 1760 = distance (yards).

(4) Time (hours) $\times$ 60 = time (minutes).

(5) Rate (miles in the hour) $\times$ 30 = approximate rate (yards per minute.)

f. Formulas Containing Conversions. Examples:

(1) $$\text{Time length (minutes)} = \frac{\text{length (miles)} \times 60}{\text{rate (miles in the hour)}}$$

(2) $$\text{Rate (yards per minute)} = \frac{\text{distance (miles)} \times 30}{\text{time distance (hours)}}$$

Section III. THE MARCH GRAPH

57. DEFINITION AND USE

a. A march graph is a time-space diagram used in planning, and controlling both foot and road marches, and in preparing or checking march tables.

b. The march graph affords an easily used device for visual presentation of movement so that conflicts and discrepancies may be prevented in the planning stage before congestion occurs on the route.

58. APPLICATION

March graphs may be applied to an individual vehicle, to a small unit, to movement of a single column, or to a large organization scheduling separate elements, moving by various means, with different rates of march, over one or different routes. In the operational stage, march graphs are useful in recording the progress of serials to determine what action may be necessary if diversion is ordered or to avoid conflicts if schedules are not maintained.

59. MAKING A MARCH GRAPH

The following preliminary steps are included in the preparation of a march graph:

a. First Step. Analyze the route on the map. Note important points such as cities, towns, road junctions, bottlenecks, etc. to be passed through, and indicate the distances between major points along the route (fig. 11).

b. Second Step. Select graph paper with a sufficient number of squares to plot distance and time involved. Across bottom, left to right, place scale of time. Up left side, from bottom to top, place scale of distance (fig. 12).

c. Third Step. Project route on graph. Names of towns, intersections, highway regulating points, and traffic control posts are plotted at proper distances along distance scale. This may be in the form of a diagrammatic strip map (fig. 12).

60. INDICATING THE MOVEMENT

a. Schedule of the Head of the Column. If the origin and destination, rate of march, and time of departure of a movement are known, the head of the column may be scheduled as follows:

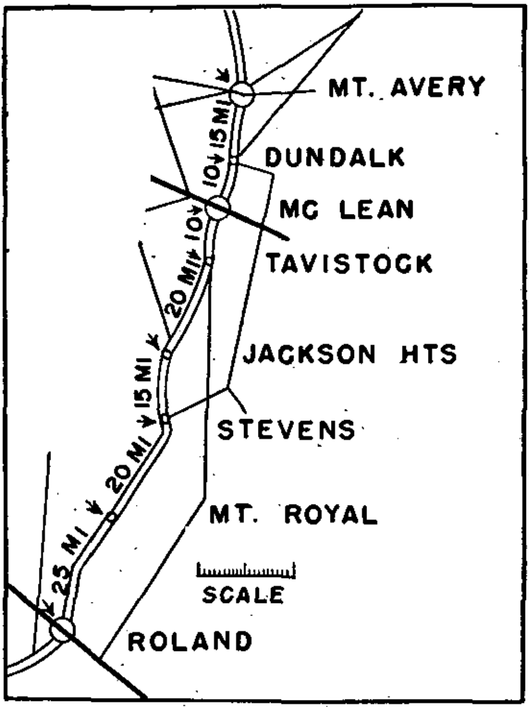


Figure 11: The route.

(1) Assume that a unit is to march from Mount Royal (at 25 miles on the vertical scale) leaving at 0700 hours and proceeding at the rate of march of 15 miles in the hour to a point 5 miles beyond Tavistock (at the 85-mile mark on the vertical scale). The distance is 60 miles (85 minus 25). At 15 miles in the hour, it will require 4 hours to cover the 60 miles (fig. 12).

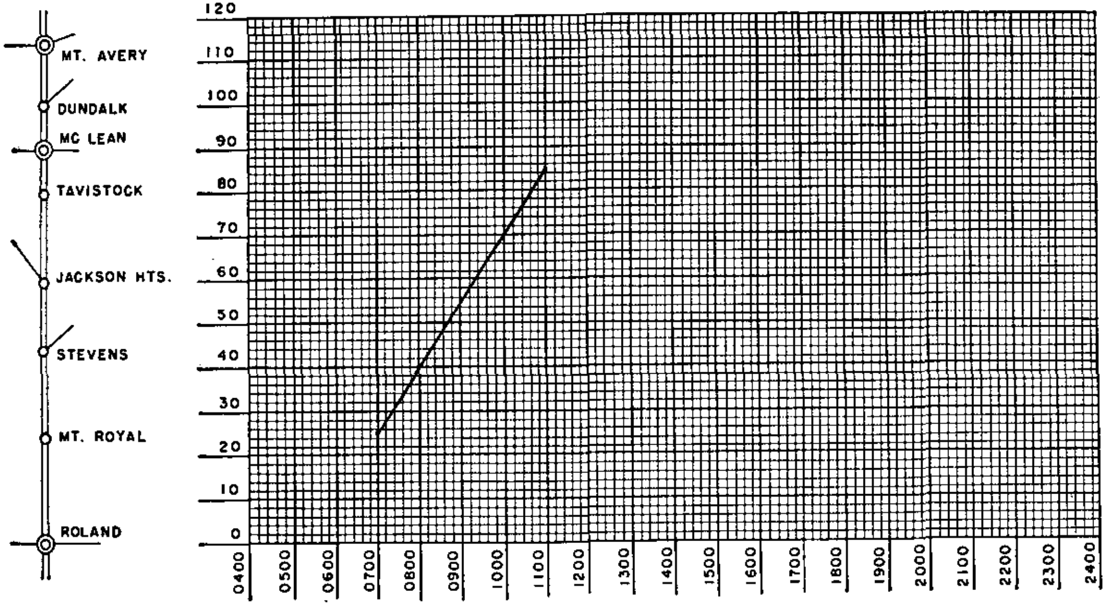


Figure 12. Schedule of the head of the column.

(2) A dot is placed at the point where the line representing the place of departure (Mount Royal at 25 miles on the vertical scale) intersects the line representing the hour of departure (0700 hours on horizontal scale).

(3) A second dot is placed at the point where the line representing the destination (5 miles past Tavistock at the 85-mile mark on the vertical scale) intersects that of the hour of scheduled arrival of the head of the column at destination (1100 hours on the horizontal scale or 0700 plus 4 hours).

(4) A straight line connecting these two points shows the schedule on which the head of the column should reach any point en route.

b. Time the Column Must Start. If it is desired to determine what time the column must start to complete a movement and arrive at the destination at a certain hour, the above procedure is reversed.

c. Schedule of the Tail of the Column. Unless the unit is very small, it is usually desirable to show the schedule of the tail of the column as well as the head. After charting the schedule of the head, the tail may be scheduled if the time length of the column is known or computed (fig. 13). Assuming that the time length of the column is thirty minutes; a line drawn from the point representing the clearance of the column at origin (0730 hours) and at the destination (1130 hours) will show the schedule of the tail of the column past all points en route.

61. ANALYSIS OF THE GRAPH
(fig. 13.)

Length, time length, rate of march, and other factors are clearly indicated on the completed graph and may be determined as follows:

a. Length of the Column. A vertical line connecting the head and tail lines, measured by the scale of miles, will show the planned length of the column on the road at the prescribed rate of march at any hour during the movement. For example, when the head of the column is at Stevens (45 miles on the vertical scale), the tail will be approximately at the 38-mile mark.

b. Time Length. A horizontal line connecting the head and tail lines, measured by the scale of hours, will show the planned time length of the column as it passes any point on the road. For example, if the head of the column arrives at Tavistock at 1040 hours, the tail will not clear that point until half an hour later at 1110 hours.

c. Rate of March. The diagonal line of the graph indicates the rate of march of the movement. For example, the distance (mile scale) between the intersection of the diagonal line with any two vertical lines (time scale) indicates the miles per *that* hour (15 miles in the hour on the illustration).

d. Other Factors. Road distance, time distance, etc., may also be deduced from the graph. Examples are shown in figure 13.

62. MULTIPLE MOVEMENTS ON A GRAPH

a. A number of serials or columns over the same route can be scheduled by use of a march graph. This

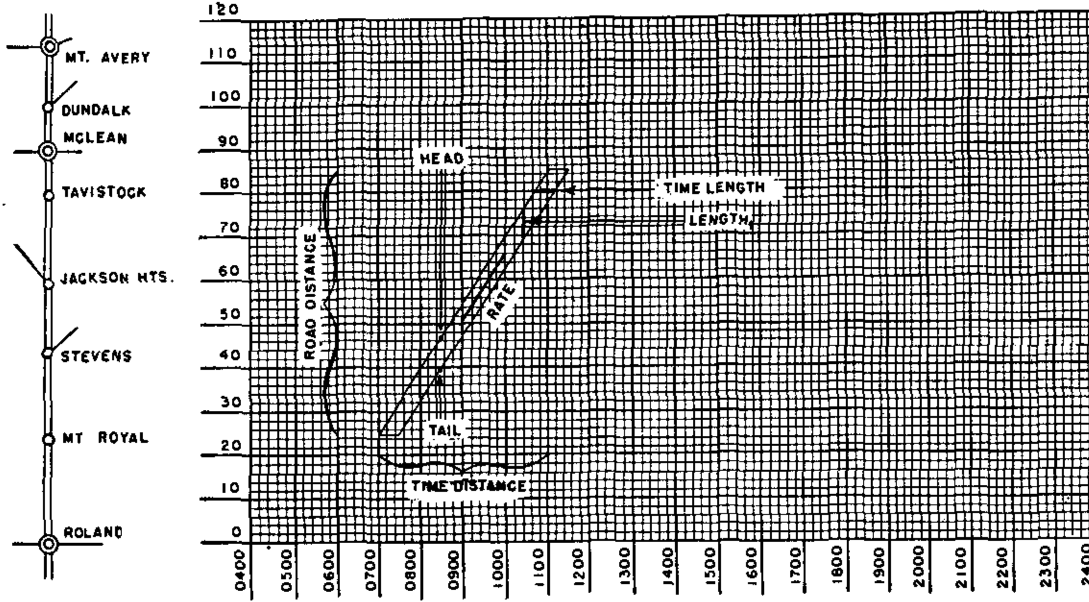


Figure 13. Analysis of major factors of the graph.

is particularly useful in scheduling successive elements of a command or in planning and recording the progress of many movements over a heavily traveled route. It helps prevent conflicts and delay and assists in altering schedules to realize new priorities or to meet changes in the tactical situation.

b. Figure 14 shows a number of serials of different compositions, speed, and size starting from various points and with various destinations. The scheduling of a number of movements over the same route within a definite limit of time requires careful planning and strict adherence to the prescribed schedule by movements in progress. A reasonable margin of safety between serials should be allowed to compensate for minor failures to adhere to schedules. Thus, in figure 14, serials A, B, C, D–1, D–2, D–3, E, and a lateral movement have been scheduled so that no conflicts will arise if the movements are made as planned.

c. The commander of a large unit or the highway regulation officer concerned can keep accurate record of the whereabouts of each serial by having information telephoned, teletyped, or telegraphed as each serial reaches or clears highway regulation points established along the route of march. As the information is received, the progress of serials on schedule may be indicated by filling in the space between the lines representing the scheduled head and tail of each column with color, tape, or in various other ways. Deviations from schedule may be indicated by similar means. This enables the headquarters concerned to see at a glance the location of each serial, to follow the progress of each movement, to correct situations

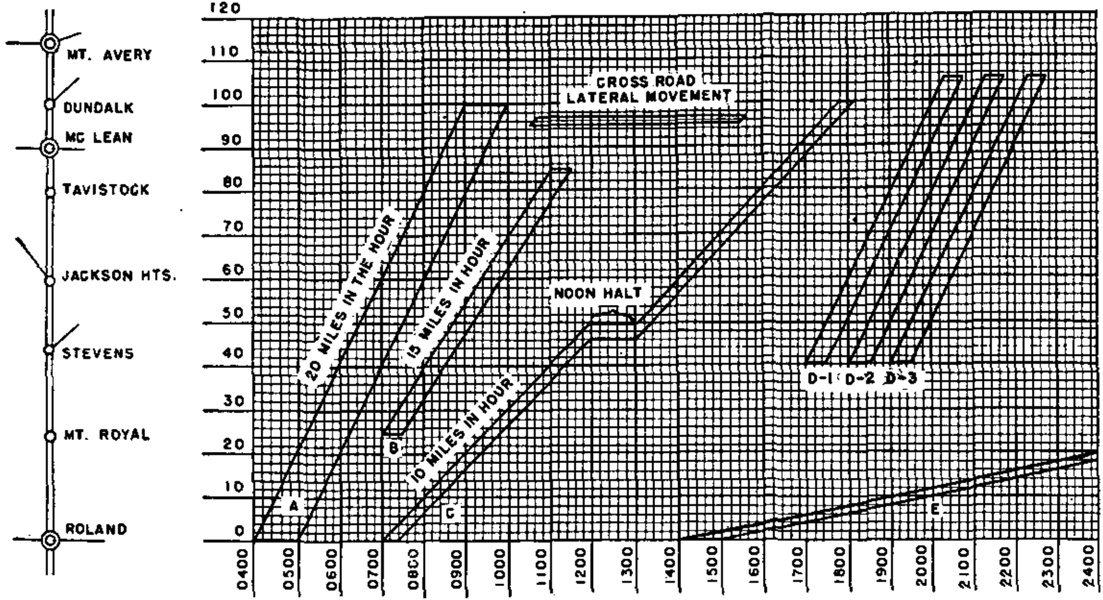


Figure 14. Scheduling a number of columns over a route.

which may cause congestion and delay, and to know where each serial can be reached in order to issue new orders if the situation demands.

d. Colored pencils, crayons, ink, or adhesive tapes may be used for indicating various schedules, the relative priority of movements, or in plotting movements in progress. For example, the head and tail schedule may be outlined by black lines, progress of each serial may be filled in with green, and failures to adhere to the schedule may be shown in red. When a conflict is indicated, decision can be made as to the action to be taken—for example, to pull an off-schedule serial off the road so that it will not upset the entire schedule for the route or, if priorities or the tactical situation so require, to revise the entire schedule.

e. Figure 15 shows the plotted progress of serials scheduled in figure 14. Note that a number of changes and adjustments in schedules had to be made. This is what happened:

(1) *Serial A.* Went through as scheduled.

(2) *Serial B.* Change in orders required that serial B continue on to Dundalk. It continued on schedule and the head of the column arrived at its new destination at noon.

(3) *Lateral Movement.* Due to change of orders for serial B, arrangements had to be made to hold the lateral movement at McLean. It made its noon halt and crossed the route 3 hours behind its original schedule and did not clear until 1830.

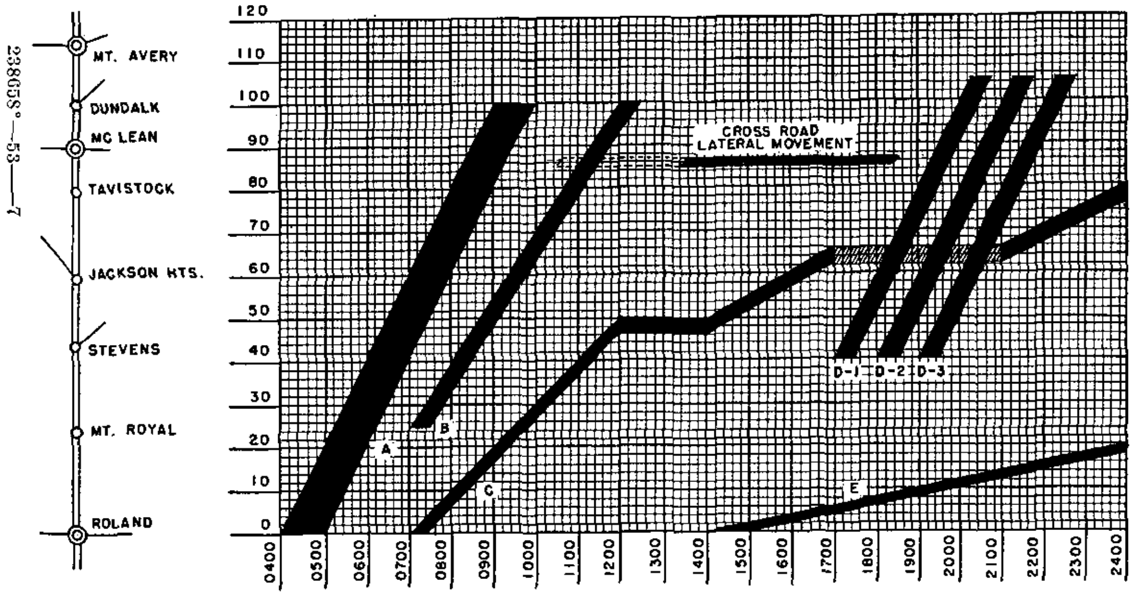


Figure 15. Deviations from schedules.

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(4) *Serial C.* At 1200 it became obvious that if serial C continued on schedule, it would conflict with the delayed lateral movement at about 1730. Serial C had also lost its priority because of arrival of serial B at Dundalk with critically needed supplies. Therefore, serial C was halted for 2 hours (1200 to 1400). It continued at a slower rate of march until 1700 when it was halted again to let serial D pass.

(5) *Serial D* (*D–1, D–2, D–3*). All elements went through on schedule.

(6) *Serial E.* Foot column completed its march according to schedule.

f. In the above examples it has been possible to make adjustments on the graph as they became necessary. If more extensive changes had been required necessitating an entirely new schedule, a new march graph would have been prepared.

63. ADDITIONAL USES OF MARCH GRAPHS

March graphs have many uses in analyzing, recording, and studying vehicular and other traffic over routes. They may be devised to indicate:

a. Position of various mixed traffic on a route at a particular time.

b. Scheduled passing of various elements of traffic at a particular point.

c. Conflicts between various elements of traffic such as occur at junctions, intersections and at bottlenecks such as bridges and defiles.

d. Deviations of columns from prescribed schedule, making it possible to anticipate conflicts before they occur.

e. Reversing directions of march either by simultaneous turn of all elements of a column or by circling about.

f. Two way traffic over a route and alternating traffic through defiles.

g. Variations in actual running speeds and in the traffic flow and traffic density of a route.

CHAPTER 5

MARCH PRINCIPLES AND METHODS

Section I. MECHANICS OF COLUMN MOVEMENT

64. GENERAL

a. Make-up of Columns. March units should be small enough to assure adequate march control. A march column should be composed of vehicles with similar march characteristics, even if this requires the temporary separation of a unit into two or more columns. However, this may not always be practical as tactical considerations may demand that a column be arranged so as to be ready to fight, and therefore be composed of vehicles of widely different march characteristics. Even in a uniformly constituted column, there will be variations in performance ability of vehicles due to mechanical differences. Hence, it is usually desirable to place the slowest vehicle at the head of the column as the pace setter.

b. Speed and Length Variance Within Columns. Theoretically, it is possible for the vehicles in an entire motor column to move simultaneously at the same speed and to maintain exact positions in relation to the rest of the column. Practically, however, a column of any size will cover simultaneously many diverse stretches of terrain; hills, sharp curves, dust, and varying road surfaces will have their effect. The result is that different parts of a large column, regardless of traffic conditions and vehicle performance characteristics, move at different speeds and at different distances from each other. This produces accordion-like action, and on a long hill or a bad stretch of road, serious difficulties may result if this action is not controlled. On the approach side of the slow stretch, vehicles will tend to close up successively as the head is retarded in speed. On the far side, as the lead vehicles regain speed, the others will tend to spread out successively causing the column to become elongated. This means that—

(1) As speed of the head of a column decreases, intervehicular gap (and lead) tends to contract.

(2) As speed of the head of a column increases, intervehicular gap (and lead) tends to expand.

c. Solution to the Problem of Column Movement at Varying Speeds. In actual practice during the movement of a column some flexibility (accordion action) is unavoidable and desirable. It is an added safety feature to have vehicles maintain greater gaps at higher speeds and to adjust their speeds and gaps as they pass over various sections of road. The ideal type of column movement is such as to permit each vehicle to pass over any given stretch of road at the same speed as the pace setting car passed over it. This ideal can be approached by varying intervehicular gaps or leads so as to produce constant time leads (headways) throughout the column and constant column time length at all speeds.

(1) Gaps and speed should be related so that as speed increases or decreases a corresponding increase or decrease in gap (or lead) will

result in relatively constant intervehicular time lead.

(2) Constant time lead throughout a march results in constant time lengths which are necessary to assure that if the head of a column is on schedule at any point its tail will clear that point at the scheduled time.

65. COMPARISON OF METHODS

a. Various Methods. Speed and space variance within columns should be controlled to the extent that will assure maximum flexibility and safety, and minimum chance of interference between vehicles and disruption of the column. Depending on the type of march and the degree of control desired, columns may be conducted according to one of the following methods:

(1) The governed method, in which speed and spacing are constantly adjusted to meet changing road and traffic conditions.

(2) The casual method, in which, subject to proper limitations, speed and space variance is left much to the discretion of the driver.

(3) The fixed method, in which an attempt is made to maintain the same distances regardless of variations in speed.

b. Governed Method. If the gaps between vehicles are governed in a manner that will allow for gradual "closing" on a slow or uphill stretch and for gradual "opening" on a fast or downhill stretch, the accordion action can be regulated to an advantage. This is accomplished by maintaining relatively constant intervehicular time leads (headways). The nearer the approach to constant headways throughout the column, the nearer will be the approach to the ideal type of column movement. Time length will remain the same throughout the movement and schedules can be better met by all elements of the column. In general there are two different methods of maintaining constant headways:

(1) *Flexible lead.* In this method the gap (and consequently lead) between vehicles is made to vary in proportion to the speed of the vehicles. It is often termed the "speedometer multiplier" method. The common way of applying it is to note the speedometer reading, multiply it by a designated number (2, 3, or 4), and then take the result as the number of yards gap to be maintained. It may also be applied as the "vehicle length" method in which the driver is simply told—

"At 10 mph follow at 3 truck lengths,
"At 20 mph follow at 6 truck lengths,
"At 30 mph follow at 9 truck lengths, etc." (Which is approximately the same as SM 3.)

Due to drivers' errors in estimating distances, speedometer multiplier and vehicle length methods are subject to inaccuracies. To make it easier for the driver these methods are normally used to determine gap rather than lead. For planning purposes these methods may be used to determine lead rather than gap.

(2) *Constant time lead.* Another method is to estimate and maintain time lead (headway) directly instead of estimating gaps based on speed. In this method time lead is computed by reckoning the period of time required for a vehicle to occupy the position just vacated by the preceding vehicle. It is normally accomplished by a cadence count using a telephone pole or some other common road object as the mark on which to base the position of successive vehicles making the count. It relates time lead (headway) directly to lead and is perhaps the more advantageous method when drivers have been properly trained to apply it.

c. Casual Method. In the casual or "follow me" method, good drivers, practiced in other methods of column marching, are able to judge the speed and spacing of their vehicles necessary to keep a small column intact. Under such conditions the casual method becomes, in effect, a governed column. However, if the column is large, the road conditions variable, or the drivers lacking in experience, this method is inadequate and may lead to serious disruption of the column. *The aim of training should be to teach drivers to so apply the governed methods that they need not apply them in normal operations, and may thus operate casually with the same natural results of governed methods.*

d. Fixed Method.

(1) If fixed intervehicular leads or gaps are maintained by a column, it causes vehicles to operate at reduced speed when it is un-

necessary to do so, and an abnormal flow over various sections of road results. As soon as the first vehicle begins to ascend a hill or hits any slow stretch and must reduce speed, every other vehicle in the column, although not yet having reached the slow stretch, must simultaneously reduce its speed to that of the first vehicle. The slow movement must continue throughout the column until every vehicle has completed its ascent of the hill or passed through the slow stretch. When the first vehicle has cleared the slow stretch, and could otherwise proceed at the normal fast speed, it must continue at the reduced speed until the last vehicle of the column has cleared the slow stretch in order not to extend the fixed distances.

(2) The latter is difficult because in a long column it is often impossible for the officer in the head vehicle to know when the tail vehicle has cleared the slow stretch. It is obvious that the effect varies in relation to the size of the column. In the case of a very small column the effect is negligible. In a large column it may be serious.

(3) In a fixed column vehicles are forced to drive at abnormally slow speeds over good stretches of road for a distance equal to approximately twice the length of the column every time a slow stretch is encountered, that is, once as soon as the head vehicle hits the slow stretch, and again from

the time that the head vehicle clears the slow stretch until the last vehicle has cleared it.

(4) The length of an exact fixed column remains constant but the time length varies each time the speed is changed. This is especially troublesome in long columns running on set schedules, and is usually undesirable except for short marches over good routes and for parade formations.

66. THE SPEEDOMETER MULTIPLIER (SM)

a. The common method for giving drivers a practical means of maintaining approximately constant time gaps (and therefore approximately constant time leads) at all speeds, is the use of the speedometer multiplier. The speedometer multiplier is any number by which the speedometer reading in miles per hour is multiplied to determine distance in yards between vehicles. It should be realized that, while the use of a speedometer multiplier may be rather complex, the driver need only be able to multiply his speed by a small number and estimate the distance in yards with reasonable accuracy.

b. March commanders should understand how the use of the speedometer multiplier affects their march column and how, when used, the speedometer multiplier must be considered in computing march data.

c. March unit commanders may apply the speedometer multiplier principle through control of the gap between vehicles by signals. As the lead vehicle reaches a slow stretch, the pace setter signals the new gap to the second vehicle, and as each succeeding vehicle reaches the slow stretch, it relays the new gap to the vehicle behind it. Similarly, as each vehicle reaches the place where speed can be resumed, the increased gap is relayed to the following vehicle.

d. Figure 16 shows the effect of a slow stretch of road on a small governed column.

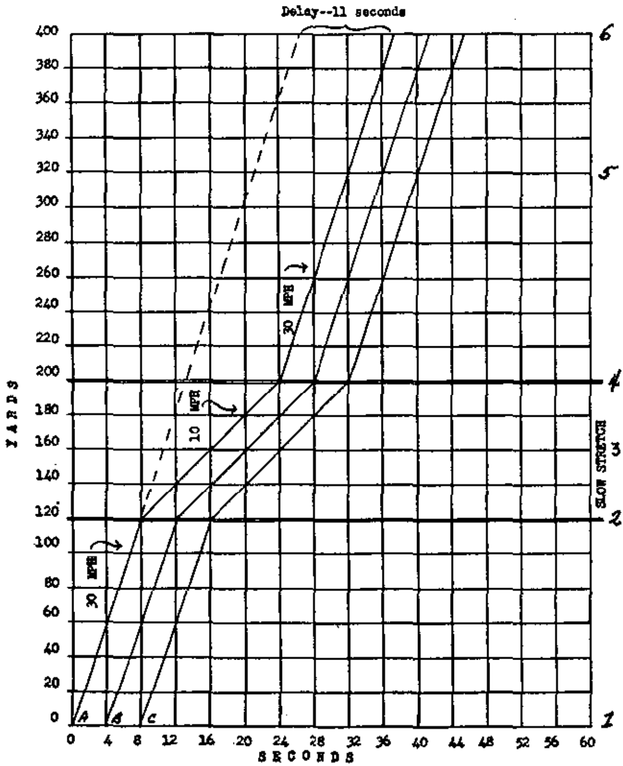

Figure 16. Effect of a slow stretch on a governed column (speedometer multiplier, 2).

(1) A convoy consisting of three trucks—A, B, and C— is proceeding along a route using a speedometer multipler of 2.

(2) Between points 1 and 2, the three trucks proceed at 15 yards per second (or approximately 30 miles per hour) with gaps of 60 yards.

(3) At point 2, truck A arrives at a hill or slow stretch necessitating a speed of 10 miles per hour. Trucks B and C do not take up the slower speed until arriving at point 2.

(4) Each truck negotiated the slow stretch at 10 miles per hour, closing up to an intervehicular gap of 20 yards. Although gaps are less, and the column length is less, at point 3 the time length (8 seconds) and the time gap (4 seconds) are the same as at point 1.

(5) At point 4, truck A arriving at a fast stretch resumes the 30 mile per hour speed. While truck B is continuing on the slow stretch for 4 additional seconds, truck A gains 40 yards additional gap on truck B. Truck C is similarly affected (20 yards+40 yards=60 yards. This is the correct gap with SM 2 (30 x 2=60 yards).

(6) As indicated in figure 16, the approximate delay due to the slow stretch of road was 11 seconds.

(7) It must be realized that the above effect does not work out exactly in each case, as change of speed is not instantaneous and drivers' estimates of gap are not exact;

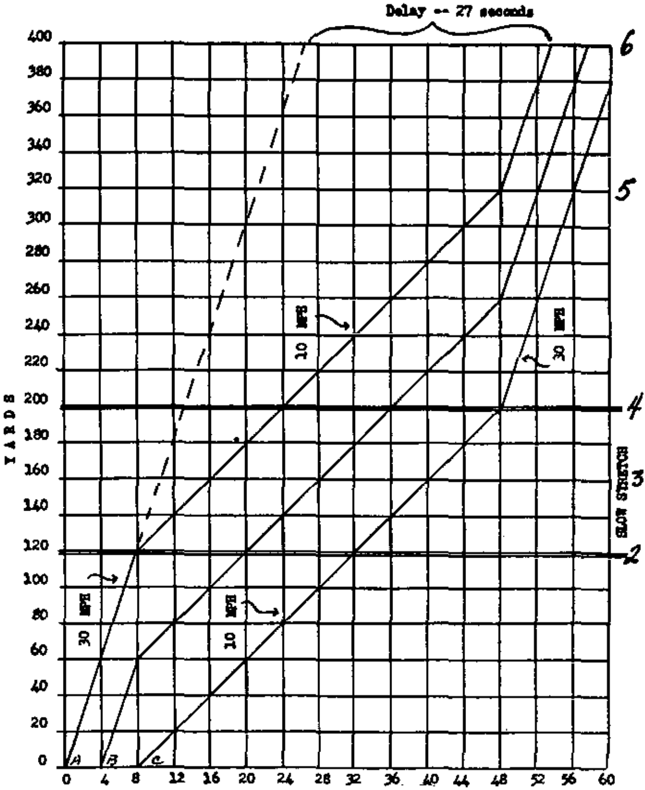

Figure 17. Effect of a slow stretch on a fixed column (inter-vehicular distance, 60 yards).

however, the accordion effect is controlled within practicable limits.

e. Figure 17 illustrates the effect of a slow stretch of road on a fixed column.

(1) A convoy consisting of three trucks—A, B, and C—is proceeding along the same route

as that shown in figure 16, but in lieu of a prescribed SM, the drivers of the trucks are to maintain fixed gaps of 60 yards.

(2) At point 1, each truck is traveling at 30 miles per hour, with a time gap of 4 seconds. In 8 seconds, truck A has proceeded 120 yards (on the vertical scale).

(3) At point 2, truck A arrives at a hill or slow stretch and assumes a speed of 10 miles per hour. Trucks B and C must take this slower rate to maintain a 60-yard gap.

(4) The three trucks traveling at abnormally long gaps for the reduced speed require 24 seconds to pass point 3 as compared with 8 seconds with SM 2 (fig. 16).

(5) Although truck A clears the slow stretch at point 4, to maintain the fixed 60-yard gap prescribed, it must continue at a speed of 10 miles per hour until both B and C clear the slow stretch.

(6) As illustrated in figure 17 the approximate delay due to the slow stretch of road was 27 seconds—more than twice the delay of a governed column over the same stretch of road. This may not be an important factor in a three-truck convoy but is an extremely important one in larger movements.

67. APPLICATION OF THE SPEEDOMETER MULTIPLIER

a. Determining the Speedometer Multiplier.

(1) The selection of a specific speedometer multiplier for any particular stretch of roadway

will ordinarily require a compromise between two conflicting requirements. It is often desirable to increase intervehicular gaps so as to avoid presenting a concentrated target to enemy aerial attack or to assure driving gaps between vehicles which will not only minimize the probability of rear end collision within the column but also permit faster-moving vehicles to enter the column while attempting to pass if another vehicle approaches from the opposite direction on a two-lane highway. On the other hand, it is often desirable to provide small intervehicular gaps in order to facilitate column control, decrease road space, or increase traffic flow.

(2) In selecting the speedometer multiplier, it is well to decide the minimum gap desired between vehicles. Since gap will vary directly as to speed, the stretch of road at which the slowest speed will occur is the one which governs insofar as assuming proper dispersion of vehicles is concerned.

(3) On the other hand, to cut the road space of the column to a minimum, the speedometer multiplier should be the smallest which will allow for safe driving. SM 1 would give 20 yards distance at 20 miles per hour, which corresponds roughly to normal civilian driving. However, though used under certain military circumstances, SM 1 is *not* considered safe for most marches. SM 2 is usually considered the most practical for close col-

umn formations. SM 2 would give 60 yards gap at 30 miles per hour or 20 yards at 10 miles per hour; either of these gaps is enough to permit an overtaking vehicle to pull safely into the column in case traffic in the opposite direction is encountered while attempting to pass the column. It is often advisable to prescribe a minimum gap beyond which vehicles will not close at the halt or while the column is proceeding very slowly.

b. Effect on Time Length.

(1) Subject to error in application, the time length of a column using a speedometer multiplier remains constant, while in a fixed column, it varies. For example, if a fixed column going 30 miles per hour with a gap of 60 yards between vehicles slows down to 15 miles per hour or half the original speed, with the same 60 yards between vehicles, road space would remain constant, but it would take twice as long for the column to pass a given point. If, however, a governed column were using SM 2 at 30 miles per hour the gap between vehicles would be 60 yards and when the column slowed down to 15 miles per hour or half the speed, the gap between vehicles would be 30 yards. Hence, the governed column while going at approximately half the speed would be roughly only half the length and would take the same time to pass a given point as if it had maintained its original speed.

(2) The speedometer multiplier used must not produce an intervehicular time gap greater than that required to maintain time length of columns within the limit prescribed by higher authority or to take up more road space than is available under orders of higher authority. If it becomes necessary or desirable to reduce the time length of a column while it is in motion, the column commander can indicate a smaller speedometer multiplier. When this is done, the head of the column should slow down until the tail of the column has been able to close up sufficiently to comply with the smaller speedometer multiplier. This time should be approximately equal to the desired reduction in time length.

68. USE OF THE VEHICLE LENGTH IN GOVERNING COLUMNS

a. The effectiveness of the speedometer multiplier is contingent upon the driver's estimate of distances. Unless drivers are properly trained in judging distances and impressed with the importance of maintaining proper gaps, the entire system becomes of little value. From the standpoint of driver application, the vehicle length may be used for estimating "sight" distances.

b. It is natural for a driver to think of distance in terms of the length of the vehicle he is operating or the other vehicles he is accustomed to in normal traffic. Every driver must be able to judge the space his vehicle requires in passing another or to let another pass or pull in ahead of him. He becomes a natural judge of vehicle length which he normally "sees" as roughly 10 yards. (The average military vehicle is actually only about 7 yards but in driving a space allowance of a few yards is made because vehicles are in motion.) Therefore, a gap of 10 yards may be termed one "vehicle length" and used as a basis for the speedometer multiplier by relating "vehicle lengths" to every 10-mile-per-hour change in speed. This may be done in such a manner as to simplify driver training.

(1) With SM 1 and at 10 miles per hour, the gap between vehicles will be one "vehicle length." This is usually regarded as a "close formation" and driver instruction for maintaining this formation might be briefly as follows: "We will march in close column formation. Stay *not more than* one 'vehicle length' from the vehicle ahead of you for every 10 miles per hour of your speed. When you increase your speed to 20 miles per hour stay two 'vehicle lengths'; 30 miles per hour, three 'vehicle lengths'; and so forth."

(2) With SM 2 and at 10 miles per hour, the gap between vehicles will be two "vehicle lengths." In the absence of factors requiring otherwise, this is the "normal column" and driver instruction for maintaining this formation might be briefly as follows: "We will march in normal column formation. Stay two 'vehicle lengths' from the vehicle ahead for every 10 miles per hour of speed.

When you increase your speed to 20 miles per hour stay four 'vehicle lengths'; 30 miles per hour, six 'vehicle lengths'; and so forth."

(3) With SM 3 and at 10 miles per hour, the gap between vehicles will be three "vehicle lengths." This, and more extended columns, will be referred to as the "open column formation" and driver instruction for maintaining this formation should be briefly as follows: "We will march in open column formation. Stay *at least* three 'vehicle lengths' from the vehicle ahead for every 10 miles per hour of your speed. When you increase your speed to 20, stay six 'vehicles lengths'; 30, nine 'vehicle lengths'; and so forth."

c. After drivers have become thoroughly accustomed to maintaining a governed flexibility within columns, it may be possible to drop all references to speedometer multiple methods. The various spacings for open, normal, and close column may become second nature to the extent that designating the type of march may be all that is necessary as prior instruction.

69. METHODS OF ESTIMATING DISTANCE

The vehicle length is one method of judging distances while driving. Some troops, especially those skilled in marksmanship, are able to estimate yards directly and need no additional training in depth perception. However, most drivers need practice in judging distances and should be taught the use of aids by taking some known space, like the distance between telephone poles or a certain number of pavement lines so as to observe how that distance appears under different conditions—at night, by day, at dusk, etc. This ability is an added safety measure which will help in many ways.

70. MAINTAINING TIME LEAD

a. One method of maintaining time lead is by counting at the rate of sixty to the minute or one per second, as "one thousand and one, one thousand and two, one thousand and three, etc." If the time lead between vehicles has been established as 4 seconds this means that upon completion of the above count "one thousand and four" the driver's vehicle should be at the position where the vehicle ahead was when he started counting. Each count would be approximately equivalent to a second's time lead.

b. If drivers are properly trained to apply it, this method of estimating time lead directly will provide more accurate results than the speedometer multiplier.

Section II. TYPES OF MARCHES

71. GENERAL

a. Military march organization does not imply that vehicles always move in column or convoy formation. In many instances such movement may be impractical in that it may not allow adequate dispersion in tactical employment or it may hamper other traffic over a route.

b. At the same time, individual dispatch may not provide the degree of control or the unit integrity necessary to carry out a military mission. Therefore, the type of march used is determined by the local situation, and decision as to the method used must be made by the commander.

c. To assist commanders in making such decisions, each of the various types is described and its respective advantages and disadvantages given.

72. THREE BASIC TYPES OF MARCHES

a. A Close Column. A close column is one in which the elements are formed as compactly as practicable in order to reduce road space and time length to a minimum. Vehicles follow at the least distance which safety, traffic conditions, and the tactical situation will permit. A close column may be governed or fixed.

b. An Open Column. In an open column the elements are spaced widely as a passive defense or safety measure. Vehicles maintain gaps sufficient to aid passive defense by affording reasonable dispersion. Gaps should also be adequate to permit overtaking vehicles to enter the column in case traffic proceeding in the opposite direction is encountered. An open column may be governed or fixed.

c. Infiltration. This march is accomplished by the dispatch of individual vehicles or small groups of vehicles over a specified route giving the appearance of casual traffic. Infiltration results in less disruption to other traffic than does the close column.

73. METHODS OF EXECUTION OF BASIC TYPES OF MARCHES

a. A Fixed Column. A fixed column is one in which a prescribed spacing between vehicles is maintained at all speeds.

b. A Governed Column. A governed column is one in which the spacing of vehicles is governed by a speedometer multiplier or by other means in such a manner as to maintain comparatively constant time lead and time length.

c. Shuttling. A movement in which vehicles make repeated trips to move troops or supplies is called shuttling. For various shuttle methods for troop movements, see paragraph 166; for supply movements, paragraph 186.

d. A Double Staggered Column. In this type column, the elements travel in two parallel lanes with individual vehicles alternating between the lanes, each marching approximately opposite the center of the gap between the vehicles in the opposite lane.

74. CLOSE COLUMN

a. Uses. Close column is used when a road net must be used to its maximum capacity. It may be used for movements through cities or other congested areas for the purpose of better control, in which case arrangements should be made for escorts through such areas. Close column may be useful for night moves under blackout conditions, particularly over poorly marked routes, when it is essential that gaps between vehicles be short enough to enable drivers to maintain contact with the vehicle ahead.

b. Execution. Vehicles in each march unit will follow the vehicle ahead at a distance governed by a small speedometer multiplier (1 or 2), sufficient only to secure safety from accident. On occasion, the casual "follow me" method of marching may be used. When this is done, drivers are instructed to follow the vehicle ahead as closely as they think is reasonable and consistent with safe driving practices. (Normally SM=2). A maximum speed (greater than the average running speed) is prescribed for vehicles regaining lost distances. Changes in speed are accomplished smoothly and gradually in order to insure safety and uniformity of column movement. The head of the column maintains its position en route by use of a time schedule or a minimum gap from the rear of the preceding unit. The at-halt gap may also be prescribed in the march order. (Unless the tactical situation prohibits congestion, vehicles within each march unit may close up to approximately 3 yards between bumpers at halts. March units and serials, however, should not close on the units ahead unless so ordered).

c. Advantages. In a close column march, full traffic capacity of the road (or lane) can be utilized as road space is reduced to the minimum for safe driving. Column control and intracolumn communication should be better in such compact columns, and fewer guides, escorts, and markers are needed.

d. Disadvantages. The close column march does not provide dispersion for passive protection against enemy observation and attack. The strength and type of organization are readily apparent to hostile observation. Vehicles may arrive at terminal areas faster than they can be handled without producing congestion. Careful scheduling and rigid control of traffic are required if dangerous blockings at intersections are to be avoided. Greater driver fatigue may be experienced because of dust and close spacings. It is also more difficult for traffic to pass the column from the rear.

75. OPEN COLUMN

a. Uses. Open column is particularly applicable to tactical moves which are made during daylight. Open column may be used to overcome the effects of dusty road conditions and for moving on routes over which a moderate volume of higher or lower speed traffic is moving which may have to enter the column. A traffic escort is usually desirable for an open column.

b. Execution.

(1) An open column may be accomplished by use of a large speedometer multiplier (3 or more) and/or a prescribed minimum gap between vehicles. In addition, a prescribed density limiting the number of vehicles over a stretch of road may be established by orders.

(2) When a speedometer multiplier is used, slow speeds may make the column take on the characteristics of a close column and high speeds may result in vehicular distances so large as to cause the column to take on the characteristics of infiltration.

In any event, the distances between vehicles of open column marches are difficult to estimate. For this reason it may be desirable to have drivers compute appropriate headways by estimate methods, that is, by cadence count.

(3) Minimum distances may be prescribed in open governed columns; however, they are not normally needed if the SM is sufficiently large. If for example in an area particularly vulnerable to air attack large minimum intervehicular distances are prescribed, the column takes on the characteristics of a fixed distance column and loses the flexibility necessary for the particular terrain.

c. Advantages. Open column movement provides the best possible compromise between the conflicting requirements of a large traffic flow (or short time length of column) and a wide dispersion of vehicles within the column. Traffic interference is minimized, and the speed may be almost as high as infiltration marching. Column control, while not as good as in close column, is superior to that obtained by infiltration. In addition, driver fatigue and the probability of accidents is much less pronounced than in close column marching. Because time gap between vehicles or elements is greater than in close column, open column allows more time to direct units to alternate routes at the dispersal point.

d. Disadvantages. Because of the relative regularity of vehicle spacing in open column, less secrecy is possible in daylight and more losses may be suffered than will be the case with an infiltration march. Vehicle distances are greater than in close column, and consequently, traffic volume on a road will be lower.

76. INFILTRATION

a. Uses. When sufficient time and road space are available, this type of march is used to provide the maximum of secrecy, deception, and dispersion as a means of passive protection against enemy observation and attack. It is therefore well-suited to daylight marches. It may also be used to execute a movement along a heavily traveled route on which it would be impracticable to impose a complete unit. As an infiltration march provides a minimum of interference with other traffic and permits a higher average rate of march, it is suitable for movements in congested areas and on routes which cross heavily traveled roads.

b. Execution.

(1) Vehicles are usually dispatched individually, or in small groups normally not to exceed one squad, at a rate that will keep the average traffic density down and prevent undue massing of vehicles. Every driver must be given detailed instructions regarding the route, running speeds, maximum speed, and restrictions before leaving the unit area. The route of march should be carefully marked, and, if practicable, a strip map should be provided for each driver. Average distance between vehicles

in the over-all play is determined initially by the rate at which vehicles are dispatched. Thereafter, speeds and distances are regulated by individual drivers in conformity with operating instructions.

(2) Deception for the purpose of preventing the disclosure of a movement to enemy observers may be provided by intermingling various types of vehicles and by permitting passing within the march. In order to provide passive protection from enemy observation and attack, vehicles should normally be dispatched so as to produce an average traffic density normally not to exceed 10 vehicles per mile. When more than one movement is taking place simultaneously over the same route, it is desirable to coordinate the rates of dispatch in order to obtain desired dispersion. Supervision of movement is affected by stationing necessary regulation and control personnel along the route of march. In order to prevent massing of vehicles at or near traffic bottlenecks or the march destination, it is important that adequate guides or markers be posted so that vehicles will proceed with minimum delay.

c. *Advantages.* The infiltration type of march provides the best possible passive protection from hostile observation and attack. Under light traffic conditions, movement of individual vehicles is not materially affected by other vehicles in the march, but is limited only by the march order; road capability; vehicle mobility; and the training, experience, and physical condition of the drivers. Higher speed by individual vehicles may be obtained by this type of movement. Since traffic density in an infiltration march is normally light, cross traffic can move without excessive interference. A unit may be moved over a road on which the traffic is too heavy to permit the movement of the entire unit at one time. A traffic escort is not normally required, although control at intersections may be desirable.

d. Disadvantages. Time length of the infiltration march is greater than with any other type of movement. Thus, in spite of a higher rate of march, the total road clearance time for a march may be longer. Because of extended distances between vehicles, internal control of the march is extremely difficult. Since drivers are usually not able to regulate their movements by the vehicle ahead, careful marking of the route is necessary to prevent individual vehicles from getting lost. If drivers operate alone, more briefing is required; maintenance arrangements may be difficult; and refueling and messing are sometimes difficult to arrange. Since individual vehicles or small units operate separately and since other units may move simultaneously over the same route, there is danger that they may "bunch up" so that, while the average density per mile is as prescribed, there is, in effect, a close column on one section of the road but no vehicle on other sections. Due to relaxed control, the tactical employment of the unit may be difficult until the march is completed.

77. FIXED COLUMN

a. Uses. Fixed distance marching, whether in open or close formation, is used for the following:

(1) Ceremonies, including street parades.

(2) Short marches over roads with good pavements having no grades, curves, or bad stretches which will slow down the column.

(3) Escorted movements with close fixed distance through towns and passing intersections when the column is given the right-of-way and it is advisable to present a solid column to cross traffic.

b. Execution. Vehicles may form at fixed distance before beginning the march or may take up the proper distance successively. The gap between vehicle, march units, and serials is maintained so far as possible, irrespective of speed at which the column is moving.

c. Advantages. The fixed column presents a uniform appearance or "parade formation" during a movement. The road space of each march unit can be accurately calculated. When sufficient gap is prescribed, infiltration of other traffic is possible. When formed with very close gaps between vehicles, the fixed column presents a wall so that cross traffic will not attempt to cut the column.

d. Disadvantages. The fixed column type of march is difficult to execute except over short distances on level, smooth roads. Driver fatigue is pronounced. When the speed is necessarily varied by grades, sharp curves, and stretches of bad roads, fixed gaps can be maintained only by difficult regulation of the speed of the pace setter. It necessitates the slowing down of each vehicle in the column as soon as the lead vehicle hits a poor stretch of road and requires the lead vehicle to maintain the slow stretch speed until the last vehicle of the column has cleared the slow stretch. For these reasons, it delays the column. Therefore, its uses are normally confined to those listed above.

78. GOVERNED COLUMNS

Close and open columns are usually understood to be governed columns unless otherwise specified. If the gaps between vehicles are governed in a manner that will allow for their gradual closing on a slow or uphill stretch and for gradual opening on a fast or downhill stretch the accordion action can be regulated to advantage. This is accomplished by maintaining relatively constant intervehicular time leads. The nearer the approach to constant time leads throughout the column, the nearer will be the approach to the ideal type of column movement. Time length will remain the same throughout the movement, and schedules can be better met by all elements of the column. In general there are two different methods of maintaining constant headways.

a. Flexible Lead. In this method, the gap (and consequently lead) between vehicles is made to vary in proportion to the speed of the vehicles. It is termed the speedometer multiplier method (pars. 66, 67).

b. Constant Time Lead. Another method is to estimate and maintain time lead directly instead of estimating gaps based on speed. In this method, time lead is computed by reckoning the period of time required for a vehicle to occupy the position just vacated by the preceding vehicle. It is normally accomplished by a cadence count using a telephone pole or some other common road object as the mark on which to base the position of successive vehicles making the count. It relates time lead (headway) directly to lead and is perhaps the more advantageous method when drivers have been properly trained to apply it.

79. SHUTTLING

a. Description. Shuttling is continued forward movement accomplished by means of repeated trips made by the same vehicles between two specified points. Any of the foregoing types of march, depending on traffic and other conditions, may be used for shuttling.

b. Uses. Shuttle moves are used to perform a specified movement when inadequate transportation facilities preclude accomplishment of the movement in a one-time load or lift. This system is suited for both troop and supply movements.

c. Execution.

(1) Shuttle movements must be properly planned to provide adequate turn-around facilities and a coordinated working schedule. The preparation of entrucking and detrucking (or loading and unloading) tables will eliminate delay and confusion at terminals and the march graph will assist in scheduling the movement.

(2) The "part-ride, part-walk" shuttle is an efficient method for accomplishing troop movement when there are not enough trucks to move a unit in a single lift. This and various other troop shuttle and relay methods are described in paragraph 166.

(3) Tractor-semitrailer shuttling is an efficient method used on cargo hauls. Semitrailers may be parked while loading and unloading, permitting the tractor to be used to tow other semitrailers and thus allowing greater utilization of the powered vehicles. This and various other supply shuttle methods are described in paragraph 186.

d. Advantages. Shuttling may be the only practical method of completing a movement when vehicle availability does not allow movement of the entire load in one lift. Since shuttling allows the vehicles and drivers in a relay to remain closer to the unit to which assigned, it facilitates control, maintenance, messing, etc.

e. Disadvantages. It is often impracticable to secure return loads. The time required to move a specified tonnage by shuttle, as compared to a one-lift movement, is increased in proportion to the number of shuttles made.

80. DOUBLE STAGGERED COLUMN

a. Execution.

(1) A double staggered column may begin as a close column march, opening into two lanes as directed, upon entering the particular

route where it is practical. In this type of column headways are based on the distance which each vehicle maintains from the preceding vehicle *in the opposite column.*

(2) Thus, if the speedometer multiplier were 1, each vehicle would follow the preceding vehicle *in the opposite column* at a distance in yards equal to the number of miles per hour shown by the speedometer reading. For example, with an SM of 1 and speed of 30 miles per hour, the distance from the preceding vehicle in the opposite lane should be 30 yards. The speedometer multiplier must be applied to fix the gap between each vehicle and the preceding vehicle in the *opposite* lane, otherwise the required relation between vehicles in the two lanes might be lost and all vehicles would not be opposite the spaces in the other lane.

(3) It is evident that if each vehicle applies a speedometer multiplier (for example SM 1) to its distance from the preceding vehicle in the opposite lane, its distance from the preceding vehicle in the *same lane* will be approximately twice as great. However, the same effect cannot be gained by using SM 2 to regulate gaps between vehicles in the same lane because the factor of human error in judging distance would soon throw the columns in the respective lanes out of balance.

(4) When an obstacle or bottleneck, such as a stalled vehicle, defile, or one-lane bridge, is

encountered, the vehicles in one lane move into the space opposite them in the other lane, and use one-half the old speedometer multiplier. This temporarily reduces gaps between vehicles in the same lane by about one-half with all the dangers and disadvantages of decreased gap. Vehicles revert back to their original positions when the obstacle is passed.

b. Advantages. The double staggered column method reduces column length and permits use of two lanes for one-way traffic.

c. Disadvantages. It is dangerous to use the double staggered column form of march without skilled drivers. Control vehicles and faster moving vehicles can pass the column only with difficulty. The column is concentrated and affords a good target to the enemy.

PART THREE

CONDUCT OF THE MARCH

CHAPTER 6

CONTROL OF THE MARCH

Section 1. MARCH CONTROL AND DISCIPLINE

81. GENERAL

Certain internal functions of march control are the normal responsibility of the personnel of the marching unit, while other functions of control are imposed on the unit by external authority. The commanders of march units should have detailed knowledge of both of these functions in order to enforce their own directives and to insure intelligent cooperation with highway regulation and traffic control personnel.

82. MARCH DISCIPLINE

a. March discipline is attained through training and through internal control within the marching unit. It is indispensable to the effectiveness of the march column. The specific objective of march discipline is to insure intelligent cooperation and effective teamwork on the part of all march personnel. Such cooperation and teamwork can be attained only by thorough training, constant and thorough supervision by every officer and noncommissioned officer, considerable practical experience in actual marching, and meticulous attention to details of technique listed below:

(1) Correct driving.

(2) Immediate and effective response to all signals and orders.

(3) Prompt relaying of visual signals.

(4) Strict obedience to traffic regulations, rules of the road, and instructions of highway regulating, traffic control, and command personnel.

(5) Effective use, as prescribed, of cover, concealment, camouflage, dispersion, radio silence, blackout precautions, and other protective measures against air, ground, mechanized, or chemical attack.

(6) Correct speeds, distances, and proper positions within the column.

(7) Observance of rules of march hygiene.

(8) Proper care of equipment.

b. Responsibility for good march discipline commences with the driver of each vehicle and increases with each commander charged with internal control. These duties are briefly as follows:

(1) The driver, or soldier in charge of each vehicle, is responsible for observing proper distance and speed, for safety precautions, for good driving, for performance of prescribed first echelon maintenance, and for strict observance of all requirements of standing operating procedure or specific orders governing the march.

(2) The assistant driver and front seat passenger should be constantly on the alert for

column signals and warnings, and for signs placed along the road, warning the driver and transmitting them back along the column when appropriate. This is particularly important at night or under conditions of poor visibility. The front seat passenger should guard against the possibility of the driver's falling asleep. He should assist the driver in other ways including "at halt" maintenance service.

(3) Squad leaders supervise the actions of the drivers of the vehicles composing their squads. They should give particular attention to spacing and should correct failure of drivers to observe regulations including first echlon maintenance and proper distances between their vehicles.

(4) Section leaders supervise the actions of the squad leaders, and give squad leaders such instructions as may be required to assure proper functioning of their section.

(5) The march unit leader or commander gives the orders to halt and move, and exercises general supervision over the conduct of his unit. He is responsible for maintaining the proper position of his march unit within a larger column and for carrying out the orders of the column commander.

(6) Higher commanders in a convoy, column, or serial are successively responsible for their units, the responsibility becoming broader and more general in nature at each higher level of command.

83. CONTROL IDENTIFICATION OF VEHICLES

It is often desirable to mark or otherwise designate vehicles of the column for internal, as well as external, control purposes. Such identification is subject to local conditions and is usually specified in standing operating procedures. Marking should be kept to the minimum consistent with its need in column control. Extra markings should be of easily removable nature.

a. Unit Flags and Symbols. Security permitting, headquarters vehicles of companies or similar units may display guidons. Message center vehicles of battalions, regiments, and similar units may be indicated by distinctive symbols or panels displayed on the front, rear, top, and/or sides. When necessary for security reasons, guidons may be cased and symbols or panels may be covered or removed.

b. Cloth Control Indicators. Control cars of columns may be indicated by cloth or flags attached to their front or rear. The following colors are standard:

(1) Blue for the head of a serial or unit.
(2) Yellow for the head of subunits, if any.
(3) Brown for the tail of subunits, if any.
(4) Green for the tail of a serial or unit.
(5) Red for danger or explosives.
(6) Black and white checkered for priority movement.

c. Serialization of Vehicles. Individual vehicles within the main body of the column may be numbered serially to facilitate formation of the column and identification of individual vehicles. Such numbers may be drawn on the sides and bumpers of vehicles with soft chalk crayons or indicated by previously prepared signs.

84. COMMUNICATIONS CONTROL OF COLUMN

a. For practical purposes, it is desirable to keep march units small enough to come within the range of signals of the commander and in the march of a larger unit to have the column so organized as to facilitate the relay of signals between march units.

b. Only brief, simple messages should be transmitted while a column is in motion. Long messages are best transmitted in the form of a written order or while the column is halted. Various methods of intracolumn communication include the following:

(1) *Sign messages.* Sign messages from the front of the column may be written on a board and posted on the driving side of the road (or displayed by a guide) so as to be visible to oncoming vehicles. Such messages are then noted by the driver or assistant driver of each vehicle as they pass the signboard. Provision is made to pick up these signboards (or guides) as the rear of the column passes.

(2) *Written messages.* Written messages directed to a unit or vehicle in the column may be written on a message blank and given to a guide stationed along the route who will transfer it to the proper vehicle. For this purpose, the message may be affixed to a large wire loop suspended at the end of a forked stick held or placed where it can

easily be caught on the arm of the front seat passenger while the vehicle continues in motion. Otherwise the use of a short stick with a slit at one end will normally suffice. The written message may also be delivered by a motorcycle messenger directly to the driver or front seat passenger.

(3) *Two-way voice radio sets.* When available, two-way voice radio sets may be located in the control cars of the commander and at the head and trail. When supplemented by receivers in other vehicles in the column, they provide the best intracolumn communication and afford maximum control of a column. However, they may not be available, or radio silence may be imposed.

(4) *Whistle and other sound signals.* Whistle and other sound signals (horn, bugle, etc.) constitute an elemental means of attracting attention or transmitting a command to a column. A single whistle code may be arranged. For example, one blast on the whistle may indicate the *next* action warranted by the circumstances; that is, the column being halted, a whistle blast indicates that personnel should detruck; or, the personnel having detrucked, the next blast indicates that they reload in their vehicles. Three whistle blasts usually express an alarm. Other whistle signals may be specified by the local commander or they may be used with visual signals, or in any manner that is understood between the troops and

the officer or noncommissioned officer giving the command.

(5) *Visual hand and arm signals.* Visual hand and arm signals constitute another elemental means of communication within a column. Besides the driver's signals, certain column control signals may be given by arm either from the cab of a vehicle or by a person standing on the road.

(6) *Flag signals.* Besides the column control cloth and/or flag indicators, certain hand-flag signals having distinctive colors or markings are used in maneuver umpiring and for particular tactical purposes as specified in orders. Such flag signals have a distinct disadvantage over other signals in that they are seldom available to everyone.

(7) *Verbal messages.* Verbal messages may be transmitted from the command car or a control car patrolling the column.

Section II. CONTROL PERSONNEL

85. THE COMMANDER

a. The officer or noncommissioned officer in command of a convoy is responsible for all that occurs in his unit. He issues the necessary orders to initiate the march and takes whatever action he deems necessary to insure that instructions contained in standing operating procedures and in march orders are adhered to during the preparation for, and conduct of, the march. He must be free to go wherever he may be required to supervise the proper movement of his command.

b. Commanders should consider the problems which are likely to be met at the head of the column and those which will develop as the column passes and may best be met at the trail. They must then make their own decisions as to where they will march. A competent representative is placed at the head and trail so that the commander is free to be where he expects trouble and to move along the column so as to observe the situation.

86. CONTROL OFFICERS OR NCO

a. Control of the column is maintained by all column (serial or march unit) officers and noncommissioned officers. In addition, personnel may be assigned specific duties in connection with column control. In large columns, the second in command or executive officer is often designated as the chief control officer. He may be given a staff which includes that part of the headquarters staff not elsewhere employed and representatives from each major unit within the column.

b. The chief control officer may be given responsibility for leading the column along the designated route and for regulating the speed of the march. This control officer should periodically check the time the head of the column passes specified check points along the route. If the column is moving in accordance with a march table or march graph, this officer will so regulate the pace that the schedule indicated thereby is adhered to. In the event this becomes impossible or any other adjustment must be made in the march, both the column commander and traffic personnel must be notified.

87. CONTROL PERSONNEL

Depending on the size of the column and the requirements of the situation, the control personnel may include the following:

a. Guides. Guides are individuals who direct a unit or vehicles over a predetermined route or to a selected locality. They may lead a unit or direct it from a stationary point. They may be members of the escort party or members from the organization who are familiar with the route or who have been instructed as to the direction to be followed.

b. Traffic Escorts. Traffic escorts may consist of military police, civilian police, or other personnel accompanying the march and aiding the movement of the convoy or column through congested area or areas of possible traffic conflicts. Escorts may include troops detailed to accompany a convoy to prevent interference by hostile forces or to protect valuable loads.

c. Traffic Patrols. Traffic patrols usually consist of traffic personnel on motorcycles or in other highly maneuverable vehicles. They are used in area control to provide liaison between key regulation or control posts, supervise traffic between such posts, and provide frequent checking of critical points on the road net where traffic blocks or bottlenecks are most likely to develop. They may precede a column and stop or otherwise direct conflicting traffic in which case they take on the characteristics of escorts.

(1) Traffic patrols, escorts, and guides perform a traffic control rather than a highway regulation function. Their purpose is to facilitate movements in accordance with the traffic plan and the schedules prescribed by the highway regulation headquarters or other higher authority. They keep traffic moving and when necessary act in emergency to restore a plan which has been temporarily disrupted. In emergencies requiring immediate action, military police make the minimum changes in plans or schedules required by the situation, and take immediate steps to notify those responsible for such plans of the action taken.

(2) Under organizational control, these duties are performed by personnel details from the unit making the move or from a higher command. Under area control, these duties are usually performed by military police detailed by headquarters responsible for highway traffic control in the area. The intensive specialized training and equipment needed for this important function are covered in FM 19–25.

d. The Advance Officer. An officer who precedes the column by sufficient distance to give the necessary aid in negotiating traffic hazards and to render other assistance to the commander is called an advance officer. This assistance may include—

(1) Reconnaissance, including check of bypass routes when in an emergency the column is

required to go around unexpected road blocks or traffic jams.

(2) Instructions to organizational traffic control personnel to be posted along the routes.

(3) Posting of guides or route markers at intersections and at other positions along the route where special directives to the column may be necessary.

(4) Notification of proper authorities of the approach of the convoy to facilitate the clearance of the column or to obtain assistance through congested areas.

(5) When traveling over a dispatch route, checking at highway regulation points for instructions or changes in instructions for the movement of the column.

(6) Command of a detachment sent forward for quartering arrangements, pioneer work, etc, when specifically detailed to such a duty.

(7) Close communication with the column commander by radio or other means to advise him of any unforeseen developments and to receive orders and instructions concerning the movement.

e. The Pace Setter. The pace setter is usually an experienced officer or noncommissioned officer who rides in a lead vehicle of a column or element thereof. His duty is primarily to maintain the rate of march in such a manner that the schedule is met and accordion action is properly controlled. He also gathers information and instructions concerning traffic obstructions or bottlenecks. The chief control officer may be the pace setter in addition to his other duties.

f. The Trail Officer. The trail officer marches at the rear of the column or an element thereof. An experienced motor transport officer should be selected. A trail officer may perform the following duties:

(1) Checking the individual vehicles, march units, or serials at the point of origin or the designated initial point (IP).

(2) Reporting the location of trail of column when requested.

(3) Preventing vehicles or other traffic which might interfere with the movement from entering or passing the column from the rear.

(4) Posting necessary guards, warning flags, caution lights, or flares to warn traffic approaching from the rear when the column halts.

(5) Picking up and, as soon as practicable, returning to the head of the column all guides and markers distributed by preceding elements of the column.

(6) Observing vehicles ahead for excessive accordion action, weaving of vehicles, or other indications of lack of discipline or driver fatigue; and taking the necessary corrective action.

(7) Rendering first aid to the injured in the event of an accident, summoning medical aid if necessary, causing prescribed accident reports to be made, and initiating a preliminary investigation.

(8) Responsibility for the abandonment of vehicles in accordance with instructions.

g. The Trail Maintenance Officers. Trail maintenance officers, as available for each march unit or for the column ride at the rear of their units with the maintenance personnel and equipment and take action within limits prescribed by the march order to maintain vehicles in serviceable condition. At halts, they proceed along the column to inspect the vehicles and supervise maintenance operations. In small columns the duties of the trail maintenance officer are usually combined with those of the trail officer.

88. OTHER DUTIES OF SUPERVISORY PERSONNEL

a. The successful conduct of a march depends to a large extent upon the aggressive action taken by the officers and noncommissioned officers of the column to prevent interruption of the march and overcome emergencies as they arise.

b. Besides duties already listed in connection with the control function, officers in the column may be assigned duties in connection with column communications, supply, inspection of vehicles at halts, reconnaissance, quartering, mess, pioneer details, defense, or other special functions as may be required.

Section III. DETACHED PARTIES

89. GENERAL

Many motor movements require no detached parties, as the function of such parties may not be needed or may be taken care of by area control. However, since the situation sometimes requires self-sufficiency on the part of the marching unit, it is necessary to know the functions of these parties and how they may be organized and used if and when needed.

90. ADVANCE ELEMENTS

a. Advance Parties. Advance parties are provided according to the situation. They may be provided by a higher headquarters for general assistance to several columns, or they may be detailed from the march column itself. Often it will be possible to combine one or more of the parties indicated below. When so combined, they are collectively referred to as the advance party. (*This advance party is not to be confused with the advance party of an advance guard.*)

b. Quartering (Billeting) Party. In organized areas, with established billeting and messing installations en route, it is only necessary to establish liaison with the commanding officer of such installations in order to have everything in readiness for the reception of troops in personnel convoys or drivers of supply convoys. In tactical situations, enemy activity may make a quartering party impractical. The mission of a quartering party is to locate, arrange for, and lay out bivouac areas, quarters or billets, loading and parking facilities, supplies and rations, water, fuel, medical attendance, etc., so that all are provided for before the arrival of the column. On the arrival of the column, the quartering party may assist traffic personnel in guiding units to their exact areas.

c. Reconnaissance Party. A traffic reconnaissance should precede a motor movement except when the march is in an already reconnoitered area. Normally, the necessary reconnaissance in rear areas is provided by area control personnel. However, when movements are to be made over unknown or unpatrolled routes, the column commander should detail a reconnaissance party from his own column. It may be practicable to assign this duty to other advance elements.

d. Pioneer Party. Necessary work in preparation of the route is usually accomplished by engineer troops. However, in the absence of such troops, this important work must be performed by any available troops. The requirements for pioneer work vary greatly. They are negligible when moving over good roads but become extremely heavy on bad roads, demolished routes, or cross country. It is therefore important that a careful estimate be made of the personnel, tools, materials, and time necessary for the elimination or reduction of obstacles to the movement.

91. FOLLOW-UP DETACHMENT

The follow-up detachment is designated to inspect bivouac areas and other halt sites after they are vacated by the column and to correct and report any deficiencies observed. During operations in peacetime and in friendly countries, the follow-up party completes necessary paper work in connection with leased camp sites or with claims arising from damage to private or public property. On the road this party may also pick up guides, guards, and markers which have been placed by the advance party, make final investigation of accidents when military police are not available, provide for the disposition of dead or wounded, and dispose of disabled vehicles separated from the column.

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92. OTHER ELEMENTS

Additional elements which make up organized movements may be required under various circumstances. These include the following:

a. Traffic Escorts. Traffic escorts consist of military police or civilian police. In the absence of such personnel, details may be assigned from the column to perform necessary traffic control functions (FM 19–25).

b. Security Forces. Security forces consist of advance, flank, or rear guards, either furnished by higher headquarters or from the marching unit.

93. REPLACING GUIDES BY ROUTE MARKING

Special signs may be used to aid a specific march. *Individuals should not be posted where signs can be used with equal effectiveness.* It is desirable for organizations to keep on hand signs which may be used in the control of their movements. If possible, organizational signs should be installed well in advance of columns but not so far as to be a nuisance to other traffic. Such signs, placed to direct specific movements, should be picked up, usually by a detail under the supervision of the trail officer, as the movements progress along the route. The signs may be used repeatedly in a manner similar to that used in the posting of guides. When the movements are to be made at night, markers should be posted during daylight hours If headlights are permitted, signs should be of the reflector type.

94. ESCORT TECHNIQUES (FM 19–25)

a. Mission. The mission of a traffic escort is to expedite the movement of a particular column, usually by obtaining for it the right-of-way over traffic of lesser importance or assuring that it is not unduly delayed by other traffic. However, a column moving under escort does not necessarily have priority over all other traffic. Escorted columns moving through territory under area control are subject to the traffic regulation orders in effect therein, and to the direction of the traffic control personnel enforcing them. Escort personnel *must not* interpret their duty to be the procurement of uninterrupted movement of their column without regard to existing regulations. Their mission is determined by the plan of the march and the specific instructions issued for its operation.

b. Duties.

(1) Escort personnel consisting of military or civil police, and guides or guards detailed to, or by, the marching unit, perform similar functions for the march column. Guides may ride in column control vehicles or be posted at points where directions need be given, but where the control of other traffic is not required. Guides are normally used at important road junctions, intersections, or crossings to prevent interference from other traffic or to warn the column of traffic hazards.

(2) In performing their mission, escort personnel perform some of the functions of both

intersection and patrol duty. They move out in advance of the column to:

(a) Provide necessary traffic control at unguarded intersections or where existing control (as by traffic signal) is inadequate or inappropriate.

(b) Advise traffic control personnel along the route of the approach of the column.

(c) Discover any road or traffic blocks, and either eliminate them or notify the column commander and highway regulation points and control posts so that proper action may be taken.

(3) Escorts or guides are especially useful at night, or when it is necessary for the column to leave the road and travel over stretches of difficult ground, such as along a detour or into a bivouac or assembly area. If the column is to be led through a difficult sector or is to travel at night, it is desirable to have the guide who is to lead the column go over the entire section in advance during daylight.

(4) Traffic escorts may establish temporary control posts successively forward of the march at all critical points along the route. This procedure is especially important before entry of the column on one-lane open roads when there is possibility of meeting another column at a location where passing is not possible. When escort personnel are mounted on motorcycles or in light vehicles, they may be repeatedly posted forward as

needed. Their greater speed allows them to proceed ahead of the column to duty at other locations.

c. Posting Escorts. Escorts are posted at selected points along the route prior to the passing of the column and are picked up after the column has cleared these points. This is usually accomplished by relaying escort personnel forward as the movement progresses. Each man is given a number as he is posted, the numbers being assigned consecutively. In this way the escort commander and his assistants have a means of checking whether any man has been missed in picking up the escort. The error will be detected at the post following the one missed, and only a comparatively short distance will have to be traveled to pick up the missing man. In the case of military police or guides having their own transportation, a distinctive flag or sign should be placed on the trail vehicle so that members of the escort party can easily identify the end of the column.

CHAPTER 7

ROAD PROCEDURES AND EN ROUTE TECHNIQUES

Section I. FORMATION OF THE MARCH

95. FORMATION OF MARCH COLUMNS

a. Whether a march operates under a single commander, as may be the case in the movement of a combat unit, or operates as a number of separate serials under respective commanders, as is normally the case in highway transportation of supplies over long lines of communications, it is necessary that the columns, or elements thereof, make formation in a systematic manner.

b. The formation of the elements is accomplished according to a plan prepared in advance.

(1) In the case of tactical troop movements, a detailed plan may require the various march units to form at unit areas and move successively on a prescribed schedule to the initial point (IP) where they join the column.

(2) On the other hand, supply or administrative movements may begin at the local dispatch office where individual vehicles are sent out to dump areas for loads, and the column is formed in an assembly area before the movement passes the IP.

96. INITIAL POINT

a. An initial point is any designated place at which a column or element thereof is formed by the successive arrival thereat of its various subdivisions; or a point where a convoy is "checked" onto the road net or route of march.

b. The schedule, recorded progress of the march, and other essential information regarding the movement are based on the IP.

97. LOCATION OF IP

a. The IP should be so located that no march unit is compelled to move back in a direction opposite to that of its destination in order to reach the IP and take its proper place in the column. It may or may not be a highway regulation point, but is normally located at an easily recognized place such as a landmark, map reference point, road intersection, or any other marked and designated point. This means that, when practicable, the IP should be forward of all areas from which a march unit or convoy departs.

b. In the case of a motor march of a large command, there may be several IP's for successively larger units—that is, battalions may join a regimental column at the regimental IP, or regimental combat teams may join a division at a division IP.

98. COLUMN CONTROL AT IP's

a. The IP is the most practical position for the commander to check the movement to see that it has departed on the prescribed schedule and according to plan. A check made here will give him an opportunity to make early adjustments which might otherwise be necessary en route due to lateness of certain elements or other unforeseen factors.

b. The IP is also the position often used to check various convoys onto a dispatch route. Whether or not the highway regulation point coincides with the one used by the unit, the commander or control officer must consider it in the conduct of the march and check or report his movement thereat as required.

c. The odometer reading of each vehicle on passing the IP should be noted and recorded by the driver or front seat passenger. Trip odometers, in vehicles so equipped, should be set at zero on passing the IP (or other specially designated point). In this manner points along the route of march can be conveniently referred to in terms of the mileage from the IP.

99. DRIVER ORIENTATION

Successful conduct of the march depends to a large extent on the information available to individual drivers and march unit commanders. Security permitting, drivers as well as supervisory personnel should be instructed as to the route to be taken and the final destination (fig. 18). Except in very rare instances, this is the minimum information to be furnished drivers. Whenever possible they should be given more complete instruction.

ROUTE CARD

ORIGIN.. Roland .... DESTINATION. Mt. Avery.

TOTAL MILEAGE.... 115 ....

ROUTE	MILEAGE Miles	MILEAGE Accum	ROUTING From – To –	SCHEDULE Arrive	SCHEDULE Depart	HALTS
			Roland		0801	
207	45	45				
			Stevens	1016	1019	
176	35	80				
			Tavistock	1201	1205	
384	10	90				
			McLean	1331	1335	1 hr.
116	10	100				
			Dundalk	1401	1406	
999	15	115				
			Mt. Avery	1446		

SPECIAL INSTRUCTIONS

Rate of March: 20 MIH

Maximum Speed: 35 MPH

Gap: 5 Mi

Lights: (March completed in daylight)

Emergency: SOP will govern

Figure 18. Sample route card.

Section II. EN ROUTE TECHNIQUES

100. GENERAL

a. Driver Responsibility. The fact that organized columns are controlled, in that their speed and distance are regulated, does not lessen the need for drivers to be elert and careful. In a march column, drivers are expected to maintain their place and still avoid accidents. They must realize that a slight delay is better than a crash and an indefinitely long delay.

b. Safety Precautions Most safety precautions apply equally well whether driving in a convoy or not. The best way to avoid accidents in a column is to observe every safety precaution. Special attention should be given to the movement of the vehicle ahead and to the passing on of proper signals. Sudden stops should be avoided.

c. Right-of-Way. Except in special military necessity, each small motor march column extends the right-of-way as would an individual vehicle, unless the column is accompanied by a police escort to block off traffic. However, large march columns running on fixed schedules might be frequently split and their schedules disrupted if they observed all the customary practices as to right-of-way, traffic signal lights, etc. To keep intact and to arrive on time, a large column must proceed steadily, without unscheduled interruptions. Ample traffic escorts are required.

d. Traffic Problem of Columns. Prevention of intersection collisions is accomplished by the use of point control, traffic escorts, patrols, and traffic control signs where applicable. Without traffic personnel to block other traffic and guide the column through congested areas, all local regulations must be obeyed. Under such conditions, it will be difficult to keep columns intact. It is advisable to maintain a close column through cities and other congested areas so as to present an almost solid column which cannot be entered or crossed by other vehicles.

e. Other Vehicles. When an "outside" vehicle not under control of the column commander breaks into a column, it may lag behind and cause vehicles in the column to lose distance. This may produce excessive and ungoverned accordion effect. It increases danger of accident. When the highway is wide enough and the escort is sufficient, this danger may be prevented by keeping the column in the right lane and compelling all other vehicles to keep out of it. However, in military operations there are usually many military vehicles, such as staff cars, jeeps, or motorcycles which must proceed in the same direction as the convoy but at greater speed. If there are not enough lanes or the escort is insufficient to keep such vehicles in a different column, the driver should permit all such overtaking vehicles to pass freely. He should keep well to the right and give them plenty of room to pass or to enter the column if necessary.

101. SIGNALS

(figs. 19–21)

Standard mounted and dismounted signals include arm and hand signals, flag signals, and light signals. Signals prescribed for use on marches are generally of three types—those given by the driver from the cab of the vehicle, those given from an open vehicle or turret, and those given from the ground. Some signals are the same regardless of the point from which they are given. Those signals most commonly used by drivers and personnel controlling the march are illustrated and described on the following pages.

The following general rules govern the use of these signals:

a. A whistle or bugle to attract attention is blown before giving signal.

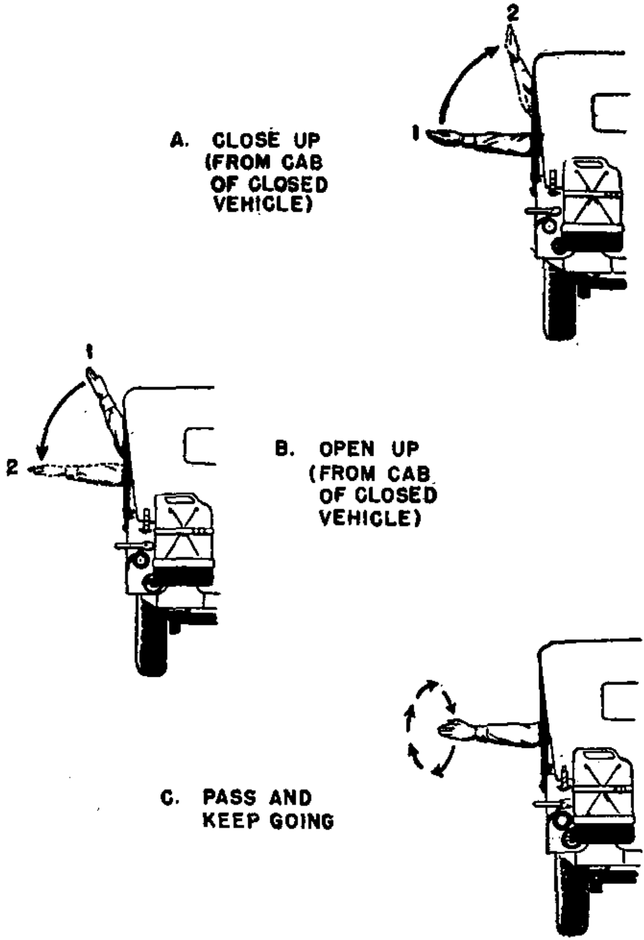


Figure 19. Driver's hand signals.

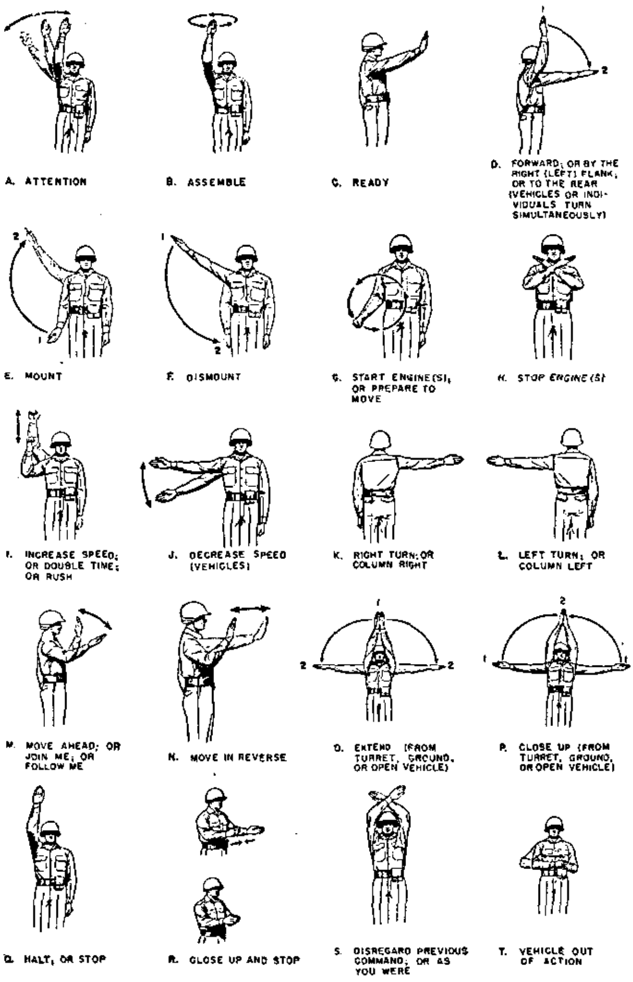
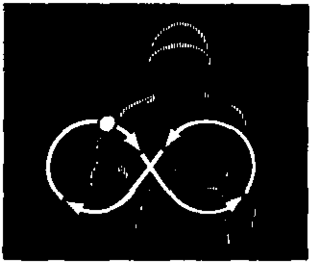
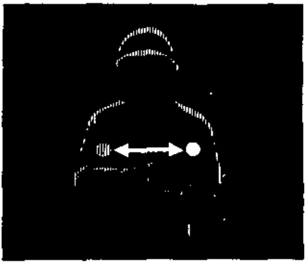


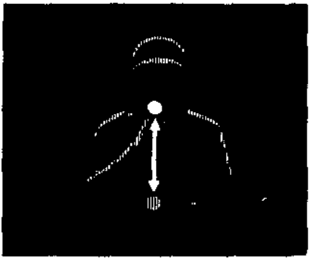
Figure 20. Motor march hand and arm signals.



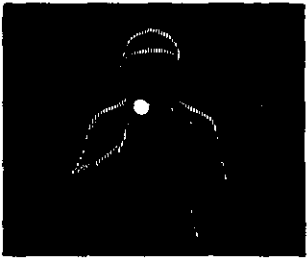
A. START ENGINE(S)



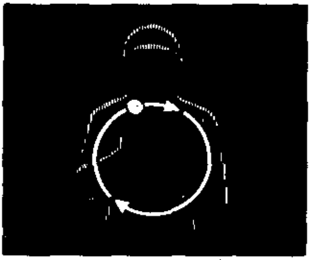
B. STOP; OR STOP ENGINE (S)



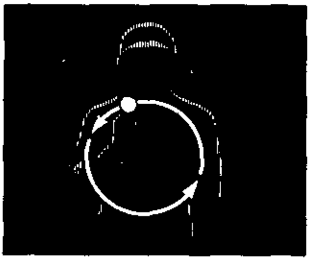
C. GO; OR FORWARD; OR MOVE OUT; OR INCREASE SPEED; OR DOUBLE TIME



D. MOVE IN REVERSE (BLINKING LIGHT)



E. TURN RIGHT



F. TURN LEFT

Figure 21. Light signals.

b. When signals are given to a motor column from the ground, the person giving the signal should, if possible, stand where he can be seen by all drivers. Most often this will be in a position on the opposite side of the road from the vehicles.

c. Whenever a motor column has to be halted on a curve, hill, or wherever some drivers cannot see the signals, signals may be relayed along the column or transmitted by messenger to all concerned.

d. Other signals not in conflict with those prescribed herein may be adapted for use in motor operations. In addition, electrical and mechanical signals and devices may be used when available.

102. PRECAUTIONS IN TRAFFIC

a. Vehicles in a march column should normally follow in a single lane. So far as possible all vehicles should remain in the lane selected by the pace setter.

b. When any column contains vehicles of unusual length, it may be necessary to post guards at curves to prevent conflicts resulting from the sweep of these vehicles.

103. KEEPING THE COLUMN INTACT

Columns may become separated and cut without the head of the column being aware of it. As it is undesirable to have delayed vehicles speed excessively to catch up with the rest of the column, it is advisable to set a maximum speed limit. This requires special measures for preventing a delayed portion of a column from becoming lost when the preceding portion is out of sight. There is perhaps no substitute for driver information regarding the route. It should be remembered that an escort does not command the column or regulate its speed, but should make its rate of march conform to that of the head of the column. When an escort is guiding a column over an unfamiliar route, it may be advisable to have some element of the escort take up the trail of the column or to patrol the column so that any cut will be noticed and proper action taken to close it. The trail officer should have full instruction as to action to take if column is cut. In case of unnecessary delay, he should move forward and ascertain the cause. If he finds that a cut has occurred, he may take up the head of the delayed section. Before doing so, he should designate and instruct a subordinate to act as the trail officer. These methods do not relieve the command, or the control officer at the head, of responsibility for maintaining such pace and making such checks as will assure keeping the column intact.

a. If the cut has been of short duration, a driver should proceed at the prescribed maximum speed until he overtakes the column or until he reaches the next intersection. Unless he is sure of the new direction, he should proceed no farther until he has contacted the next senior officer or noncommissioned officer to his rear.

b. If the cut occurs on a supervised or dispatch route, a driver should proceed at the prescribed maximum speed until he overtakes the column or until he reaches a traffic control post or highway regulation point where he can secure directions.

c. If the cut is for a long period (5 minutes or more) or a long delay is anticipated, a driver should pass the word back along the column advising the trail officer of the cut. Normally he should not dismount from his vehicle or turn around. Successive drivers should advise those behind until the information has been relayed to the trail officer.

d. If an individual vehicle becomes separated and lost and above methods are impractical, the following procedures govern. It should be understood in advance that the driver's unit will send someone in search for him if he becomes lost; and if this happens the driver should park and proceed no farther. To do so might cause him to become lost where his unit could not find him. If the standing operating procedure of his unit does not cover such situations, the driver should use judgment as to the best action to be taken. He may seek advice and assistance from traffic personnel or from other friendly forces he is able to contact.

e. If a number of vehicles are separated from their march unit and become lost, they should be parked and have the senior officer, noncommissioned officer, or driver proceed in a single vehicle in an attempt to contact the unit or to seek or telephone the nearest highway regulation point, traffic control post, or patrols. He should be especially careful not to lose his direction from the lost vehicles and should set a stated time in which he expects to return. If he does not contact the unit or get directions within a reasonable time, he should return and act in accordance with one of the above suggested methods.

104. CONVOY HALTS

a. Purpose. Halts are made for rest, personal comfort and relief, refueling, messing, allowing other traffic to pass, checking equipment, etc.

b. Time, Duration, and Frequency.

(1) Halts are usually prescribed in orders from higher headquarters or in highway regulation orders. Where the choice lies with the column commander, a halt of 15 minutes should be made at the end of the first hour. Thereafter, a halt of 10 minutes every 2 hours is advisable. One-half hour to one hour is usually allowed for mess and refueling halts. Depending on the urgency of the march, both the duration and frequency of halts may have to be reduced to shorten road time.

(2) When a halt must be made to permit passing of columns, such halts should be timed to coincide with a regular mess or rest halt.

(3) In the case of long columns, it is usually best to prescribe halts for all elements at specified times, rather than on a signal transmitted from the head of the column. Unless definite halt times are specified, serials may close up on ones ahead, thereby losing their proper gaps and possibly creating congestion.

c. Halting Places.

(1) Halting places should be selected in advance. These selections may be prescribed by higher authority, made tentatively by map reference, or made by the reconnais-

sance party. On dispatch routes, highway regulation points may include refueling stations, messing facilities, temporary quarters, maintenance facilities, etc. When such facilities have been provided, highway regulation orders or other orders from higher headquarters, usually prescribe the places at which halts will be made.

(2) If the halt is of only brief duration and will not interfere with the normal traffic flow, the column may stop on the shoulder of the road. It is desirable that halting places, especially off-road areas, provide turn-around facilities or circuitous exits so the column may be quickly reversed or be able to reenter the route when necessary.

(3) If crossroads, railroad crossings, and similar danger points lie within the halt area of a column, subordinate commanders will require vehicles to stop a reasonably safe distance from such points. No part of a column should stop on bridges. Halts on steep grades and sharp curves should be avoided.

(4) Comfort of personnel and servicing facilities for vehicles are important considerations in selecting sites for long halts. If a column starts from a populous area, its first halt should be delayed, when practicable, until the country is reached so as to facilitate relief of personnel. For the same reason halts should not ordinarily be made

in villages or towns unless there is a special need therefor.

d. *Precautions at Halts.*

(1) Columns should be halted at points providing a clear view; normally more than 200 yards should be maintained to the front and rear of the column. If road conditions prevent adequate site distances, steps must be taken to forewarn approaching traffic.

(2) Guards, warning flags, or caution lights or flares (security permitting) should be posted in front and rear of the column and at any other points where there is a hazard to passing traffic. If the column blocks part of the road at the halt so that it is necessary to operate alternating one-way traffic, authorized traffic movements may be alternated by using flags transmitted alternately from one end of the single lane to the other by the last vehicle of each passing traffic group, or by guards to control traffic first in one direction and then in the other.

(3) When the column halts so as to force traffic proceeding in the same direction to move on the left of the center line, vehicles should be parked with enough distance to permit passing vehicles to enter the column in case traffic in the opposite direction is encountered.

(4) Unless otherwise prescribed, when traffic approaches from the rear of a halted column and cannot clear the column before its

resumption of march, trail officers may require such traffic to remain behind until it is safe to pass.

(5) All personnel other than traffic guides must remain off the road to the right of their assigned vehicles and keep the traveled portion of the roadway clear at all times.

e. Duties at Halts. In addition to rest and relief, there are certain functions which should be accomplished during halts.

(1) Officers and noncommissioned officers should check on the welfare of personnel and the security of loads and take action necessary to correct faults.

(2) Control personnel should make checks to assure that vehicles are in proper position and prepared to move out on order.

(3) Drivers and assistant drivers make the at-halt preventive maintenance check.

(4) Personnel having special duties, such as cooks and medical personnel, take advantage of halts to perform such of their duties as would be difficult during movement.

105. CHANGING DIRECTION

a. The control officer or pace setter at the head of the column should make sure that the column is in the appropriate lane some distance before reaching a turn in order to avoid the possibility of accidents or the cutting of the column. Turns should be made with as little interference to other traffic as possible. On two-lane highways all turns should start and end in the right lanes. On multiple-lane highways right turns should start and end in the extreme right lanes; left turns should start and end in the lane just to the right of the center line.

b. Turns should be made at speeds commensurate with the load, road, and traffic conditions. Each driver should always give the appropriate signal in sufficient time to afford ample warning that a change in direction is to be made.

106. REVERSING DIRECTION

a. General.

(1) It is a simple process to reverse the direction of a single vehicle, but to reverse the direction of a column of vehicles, which may include trailed loads, is another matter. To reverse convoys traveling on a one-track road may at times be almost impossible.

(2) There are two ways of making complete turns, and two methods by which each of these ways may be used in reversing the direction of a column. Individual vehicles may make U-turns or Y-turns, and these may be made successively or simultaneously by vehicles of the column.

b. Circling Back. This is the simplest method reversing direction of a column. It is accomplished by making successive U-turns or by following a circuitous route. If only a short detour is involved, a loop road or sufficiently wide space is used. A loop road is not essential when a passable circuit of sufficient size is available off the road, or when the road itself is of sufficient width. When traffic must leave the road to circle back, it may sometimes be necessary to cut a gap in a fence or fill a ditch. This is often preferable, however, to a long detour.

c. Successive Y*-Turns.*

(1) Successive Y-turns are executed consecutively from the head of the column, or elements thereof. Vehicles follow each other through the turn as closely as practicable consistent with prescribed distances. When completing the turn, the leading vehicle moves out in the new direction in the same manner as from a halt. Other vehicles follow in turn, taking up their positions in column in accordance with the type of march specified.

(2) A Y-turn differs from a U-turn or one made by circling back in that it is necessary to operate the vehicle in reverse at one stage of the turn. Crossroads, road forks, or a fairly wide road are generally sufficient to accommodate a Y-turn, whereas a larger area is required for U-turns or circling back. The back movement of a Y-turn should be executed to the driver's left rather than to his right, unless poor footing or some other local feature makes this inadvisable. When a Y-turn is executed in this manner, vehicles coming out of the turn conflict least with succeeding vehicles in the column, or with the flow of other traffic. If the backing movement is executed to the right on the other hand, it is necessary for vehicles leav-

ing the turn to cross the path of traffic or of vehicles entering the turn.

(3) Normally, assistant drivers should dismount in order to assist their drivers in making a Y-turn. When full trailed loads are being carried, Y-turns are very difficult and require great skill on the part of drivers and assistant drivers. Full trailed loads may have to be uncoupled and manhandled. With full trailed loads, therefore, it is usually worth while to make a reasonable detour in order to execute the turn.

d. Turning Simultaneously.

(1) When vehicles turn around simultaneously, the head of the column becomes the tail, and the order of the march is reversed. No attempt is made to resume the prior order of march, but elements which are required at the head or trail may be returned to their proper position in the column when practicable. For example, the head of the column (or elements thereof), which will be at the tail, may pass up the main body and resume its position. The trail party of the column, which will be at the head of the column when the direction has been reversed, may be directed to stand fast while other vehicles pass by and resume the proper position of a trail party.

(2) When making simultaneous turns, on most roads other traffic should be blocked off at both ends of the column before the signal for reversing direction is given. Even

though the traffic is heavy, it may be advisable to attempt simultaneous turns, assuming guards can stop traffic for the short time necessary.

107. BACKING

a. If a road is narrow and adjacent areas are flooded, mired, or otherwise impassable, it may be necessary to reverse the entire convoy by backing until space for turn-around is reached. This is an abnormal condition which should not occur if proper reconnaissance, highway regulation, and control are practiced. However, in an emergency, such as meeting another convoy head-on, or running unexpectedly into enemy action on a one-lane road, it may have to be done. The assistant driver or a member of the troops being transported, if any, should dismount or take a position in the rear of the vehicle so he can assist the driver in backing and guide him in such a manner as to prevent backing off the road or into the vehicle behind. As to the driver, it is advisable for him to judge the proper distance from the left hand limit of the road and make use of his rear view mirror rather than lean too far out of the cab or stand on the running board. A driver should never back his vehicle until he is certain the way is clear. When his view is obstructed he should act on the directions of an assistant on the ground. When backing unassisted, the driver should always give warning of the movement vocally or by sounding his horn.

b. Considerable practice is necessary to back vehicles safely and accurately. This is particularly true when there are towed loads. Full trailers are very difficult to back for any distance. Backing semitrailers requires skillful drivers. When no other alternative is available, full trailers may be attached to the front of the vehicle to the rear and backed in that manner, or they may be manhandled.

108. NIGHT MARCHES

a. Purpose. Round-the-clock military operations require that marches be conducted with effectiveness night and day. Night marches have certain advantages over day marches: they provide concealment from hostile observation; in hot weather they may be made to avoid excessive heat; and, under most night conditions, casual and unorganized traffic is less and therefore causes less interference with organized moves.

b. Control. Night marches must be carefully planned. Prior reconnaissance of routes and assembly areas is especially important. Special precautions are taken to insure the maintenance of direction and contact within the column. Guides and connecting groups are furnished when necessary. After any halt, scheduled or unscheduled, the control personnel of the column must check to assure that drivers are awake and move out to avoid a break in the moving column.

c. Driving Lights. Normal night driving requires good lights and good eyesight. A dangerous period of the day is twilight when the eyes of the driver are not completely adjusted to the artificial lighting necessary at night. Therefore, if lights are allowed, they should be turned on early so that the driver's eyes have ample time to adjust to the change. Operations at night differ from daylight operations only in the measures that must be taken to overcome the adverse influence of darkness upon ease of control and avoidance of accidents. When driving lights are permitted, care must be taken not to exceed the speed which will permit the vehicle to be stopped within the space visible by the headlights. When a movement with lights is to be continued without lights, a few minutes should be allowed to accustom drivers' eyes to the changed conditions. The best way to pass oncoming vehicles safely at night is to keep well to the right side of the road or lane and slow down. It requires a few seconds after a vehicle passes for the driver to accustom his eyes to the darkness again. These few seconds are most dangerous during night driving and extreme caution should be exercised. Vehicles in convoy should follow the taillight or blackout taillights of the vehicle ahead, particularly in bad weather or on winding roads. If a convoy halts on the road at night in territory where lights are permissible, flares should be set to the rear of the last vehicle and the front of the first vehicle, or the first vehicle should keep its low beam headlight on.

d. Mountain Driving at Night. The danger of blackout driving in mountains must be weighed against the danger of enemy action, and a decision made as to which risk should be taken. Driving without lights on narrow winding mountainous roads should be held to a minimum. When blackout driving is necessary because of enemy observation it should be limited to those stretches of road estimated to be visible to the enemy. At these points signs and guides should be posted to give special instruction to each driver as he approaches. Trucks should normally be in close column. Only when the driver can definitely see the road or the taillight of the vehicle in front is it safe to drive without an assistant driver preceding on foot. Lead vehicles should proceed slowly. In the absence of military police, traffic control must be delegated to persons within units making the march. Telephones should be installed to regulate or control traffic on stretches of one-way road. Traffic jams can be largely avoided if the following precautions are taken: establishing a block system for one-way roads; setting definite priorities; preventing turn-arounds except at places especially prepared and designated for that purpose; requiring troops to march at the side of the road when necessary. When trucks must pass each other on a narrow road, the one on the safe side should move forward only after the one on the more dangerous side has pulled over as far as possible and has come to a full stop.

109. BLACKOUT RESTRICTIONS

Restrictions on use of lights are required to provide secrecy and concealment at night. To prevent light from any source being observed, there must be no smoking or lighting of matches during marches made under blackout conditions. Flashlights, headlights, and vehicle parts that might reflect light should be covered. Special blackout lighting equipment on vehicles has been devised to facilitate move-

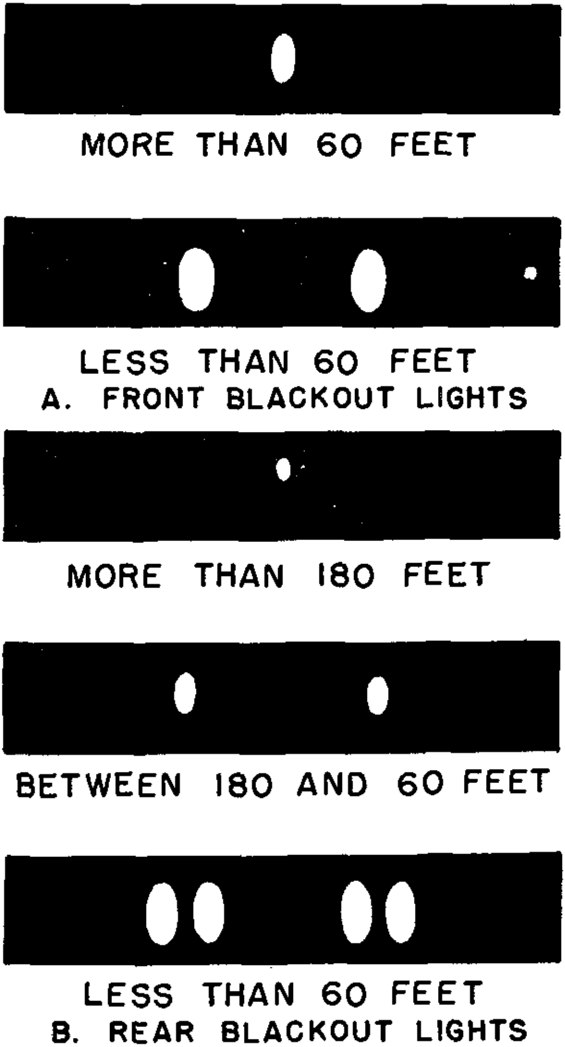


Figure 22. Blackout lights.

ment under these conditions (fig. 22), but in close proximity to the enemy use of any lights whatsoever may be inadvisable. Blackout restrictions are usually covered in the general highway traffic plan, in orders or SOP or in the traffic paragraph of the administrative order. They may be repeated in the march order.

SECTION 111. COMPLETION OF THE MARCH

110. GENERAL

A unit march is completed when the unit has completed its march mission and reached its new location. In the case of a supply movement, the march is not completed until the load is properly made available to the receiver or until empty vehicles have reported to their final destination.

111. RELEASE POINTS (RP)

a. A release point is a location at which specified elements of a column or a convoy revert to control of their respective commanders. It is the final point at which the march is checked upon leaving the route of march and breaking up before entering bivouacs or dumps. In case of larger moves, there may be successive release points for successively smaller elements. For example, there may be a regimental release point, a battalion release point, etc.

b. In many cases guides may be required at release points to direct march units or individual vehicles to their respective areas. They may be picked up at the point and accompany the lead vehicle to the destination point or they may be posted so as to direct vehicles to bivouac or dump areas. If the march has been preceded by advance elements or is moving to an established area, route signs and markers may be placed so as to direct elements from the release point to their destination.

112. DUTIES FOLLOWING THE MARCH

Facilities for washing, messing, and rest should be available to personnel as soon as possible upon completion of the march and the performance of after-operation service by vehicle crews. If the march ends in a new bivouac, such facilities as latrines, kitchen and shelters should be immediately set up. Sick call may be held, and the commander may conduct an informal inspection to determine the health and comfort of his men and the condition of his equipment.

CHAPTER 8

SUPPLEMENTAL ACTIVITIES ON THE MARCH

Section I. GENERAL ADMINISTRATIVE ARRANGEMENTS

113. GENERAL

A military organization must be able to carry on its routine administrative functions while a movement is in progress. Unit headquarters, messes, supply, and attached medical personnel should be prepared for possible moves at all times and at the same time be prepared to carry out such functions as may be necessary during a march.

114. ROUTINE ADMINISTRATIVE REQUIREMENTS

Certain administrative matters are necessary in connection with every march. Besides arrangements for messing, quartering, and medical aid, covered in later sections, the following administrative matters must be considered:

a. The march plan must result in orders and instructions to subordinates.

b. Any change in status of a unit or of personnel resulting from a move must be properly recorded in appropriate records.

c. Clearances for the move may be required either through the highway regulations office or from the civil authorities.

d. Security of files must be maintained and provision must be made for disposal of classified material in event of emergencies.

e. The commander should have up-to-the-minute data regarding the status of personnel and equipment of all elements of his command. This may include strength figures; rosters; reports on health and morale of troops; equipment lists; reports on condition of weapons, and supply of ammunition, vehicle loads, etc.

Section II. MESSING

115. GENERAL

Arrangements for messing for personnel of a convoy or march unit depend on the situation and facilities available.

116. COOKING EN ROUTE

Kitchen trucks may march either in the head or the trail of their respective units or, in long columns, halfway between head and trail. When kitchen trucks march at the head, they halt at the prescribed hour, and personnel in the rear are brought up for mess. When they march at the rear, they may pass along the column and issue mess. When the kitchen truck is located at a halfway point in the column, troops may dismount and march to it for meals. It may be desirable to have a schedule for messing so as to prevent crowding at the mess truck or on the side of the roadway.

117. MESSES ALONG THE ROUTE

a. On dispatch and other regularly used routes, messes are sometimes set up by personnel stationed along the route. Frequently, such messes are located at highway regulation points or other centers where large numbers of troops pass.

b. Mess stations must be notified sufficiently in advance, to enable them to have the required quantity of food at the scheduled hour. This form of mess is particularly suited to convoys on a regular, established line haul.

Section III. QUARTERING

118. PLANNING

a. Regardless of the type of movement, whether it be of supplies or personnel, it is important that plans for quartering be made in advance.

b. In the case of large columns or convoys, the quartering arrangements are usually included in orders from higher authority or in standing operating procedures.

c. In the case of movements over dispatch routes, quarters may be provided along the route, frequently at highway regulation points. Use of these facilities may be included in highway regulation orders or specified in other directives.

d. Small units proceeding independently may have to send advance parties to make suitable arrangements for quartering.

119. BIVOUACS

a. It is important to base the selection of bivouac sites on factors other than mere map study. Unnecessary congestion has been caused by units selecting the same bivouac area. If the area is congested, selection of bivouac sites should be coordinated by higher command.

b. The best bivouacs are those providing concealment cover and a potable water supply. Low, marshy ground should be avoided. Entrance and exit roads for vehicles are an important consideration in selecting this site.

c. Within metropolitan areas bivouacs may be found in large parks, fair grounds, and on or adjacent to airports not in use. In the continental United States bivouacs must be arranged for in advance. Usually it is preferable to stay at some distance from cities or other thickly populated areas.

d. Drivers should be bivouacked or billeted in the vicinity of the motor park where their vehicles are located. At some posts this may not be practicable nor necessary. However, in the field it is usually essential.

e. When tactical considerations govern, vehicles may be scattered throughout the bivouac rather than grouped into a motor park. When this is done troops may be allowed to sleep in empty vehicles, but they should never be allowed to sleep under them or at positions along their exit routes from the bivouac. On breaking bivouac every driver should check under his vehicle and along the route he will take out of the bivouac to assure that he will injure no one on the ground.

Section IV. MEDICAL

120. GENERAL

Medical service should always be available to a march. It may be provided by the area command through which a march proceeds, or it may accompany the march.

121. MEDICAL SERVICE ON THE MARCH

a. Elements organic to a unit should accompany the parent organization. Medical elements in a large column are dispersed throughout the column; in small columns the medical element should be located at the trail. In large columns, a sufficient number of ambulances should be made available. When only a few vehicles are involved in a convoy, medical service may consist of first aid kits only.

b. No one should be allowed to ride in ambulances or other medical vehicles except the assigned medical personnel or men actually sick or under treatment.

c. If the march lasts more than a day, arrangements should be made for regular sick call during a halt or before breaking bivouac.

d. First aid kits should be readily available at all times, even if a medical detachment is marching with the convoy.

e. Every driver should know the rudiments of first aid.

Section V. ACCIDENTS AND PROCEDURES FOLLOWING ACCIDENTS

122. GENERAL

a. Motor vehicle accidents usually result from careless driving, disobedience of traffic directives, or disregard of the rules and normal courtesies of the road. Prevention is far more important than corrective action. Safe driving practices, defensive driving, and common courtesy, instilled in Army drivers, constitute the best insurance against mishaps on the road (TM 21–305).

b. Because of the greater degree of supervision and control, accidents are less likely in an organized march. Nevertheless, when accidents occur in column formations, they may temporarily disrupt the march and for this reason are more serious from the standpoint of keeping the organization intact and on its prescribed schedule.

c. Many accidents ocurring in convoy formations may result from faulty march planning or from causes other than driver neglect. Columns formed too compactly for safe driving may create hazardous conditions. Improper control, especially at intersections and in congested areas, may be the cause of accidents and disruption of the column.

123. NORMAL PROCEDURE IN EVENT OF ACCIDENT WITH A MARCH COLUMN

The following procedures are those normally required regardless of the location or circumstances surrounding an accident. They may be followed in the case of damage or casualties resulting from enemy action as well as in the case of damage or casualties caused by carelessness. However, certain deviations may be necessary, depending on circumstances.

a. Column Continues the March. The main part of the column does not stop to render assistance. Every effort is made to clear the route and continue the march. However, a serious accident may cause part of the convoy to be blocked, or it may make it advisable for a small convoy to be halted. Such halts should be made a sufficient distance from the scene to avoid further congestion and mishap.

b. Trail Gives Assistance. Vehicles to the rear pull around the accident. If the accident blocks the route, the occupants of vehicles in the rear must clear the way at once, then proceed with the march. If immediate assistance is needed to aid personnel involved in the mishap, this may be given by the next following vehicle. The next following officer, or noncommissioned officer, takes control in rendering emergency aid and in directing other vehicles past, until the trail officer or medical officer arrives, or until other assistance is obtained. Necessary steps to care for the injured and to salvage vehicles and cargoes are normally carried out under the direction of the trail officer, assisted by any medical, maintenance, and salvage personnel which may be available for the purpose.

c. Precautions Against Further Accident.

(1) After a motor vehicle accident the vehicle or vehicles involved are frequently in dangerous locations, and sometimes a crowd collects in the road. Another accident—per-

haps more serious than the first—may occur when another vehicle crashes into the wreck or hits persons in a crowd. To prevent additional accidents, damage, or injury, the first thing to be done is to post guards, flares or lights (except in blackouts), or flags to warn all other traffic to proceed with caution. If civil or military police are present, they will usually direct traffic; otherwise soldiers may act as traffic guards.

(2) Traffic personnel restore normal traffic movements as soon as possible. It is desirable that damaged vehicles be left undisturbed, when this does not interfere with important traffic, to assist the investigating officer in determining how the accident occurred. Military need permitting, witnesses should remain at the scene of the accident to provide information for the investigating officer. All others are kept away, and traffic is kept moving so far as possible.

d. Aid to Injured. Personnel injured in an accident should be given immediate first aid. Unless competent medical personnel are immediately available, first aid should be restricted to removal from the vehicle if this can be done without further injury or if there is danger of fire. (Injured should be moved as little as possible before arrival of competent medical personnel.)

e. Precautions Against Fire. In motor vehicle accidents, there may be gasoline leakage. Gasoline exposed to the air creates a highly flammable vapor, which means great danger of fire. This should be lessened by cutting off engines and permitting no smoking and no open flame near the wreck.

f. Summon the Proper Authorities.

(1) Normally all accidents, however trivial, which result in injury to an individual or animal or damage to property, are reported to the column commander or designated staff officer without delay and to the military police of the nearest military installation (sec. XII, ch. 3, FM 19–25).

(2) Most civil governments require that police be summoned in cases of motor vehicle accidents. The army cooperates with civil authorities in the United States and friendly countries in such matters. If civil police are not on hand, they should be notified.

Section VI. REFUELING ON THE MARCH

124. GENERAL

a. When convoys require fuel beyond the capacity of the vehicle tanks used, provision must be made for refueling en route. It is important that refueling be accomplished before there is any possibility of exhaustion of fuel by any vehicle in the column, but vehicles should not be refueled too early, as the operation must then be repeated more frequently.

b. However, advantage is taken of every opportunity to keep fuel tanks filled without delaying the march. Halts made for any other purpose should be used for refueling when practicable. Close supervision of fuel distribution is necessary to take care of differences in fuel requirements of various vehicles.

c. Every precaution should be taken against fire during refueling. Engines should be cut off, care should be taken to avoid spilling fuel, and there must be no smoking on or near vehicles at this time. When the column is subject to enemy attack, refueling should be carried out under cover of darkness or, if in daylight, in concealed areas.

125. METHODS

Fuel may be supplied to vehicles in column by means of the following:

a. Filled Containers Carried by the Column. The most rapid method of refueling is by use of filled containers issued to vehicles before starting a march. If sufficient cans are available, no other method of refueling may be necessary for the entire march. Filled containers may be issued to each vehicle or all cans may be loaded on one particular truck of the column, which during a halt moves along the column exchanging filled containers for empties.

b. Refueling Points Established Along the Routes. Refueling points established along the route or set up in advance by the moving unit may be of the nature of gasoline dumps or parked tank trucks. To prevent congestion at such refueling points casual vehicles and those comprising infiltration marches may be refueled and dispatched as they arrive, and vehicles in column may pick up containers and move to a less congested place beyond the point for refueling. When permitted by local regulations, empty containers may be left at the roadside after refueling to be picked up later and returned to the point. Care must be taken to assemble by unit and stack the cans neatly and in such a manner as they may be easily observed from the road.

c. Permanent Gasoline Dispensing Units or Filling Stations. Commercial filling stations may be made available to military use or may be operated by the military; otherwise, gasoline dispensing units supplied from tanks or from taps off military pipelines may be provided at established locations.

d. Tank Trucks. Tank trucks may be located at refueling points or attached to the column, or they may move along a route to refuel convoys at prearranged locations. At the halt tankers will move along the column filling tanks and containers, or vehicles may be moved past parked tankers.

PART FOUR

HIGHWAYS AND HIGHWAY TRAFFIC

CHAPTER 9

MILITARY HIGHWAY TRAFFIC

Section I. GENERAL

126. CHARACTERISTICS OF MILITARY TRAFFIC

a. Military traffic consists largely of movements of groups of vehicles having a common mission. Civilian traffic is usually movements of individual vehicles having limitless variations in origin and destination. Nevertheless, there is a considerable amount of casual military movement which is similar to ordinary civilian traffic. There is also, in many cases, flow of civilian traffic, in areas of military operations, which is essential and cannot be disregarded.

b. The flow of military traffic is subject to large, erratic, and often unpredictable changes; and this flow may be interrupted by traffic jams and bottlenecks for short or long periods of time. Such changes and interruptions may occur with little or no advance warning.

127. TRAFFIC CONFLICTS

a. All traffic difficulties including accidents, delays, and confusion arise from the same basic cause, which is the *conflict* of moving traffic units, with each other, or with fixed objects in or adjacent to the normally traveled roadway. Conflicts which the column or march unit and the traffic engineer must consider are of four types:

(1) Between vehicles at intersecting courses.

(2) Between vehicles meeting from opposite directions on the same route.

(3) Between vehicles moving along a road and other vehicles, persons, or objects at the edge of or immediately adjacent to the road.

(4) Between vehicles proceeding at different speeds in the same direction.

b. These conflicts may result in either congestion or collisions, due to many factors, including deficiencies and limitations of roads, vehicles, and drivers. The approach to the problem may be facilitated by a distinction between correctable deficiencies and limitations which are not correctable. By correctable deficiencies is meant those characteristics of men, vehicles, and roads which a commander can effectively overcome before they are allowed to seriously handicap his mission; by limitations, is meant these characteristics which, because of their more inherent nature, cannot be immediately overcome and to which the commander's plans must conform. For example, the mechanical defects of vehicles may be corrected, however, vehicle size and capacities limit the loads which may be transported in them. The highway network might be improved or extended if time and equipment allowed; but in many cases there is no time for such corrective measures, so limitations as to widths and clearances must be considered.

128. COORDINATION

a. Traffic difficulties can be resolved only through the coordinated efforts of all concerned—from the commander and his staff to the drivers of individual vehicles and their immediate supervisors. This requires a closely intergraded system of traffic management.

b. For the best results it is necessary that traffic management be a coordinated function under a central agency and, equally important, that the unit commander understand his relationship and responsibility to the over-all function of traffic management. Traffic management must provide effective correlation of highway transport equipment and highway facilities with the demands of supply and personnel movement. It must also provide the necessary coordination of all traffic moving over highways in order to realize priorities and the demands of the tactical situation.

c. When movement must proceed over roads under jurisdiction of civilian authorities, appropriate coordination with those authorities must be effected. Generally, this will include advance notice of military movements given to civilian agencies and fullest cooperation on the part of marching personnel with civilian traffic police.

129. *HIGHWAY MOVEMENT RECONNAISSANCE*

a. General. Highway movement reconnaissance may be necessary to obtain information upon which to base the traffic plan or to supplement or confirm available data. The amount and type of information to be obtained is dependent upon available time, personnel, equipment, and the situation.

b. Personnel. Highway movement reconnaissance should be made by highway traffic engineers obtaining specific data on a particular route. In the absence of technically trained personnel reconnaissance parties may be sent out over sections of the road net to obtain general information as to best available routes, etc. In established areas traffic reconnaissance should be a continuing process accomplished by technical personnel stationed throughout the area who furnish headquarters information on the ever changing traffic situation.

c. Sources of Information. Preliminary information as to the location of roads, their general alinement, general capabilities of routes to handle required traffic, and other characteristics is usually obtained from a study of maps or aerial photographs and from traffic authorities. Even though other sources of information may be available, traffic reconnaissance may be necessary to supplement data already obtained, to substantiate this information, or to bring it up to date. When sufficient data is available, reconnaissance may be negligible or even omitted.

d. Reconnaissance Equipment. Equipment needed for highway movement reconnaissance will vary with the type of information sought. The reconnaissance parties may have need of the following:

(1) *Transportation.* Sufficient light vehicles are usually a necessity. Aircraft may also be used for this reconnaissance.

(2) *Communication.* Exisiting communication facilities such as telephone and teletype may be used in transmitting reconnaissance data. Communication by radio may also be desirable. When aircraft are being used for traffic work, prearranged signals may be used by traffic personnel on the ground.

(3) *Maps and aerial photographs.* Maps, particularly road maps, are needed for orientation and guidance. They also provide a convenient form on which to record road data. Recent aerial photographs are a valuable supplement to maps, particularly when available maps are not up to date.

(4) *Special equipment.* The following equipment will be found useful on traffic reconnaissance:

(*a*) Vehicle mileage recorder for tabulating distance between points.

(*b*) Stop watch for use in timing traffic past particular points and in estimating traflic flow.

(*c*) Tally counters or traffic recorders for estimating traffic volume.

(*d*) Tapes or calibrated rods for measuring bridges, fords, overpasses, road width, etc.

(*e*) Engineer sketching equipment for preparing sketches or overlays.

(*f*) Camera for photographing hazardous or other positions of interest to the planners.

(*g*) Binoculars.

(*h*) Tool kit for hasty correction of damaged or fallen signs.

e. Information to be Furnished Reconnaissance Personnel. Directives for reconnaissance should include the following:

(1) Basic information.

(*a*) Routes to be reconnoitered.

(*b*) Extent and nature of information to be obtained.

(*c*) Brief statement of the situation as it affects the reconnaissance.

(*d*) Personnel, transport, and equipment available for the task.

(*e*) Type of report desired; time and place to submit report.

(2) More specific information which may be required by a particular reconnaissance.

(*a*) The tactical or logistical requirements directly affecting traffic over routes, including size and type of units to be moved, destination, etc.

(*b*) Maximum loads expected, maximum overall lengths, widths, and heights of vehicles when loaded, and minimum turning requirements.

(*c*) Weights of heaviest units to pass over the route, destination of loads, out-sized loads, etc.

(*d*) Types and methods of march to be employed, that is, individual dispatch, convoy, or other.

(*e*) Requirements as to location of dumps and terminals, staging areas, etc.

(*f*) Required route signing and marking to be accomplished.

(*g*) Other specific questions as to information to be obtained.

(*h*) Reconnaissance personnel to be furnished all available information pertaining to the route(s) to be reconnoitered.

f. Information to be Obtained by Traffic Reconnaissance. Following are types of information which may be obtained by traffic reconnaissance. Very seldom will all of these items be required from reconnaissance parties.

(1) General route information.

(*a*) Location and nature of major routes.

(*b*) Location and character of major junctions and access or egress routes to the major routes being reconnoitered.

(*c*) Location and character of major road blocks, contaminated areas, mines, and other potential hazards.

(*d*) Location and characteristics of bypass routes or detours around congested areas, fords, and road blocks.

(*e*) Location and characteristics of routes that provide maximum protection from hostile ground or air attacks.

(*f*) Distance between all important points.

(*g*) Types of surface and condition of roadways and shoulders.

(*h*) Width of roadway and/or number of traffic lanes available in each section of roadway.

(*i*) Limiting physical features (clearance heights and widths and maximum allowable loads) of structures such as bridges, overpasses, and culverts.

(*j*) Maximum gradients of steep hills.

(*k*) Road and bridge construction required and in progress.

(2) Dump, terminal, and other facilities.

(*a*) Adequate sites for the location of dumps, depots, servicing stations, and other supply facilities, particular attention being given to their access from the major routes.

(*b*) Evacuation and hospital facilities.

(*c*) Location and characteristics of turn-around facilities, off-road halting places, bivouacs, etc.

(3) Traffic information.

(*a*) Traffic density and traffic volume existing or anticipated and by which an estimate as to military vehicle and tonnage capability of the route may be made.

(*b*) Variations in traffic flow during particular time periods over sections of routes. This information may sometimes be obtained from civil authorities, or by devices which automatically count traffic flow in relation to time.

(*c*) Location of sensitive points of high traffic volume, potential bottlenecks, cross-road interference, intersections needing control, railroad crossings needing guards, defiles needing two-way regulation, sections of routes needing patrols, etc.

(*d*) Existing or needed signal communication facilities.

(*e*) Existing or needed traffic control devices including signs, route markers, etc.

(*f*) Traffic control techniques employed or deemed necessary.

(4) Recommendations and conclusions.

(*a*) A general estimate of engineer work needed.

(*b*) Recommendations as to traffic circulation, possible routings, etc.

(*c*) Estimate as to officer and noncommissioned personnel required for traffic control and highway regulation purposes.

(*d*) Summary of findings, recommendations, and conclusions.

g. Limitations. Traffic reconnaissance should be for the specific purpose of gaining information upon which headquarters will base the traffic plan. For that reason reconnaissance parties should not normally be assigned tasks which would delay or otherwise handicap them in their primary assignment.

Section II. FUNDAMENTALS OF HIGHWAY TRAFFIC PLANNING

130. GENERAL

a. Only with the cooperation of all elements using the highways may the traffic authority properly perform its functions of regulation and control. To the accomplishment of this end it is important that the individual commander of a march be familiar with the fundamentals of higher level traffic planning.

b. Knowing the number, nature, and capabilities of the highways, and the quantity and nature of that which is to be moved, the highway transport officer must plan the number and type of vehicles and truck units needed. These plans must consider whether the situation requires vehicles capable of negotiating unimproved or poorly constructed roads or of driving off-road over difficult terrain. Must they be capable of cross-country movement or will the road net permit the use of larger vehicles capable of transporting big loads and thereby conserving road space, personnel, and fuel? Plans must be made for the necessary highway transport personnel, not only for the actual hauling but for command and staff supervision, including highway regulation functions.

c. In planning the location of terminals, depots, and dumps, care must be taken that they conform to the general traffic circulation plan, that it is practicable for vehicles to reach the dumps, or depots, even in bad weather, and that there is sufficient hardstanding for operation within the installations.

d. Highway traffic planning is a continuing project during the course of an operation. Concurrent movements are separated in space by assignment to nonconflicting zones of movement, routes, or traffic lanes. Movements can be separated in time by scheduling to avoid conflict. The plan must be adaptable to ready modification, expansion, or alteration.

131. FACTORS IN HIGHWAY TRAFFIC PLANNING

Basic factors used in highway traffic planning have to do with the number and types of vehicles which may either occupy or move through a segment of roadway. Traffic density (vehicles per mile) is the space factor and traffic volume (vehicles per hour) is the time factor. The use of these two factors is related to the time and distance factors used in march planning, and the formula by which they are computed is somewhat similar. Traffic volume and density are very important in studying highway vehicle and tonnage capability, but are only a secondary interest to the march unit commander. He should, however, be familiar with them in order to fit the movement of his unit properly into the traffic pattern.

a. Traffic Volume. Traffic volume is the number of vehicles moving in a specified direction or directions on a given lane of roadway that pass a given point during a specified period of time. (*Traffic flow*, often used synonymously, implies volume of vehicles flowing in one direction only).

b. Traffic Density. Traffic density is the number of vehicles occupying a unit length of roadway at a given instant. It is usually expressed in vehicles per mile.

132. TRAFFIC VOLUME

a. Traffic volume (or flow) is usually expressed in vehicles per hour and can be determined by the following formula:

Density $\times$ speed = volume

This may also be stated as follows:

Vehicles per mile (vpm) × average miles per hour (mph) = vehicles per hour (vph).

b. For planning purposes, when a major portion of traffic over a route is organized military movement, allowance must be made for the time gap between march units and serials. The traffic volume of individual march units, because of their internal densities, will be higher than the average flow over a specified lane of the route. Therefore, the average volume per lane must be appropriately increased before being applied to the flow of march units or columns. For adaptation to a specific area under field conditions, it is necessary that time and space studies be conducted continuously in order to arrive at a suitable factor. This study may result in traffic volume to which allowances for time gap between march units and serials must be added, or a traffic volume which includes allowance for time gap between march units and serials.

133. TRAFFIC DENSITY

a. Traffic density is usually expressed in vehicles per mile and can be determined by the following formula:

Volume ÷ speed = density

This may also be stated as follows:

Vehicles per hour ÷ rate of march in miles per hour = vehicles per mile.

b. Any traffic density desired to effect dispersion or to maintain maximum capacity of a route may be arrived at by another process as follows:

One mile (in yards) ÷ desired intervehicular lead (in yards) = density.

For example, if, for security reasons, it is desired to disperse vehicles every 100 yards (lead), the density established would be:

1,760 yards ÷ 100 = 17.6 vehicles per mile.

Section III. TRAFFIC AIDS—MAPS AND SYMBOLS

134. TRAFFIC MAPS

a. General. Traffic information presented through use of symbols on maps may include the following items:

(1) Road net; adjacent signal communication net; connecting or parallel rail and other transportation nets.
(2) Designation by lettering or numbering of specific routes.
(3) Identification of traffic terminals, cities, towns, intersections, military establishments, and important terrain features.
(4) Road data, distances, limitations, etc.
(5) Direction of traffic movements, lanes, etc.
(6) Classification of routes.
(7) Traffic volume, traffic density.

b. Strip Maps. These maps are particularly useful to march personnel. They give a schematic picture of a route of march and information pertaining thereto. When practical, strip maps should be reproduced in quantity and supplied to all personnel concerned, such as column commanders, control officers, trail officers, serial and march unit commanders,

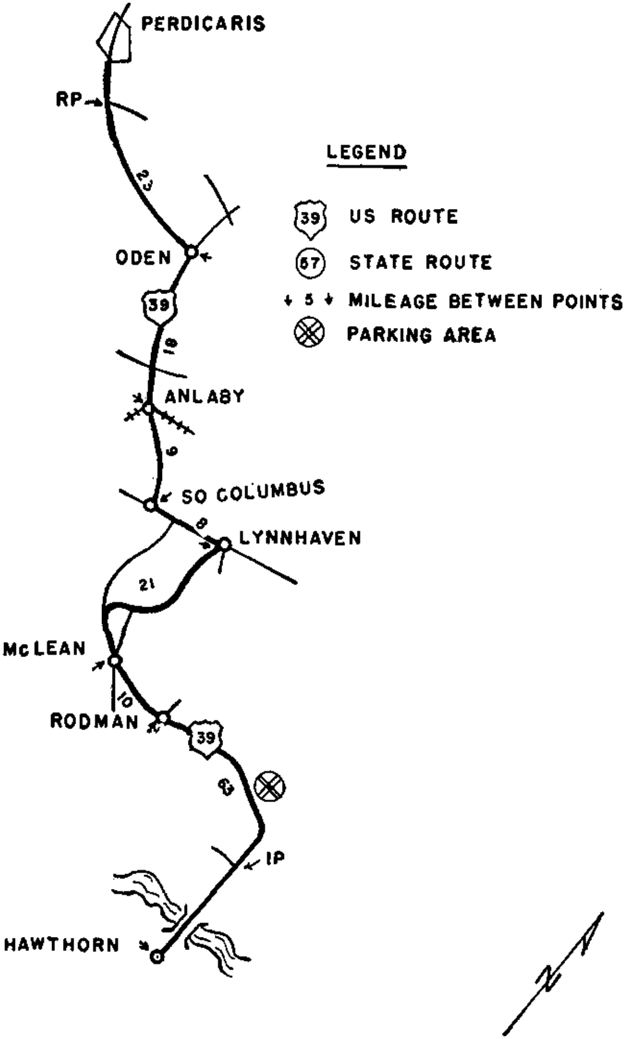


Figure 23. Strip map.

vehicle drivers, guides, and escort personnel. A strip map is especially neeeded when drivers operate independently or when gaps between vehicles are so large that individual vehicles may become separated from their column. When strip maps cannot be made available, march personnel should be provided with a list of places through which they must pass, numbers of highways to be used, and detailed directions regarding turns to be made en route (fig. 23). Strip maps need not be accurately, but should be roughly, to scale.

c. Overlays. An overlay is a transparent sheet used in connection with a map, which gives special military information not shown on the map. When laid over the map on which it is based, the details on the overlay will supplement the map. Overlays and strip maps traced from larger maps are easily reproduced in the field and are beneficial in outlining the route to be followed on a particular march. They may also give location of bivouacs, initial points, halts, etc. (fig. 24).

d. Traffic Maps. Traffic maps are used by higher headquarters in preparing the traffic plan. Strip maps, overlays, and circulation maps may be derived from traffic maps. The circulation map is a type of traffic map.

e. Circulation Maps.

(1) Circulation maps are used to indicate a road net or system of routes, and necessary information and traffic restrictions pertaining thereto.

(2) The circulation map establishes one-way, two-way, and alternating routes of traffic

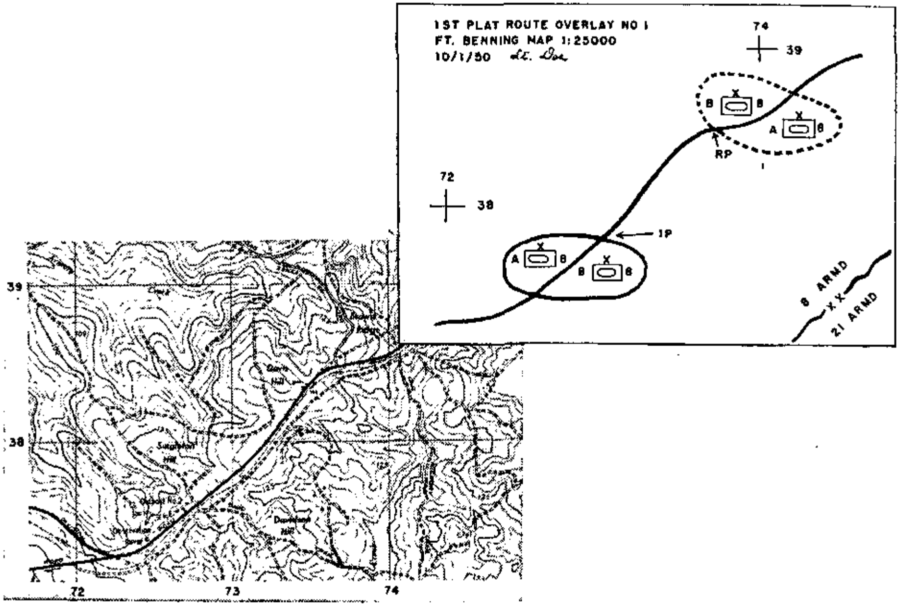


Figure 24. Overlay.

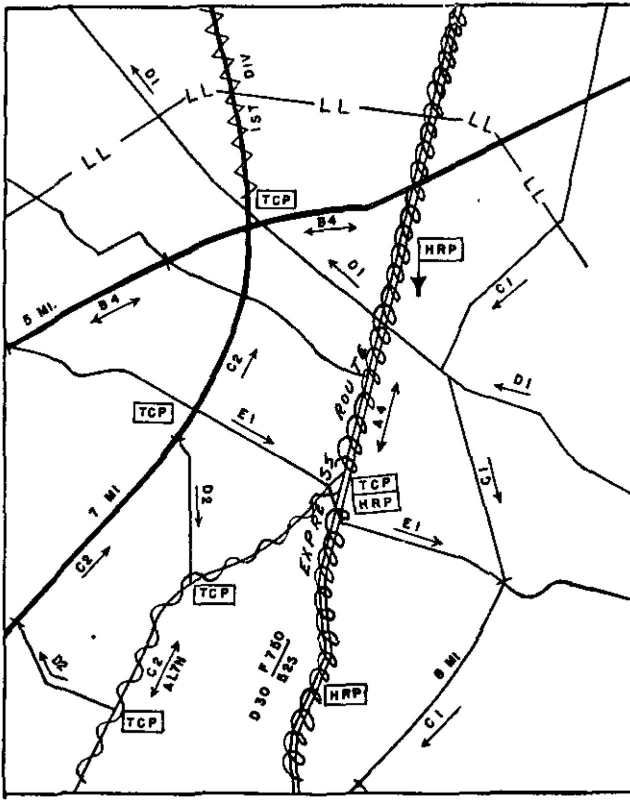
flow. Care is taken to assure that routes are available for a circuitous flow in the required directions. A one-way route normally requires a compensating route in the opposite direction for the return of vehicles, and adequate access and egress routes must be provided along all routes. Where the balance between main routes and access-egress routes is not maintained, the capability of main routes may be limited to the capability of the access or egress facilities.

(3) Circulation maps show such information as open, supervised, dispatch, and reserved routes; limit lines; area boundaries; mileage between important points; bridge and other weight limitations; restrictions on density, speed, etc; and location of dumps, depots, highway traffic control posts, and highway regulation points. Road information shown on circulation maps applies throughout the length of road between points shown by heavy dots or crossbars.

(4) Circulation maps frequently consist of a standard map plus an overlay which together give the needed information. In some cases the needed information may be too much to get on one overlay, in which case separate overlays may be used to show different types of information (fig. 25).

135. MAP SYMBOLS

a. General. The following symbols may be used to present traffic information in convenient and con-



EXPRESS ROUTE (RESERVED-DISPATCH)

Figure 25. Traffic circulation map.

cise form on highway maps. Other map symbols are covered in FM 21–30.

b. Road Classification Symbols:

(1) In classifying a stretch of road a rating of either good or poor is determined independently for each of the following elements of

the road: alinement, drainage, foundation, and surface. In recording the ratings, each element is symbolized by the first letter of the word denoting it—"A" for alinement, "D" for drainage, "F" for foundation, and "S" for surface, as indicated in table I. The classification also includes symbols pertaining to the length of the stretch of road to which the classification applies, the width of the traveled way at its narrowest point, and the type of surface material. Table II shows these additional symbols. All of the road classification information is presented in the form of a fraction. Symbols for elements rated "good" and symbols for road widths and surfaces are placed in the numerator, while symbols for elements rated "poor" and for road lengths appear in the denominator. For example—

$$\frac{\text{“good” elements, road width, surface type}}{\text{“poor” elements, road length (in miles)}}$$

The following:

$$\frac{\text{F W20 bs}}{\text{ADS 9.2 mi}}$$

denotes a stretch of road 9.2 miles long and 20 feet wide at the narrowest point in the traveled way, which has a good foundation, poor alinement, poor drainage, and a light-duty bituminous surface in poor condition.

(2) *Certain temporary or singular data such as* one clogged culvert or one sharp curve in a long length of road should not be the limiting factor for classifying the entire length,

Table I. Ratings of Elements Used in Road Classification

Element	Symbol	Rating	
		Good [a]	Poor [b]
Alinement	A	Moderate grades, gradual curves, adequate sight distances.[c]	Steep grades, sharp curves, inadequate sight distances.
Drainage	B	Adequate ditches, crown or superelevation, with adequate culverts in good condition.	Inadequate ditches, crown superelevation, or culverts; culverts and ditches blocked or otherwise in poor condition.
Foundation	F	Stabilized, compact material of good quality.	Unstable, loose, or easily displaced material.
Surface	S	Free of potholes, bumps, or ruts; pavement, if present, free from excessive cracking.	Potholed, bumpy, or rutted; pavement badly cracked.

[a] If the rating is "good," the symbol will be placed in the numerator of the fraction.

[b] If the rating is "poor," the symbol will be placed in the denominator of the fraction.

[c] Moderate grades are 6 percent or less steep grades more than 6 percent. Gradual curves have 150-foot radius or more, sharp curves have less than 150-foot radius.

Table II. Symbols for Length and Width of Road and for Types of Road Surfaces

Symbol	Meaning
	LENGTH AND WIDTH
mi	Preceded by numeral indicates length of the road in miles between two points identified by dots on the map or overlay.
W	Followed by a numeral indicates width in feet of the traveled way at the narrowest point.
	TYPE OF SURFACE
k	Concrete.
bt	Bituminous pavement, heavy duty.[a]
bs	Bituminous surface treatment (except on concrete, brick, or block pavement), bituminous stabilized sand or gravel, or other bituminous type suitable only for light duty.[b]
br	Granite cube, stone block, or clay brick pavement.
m	Crushed rock, macadam, or coral.
g	Gravel.
sm	Stabilized soil, sand-clay, shell, cinders, disintegrated granite, or other select material.
ea	Earth.
XX	Other types not itemized above. See reconnaissance notes for complete description.

[a] Flexible pavement on a base course and subgrade capable of carrying continuous heavy-duty traffic.

[b] An initial course less than 1 inch thick is considered a bituminous surface treatment rather than a pavement.

but should be noted in an appropriate manner with complete description.

c. Bridge Symbols. (See fig. 26.) Bridge information is shown by a symbol such as:

$$\frac{\text{W18}}{\text{Clr 14 Cl}\ \frac{40}{20}}$$

W18 Indicates the width of the bridge curb to curb—in this case 18 feet.

Clr 14 Indicates the overhead clearance of the bridge in feet—in this case 14 feet. When the clearance is unlimited, the symbol Clr 00 is used.

Cl $\frac{40}{20}$ Indicates the weight class of the bridge and length of critical span. In this case, the weight class is 40 tons, and the length of the critical span is 20 feet.

d. Traffic Symbols (FM 21–30). Special traffic data may be abbreviated on maps in such a manner as to indicate a ratio of traffic density, speed, and resulting traffic volume or flow (pars. 132, 133). This combined symbol usually indicates the average speed and density and the resulting volume on a particular segment of roadway. However, it may be used to prescribe rates when so explained in marginal notes.

(1) The symbol for volume of traffic on two lanes of a roadway with traffic moving in both directions is given below:

$$\text{D60}\quad \frac{\text{V1500}}{\text{S25}}$$

D60 Indicates an average density of 60 vehicles per mile. (If density is prescribed, it normally indicates a

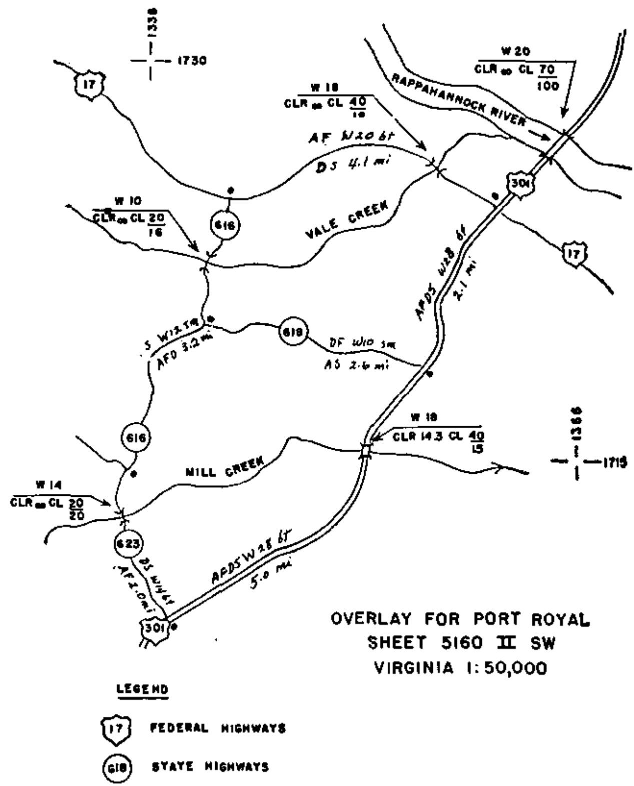


Figure 26. General road and bridge information which can be shown by symbols.

minimum which must be maintained.)

S25 Indicates an average speed of 25 miles per hour. (If speed is prescribed, it normally indicates a maximum which must not be exceeded.)

V1,500 Indicates the average traffic volume of 1,500 vehicles per hour resulting from the other two factors. (If volume is prescribed, it normally indicates that an established ratio of density to speed must be maintained.)

(2) The symbol for flow of traffic in one direction on a single lane of the same roadway is as follows:

$$D30 \quad \frac{F750}{S25}$$

D30 Note that density has been reduced by one-half so as to indicate 30 vehicles per mile on a single lane of the roadway.

S25 The speed remains the same, regardless of the number of lanes.

F750 Indicates an average traffic flow of 750 vehicles per hour in a given direction on a single lane. Note that traffic flow on the two-lane route results from dividing the volume by the number of lanes—in this instance, flow is one-half the volume.

Section IV. SIGNING AND MARKING ROUTES

136. IMPORTANCE

a. Traffic signs and markings are invaluable for orderly and safe circulation in the road net. However, their purpose is accomplished only if such devices are properly employed and uniformly understood. Improper practices on the part of those responsible for erecting signs and markers and inadequate training of drivers in recognizing the meaning of signs defeat the intention of route signing and marking, and hinder the flow of traffic.

b. Proper standardized traffic devices prevent individual vehicles or units from getting on the wrong route. Such devices indicate one-way routes; show speed limits and other regulations; prevent accidents by giving warning of conditions ahead; and minimize the need for guides and information stations, thereby conserving personnel.

137. EFFECTIVE USE OF TRAFFIC CONTROL DEVICES

The following essential factors require careful attention on the part of the agency erecting traffic control devices:

a. *Justification*. Installation of signs or other devices must be kept at a required minimum. Excessive use of signs detracts from the conspicuousness of important signs and often causes them to be overlooked.

b. *Uniformity*. To facilitate recognition, signs and markings must be of standard design. Uniformity involves adherence to standard size, shape, colors, wording, and symbols. Important features of the uniform standards are sign shape and color combinations.

c. *Location*. Devices must be placed where they can be observed in time to permit compliance.

d. *Position*. Signs should be mounted close enough to the roadway to be conspicuous, but not so close as to be likely to be struck by passing vehicles.

They should be installed where they will not be obstructed by undergrowth, branches, and buildings. At no time should unit signs be placed on the same mounting as general traffic signs. Traffic signs serving the greatest number of people should be given preference as to location and visibility.

e. Legibility. Words and symbols should be large enough to be read with ease. Wording should normally be limited to not more than four words to assure ready comprehension.

f. Color. Color combination and type of paint must be selected with care. Experience has shown that a flat, nonglossy paint is preferred to enamel. Bright lemon yellow contrasts best with black on warning and caution signs, and has highest visibility.

g. Accuracy. All signs and markers should be accurate, indicating exact condition. If a sign states that the speed limit is 15 miles per hour, then it should mean that a 15 mile per hour speed limit *will be enforced.* The warning "sharp curve" on a sign should indicate a *sharp* curve and not a gradual one. Use of signs which are not accurate causes drivers to have little respect for the signs and to disregard them.

h. Maintenance. Signs must be cleaned, reinstalled, replaced, and repaired promptly when necessary. All obsolete signs must be promptly removed. Provision must be made to prevent damaging, defacing, altering, or removing current signs.

138. SECURITY

a. It is occasionally advisable to remove all signs and markings which may aid the enemy. However, care should be taken that removal of signs and markings does not handicap our own and allied forces to a greater extent than it does the enemy.

b. It must also be remembered that signs which give the location of units and installations, while very helpful to those who must reach that unit, may also be read by enemy agents. The use of such signs must be determined by existing conditions and must be subject to orders of the commander concerned.

139. RESPONSIBILITY FOR POSTING OF SIGNS

The general responsibility for posting of signs and markings lies with the engineers, who procure or construct and erect all signs except those for temporary routes and traffic control; with the provost marshal, who prepares and posts route markings and traffic control signs for temporary routes or use; and with commanders concerned who always have a responsibility inherent to their command functions.

140. STANDARD MILITARY SIGNS

a. Military forces normally observe and make use of existing road signs in an area, and it is important that military drivers be familiar with the standard traffic devices of the United States (fig. 27) and of foreign countries (par. 146) where military operations may be conducted. However, there are many occasions when a military force must prepare and erect its own route signs and markers.

b. The US, British, and Canadian Armies have agreed on a standard system of military route signing for use wherever the existing devices are inade-

Figure 27. Examples of standard US signs.

quate or lacking. This system does not differ radically from standard US practice; it consists of regulatory signs (combining US regulatory and warning signs) and guide signs.

(1) *Regulatory signs.* Regulatory signs control the movement of traffic as directed by

authority or call attention of drivers to hazardous conditions on or adjacent to a road. The basic sign is a *yellow*, *diamond-shaped* sign with legend or symbol stencilled in black. Some samples of regulatory signs are given in figure 28. Special types of regulatory signs are the "railway crossing stop" sign and the "stop" sign as given in figure 29.

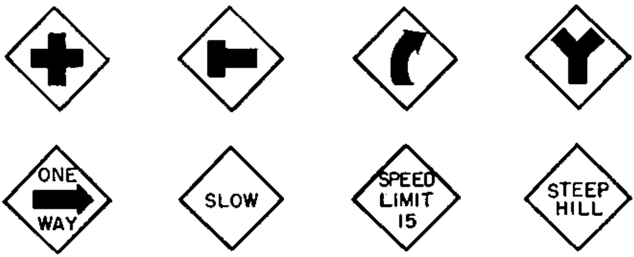


Figure 28. Joint US, British, Canadian regulatory signs.

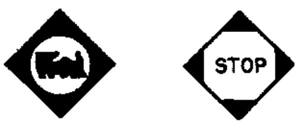


Figure 29. US, British, Canadian special regulatory signs.

(2) *Guide signs.* Guide signs direct drivers to places, indicate distances and directions, and furnish other type information. The basic sign is a *white square* or rectangle with legend or symbol stencilled in black. Some samples of guide signs are given in figure 30. An important special type of guide sign is

the British "directional disc" which may be used in conjunction with other signs or on the face of a "guard lamp" placed beside the road. The arrow may be turned in different positions to indicate directions. For examples of this type see figure 31.

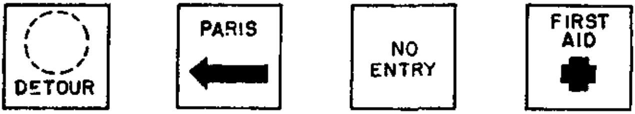


Figure 30. US, British, Canadian guide signs.

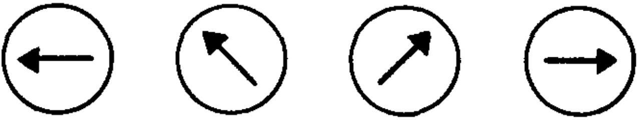


Figure 31. British directional discs.

141. UNIT INSTALLATION SIGNS

a. A standard design for unit name signs should be prescribed in all theaters or other area commands in order to achieve uniformity and to facilitate recognition. Units should be forbidden to install on roads any signs which do not conform to the prescribed standard design.

b. Unit name signs should be installed only at the location of the unit and at the junction of the access road, if any, with the nearest main road.

c. In areas containing a number of units in bivouac or quarters, unit name signs should be erected on sign ladders provided at road junctions. In the absence of these devices, signs should be erected in a neat manner on existing posts, poles, etc., or on mountings provided by units themselves. They should not be affixed to any special mountings provided for traffic control signs, nor in such a way as to obscure such signs.

d. Unit commanders are responsible for the prompt removal of their signs upon changing locations.

142. UNIT GUIDE SIGNS

a. In the conduct of marches temporary unit signs may be used in a similar manner to guides. They should be posted by any advance detachment preceding the column and should be taken up by a trail party immediately after the entire column has passed.

b. Similar temporary signs may be used at release points to direct march units of a column into their respective areas or bivouacs.

143. MARKINGS

Traffic markings are devices, lines, patterns, words, or colors embedded in the surface or applied on or attached to the pavement, curbing, or adjacent objects. They are officially placed for regulating, warning, or guiding traffic.

144. SIGNALS

Traffic signals are any devices having moving parts or using light which flashes or otherwise warns or directs traffic to take some specific action.

145. TRAFFIC ISLANDS

Traffic islands are areas within a roadway from which vehicle traffic is intended to be excluded, as well as areas at the approaches thereto occupied by warning devices.

146. INTERNATIONAL SIGN SYSTEM

Foreign traffic control devices, especially signs, have been standardized to a considerable extent in many European countries and elsewhere throughout the world. It is therefore desirable that military drivers in areas employing the international system be familiar with its application. The international system (fig. 32) of road signing includes three classes of signs—danger signs, signs giving definite instructions, and signs giving indications only. These correspond to the three types of United States signs—warning, regulatory, and guide, respectively.

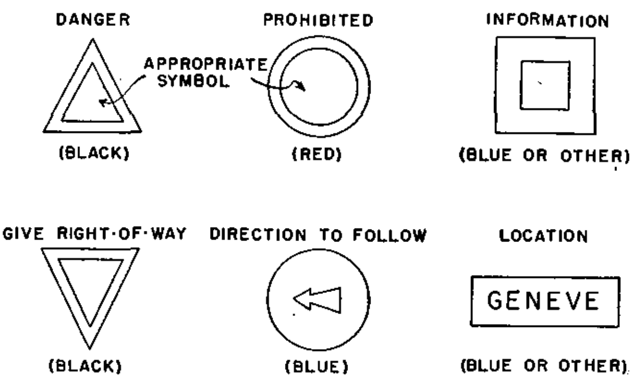


Figure 32. Standard international sign system.

CHAPTER 10

HIGHWAY REGULATION AND TRAFFIC CONTROL

Section I. GENERAL

147. MILITARY TRAFFIC MANAGEMENT

The general control of movement of military personnel and supplies may be divided into separate functions as follows:

a. Command determination of priorities of movement that personnel and supplies will have over lines of communications.

b. Movement control exercised over routing and movement of personnel, troop units, and supplies over lines of communications. Movement control specifies what is to be moved, when it is to be moved, where it is to be moved, and which transport service will be used (water, land, or air), but *not how* the transport service conducts the movement.

c. Regulation is concerned with the planning, routing, scheduling, and directing of the use of travel ways to utilize transport equipment and facilities most effectively. The transport service specifies how the operation will proceed.

d. Traffic control is the enforcement of rules of the road, traffic regulations, and road discipline, including point direction of traffic on highways. Traffic control is performed by military police.

148. THE TRANSPORTATION OFFICER

The transportation officer is the staff officer responsible for technical supervision of the transportation service required by the command.

149. REGULATION AND CONTROL OF HIGHWAY TRAFFIC

a. Two forms of control, organizational and area, are exercised to insure that highways are used most effectively and efficiently.

(1) Organizational control is exercised by the commander of the unit passing over the road to insure that rules of the road and traffic and other regulations as prescribed by higher headquarters are followed. Within limitations prescribed by higher headquarters, this control includes fixing the speed, spacing, and routing; adhering to schedules; enforcing discipline, local security, etc.

(2) Area control is exercised over highway traffic moving within or through a given area and consists of those laws, ordinances and regulations established over a road net which are external to the control of the organization moving over the routes. Directives of the area must conform to those of higher authority and, in the case of dispatch or reserved routes passing through an area, control is vested in the command embracing the entire route.

b. Successful highway movement requires close cooperation and integration of the following activities:

(1) Highway regulation is a Transportation Corps responsibility, except when there is no transportation section of the staff in which case it is the responsibility of the officer charged with staff supervision of transportation matters (i. e., G4, S4). It is mainly concerned with making fullest use of available highway facilities and the transport conveyances moving over highways.

(2) Military traffic control, a Military Police Corps responsibility, is primarily concerned with the control of vehicular, animal, and foot movements over roadways, or in areas where vehicles move, to facilitate the safe and continuous flow of traffic in conformity with military requirements, including the highway regulation plan.

(3) Road maintenance and construction is the responsibility of the Corps of Engineers, which effects the necessary road and bridge reconnaissance and classification; prepares road maps; and performs necessary construction, repair, and maintenance of roads and bridges.

(4) Signal communication is the responsibility of the Signal Corps, which provides the essential communication services (by telephone, teletype, radio, etc.) necessary for efficient centralized management of highway traffic.

(5) Automotive maintenance support is the responsibility of the Ordnance Corps, which provides third and higher echelon service and repair in support of the operating units.

(6) Provision of fuel, oil, and lubricants necessary for the operation of vehicles is a responsibility of the Quartermaster Corps.

(7) Other technical services play a part by providing personnel, supplies, and facilities.

150. CONTROL CLASSIFICATION OF HIGHWAYS

Highway routes are classified in accordance with the degree of highway regulation and/or control that may be necessary.

a. Open Routes. An open route is a roadway over which only a minimum of supervision is exercised. Ordinarily, supervision on an open route is limited to control of traffic at intersections, and to the provision of necessary traffic signs and markings. Control on such a route is similar to civilian control over local country roads carrying a small traffic flow.

b. Supervised Routes. A supervised route is a roadway over which limited control (by means of traffic posts, traffic patrols, or both) is exercised by military police. Small units are ordinarily allowed to use a supervised route without prior correlation of individual march schedules, but time of access to the route may be regulated at control posts in conformity with the traffic situation. Control on a supervised route is somewhat similar to the civilian control normally exercised over primary highways.

c. Dispatch Routes. A dispatch route is a roadway over which full control, both as to priorities of use and the scheduled movement of traffic in time and space, is exercised. Both highway regulation and highway traffic control are exercised on dispatch routes. The operation of such a route is somewhat similar to that of a railroad.

d. Reserved Routes. A reserved route is one that is set aside for the exclusive use of a designated unit or specified type of traffic, or for other specific purposes. When reserved for a specific unit, the commander of that unit decides the degree of regulation and control which will be exercised. It may or may not be operated as a dispatch route.

Section II. HIGHWAY REGULATION

151. GENERAL

(FM 100–10)

a. The rapidity with which tactical situations change in war makes it necessary to keep all convoys in hand so that the routes, schedules, and destinations may be changed at any time to meet new situations. It is evident that exact routing and scheduling cannot be maintained over convoys if troops, civilians, refugees, and other casuals are permitted to occupy road space on the same routes at will. Therefore, to prevent conflict and confusion, it is necessary that movements over highways be regulated by one agency, or that the actions of agencies concerned be well coordinated.

b. Highway regulation is the planning, routing, scheduling, and directing of the actual use of highways by vehicles, personnel afoot (including troops, refugees, and other civilians), and animals, so as to meet operational requirements. This function includes:

(1) Preparing highway regulation standing operating procedures (SOP) and/or traffic plans.
(2) Selecting routes necessary to implement such plans.
(3) Planning the nature and size of convoys.
(4) Making march graphs from which to develop and follow schedules covering all convoys or other units moving over dispatch routes.
(5) Keeping every serial constantly in hand through a system of highway regulation points (HRP) located strategically along the route.
(6) Recording the actual progress of each serial on graphs or otherwise.
(7) Revising schedules and routes to meet changes in priorities or destinations made necessary by orders, changes in tactical situation, failure to adhere to schedule, enemy action, etc.
(8) Regulating highway traffic over routes under supervision, as may be required.

c. Highway regulation is essential for three reasons: to implement the movement control program; to avoid congestion and conflict of traffic; and to keep serials constantly in hand so that their orders may be changed at any time to conform to changes in the tactical situation with consequent changes in destination, routing, and priorities. Highway regulation is applied only to the degree which will assure an orderly and effective flow of supply and personnel, and in such a way as to aid the movement control program and meet the priorities established by the responsible commander.

152. ORGANIZATION FOR HIGHWAY REGULATION

a. Highway regulation on a given route or network must be a centralized function. A highway regulation office is normally established within the command as part of the highway section of the transportation staff. This office is a staff agency of the commander concerned and works in close cooperation with other agencies of the staff to effect the will of the commander.

b. However, there are important exceptions to the above practice. They are as follows:

(1) When the communications zone is not divided into sections and the respective chiefs of service are charged with the conduct of all operations of their services throughout the communications zone (par. 22*b*, FM 100–10), the communications zone chief of transportation exercises highway regulation for the communications zone commander.

(2) When an intersectional highway service is created (par. 23, FM 100–10), the communications zone chief of transportation exercises highway regulation through the commander of that service.

(3) When a route is reserved for the use of a single unit, such as a division, corps, or army, or for an express operation by a highway transport service, the commander of the operating unit exercises such regula-

tion as he deems necessary. He decides on the nature and degree of supervision over the assigned route, and exercises that supervision.

(4) When highway transport units of the communications zone deliver supplies to installations in army rear areas, highways used for such purposes are regulated as ordered by the theater commander, or in the absence of such direction, as agreed between the army and communications zone commanders. Responsibility for regulation on such highways may be given to the commander of the communications zone, or advance section, or of the highway transport unit operating the haul.

153. HIGHWAY REGULATION POINTS

Highway regulation points are set up along dispatch routes to transmit orders and report progress of serials. The number of points required on a route depends upon the road net, the situation, the volume of traffic, and/or the degree of regulation necessary. Personnel of highway regulation points work in conjunction with military police manning traffic control posts. As each convoy or other scheduled movement passes a highway regulation point, the information is telephoned, radioed, or teletyped to the highway regulation office where the actual progress is plotted. However, when security or overloading of communication facilities makes it advisable, the regulation points may report only those serials which are off schedule, and it may be assumed that those not reported are on schedule. The first method is surer and is preferable, but in either case the highway regulation officer knows where each serial is and has the over-all picture of traffic moving over the supervised network. If a serial is late, headquarters issues new orders to prevent it from jamming up the entire schedule. If the tactical situation changes so as to require some diversion of serials or changes in priorities, the highway regulation office knows just where the serials can be intercepted so that new instructions reach them through the regulation points without delay. Thus, the entire movement is kept constantly in hand.

154. STANDING OPERATING PROCEDURES AND HIGHWAY REGULATION ORDERS

a. General. Motor marches and convoys over dispatch routes normally move under orders of superior authority and are governed thereby. Details which concern one unit only, such as its time schedule, are included in orders issued to that unit. Standing operating procedures which apply to all units are attached.

b. Standing Operating Procedure. Standing operating procedures are orders which govern the routine procedure to be followed. Standing operating procedure governing highway regulation must be based upon the current features of operation the commander desires invoked. It must be flexible; must provide for operational requirements; must be capable of implementation; and must conform to the general traffic affecting the area in which the route concerned is included. It includes particulars applicable to all movements made over the dispatch route. For example, it may include information concerning the following:

(1) *Route or routes.*

(*a*) Description and general limitations of the route with references to applicable traffic plan.

(*b*) Location of highway regulation points and military police traffic control posts.

(*c*) Location of terminals, transfer points, depots, dumps, etc.

(2) *Organization of serials.*

(*a*) Type of march (open or close column, etc.).

(*b*) Intervehicular gaps, leads, or speedometer multiplier.

(*c*) Interserial time leads.

(*d*) Control measures required (use of guides, flags, markings, etc.).

(3) *Rates and speeds.*

(*a*) Rate of march.

(*b*) Maximum permissible speed.

(4) *Convoy operation.*

(*a*) Checking in at highway regulation point.

(*b*) Frequency and duration of halts.

(*c*) March discipline.

(*d*) Special rules of the road (if any), such as passing of convoys.

(*e*) Driver relief.

(5) *Security.*

(*a*) Passive security measures (camouflage, minimum gaps, restrictions on use of radios, lights, etc.).

(*b*) Action in case of air or other attack.

(*c*) Prevention of pilferage.

(6) *Supplies and maintenance.*

(*a*) Maintenance, including emergency repair.

(*b*) Disabled vehicles.

(*c*) Fuel and oil.

(*d*) Rations and messing.

(*e*) Casualties.

(7) *Other.*

(*a*) Communications.

(*b*) Reports and reporting procedure.

c. Highway Regulation Orders. Highway regulation orders emanate from and are issued in the name of the responsible commander. Highway regulation orders allocate road space, prescribe routes, and give time schedules and special instructions to each serial operating over dispatch routes. They may include standing operating procedure but it is more practical and economical to give the details which are peculiar to each serial in a separate highway regulation order, and to attach the applicable published SOP. These orders cover all marches over dispatch routes in accordance with priorities established by the command. For example, a troop movement may be ordered over a dispatch route supervised by a highway regulation office. Such a troop movement is given the priority ordered by the appropriate commanding general and is routed and scheduled accordingly. The highway regulation office must adjust other routings and schedules to meet that priority.

d. March Orders. March orders are those orders issued by the commander of the unit making a march and giving only the details of the march of his unit. They may or may not be required to supplement highway regulation orders. See paragraphs 177–180 regarding march orders and march tables.

155. HIGHWAY PRIORITIES

a. Priorities for use of the highways establish, in order of time, the precedence of troop movements and movements of cargo. The fixing of priority is a command function based upon tactical and administrative requirements.

b. Highway movements in progress at a particular time may or may not correspond to the established priorities. There may, for example, be opportunity to send out a convoy ahead of a priority movement which has been delayed. However, if the priority move catches up, the other convoy may have to be held en route to let it pass. Priorities may be revised at any time, and movements in progress may have their orders changed to effect new priorities.

c. It is impossible to standardize priorities which apply in all situations. For example, it may be more urgent to supply ammunition or gasoline to forces actively engaged than to give them reinforcements. With this qualification, the following general priorities for highway regulation are normally applicable:

(1) Equipment proceeding to remove a traffic obstruction.

(2) Tactical movement of troops.

(3) Ambulances.

(4) Wire patrols and construction crews.

(5) Supply convoys.

(6) Casual administrative traffic.

d. Isolated vehicles of troop commanders, staff officers, and messengers are normally allowed freedom of movement.

156. HIGHWAY REGULATION SCHEDULES

a. Highway regulation schedules are the means of assigning routes, making a time apportionment of roadway use, meeting priorities, coordinating arrival and departure, preventing traffic congestion, controlling average speed, and limiting densities.

b. Schedules are of several types as follows:

(1) *Infiltration*. A vehicular dispatch rate assigned to a unit for use during a specified period by which vehicles of the unit, either singly or in small groups, are permitted to proceed to their destination at prescribed time periods is an infiltration schedule. Example: Two vehicles are dispatched every 5 minutes for the first hour and three every 10 minutes the second hour.

(2) *Location*. The apportionment of time to different movements at a location, such as an initial point, an intersection, terminal, or traffic bottleneck is a location schedule. Example: Northbound movements proceed through a defile every even hour and southbound every odd hour.

(3) *Column*. The designation of successive arrival and/or clearance times for successive columns or serials at a specific point on a route is a column schedule. Example:

Schedule of serials past Point "X" (time cleared)—Serial A, 0819; Serial B, 0923; Serial C, 1057.

(4) *Route.* The apportionment of time to different movements along a given route is a route schedule. Example: Schedule of Serial A along a route (arrivals)—Point X, 1325; Point Y, 1403; Point Z, 1752; etc. Route schedule combined with column schedule ((3) above) is usually used in regulating movements over dispatch routes.

(5) *System.* A composite schedule for time and space control of all important movements on a given road net is a system schedule. Table III illustrates such a schedule.

c. The need for detailed scheduling by the unit conducting the march is indicated in pertinent orders. When time limits for completion of the march are the only instructions in such orders, units prepare their own detailed schedules within these time limits.

157. CLEARANCE FOR DISPATCH ROUTES

a. Movements over dispatch routes may be given clearances by the appropriate highway regulation office. Normally the clearance will have been arranged by headquarters ordering the movement, and no action by the unit conducting the march will be required. However, smaller movements and those made independently of the higher command may receive clearances by furnishing the highway regulation office the necessary information, which may include the following:

Table III. System Schedule, a Composite Schedule for a Road Net

SCHEDULE 178 -- NORTH-SOUTH ROUTES (Corresponds to Schedule 179 -- East-West Routes)				
TIME a/	ROUTE A Giles Hill to Reuel	ROUTE B Mt Evan to LeJune DISPATCH	ROUTE C Nobbs to Eggeratown	INTERSECTION ROUTE A and C Jones Junction
0600 to 0659	Reserved 1st Inf. Div.	Supply Serial # 1, 2	Closed for repair	Open
0700 to 0759	Reserved 1st Inf. Div.	Supply Serial #3 and 4	Open	Alternating traffic MP supervision
0800 to 0859	Reserved 1st Inf. Div.	Supply Serials # 5, 6, 7	Open	Alternating traffic MP supervision
0900 to 0959	Open	Intersecting E-W Traffic See Schedule 179	Supervised by MP Patrol	Reserved 1st Inf. Div.
1000 to 1059	North traffic only	Intersecting E-W Traffic See Schedule 179	Reserved 1st Inf. Div.	Alternating traffic MP supervision
1100 to 1159	South traffic only	Supply Serials # 8, 9, 10	Reserved 1st Inf. Div.	Open
1200 to 1259	Open	Priority move 295th Arty Brig.	Reserved 1st Inf. Div.	Open

a/ Indicates period of access and must be supplemented by detailed schedules.

FM 25-10
Table III. System Schedule, a Composite Schedule for a Road Net.

(1) Headquarters requesting clearance.
(2) Name of convoy commander.
(3) Unit to move.

(4) Authority to move.
(5) Total number of vehicles.
(6) Size and number of march units.
(7) Size and number of serials (if applicable).
(8) Gross weight of heaviest vehicle in column.
(9) Location of unit.
(10) Destination.
(11) Time and date of movement.
(12) Route desired.
(13) Speed at which the element can move.

b. The clearance for a specific move may be the inclusion of that unit in the schedule for the particular dispatch route. A copy of this schedule accompanying the unit's orders will be the unit commander's authority to use the route at the time and within the limits specified; the unit's schedule will be extracted from the general schedule.

Section III. HIGHWAY TRAFFIC CONTROL

158. GENERAL

a. Traffic control personnel keep traffic moving in conformity with the traffic plan. Under organizational control, these personnel normally consist of details from the organization involved.

b. The training and equipment needed for traffic control are covered in detail in FM 19–5, FM 19–10, and FM 19–25. All drivers should be familiar with the signals employed by military police as described in FM 19–25. Paragraphs 159 and 160 discuss some of the more important aspects of traffic control applicable to the proper conduct of motor marches and convoys.

159. CIVIL LAWS AND ORDINANCES

Except when military necessity requires contrary action, it is general policy to conform to all laws and ordinances when in the continental United States or in territory of friendly nations. However, this does not prevent arrangements being made with civil authorities which permit motor march units and convoys to run through red lights, or otherwise disregard usual civilian law and regulation when adequate safeguards, such as police escorts, have been provided.

160. AUTHORITY OF MILITARY POLICE

a. The provost marshal exercises highway traffic control through military police, whose specific functions include the following:

(1) Enforcing applicable rules for safe driving, speed, spacings, blackout measures, local rules of the road, etc.

(2) Point control at road intersections, defiles, bottlenecks, etc.

(3) Keeping unauthorized traffic off dispatch or reserved routes.

(4) Reducing traffic conflicts which may occur even on dispatch routes.

(5) Effecting emergency adjustments to the traffic circulation and control plans and attempting to restore the schedules with the least delay.

(6) Preventing pilferage, straggling, and other infractions of discipline.

(7) Providing road patrols and escorts.

(8) Giving information, local directions, etc.

b. Military police are empowered to take such action in traffic matters as may be necessary to enforce existing orders and regulations. They are empowered to direct traffic in emergencies and in the absence of specific regulation, but the action of military police must normally be designed to restore and maintain an orderly traffic flow in accordance with prescribed schedules and routes. Routing and scheduling on dispatch routes are functions of the highway regulation office of the appropriate commander. The military police function is to aid in carrying out highway schedules and routings; rerouting and rescheduling will be done only in emergencies and will be followed by a report to higher headquarters indicating the emergency faced, the action taken, and requesting further instructions.

c. While it is of the utmost importance that each column, serial, convoy, or march unit commander observe all orders issued as part of the necessary external control, it is equally important that such commanders realize their respective responsibilities and that they do not permit unauthorized persons to change the schedules or routings prescribed by higher authority. The convoy or march unit commander is responsible for adherence to his prescribed routing and schedule. On the other hand, military police must take action required to meet unexpected emergencies. If the military police issue instructions contrary to the prescribed routing and schedule it should be done so far as practicable, in coordination with the appropriate highway regulation office.

d. On dispatch routes, any emergency action taken should be referred to the nearest highway regulation point in order that the point may acquaint the highway regulation office with the situation, and enable that office to revise the existing plans so as to meet the situation and keep the organized traffic plan in effect.

161. TECHNIQUES OF TRAFFIC CONTROL

The three control techniques are point control, patrols, and escort. A combination of point control and patrols is normally used in area control. Escorts are used in both area control and in conjunction with organizational control. Point control makes use of fixed traffic control posts at road intersections, defiles, and other bottlenecks. Traffic control by patrol makes use of motorized personnel who travel the roads between traffic control posts. Traffic control by escort makes use of motorized personnel who precede and/or accompany the march and regulate traffic at successive points of conflict.

162. COLUMN PASSAGE

a. Traffic rules regarding overtaking and passing of vehicles apply generally to columns. However, where priorities and schedules are in effect only a column of higher priority will pass another. Prior arrangements should be made for all passing operations. Coordination with the commander of the overtaken column should be effected before passing is begun. Control personnel at the head and trail of the slower or halted column act to facilitate the passing operation, or to prevent it, when passing is unsafe. When the lane to be used for passing is known to be clear, or when conflicting traffic has been held back by a guard, the trail officer of the slower or halted column signals the faster column to move by. When the last element of the faster column has cleared the head of the column being passed, normal operations are resumed. Passage of columns should be made at suitable prearranged locations and, whenever practicable, during a scheduled halt of the slower column.

b. On roads of two lanes with traffic in opposite directions, control personnel of the passing column are responsible that all vehicles are cleared from the counterflow lane before passing is begun, regardless of whether assistance is obtained from the column being passed.

c. When any column contains vehicles of unusual length, it may be necessary to post guards at curves to prevent conflicts resulting from the rear sweep of these vehicles during the passing operation.

PART FIVE

CHARACTERISTICS OF PERSONNEL AND SUPPLY MOVEMENTS

CHAPTER 11

PERSONNEL MOVEMENTS

Section I. DISTINCTIVE CHARACTERISTICS

163. GENERAL

a. Since it is normally desirable that troop units be kept together, motor columns transporting personnel are often larger than supply convoys, which may more readily operate as small march units or serials. However, while columns of a tactical troop movement are often much longer than those of supply convoys, they are nevertheless broken down into march units corresponding as closely as practicable to the smaller units making up the troop organization.

b. Two units—the unit being transported and the truck unit furnishing the transportation—are frequently involved. It is therefore essential that the *functions of* and *the restrictions on* each be clearly delineated and that command responsibilities be understood and observed.

c. Where personnel are being transported, some of them may be detailed to guide, guard, reconnaissance or security duties. This presents a command problem in the delineation of responsibility for conduct of the movement (par. 164).

d. It is of utmost importance that officers of all troops have knowledge of the general principles of highway transport movement. Movement by highway, like that by rail, must operate under a thoroughly coordinated system. The effectiveness of troops depends not only on their own movement but also on the movement of supplies.

164. COMMAND

a. Personnel movements require close coordination between those in command of the transportation and those in command of the troops being transported.

b. Personnel movements by motor vehicles include:

(1) Those using vehicles which are organic to the unit being transported.

(2) Those made by means of truck units attached or assigned to the unit being transported.

(3) Those made by means of Transportation Corps (TC) truck units, operating as part of the general hauling service provided by highway transport service and not assigned or attached to the unit being transported.

c. When a unit is being transported by its organic vehicles, the troop commander has full command of both the personnel being transported and those operating the vehicles.

d. The commanding officer of a unit to which a truck unit has been assigned or attached by proper authority, exercises command over the unit through its commanding officer.

e. When a truck unit is not assigned or attached to the unit which it is transporting but is merely providing the transportation service required, command of the convoy and of each serial or march unit thereof remains with the truck unit commander and his officers and noncommissioned officers at their respective levels. In such case the commanding officer of the troops being transported (troop commander) retains full command of his troops and issues such orders as may be necessary to conform to those issued by the convoy commander as to schedules, march discipline, and operation of the convoy. The troop commander should no more interfere with the operation of the convoy than he would with the operation of a troop ship or railroad train by which his troops were being moved. However, should a tactical emergency so require, the commander of troops being transported, regardless of rank, may assume command of the convoy and issue such orders as may be necessary to meet the emergency. In so doing, the troop commander should realize that the convoy commander may be proceeding under orders which are part of a closely integrated schedule and that unnecessary changes in any part of the schedule may seriously impair the plan. The troop commander must accept full responsibility for any action which unnecessarily interferes with the over-all highway schedules.

165. COMMAND DURING THE MOVEMENT

a. The senior officer or noncommissioned officer of the troops in each truck commands the personnel transported in that truck. He is responsible for their discipline and for making sure that they comply with the existing convoy regulations.

b. The driver of a vehicle, or the senior officer or noncommissioned officer of the personnel operating a group of vehicles, is responsible for compliance with his schedule and instructions. He is responsible for safe operation of the vehicle, and is required to make sure that personnel being transported observe safety, sanitary, and other regulations. Regardless of rank, he will give the senior officer or noncommissioned officer of the troops being transported necessary instructions.

c. While the senior officer or noncommissioned officer of troops being transported should not interfere with the operation of the vehicle, and should conform to all proper instructions of the vehicle operating personnel, it is his duty to report to the appropriate superior any derelictions on the part of vehicle-operating personnel.

d. At the lower levels of command, these principles apply whether the movement is by organic vehicles, by attached TC truck units, or by independently operated TC units. In each case, certain personnel are charged with responsibility for the movement. They operate under definite plans, and officers and noncommissioned officers of troops being transported should conform to the orders issued under those plans.

e. In singly dispatched vehicles (for example, passenger sedans), the senior passenger is responsible for seeing that the driver obeys laws, regulations, etc., which are usually set forth on a card carried in the passenger vehicle.

Section II. METHODS AND PROCEDURES

166. GENERAL

There are four general methods for accomplishing personnel movements. These may be adapted to tactical or administrative troop movements under various conditions.

a. Full Lift. When sufficient truck units are available or the troop unit is completely motorized, the entire movement may be accomplished in one lift.

b. Point-to-Point Shuttle. Truck units may shuttle back and forth from point to point, taking a portion of the troops on each trip, until the movement is complete. Unless the situation is well in hand or can be met by the first troops transported, this method is not usually suited to tactical movements in which the troops may be required to go into immediate action.

c. Leapfrog Shuttle (fig. 33). Leapfrog shuttle is perhaps best applicable to tactical troops while making advance or retrograde moves in combat or while in close support of combat operations. It is a variation of the point-to-point shuttle and may be varied to meet the situation. It may be demonstrated by the movement of two units of a single command. From one position, a unit moves and establishes and holds another position. When this position has been established, the vehicles return for the second unit. Instead of taking them to the position established by the first, they carry them past, where they establish a third position. Then the vehicles return for the first unit and carry it past the new position established by the second. This is repeated any number of times, depending on the length of the movements, whether or not the enemy is contacted, etc. The leapfrog method allows the movement to continue uninterrupted while adequate positions are maintained. It may also be used to advantage in support of tactical forces.

d. Part-Ride, Part-Walk Shuttle (fig. 34). Troop movements may be made by a type of shuttle move-

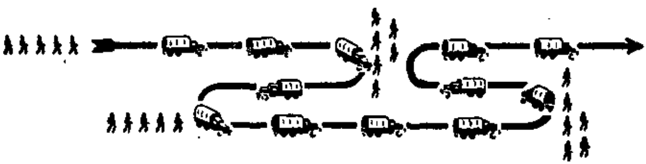


Figure 33. Leapfrog shuttling.

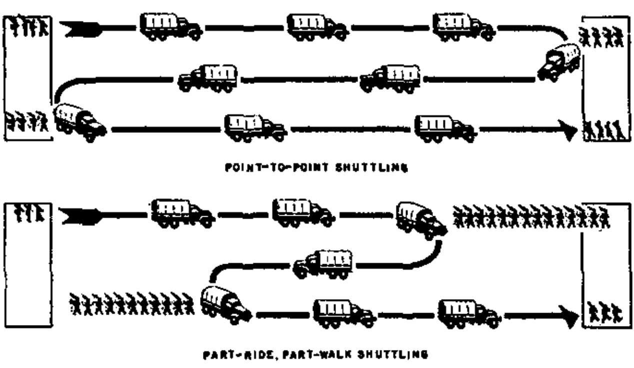


Figure 34. Troop shuttling.

ment, know as part-ride, part-walk. Some of the troops are transported by truck, while the remainder march on foot. At a designated point the troops, first transported by truck, detruck and march on foot the remainder of the way, and the trucks return and pick up those which started out on foot.

167. TACTICAL CONSIDERATIONS

a. During war troops being transported by highway should habitually be ready to go into action. Regardless of where a movement takes place, there is no absolute guarantee that there may not be some form of attack. In rear areas there may be the possibility of a parachute or fifth column attack or of an ambush by infiltrated forces of the enemy. Even in the zone of interior, where attack may be unlikely, it is good practice to remain alert from the standpoint of training and conditioning for future combat and as an insurance against surprise attack, which, in future war, may strike anywhere. Therefore, unless the requirements for speed and vehicle utilization outweigh the requirements for security, those in charge of highway movements must make plans which permit the troops being transported to carry the arms and ammunition necessary to enable them to go into action.

b. *When there is any probability of encountering* the enemy, marches should be made in organized tactical teams and troops should be loaded in such a manner that they can quickly detruck and go into action. In such case this requirement normally takes priority over getting the maximum troop transportation with minimum vehicle requirement.

c. Vehicles which contain essential equipment or supplies (such as ammunition) in immediate support of troops are formed in combat trains which accompany their respective units. Impedimenta which are not essential to the troops during immediate action are normally transported in field trains which may move independently of the troops but closely enough to rejoin them when conditions permit. The movement of trains is similar to that of supply convoys, and impedimenta must be loaded and unloaded in the same manner as prescribed for supply convoys (pars. 181–201).

168. ADMINISTRATIVE CONSIDERATIONS

a. Tactical loading of troops and tactical formations of columns, desirable when the enemy may be encountered, are not always the most efficient methods from the standpoint of comfort to personnel and of complete utilization of transport space. Peacetime movements and some movements made under complete security in wartime, may be more effectively accomplished by certain administrative considerations. Under these circumstances troops may be loaded to the maximum capacity of the vehicles, consistent with personal comfort and without regard to tactical organization.

b. Movements of this nature may be of short duration, that is, transporting troops to field showers or to consolidated messes, or for social purposes in which no appreciable equipment would accompany them. Or they may be of greater duration, in which a large force of reserves is being built up in a rear area or in which a casual body of troops is being transferred to another station. In the latter case supplies and equipment can often be transported more efficiently by loading in separate vehicles or in a separate convoy or convoys preceding or following the personnel convoy. Small trailers (1½ ton) are most useful in personnel convoys made in medium trucks.

169. LOGISTICS FOR PERSONNEL MOVEMENT

a. March Day. During peacetime, and during war when tactical considerations do not interfere, the following may be used as a guide in planning an average day's motor march:

(1) Preparation for the march—1 hour—includes time for breakfast, inspection of vehicles, and breaking camp.

(2) Running time—7 to 8 hours—includes all halts except noon halt.

(3) Halt for lunch and refueling of vehicles—1 hour. (This halt may be shortened under wartime conditions.)

(4) Inspection and servicing of vehicles after arrival at camp—1 hour.

b. Forced March. A forced march may be extended to 24 hours, in which case the running time is approximately doubled.

c. Rate of March and Distances. Rates of march to be adopted and the daily distance that can be covered will vary according to conditions encountered en route. Table XI, appendix II, can be used as a guide for motor marches.

d. Troop-Capacity of Vehicles.

(1) The troop-carrying capacity of common presently existing types of motor vehicles (troops carrying only individual arms and equipment) is as follows:

	Persons
Trucks, ¼-ton	2
Trucks, ½-ton	5
Trucks, ¾-ton	10
Trucks, 1½-ton	15
Trucks, 2½-ton, SWB	18
Trucks, 2½-ton, LWB	20
Trucks, 2½-ton, cab over engine (COE)	25
Semitrailer, 10-ton	40

(2) Loads listed are in addition to driver and one man on the front seat. For distances greater than 75 miles, the above figures should be reduced.

e. Troop Loads.

(1) In loading for personnel movement the following must be taken into consideration:

(*a*) *Underloading.* If vehicles are not loaded to their practicable capacity, it may be impossible to transport the required number of troops on the trip.

(*b*) *Overloading.* If vehicles are overcrowded, especially for long trips, the troops will become overfatigued, and, in case of possible contact with the enemy, will not be at their peak efficiency for battle.

(*c*) *Improper loading—distribution.* If troops are loaded in the same vehicles with supplies and equipment they may become cramped with resulting loss of efficiency.

Or, if loads are not properly secured they may shift and injure troops.

(*d*) *Improper loading—mission or destination.* If, in loading, troops are separated from the equipment needed to accomplish an immediate or possible emergency mission, the accomplishment of that mission may be retarded or prevented.

(2) For successful troop movements and efficient utilization of equipment each vehicle should, so far as practicable, contain loads—

(*a*) Which will comfortably fill the carrying capacity of the vehicle without unnecessary cramping.

(*b*) Made up of troops of a single unit, that is, squad, section, or platoon, so far as possible and consistent with the circumstances and possible emergency mission.

(*c*) With only the necessary equipment for the personal or emergency use of troops being transported, consistent with existing or expected conditions.

f. Computing Truck Availability and Requirements. Computations as to truck requirements should be made first on the basis of organic vehicles available to the command and next on the basis of requirements for movement of troops and equipment over and above those which can be transported in organic vehicles. Table IV may be used in computing organic truck availability, and additional requirements which must be requested of higher headquarters may be computed as in table V.

Table IV. Table for Computing Organic Truck Requirements for Troop Movement

Unit or Serial Number	Actual Strength	ORGANIC VEHICLES AND TROOP SPACE AVAILABLE a/				Total for which organic vehicles are available	Total to march on foot	Require- ments above organic means
		1/4 Ton / 3 men each	3/4 Ton / 8 men each	1 1/2 Ton / 10 men each	2 1/2 Ton / 20 men each			
Serial A (1st Bn)	897	28 / 84	4 / 32	3 / 30	4 / 80	226	423	248
Serial B (2nd Bn)	876	22 / 66	3 / 24	3 / 30	5 / 100	220	603	53

a/ In computing troop space available, first consideration is given to the load of the vehicle, i.e., equipment, weapons, ammunition. After this prescribed load is ascertained, personnel are loaded within the rated capacity of the vehicle.

Table V. Table for Computing Truck Requirements (for Troop Movement) Requested from Higher Headquarters

TROOP TRUCK REQUIREMENTS

Unit or Serial Number	Actual Strength	Number not requiring Transportation		Number requiring Transportation a/	
		Transported in organic vehicles	Marching on foot	With individual equipment	Without individual equipment
Serial A (1st Bn)	897	226	423	248	
Serial B. (2nd Bn)	876	220	603		53

a/ Actual vehicles required will be determined by headquarters furnishing transportation.

g. Entrucking and Detrucking. For entrucking and detrucking planning factors, see paragraph 176.

Section III. ENTRUCKING AND DETRUCKING

170. RESPONSIBILITIES

a. In the case of motor marches made by a unit's own or attached transportation, the commanding officer of a unit prepares the entrucking and detrucking plans.

b. When a unit is to be moved by truck units, which are not under command of the troop commander, it is important that there be a thorough understanding between the convoy commander and the troop commander as to place, time, and method of entrucking and detrucking. This is usually determined through orders and/or standing operating procedure issued by a common superior, but it may be by agreement between the convoy commander and the troop commander. In the absence of orders prescribing details, it becomes the duty of the convoy and troop commanders to arrange the schedules and methods to be used.

171. ENTRUCKING POINT

a. An entrucking point is a location where a convoy or column, or element thereof, halts for the boarding of personnel.

b. Normally, it is easier to move trucks than troops and their impedimenta. Hence an entrucking point should be selected which, while not presenting undue obstacles to the movement of the vehicles, will nevertheless require a minimum of foot marching by the troops.

c. The entrucking point should afford a suitable area for the method of entrucking selected. It should be a point affording ready access to the route which the motor column will take.

172. METHODS OF ENTRUCKING

a. There are two methods of entrucking, either of which may be effective under certain conditions.

b. When time and space allow, the troop commander may ascertain the exact make-up of the motor column which will transport his unit, the exact number of troops which can be transported in each vehicle, and the exact distances between vehicles when they halt for entrucking. (For personnel capacities of vehicles, see par. 169*d*.) The troop commander then forms his command into parties corresponding to the formation and capacities of each vehicle. At the prescribed hour, the troop commander forms his unit in line or line of columns, along the line of march of the vehicles, with intervals corresponding to the gaps with which the vehicles will halt. The vehicles pull up opposite the troops they will transport. At command, all troops entruck simultaneously, using their assigned vehicle. This is by far the quickest method of entrucking, but it requires careful planning and sufficient space for the troop formation and for the column of trucks.

c. When time for planning is insufficient or the available space is unsuited for the above method, the trucks may be parked and the troops marched alongside in columns of ones, twos, or threes, and counted off into vehicle parties. Each party is then led to its proper vehicle. This method is slower than that described in subparagraph *b* above but is the easiest and most practicable method under many circumstances.

d. A combination of the two methods of entrucking may also be used for general troop loadings by assigning each section, platoon, or company to a selected number of trucks. Then upon the proper command, all units are marched simultaneously alongside their assigned trucks, and each platoon or section leader counts off his men into parties as they board the assigned vehicles.

173. DUFFEL BAGS AND PACKS AND OTHER INDIVIDUAL EQUIPMENT

a. Duffel bags may be loaded on the same vehicle with the men to whom they belong. This materially reduces the number of men who may occupy a vehicle with comfort, but lessens the probability of loss of equipment.

b. Packs present a problem in that troops carrying them cannot sit comfortably in most military vehicles. Usually, it is desirable to have troops board the vehicles with packs on and then take them off and stack them on the floor between or under seats. However, combat packs may be worn in relative comfort during the march.

c. Duffel bags, bedding rolls, cargo packs, and other items not needed during the march may be loaded in separate trucks or in trailers. When this is done they should be loaded by troops detailed for the purpose in advance of entrucking. This method relieves the troops of responsibility for their individual bags and is less fatiguing, but there is greater probability of loss. If contact with the enemy is probable, it is desirable that troops should not be burdened with responsibility for duffel bags, and that they have only that equipment with them to meet the possible emergencies.

174. LOADING ARMS

a. Individual arms should remain with the individual soldier.

b. They are, however, likely to cause accidents if the soldier tries to carry his arms while boarding the truck. Therefore, troop commanders should instruct their troops in the proper manner of boarding with arms. After the first man has boarded, each man in turn may pass his weapon up to the man ahead of him, securing it again before taking his seat.

175. DETRUCKING

a. In general, methods of detrucking involve the same factors of planning, orderly execution, and provision for safety as are involved in entrucking.

b. Training should include practice in detrucking in the quickest possible time. This method of detrucking requires jumping out over sides of the vehicle, or any other way that is quickest, with weapons in hand and ready for use. It should take only a fraction of a minute.

c. However, such emergency detrucking is likely to cause sprained or broken ankles or other injury.

Training must be designed to avoid casualties, and troops should be instructed in such manner that they will not take unnecessary risks. In no case should troops be allowed to detruck before vehicles stop.

d. Detrucking requires less planning than entrucking, but it does require a plan to assure its being done in an orderly manner which keeps the troops in hand, permits prompt formation, and prevents injuries.

e. Troops should not detruck until an order or signal is given by the appropriate commander. Except in emergency, that order should not be given until drivers have lowered tailgates so as to decrease the probability of injuries in detrucking.

f. As in entrucking, the method of detrucking must be governed by the available area.

(1) When sufficient area is available, the column may be halted in close formation and all troops detrucked simultaneously. This method is quick but may require troops in the rear to march the length of the column in assembling or in reaching their immediate destination.

(2) A second method is to have successive trucks, or truck squads, sections, or platoons, pull up to a given detrucking point, at which the troops detruck and assemble or march to a designated area.

(3) When troops are going into billet or bivouac, a satisfactory method is to designate a dispersal point, from which guides conduct sections of the truck column to the vicinity of the place of bivouac or billet of

the troops being transported. The troops then detruck near their bivouac or billet.

176. ENTRUCKING AND DETRUCKING PLANNING FACTORS

a. Troop entrucking and detrucking time. With troops properly disposed at loading site, average time required to entruck and detruck personnel and to load and unload their individual equipment into and out of military trucks is as follows:

	Average time required (minutes) [1]	
	Day	*Night*
To entruck personnel	10	20
To detruck and re-form foot troops	5	10

b. Entrucking and Detrucking Tables. Computations necessary to entruck and detruck personnel should be made on tables as exemplified in tables VI and VII. These tables may be published as an annex to the march order.

Section IV. MARCH ORDERS AND MARCH TABLES

177. ORDERS

(FM 101–5)

Warning orders and march orders, which may be routine or combat, are of primary concern to those responsible for motor marches. Standing operating procedure may also contain information vital to the conduct of motor movements.

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[1] Well-trained troops, properly organized and prepared, can load and unload in much less time under good conditions.

Table VI. Work Sheets for Preparation of Entrucking and Detrucking Tables

A. ENTRUCKING WORK SHEET

Unit or Serial Order of arrival at IP	Assembly in unit area		March to Entrucking point		Entrucking		Movement from Entrucking point to IP		Head arrives at IP
	Time begun	Time allowed	Time begun	Time allowed	Time begun	Time allowed	Time begun	Time allowed	
1	0432	:20	0452	1:15	0607	:20	0627	:06	0727
2	0351	:20	0411	2:00	0611	:20	0631	1:10	0741
3	0517	:15	0532	1:30	0702	:20	0722	1:30	0852
4	0602	:20	0622	2:00	0822	:20	0842	1:05	0947

B. DETRUCKING WORK SHEET

Unit or Serial Order of Clearance of RP	Tail clears RP	Movement from RP to Detrucking point		Detrucking		March to Assembly area		Assembly in unit area	
		Time allowed	Time completed	Time allowed	Time completed	Time allowed	Time completed	Time allowed	Time completed
1	1927	:50	2017	:10	2027	1:00	2127	:20	2147
2	2031	:30	2101	:10	2111	:30	2141	:20	2201
3	2106	1:20	2226	:10	2236	:50	2326	:15	2341
4	2218	:45	2303	:10	2313	:40	2353	:20	0013

178. WARNING ORDER
(fig. 35)

a. This is an order issued by a commander to inform a unit or units of his command of a planned action.

b. A warning order is of value in alerting troops and preparing them for a march before receipt of the

Table VII. Entrucking and Detrucking Tables

A. ENTRUCKING TABLE a/

Unit or Serial Order of arrival at IP	Assembly in Unit Area	March to Entrucking point Begins	Entrucking Begins	Movement from Entrucking point to IP Begins	Head arrives at IP
1	0432	0452	0607	0627	0727
2	0351	0411	0611	0631	0741
3	0517	0532	0702	0722	0852
4	0602	0622	0822	0842	0947

B. DETRUCKING TABLE a/

Unit or Serial Order of Clearance of RP	Tail clears RP	Movement from RP To Detrucking point Completed	Detrucking Completed	March to Assembly Area Completed	Assembly in Unit Area Completed
1	1927	2017	2027	2127	2147
2	2031	2101	2111	2141	2201
3	2106	2226	2236	2326	2341
4	2218	2303	2313	2353	0013

a/ Information extracted from work sheets (Table IV)

detailed march order. A warning order may be issued orally, or in the case of a large unit, may be in writing.

THESE SPACES FOR MESSAGE CENTER ONLY

TIME FILED	MSG CEN NO.	HOW SENT

PRIORITY
PRECEDENCE

MESSAGE (SUBMIT TO MESSAGE CENTER IN DUPLICATE)

No. A 13 DATE 30 DEC 51

To CO CCA

DIV MARCHES 1 JAN

PAR 9, SOP APPLIES

DETAILS FOLLOW

CG 21 ARMD DIV — OFFICIAL DESIGNATION OF SENDER | 0815 H — TIME SIGNED

[illegible], Maj Gen
SIGNATURE AND GRADE OF WRITER

Figure 35. Example of a warning order.

179. MARCH ORDER
(fig. 36)

a. Definition. A march order is an operation order for movement of personnel and prescribed equipment from one location to another within a stated period of time. These orders are issued by the authority having jurisdiction over the personnel involved in the order. See FM 101–5 for examples of march order for larger units.

b. General. The march order should be issued in sufficient time to allow subordinates to make their plans, issue their orders, and complete their preparations for the march. The amount of detail given in march orders depends on the tactical and traffic situation, the state of training of the command, and the degree of adherence to a standing operating procedure.

c. Form. Fragmentary orders may be used; but when time permits, a detailed march order is issued in the form of a five-paragraph operational order accompanied by appropriate annexes. Annexes to the march order may include one or more of the following: march table (par. 180), strip map (par. 134*b*), entrucking and detrucking tables (par. 176), and administrative annex. When administrative details are too voluminous for convenient inclusion in the march order, it is customary to issue an administrative order or an administrative annex to the march order. Any of the following information is among that which may be included in the administrative annex:

(1) *Supply.* Methods of supplying food, water, fuel, ammunition, vehicle parts, etc. Special instructions with reference to local purchase of supplies and services.

(2) *Evacuation.* Details with reference to evacuation of casualties, burial, salvage of disabled vehicles and their cargoes, disposition of captured material, and handling of prisoners of war. Special instructions with reference to use of civilian hospitals for military casualties.

(3) *Traffic.* Necessary general instructions as to relief of drivers, blackout restrictions, marking of vehicles, marking of routes, maximum speeds, traffic regulations, etc.

1st Inf Div
NABE, KYUSHU
100800 Dec____

Opn O 10

Map: JAPAN, 1:250,000, KAGOSHIMA—NOBEOKA.

1. a. Annex 1, Opn Overlay.
   b. I Corps moves to detrucking areas vic SEMANO—TAKAHARU -- AIMUTA Road prep to seizing KOBAYASHI—MAGATA.

2. a. 1st Inf Div moves 101100 Dec to detrucking areas SE of SEMANO—AIMUTA Road; prep to atk NE on div O.
   b. Annex 2, March Table.

3. a. CT 1:
   b. CT 2:
   c. (1) CT 3 (-):
      (2) One bn, 3d Inf (Reinf): Fol 1st Recon Co. Secure div fwd area.
   d. 1st AAA AW Bn (-): Protect Div Tns en route.
   e. 1st Recon Co: Move 100930 Dec. Recon routes Red and Blue. Maintain ln 201st Armd Cav.
   f. Div Trps:
   g. Div Tns:
   x. (1) Annex 3, Veh Asg Table.
      (2) EEI: What are loc, str, type dml, mine fld and natural terrain barriers 1st Inf Div zone of action?

4. Admin O 7.

5. a. Index 7, SOI. Rad silence until terminated by div O.
   b. CP:
      (1) 1st Inf Div: Head serial 4.
      (2) Others: Rept loc.
   c. Div march ctl pt: MIYAKONOJO.

JONES
MAJGEN

Annexes: 1 - Opn Overlay (omitted)
2 - March Table (omitted)
3 - Veh Asg Table (omitted)

Distr: A

OFL:
/s/ Smith
G-3

Figure 36. March order.

(4) *Personnel.* Uniform to be worn and equipment to be carried by personnel, method of handling mail, instructions to quartering and clean-up parties, details as to camp site routine, hygiene and sanitation, etc.

(5) *Maintenance.* Instructions relative to vehicle maintenance and special types of repairs authorized or prohibited.

(6) *Miscellaneous.* Any necessary administrative instructions not otherwise covered.

180. MARCH TABLE
(table VIII)

The march order may be accompanied by a march table. This march table is normally derived from the march graph and affords a convenient means of transmitting to subordinates their schedule and other details pertaining to the march. Frequently time may be saved if the march graph is reproduced and distributed in lieu of the march table. The inclusion of this information in the body of the march order would tend to complicate it or make it unduly lengthy.

Table VIII. Example of a March Table

21st ARMD DIV
YREVA, BLOKSKY
011030 Jan 1952

Annex 2 (March Table) to Opn O 14
Maps: Blokaky, 1:250,000, Notkcots-Drabcir, and Opn Overlay

1	2	3	4	5	6	7	8	9	10	11
					March			Contl of Mvmt		
Serial No.	Orgn and Comdr	Present Loc	Route	Loc by 020400 Jan	Rate (MPH)	Type	Time Length (Min)	Loc of Critical	Earliest Arrival Time	Latest Clearance Time
1	CCA Col J H Gleason	Yreva 83.8-06.2	Exe-Wye	Naej 82.8-37.3	10	Close Colm (SM2)	69	RJ83.8-06.2 (IP) RJ81.6-37.1 (RP)	2030 2330	2145 0045
2	Div Arty Brig Ger G I Hooton	Yreva 83.2-05:1	Exe-Wye	Naej 84.6-36.1	10	Close Colm (Sm2)	37	RJ83.8-06.2 (IP) RJ81.6-37.1 (RP)	2200 0100	2245 0150
3	CCB Col S R Knill	Yreva 85.6-07.1	Zed-Que	Naej 86.2-36.7	10	Close Colm (SM2)	69	RJ87.1-06.8 (IP) CR86.8-38.1 (RP)	2030 2300	2145 0030
4	Res Comd Col R W Bruce	Yreva 86.1-06.3	Zed-Que	Naej 86.5-34.5	10	Close Colm (Sm2)	71	RJ87.1-06.8 (IP) CR86.8-38.1 (RP)	2200 0045	2320 0205

[a] Only 4 serials shown, 2 on each route. Other serials would be shown similarly.

Distr: A
OFFICIAL:
/s/ Cullum
G3

AVERS
Maj Gen

Table VIII. Example of a March Table.

CHAPTER 12

SUPPLY MOVEMENTS

Section I. DISTINCTIVE CHARACTERISTICS

181. GENERAL

a. As most supply convoys operate in the communications zone or in rear areas of the combat zone, they normally require no advance, rear, or flank guard. Since supply movements are normally made by truck companies with personnel sufficient only for the actual conduct of the convoy, there is no personnel available to provide security or for extensive reconnaissance. When supply convoys require such safeguards, they usually must be provided by other troops.

b. Supply convoys should be of such size and formation as to assure the most effective flow of traffic over the supply routes. Experience indicates that, in operation of supply convoys, the best results are normally obtained through small groups of vehicles. March units of a supply movement normally shoud not exceed one truck platoon; serials should not exceed one truck company.

c. Smali convoys may or may not constitute a serial. For example, if an entire truck company is proceeding on a mission, its platoons may be separately constituted as serials, each platoon being given a separate time schedule; or the entire company, with platoons operating as march units, may constitute a single serial under one order and one march schedule.

d. Large serials are cumbersome. While it is easier to use large serials in planning a movement, less detailed information is possible as to progress and the movement is more likely to get out of hand. With small serials, more detailed information is available for the purpose of highway regulation, and the movement can be kept under closer supervision and in better control in case the situation requires a change in orders; but small serials involve much more staff work in planning and in recording the progress of movement.

182. MAKE-UP OF SUPPLY SERIALS

So far as practicable, each serial should contain supplies of a generally similar nature, so that, if it becomes necessary to divert a certain type of supplies, the diversion order may be issued to a particular serial. It is not practicable to make rigid specifications as to how the supplies should determine the division between serials. However, in general, vehicles transporting gasoline, ammunition, rations, or other different types of supply, should constitute different serials, so that, if necessary, diversions can be made according to the class of supply being transported. This does not preclude the possibility of formation of a serial of several kinds of supply needed by a certain unit or installation. However, when supply serials are formed for the needs of a certain element, it must be realized that while they may meet the demands of that specific element, they may not be suited for diversion to other elements. Serials formed with several kinds of supply for a single element make the highway transport system less flexible. Nevertheless, such serials may be used when other conditions outweigh the loss in flexibility. Under such conditions if each unit or vehicle is loaded with the same kind of cargo and there exists good highway regulation, serials consisting of a number of vehicles and transporting various kinds of supplies can be intercepted at a highway regulation point, reorganized, rerouted, and rescheduled to meet a change in the requirements. However, the extra work, delay, and increased possibilities of error indicate the advisability of avoiding such situations. When the individual vehicles carry mixed loads such changes are almost impossible.

183. COMMAND

a. Generally, convoys of motor vehicles hauling supplies are commanded by the senior officer or noncommissioned officer of the unit whose trucks make up the convoy.

b. However, command of supply movements may depend on the assignment of the vehicles being used.

(1) Supply movements made by a unit to transport its own supplies in its own organically assigned vehicles are under command of the appropriate officer or noncommissioned officer of the unit.

(2) Supply movements made in vehicles of assigned or attached truck units are under command of the appropriate officer or non-

commissioned officer of the truck unit, who, in turn, is under command of the appropriate officer of the organization to which the vehicles or truck unit are assigned or attached.

(3) Supply movements made by truck unit operating as part of the general hauling service provided by highway transport service are under the command of the senior highway transport officer of the convoy.

c. In cases where the tactical situation requires an armed escort to protect the supply convoy, the senior officer of the protecting troops may be placed in command. Under such circumstances, the highway transport officer will act as his technical adviser. For example, assume that a truck platoon is carrying emergency supplies of small arms ammunition for the direct support of an infantry division in the combat zone. The highway transport officer in charge of the vehicles has complete command of his convoy from the time it leaves the rear dumps until delivery of the supplies and return to his base. If, because of enemy infiltration, an escort from the division troops is sent to accompany and protect the convoy while in the danger area, the escort commander may issue such orders as are necessary to assure its safe arrival. The officer in charge of the vehicles continues to exercise command over the personnel of the convoy though he gives complete cooperation to the tactical commander; and the tactical commander should, insofar as possible, conform to established routes and schedules.

d. Supply convoys consisting of vehicles organic to a unit carrying their own equipment and supplies and furnishing, when necessary, their own protection, operate under the command of the senior officer or noncommissioned officer with the convoy.

Section II. TYPES AND METHODS OF SUPPLY OPERATION

184. HIGHWAY TRANSPORT HAULS

a. Highway transportation may be employed in any variety and combination of ways to accomplish specific transportation missions. Types of operations in which trucks are used are determined by the task to be accomplished, whether it be for the purpose of *clearing* a congested area, *connecting* other modes of transportation, *adjusting* the distribution of supplies within a depot, or *supporting* troops in combat.

b. Hauls may be described as "short" or "long" depending on the comparative distances or ratios of time involved; or they may be described as "local" or "line" hauls depending on whether they are performed within the immediate vicinity of their base or over the roads that connect terminal points.

c. Local or short hauls are characterized by low running time in relation to loading and unloading time. They normally involve a number of trips per day and are evaluated on the basis of tons moved during the operational period.

d. Line or long hauls are characterized by high running time in relation to loading and unloading time. They normally involve one or a portion of a trip per day and are evaluated on the basis of ton-miles accomplished during the operational period.

185. HIGHWAY TRANSPORT OPERATIONS

The types of logistical support operations in which motor transport is employed, over varying distances, may include the following:

a. Port and Beach Clearance. Port and beach clearance is discussed in paragraph 187.

b. Truck Terminal Operations. Truck terminals are normally located on the extremities of line hauls and form the connecting link between local hauls and express services. Their function is that of an assembly point for highway transport equipment. At times they may be utilized for in-transit storage, but they normally operate as marshalling yards for line hauls. In a typical operation loaded semitrailers are picked up by terminal tractors at depots or dumps near the forwarding terminal, moved to the marshalling yard, and formed into convoys and serials. Incoming long-haul tractors drop their empty semitrailers and, after any scheduled maintenance, are coupled to the loaded semitrailers and moved out in convoy formation for the express haul.

c. Transfer or Connecting Operations. Railhead, air terminals, and transfer points are installations where supplies are unloaded and issued or distributed usually by other means of transportation. Truck transport often forms the connecting link between these forms of transportation or between these services and the using troops. Such operations usually require that motor transport meet the schedules and requirements of the connecting carriers or the troops served.

d. Express Operations. Highway express operations are long distance hauls over main supply routes. They are often movements extending through the communications zone and into the army service area, operated with railway precision, and supplementing or replacing railway service. Express services are usually intersectional and come under the commander at a level which embraces the entire length of the haul. They may be given specific missions to support a field army, or other large unit, or to move a designated tonnage or type of supply within a specific period.

e. Direct Support of Combat Units. Highway transport operations in direct support of combat units are discussed in paragraph 188.

f. Motor Pool Operations. See paragraphs 21–29.

186. METHODS OF OPERATION

There are three general methods employed to accomplish the transportation mission of hauling supplies by highway. These may be classified as direct, shuttle, and relay.

a. Direct Hauling. This is the simple method of a single hauling job accomplished in one trip, involving no transfer of supplies or exchange of equipment. It is normally limited to local hauls during the initial stages of an operation before transfer or exchange points have been set up and when it may be desirable to expedite forward movements. As a line of communication haul method, it greatly taxes drivers and equipment and often results in loss of control by the unit.

b. Shuttle. The simple shuttle is accomplished by means of repeated trips made by the same vehicles between two specified points. The continued movement forward is accomplished by a repetition of this operation by vehicles operating successive legs of the over-all distance.

c. Relay. This is the continuous movement of supplies or troops over successive segments of a route without transfer of load. It is accomplished by change of drivers and/or powered vehicles for each segment. In tractor-semitrailer operations, relay implies the through movement of semitrailers by shuttle tractors operating over segments of the route.

187. PORT AND BEACH CLEARANCE

a. Port clearance, as it pertains to highway operations, is the clearing of cargo from the immediate vicinity of port operations to permit continuous unloading of ships that would otherwise be hampered by backlogs of supplies within the port area.

b. Beach clearance is the clearing of cargo from the immediate vicinity of beach operations. A successful operation of this type must be speedily executed in spite of poor roads and unloading facilities of a temporary nature.

c. So that ports or beaches may be cleared promptly, depots or dumps are usually located nearby. Since operations at a beach or port of debarkation are irregular (great activity coincident with arrival of ship convoys and little or no activity for intervals between ship convoys) and since highway transport is usually in short supply, it is wasteful and impractical to permit permanent assignment of vehicles to a port or beach in sufficient quantity for its peak requirements. Therefore, the practice is for the movement control staff to determine the quantity of cargo to be cleared by highway. With these requirements in mind the appropriate highway staff allocates the necessary truck units, which, upon completing each clearance mission, return to the highway transport service pool and are available for other tasks.

d. Port or beach clearance is chiefly a problem of control of vehicles so as to get the cargo to the correct depot or dump without congestion or delay. The truck units allocated to the port or beach clearance job establish a temporary pool near the loading area from which vehicles are dispatched as needed. When loaded, they proceed to the proper dump or depot. When the port or beach area is widely distributed, several temporary pools or subpools may be established. The shuttle system is generally used and vehicles are dispatched individually or in small groups. Multiple waybills given to the driver normally show what cargo is on the truck and give its destination and routing. They serve as tally sheets and receipts.

188. OPERATIONS IN TACTICAL SUPPORT

Hauls by truck units may be made in direct support of tactical troops. Armies, corps, or divisions may utilize organic or attached motor transport as a pooled service to be allocated when and where needed to meet the changing tactical situation. Or, at times, the theater or communications zone highway transport service may be extended into the army service area and even up to division dumps. Methods of operating highway transport in support of tactical forces are similar to line or local haul operations except as altered by proximity to the enemy and demands for increased security measures. Equipment adapted for off-road operation may be required in most tactical support operations.

189. LOGISTICAL FACTORS

Logistical factors are used to determine the ability of available highway transportation to move required tonnage over a specified distance within a stated period of time.

a. Availability. In highway transportation, availability means the number, or percentage, of vehicles in a unit that can be operated at a given time. In advance planning, for example, complete availability per the present truck company (T/O & E 55–17) would be 48 vehicles; under normal conditions with proper provision for scheduled maintenance, it would be approximately 40 vehicles per company; and under adverse conditions, averages over extended periods might be 36 trucks or less.

b. Load and Lift. For planning purposes, the pay load tonnage that can be carried by a single vehicle (load) or by the available vehicles of a unit (lift) at one time is as follows:

(1) *Load.* The planning factor load for one 2½-ton truck is 4 tons, but under conditions requiring off-road hauling, this may fall below the 2½-ton rated capacity of the vehicle. The planning factor load for the 10-ton semitrailer is 8 tons.

(2) *Lift.* The lift capability of a truck unit is the sum of the loads of the available vehicles of the unit. For example, a truck company operating under conditions which allow it to average 4 tons per vehicle, and with a vehicle availability of 40, can move 160 tons in a single lift (40 vehicles × 4 tons per vehicle = 160 tons).

c. Miles Forward. This is the one-way distance from origin to destination or one-half the round-trip distance.

d. Turn-Around Time. This is the time required to complete a single trip from origin to destination and return to origin. It includes loading time (or coupling time) plus forward haul plus unloading time (or uncoupling time) plus return trip. Turn-around time is determined by combining loading-unloading time (or coupling-uncoupling time) and running time.

(1) *Loading-unloading time.* This is the combined loading and unloading time and is usually estimated as 2 or 2½ hours per trip—that is, approximately 1 hour loading and 1 hour unloading. (Coupling-uncoupling time is the combined coupling and uncoupling time required by tractor-semitrailers in shuttle or relay operations. As this time is negligible, it is seldom figured in turn-arounds.)

(2) *Running time.* The combined going and return travel time, known as running time, depends on a ratio of the rate of march and the two-way distance between origin and

destination. In planning, 10 to 15 miles in the hour are used as the rate of march. This figure allows for short rest halts, refueling, and delays, and is therefore less than might normally be the actual speed of 20 to 35 miles per hour. Rate of march is divided into round-trip distance to determine running time. For example, at 15 miles in the hour, 4 hours would be required for a 60-mile round trip (30 miles forward and 30 miles return.) Adding the 4 hours of running time to 2 hours of loading-unloading time results in an estimated 6 hours of turn-around time.

Section III. LOADS AND LOADING

190. GENERAL

a. Correct loading of cargo is essential to securing reasonable vehicle life and full utilization of vehicles. Full utilization of the vehicle carrying capacity is essential to efficient handling of the transportation load.

b. In loading for supply movement the following must be taken into consideration:

(1) *Underloading.* If vehicles are loaded with less than their capacities for the existing conditions, more vehicles will be required to perform a given job. For example, if 2½-ton, 6 x 6 trucks are loaded with only 2½ tons when the condition of the vehicles and the road permit 5 tons, twice as many vehicles and twice as many drivers as are necessary will be required.

(2) *Overloading.* If vehicles are loaded with more than their capacities for the existing conditions, damage to vehicles may result and mobility may be impaired. For example, if 2½-ton, 6 x 6 trucks are loaded to 5 tons, when the road or offroad conditions of operation make such weight an overload, the progress of the movement may be impeded and damage to springs or other parts may result in excessive vehicle deadlining.

(3) *Improper load distribution.* If vehicles are improperly loaded with uneven or top-heavy distribution of weight, an undue strain may be placed on one part of the vehicle and loads may shift or fall off resulting in damage to the cargo. In addition there is possibility that the vehicle may overturn or be otherwise damaged, with a resulting delay of the movement.

191. WEIGHT OF LOAD AND DISTRIBUTION (fig. 37)

a. In many cases neither scales nor loading reference data giving weight of certain quantities of different types of cargo will be available. Under such circumstances it is necessary to estimate the weight of the cargo loaded.

b. When no indication of weight of cargo is available, overloading may often be avoided by rough estimates based on the position of the springs. With a known full load the position of the springs is noted and loads which further depress the springs are avoided. While this method is better than none, at best it is inaccurate and it must be remembered that springs tend to weaken with use.

c. The distribution of weight on a motor vehicle has a very definite bearing on the life of the tires,

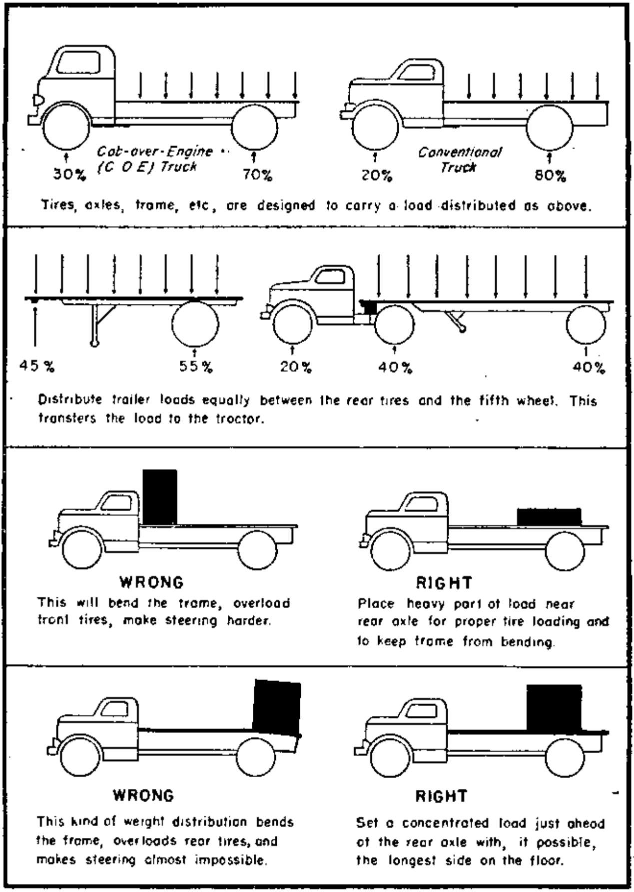

Figure 37. How to load a truck.

axles, frame, and other parts. The fact that a truck is not loaded beyond its rated total gross weight capacity does not necessarily mean that the individual tires and axles may not be overloaded. Over-

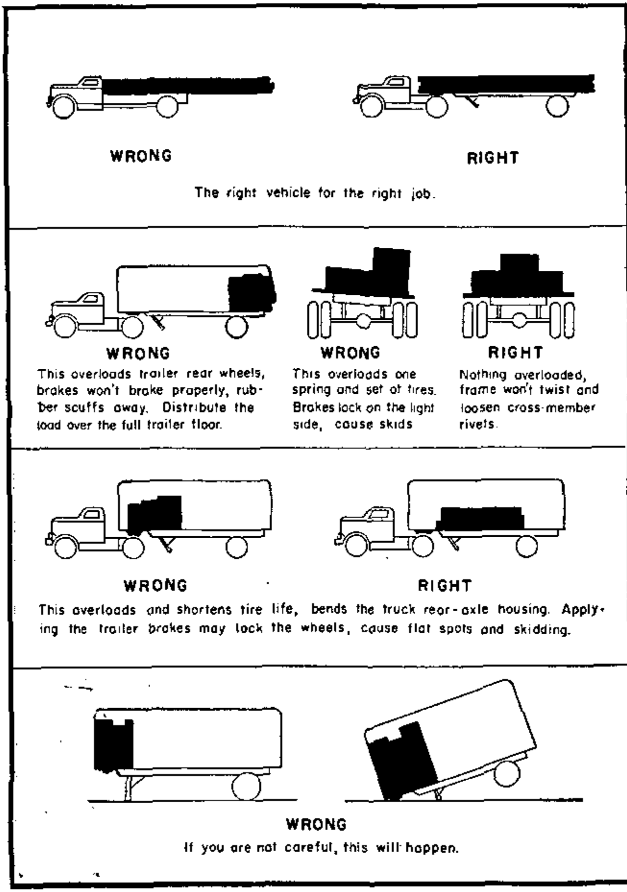

Figure 37—Continued.

loading may be due to improper distribution of heavy materials, so that the load is excessive over one rear tire or on the rear axle or so far forward in the body that the front axle and tires are overloaded; or loads such as structural steel, iron pipe, and lumber may project far out beyond the rear axle thereby overloading the rear axle and tires and tending to lift the front wheels, reduce front-wheel traction, and make steering difficult.

192. HIGHWAY LOADING

a. Military cargo vehicles of the tactical type have been developed to give satisfactory performance when operating under off-road conditions and are powered to negotiate unusually steep grades. Thus, given a smooth hard-surfaced highway, a tactical type vehicle can be expected to carry more than its off-road rated capacity.

b. Under certain conditions regulations authorize loads greater than the rated capacity. On good roads tactical general purpose cargo trucks are now permitted to carry loads up to 100% over their rated capacity. Trucks towing trailers are limited to a 60 percent overload, and rated trailer loads may not be exceeded, except under certain emergency conditions. However, only in case of emergency and upon proper authority will vehicles operating cross-country, or on anything less than smooth hard-surfaced highways, be loaded above rated capacity.

c. While carrying more than the rated load has, by common usage, come to be called overloading it should be realized that it is not in fact an overload, but a calculated safe load under favorable conditions.

However, those responsible for automotive equipment must realize that much of the safety margin built into a vehicle disappears under overloading, and drivers must be instructed to exercise caution when their vehicles are loaded to maximum highway capacity. A well-trained or experienced driver will have no trouble, a less experienced or less careful driver might.

d. The advantages of maximum calculated safe loads are many, especially when the transportation load is high in comparison to vehicle availability, but the dangers of overloading can not be overemphasized. The safety margin built into trucks is reduced in either case. To the driver this means that the same hole in the road he hit with 2½ tons without doing any immediate damage to the truck may now with 5 tons result in a broken spring or ruined shock absorber. The element of greater shock loads enters the picture. Twice as much load comes down on the frame, wheels, and body. Bolts loosen or shear more easily. Even smooth hard-surfaced highways can be expected to develop some chuck holes under heavy traffic—the driver must learn to avoid rough spots or take them slowly.

e. Heavier loads require more gear shifting. The driver must be careful in picking up the load with the clutch. Up hills, the engine will be working harder at pulling the load—proper gear ratios must be strictly observed.

f. Running over highways often means running at sustained and relatively high speeds. The "lube" in the gear boxes must be checked more often and vents must be kept open. For highway operations heavier loads make it more important to stay out of front wheel drive when it is not needed, because the extra weight causes the difference in travel between the front and rear wheels to scuff off more rubber.

g. It is *not* necessary to carry higher tire pressure since the tires normally carry approximately maximum desirable pressure. It is, however, more important to keep tires up to regulation pressure since heavier loads will flex low tires and cause them to wear and rupture.

h. A heavily loaded vehicle requires more time and distance to stop from a given speed than a vehicle carrying its normal load. The driver must be constantly mindful of this in maintaining intervehicular distance and especially when operating on surfaces affording low traction.

193. RULES FOR LOADING

a. Responsibility. The driver is not normally required to handle cargo during the loading and unloading operations, but he is responsible for his vehicle's being properly loaded.

b. Rules for Loading. Efficient loading assures maximum use of cargo-carrying capacity and safety in transit. One loose piece of cargo may release an entire load; and if the load is unbalanced, the vehicle is difficult to handle, is in danger of overturning, and is a menace to traffic. The following principles summarize the rules that should be observed for correct loading:

(1) Heavy supplies should be placed at the bottom of the load and properly distributed.

(2) In building up the load, cargo should be placed carefully to avoid shifting and to distribute the weight equally.

(3) Loosely distributed loads should not be built up too high. High, loose loads cause swaying, make the vehicle difficult to handle, and increase danger of cargo loss or overturning of vehicle.

(4) If the truck is not a covered vehicle, a tarpaulin should, when practicable, be placed over the cargo as a protection against sun, dust, or rain.

(5) Barrels and drums should be loaded on their sides, parallel with the length of the truck, braced and pyramided, or they may be stood upright.

(6) Boxed, crated, and packaged cargo should be combined, so far as possible, with like items or items of combining shapes.

(7) Sacked cargo should be loaded separately or out of danger from puncture by odd-shaped or sharp-edged items, and should be stacked in overlapping layers to prevent shifting.

c. Protruding Loads. Whenever practicable, loads which extend beyond the tail of the truck should be avoided, and no load should extend over the driver's seat. Loads which extend over the side, so that the vehicle requires a wider lane than usual, are especially dangerous. If a load unavoidably extends more than 2 or 3 feet beyond the rear of the truck, it should be marked on the end so that others will plainly see it. In daylight a red cloth at least

12 inches square is preferable; at night, security permitting, a lighted red lantern.

d. Securing Loads. The safety of loads on cargo vehicles is dependent upon the protection offered by the stakes or sides, the tailgate, and the tarpaulin in combination with its rear and front curtains. Loads consisting of objects which are longer or higher than the body of an open cargo truck should be lashed. Two 60-foot ropes are suitable for lashing. Lash hooks or rings are provided on the bodies of most cargo vehicles. Lashing may be accomplished as follows:

(1) Fasten the end of one rope to one of the front lash hooks or rings.

(2) Pass the rope diagonally across the top of the load through or under the second rope support on the other side, and pull the rope tight.

(3) Pass the rope diagonally back across the top of the load to the first side through or under the third rope support on the side and pull the rope tight.

(4) Continue the process until the rear of the truck is reached, and then fasten the end of the rope securely.

(5) Using the second rope, start at the other front corner of the truck and repeat the procedure using alternate lash hooks or rings.

e. Towed Loads. Towed loads (other than semi-trailer) are attached to their prime movers or towing vehicles by means of the lunette of the towed load placed in a pintle on the towing vehicle. The pintle latch must be closed and secured before the load is moved. Safety chains, when available, should be used. Care should be taken in regard to hooking up the electrical connection for lights and brakes on trailers.

Section IV. CARGO LOSSES

194. GENERAL

Cargo losses are sustained in transit primarily by damage resulting from careless handling, sabotage, or neglect of protection against the elements, and pilferage—which is often the great cause of cargo losses. The loss of military supplies can usually be attributed to laxity in fixing responsibility for cargo between the time it leaves the shipper and is received by the user. The primary preventive of such waste is the elimination of weak or missing links in the chain of in-transit responsibility. Drivers of motor vehicles, noncommissioned officers, and the commanders of march units and convoys are important links in that chain of responsibility. Contrary to popular belief, the weak links are seldom well-trained drivers. More often, the real neglect lies with those responsible for properly loading and documenting the load, training and disciplining drivers, and guarding and caring for loads in transit.

195. PREVENTIVE MEASURES

a. Proper packaging, prompt cooperage of damaged packages, correct preparation and usage of documents in transferring responsibility, closely supervised dispatch, well-controlled movement, and a thoroughly organized system of cargo handling are the major preventive measures. Guards are also important in preventing cargo losses, but need for guards, is lessened if other measures are adequately imposed.

b. Unit commanders should impress drivers with their responsibility for the supplies carried in their vehicles. This responsibility includes that of protecting themselves by assuring that their loads are properly listed at point of origin, that discrepancies are noted, and that receipt is obtained for the full load at destination. This responsibility further includes loading properly, securing load, and caring for load during the haul.

Section V. HANDLING EXPLOSIVES AND INFLAMMABLE LIQUIDS

196. DISPERSION

Explosives and inflammable liquids (FM 5–25 and TM 9–2900) should be stored, handled, and transported with care; when practicable, they should be sufficiently separated from each other so that if an explosion or a fire involves one it will not involve another. This is particularly important when it is necessary to transport explosives and inflammable liquids over important bridges or through congested areas, tunnels, or other vulnerable locations.

197. SEGREGATION OF CAPS

Separately packaged detonating caps should never be transported in a vehicle carrying other explosives or inflammable materials. With the exception of completely factory-loaded items, such as small arms ammunition and hand grenades, explosives should not be fuzed until they are ready to be used, and when applicable, fuzes should be removed by Ordnance before such explosive materials are accepted for transport to a new location.

198. PROTECTION FROM SPARKS AND FIRES

a. Static Electricity. Ground conductors should be provided to neutralize charges of static electricity before and during transfer of inflammable liquids. When transferring inflammable liquids from one container to another, the two containers should be bonded by an electric conductor. Bonding can be affected by touching the metal of the two containers together. In fueling vehicles from drums or cans, the flexible nozzle of the can should be brought into solid contact with the filler opening. When filling drums or vehicles from a hose of a dispenser, the nozzle should always be brought solidly against the metal of the drum or tank. Special bonding arrangements may be needed in filling tank trucks.

b. Exhaust Gases and Ignition Sparks. As a precaution against accidental fire or explosion caused by hot exhaust gases or sparks from a vehicle ignition system, vehicle ignitions should be cut off when loading explosives or inflammable liquids.

c. Sparks from Metal. To avoid the possibility of sparks, nonmetallic tools, if available, should be used for handling explosives or inflammable liquids. When practicable, the interiors of truck bodies used for transporting explosive and packaged inflammable liquids are normally lined with wood or other nonsparking material.

d. Open Flames. Lighting matches and smoking should be prohibited when in the vicinity of explosives or inflammable liquids, particularly when such materials are being loaded or unloaded. Electric lights only should be used for illumination. Inflammables and explosives carried in open trucks should be well covered with a tarpaulin to protect the load from cigarettes carelessly thrown from other vehicles. Vehicles carrying explosives or inflammables should always maintain a safe distance from open fires.

e. Fire-Fighting Equipment. Effective fire extinguishers (SR 385–155–1) should be carried by vehicles transporting inflammable or explosive materials. In areas where considerable quantities of such materials are being handled, special apparatus for fighting large-scale fires should be available.

199. GENTLE HANDLING

Jars or shocks must be avoided in handling explosives. This is particularly essential in carrying sensitive explosives used in detonators. Containers packed with explosives should never be carelessly rolled, thrown, or dropped. All reasonable precautions, such as stopping the engine and placing the vehicle in gear, setting the hand brake, and blocking wheels, should be taken to prevent accidental movement of vehicles when they are parked. Explosive materials should be securely loaded inside the vehicle in which they are being transported so as to reduce the possibility of their shifting or falling out. Explosives should never be carried on a tailgate or on the outside of a truck body. Unless there is need for secrecy, vehicles carrying explosives should be clearly identified. Whenever vehicles are halted on the road, guards should be provided or signs should be conspicuously posted to warn approaching traffic of the danger of collision. Speeds of such vehicles should be moderate to avoid jars to loads and collision with other vehicles.

200. LEAKAGE OF INFLAMMABLE LIQUIDS

If a vehicle transporting inflammable liquids develops leakage en route, further movement should be limited to the minimum distance necessary to dispose of the load safely. When leakage is of such a nature that further transportation is unsafe, the vehicle should immediately move off the traveled portion of the road. Trenches may be dug to prevent the liquid's being spread over a wide area. If possible, the liquid should be kept away from streams and sewers. Spectators should not be permitted to congregate, and lighting fires or smoking in the vicinity must be prevented. Guards should be stationed or markers posted to outline the area involved and to warn all concerned against the danger of sparks, open flames, or smoking.

201. REGULATIONS CONCERNING SHIPMENT OF EXPLOSIVES AND GASOLINE BY TRUCK

a. The Interstate Commerce Commission regulations applicable in the United States are good guides for safety measures for shipment of explosives and inflammables by military forces. Methods of handling such cargoes overseas depend on the circumstances and the urgency of military necessity. In heavily populated areas in allied and liberated countries, regulations for handling dangerous cargo are arrived at by joint agreement between representatives of United States Armed Forces and the authorities of the government concerned. In occupied enemy territory, the safety regulations that apply are those provided in local army directives. It is essential that all personnel be constantly reminded of the safety rules governing the movement of dangerous cargo because the slightest carelessness may have fatal results. Officers and enlisted men charged with such movements will not only instruct their men thoroughly on safety rules but will also constantly conduct informal inspections to insure that safety measures are followed. All personnel are required to bring the attention of the person concerned to any violation of safety rules.

b. The following safety rules will be observed by all personnel moving gasoline or explosives:

(1) *Rule 1*. To prevent fire, the following measures will be constantly enforced:

(*a*) Smoking is forbidden within 100 feet of any truck loaded with explosives or gasoline.

(*b*) Open flames such as those produced by striking matches, use of cigarette lighters, torches, etc., are prohibited within 100 feet of any motor vehicle loaded with explosives or gasoline.

(*c*) Two fire extinguishers properly filled, one inside the cab and one outside on the driver's side, are recommended on each truck hauling explosives and inflammables (par. 103*b* (5), Ordnance Safety Manual OO Form No. 7224).

(*d*) All personnel will be instructed in the proper use of fire extinguishers, and where practicable, the instructions will be supplemented by demonstration.

(*e*) If a truck catches fire, all trucks will be moved away from the vicinity of the fire and all traffic stopped. Every practicable effort will be made to warn inhabitants living in the vicinity of the danger.

(*f*) When loading or unloading trucks, explosives will not be placed in the vicinity of the exhaust.

(*g*) Ignition and lighting systems will be properly insulated and frequently inspected to insure that danger from short circuits is eliminated.

(*h*) Every effort will be made to prevent leaks in gasoline tanks, fuel lines, and carburetors. When a leak is discovered, the truck will be unloaded and moved to a safe distance before repairs are made.

(*i*) Oil and grease thrown from moving parts will not be allowed to accumulate on the truck body, engine, or other places where a fire hazard will result.

(*j*) Motor vehicles transporting explosives or gasoline will not be driven past fires of any kind until it has been ascertained that the fire can be passed with safety.

(2) *Rule 2.* Advance reconnaissance and contact with state and local officials are essential. Routes selected should avoid heavy traffic and large cities if possible.

(3) *Rule 3.* Loitering will not be permitted in the vicinity of the convoy.

(4) *Rule 4.* When a truck breaks down, it will be moved as far to the side of the road as possible and, pending the arrival of an empty truck or repair party, the truck will be left in charge of a guard.

(5) *Rule 5.* Fuzes and detonating devices will not be carried in the same truck with other explosives (fixed ammunition an exception).

(6) *Rule 6.* The interior of the truck body will be lined so that every portion of the lining with which a container may come in contact shall be of wood or other nonsparking material.

(7) *Rule 7.* Loads will be braced and stayed to prevent shifting.

(8) *Rule 8.* Trucks loaded with explosives or gasoline will never be towed or pushed by another truck except to move a disabled truck to the side of the road.

(9) *Rule 9.* Hourly halts will be made to inspect loads and vehicles.

(10) *Rule 10.* Motor vehicles transporting explosives on public roads or highways will be marked with placards bearing the word "Explosives" in letters at least 3 inches high. The placards will be prominently located

on each side and on the front and rear of the truck.

(11) *Rule 11.* No motor vehicle transporting explosives or gasoline will be left unattended upon any public street or highway.

(12) *Rule 12.* The motor will be stopped when loading or unloading a truck hauling explosives or gasoline.

(13) *Rule 13.* Where trucks are of the open body type, a tarpaulin will be used to protect the cargo from rain or the direct rays of the sun.

(14) *Rule 14.* The entire cargo of explosives or ammunition shall be contained within the body of the truck. Truck tailboard or tailgate shall be closed effectively and secured.

PART SIX

CONDITIONS OF OPERATION

CHAPTER 13

MILITARY HIGHWAY TRANSPORTATION WITHIN THE UNITED STATES

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202. CLEARANCES FROM CIVILIAN AUTHORITIES

a. To assure compliance with state and local laws, to safeguard highway facilities, and to avoid delays and accidents, movement within the continental United States and territories or possessions of the United States will be coordinated with state or local highway traffic authorities concerned and other appropriate civilian agencies. For example, the movement of ten or more vehicles organized to operate as a column or the dispatching of ten or more vehicles per hour to the same destination over the same route or of military vehicles of sizes or weights unusual for ordinary highway travel should be cleared with civil authorities. All necessary permits, clearances, escorts, and guides prescribed by civil authorities will be secured as far in advance as practicable and in no case, except in an emergency, less than 24 hours in advance of the movement.

b. In the case of an intrastate movement by highway, civilian assistance in planning the movement is obtained by the local installation or unit transportation officer, who makes the necessary arrangements with the highway traffic authorities of the state concerned and other appropriate civilian agencies.

c. In the case of interstate movements within the area, the matter should be referred to the area transportation officer, who coordinates the movement with the authorities of the various states concerned.

d. When the movement passes out of the continental Army area in which it originates, the transportation officer of that area coordinates the movement with the transportation officers of all areas through which it passes, and the transportation officer of each such area coordinates the movement with the proper civilian authorities within his area.

e. Civilian authorities will be furnished with any information (except data classified above restricted) which they may request. The data which may be given to civilian authorities concerned is governed by regulations and directives existing at the time of the movement. For example, during peacetime the identity of troops being moved is normally not concealed, but in the case of war or imminent war, identities of units are usually secret.

f. The following example illustrates information which civilian authorities may desire:

(1) Origin and destination of movement.

(2) Desire to enter state at ______(hour) on ____________(highway number or name) at ____________(point).

(3) Desire to leave state at ______ (hour) on ____________ (highway number or name) at ____________ (point).

(4) Designation of column.

(5) Officer in command.

(6) Number of vehicles.
(7) Personnel strength.
(8) Necessary halts.
(9) Column does (does not) have explosives. If so, their nature.
(10) March characteristics of column.
  (*a*) Speed.
  (*b*) Type of column, that is, whether infiltration, open, close, or fixed. (Explain meaning of terms rather than merely use the term.)
  (*c*) Distances between vehicles, speedometer multiplier (SM). (Explain SM.)
(11) List of overweight or oversize vehicles, if any, and characteristics of weight of each.
(12) Other data (for example, whether blackout will be maintained).

g. Civilian authorities may, in return, be of material assistance to military authorities by furnishing advice as to:

(1) Most practicable route(s) to be used, identifying route markings.
(2) Alternate route(s), identifying route markings.
(3) Points where it may be advisable to divide columns and use two or more routes to alleviate congestion or road wear.
(4) Time when it is best to pass through areas of traffic congestion or traffic defiles.
(5) Vehicle spacing and speeds most desirable for coordination with other traffic.
(6) Location and nature of any unusual road conditions.

(7) Highway repair work which may be encountered or required.

(8) Information on weight limitations of bridges and clearances in height and width along the route.

(9) Location of facilities for service and supplies.

(10) State and city police escorts to assist the column.

(11) Availability of police communications system for emergency messages, including possibility of tuning column radios into police net.

(12) Location of hospitals available in case of emergency.

(13) Procurement of dependable road maps.

h. Whenever unforeseen circumstances dictate a change in the plans for the movement, the civilian agency concerned will be notified promptly of the change.

i. Information in *a* through *h* above does not preclude the establishment of standing operating procedure with the proper state or local authorities for the coordination local, routine, or regional movements in the vicinity of or between installations.

j. So far as the civilian practice permits, contact with civilian authorities should be informal and, when practicable, should be established by personal conference between civil authorities and the appropriate commander or his representative. When time will not permit personal conference, liaison should be established by telephone, telegraph, or radio, in which event sufficient information will be furnished to permit intelligent planning.

203. TRAFFIC ESCORTS

a. Normally, military police will provide traffic escorts as needed; however, civil authorities may provide the escorts necessary in assisting a movement through congested areas.

b. A city, county, or state police force or state highway patrol may furnish a traffic escort for the length of the movement within the boundaries of the city, county, or state concerned, but such police units normally have no jurisdiction beyond their respective areas. Hence arrangements should be made for another traffic escort, when needed, to meet the column at the point where the column leaves one area and enters another.

c. Civilian police escorts may be provided to aid the military police. When military police are not available, civil police may furnish the entire escort.

(1) In the absence of both civilian and military police, such traffic escorts as may be necessary are furnished from the column.

(2) It should be kept in mind that military police or escorts furnished by the column do not have the same authority as civilians (except in case of martial law). In practice, military police will usually be obeyed, but soldiers used as traffic escorts should be carefully selected and well-instructed to reduce the probability of antagonizing civilians encountered in the course of their duty.

204. TOLLS AND FERRIES

a. Normally, there is an arrangement between the Army and authorities controlling a toll route or ferry under which tickets are provided or slips signed to cover the passage of Army vehicles.

b. Commanding officers of columns should ascertain in advance whether there are any toll bridges, tunnels, or ferries on their routes, and they should make sure that they are prepared to comply with the prescribed procedure.

205. RECONNAISSANCE WITHIN THE UNITED STATES

Main roads within the continental United States are generally good, lacking in prohibitive grades, and of high capability. Moreover, they are well signed and marked. Good up-to-date road maps are readily available, and information concerning roads under repair, unusual conditions, bridge capacities, detours, etc., is readily available through the civil authorities. It is therefore seldom necessary to make a detailed reconnaissance before the movement of a column over the main roads of the United States. However, during maneuvers, simulated reconnaissance is frequently practiced and, for marches off main roads, it may be advisable in any case.

206. SAFETY PRECAUTIONS

Civilian safety precautions for movements in the United States are fully applicable to military movements. So far as consistent with military necessity, it is the policy of the Army to conform to all interstate commerce and local safety regulations.

207. PROCEDURES IN CASE OF ACCIDENT

(pars. 122, 123)

Accident procedures as prescribed herein are designed to meet normal conditions and are applicable in the continental United States.

208. ADVANCE PARTIES

(par. 90)

Advance details (nontactical) should be sent out when it is necessary to rent ground to establish bivouacs and to arrange for rations.

209. FOLLOW-UP PARTIES

(par. 91)

The functions of a nontactical follow-up party are especially applicable in the continental United States, where it is important that property used for bivouac or quarters should be left as nearly as possible in the same, or better, condition than before occupancy by troops.

CHAPTER 14

MOVEMENT OF CONVOYS IN COMBAT AREAS

Section I. GENERAL

210. ENEMY CAPABILITIES

Motor columns are a prime target for attack by air from infiltrating enemy forces, guerillas, or parachutists. They are particularly vulnerable to such attack if countermeasures are not planned and executed, especially where terrain features tend to produce congestion. When convoys must pass through areas where ambush is a possibility, responsible commanders must furnish security detachments capable of clearing the route of effective resistance.

211. SELECTION OF THE INITIAL POINT

The initial point selected should be inconspicuous to hostile observation, but it must be easily identifiable to those in the column. The column commander normally checks his units here. When several elements from different routes converge on a single road, their arrival must be so timed that there will be no congestion or interference between columns.

212. RECONNAISSANCE

Advance reconnaissance in the direction of march is best provided by organic or improvised reconnaissance units that operate well ahead of the column and cover the main routes and important intersecting routes in the direction of march. Advance reconnaissance elements send out small patrols as required. Each patrol should have at least two vehicles in addition to any vehicles required for messengers. Promptness and speed may contribute more to the safety of a moving column than deliberate and detailed security measures.

213. PROTECTION FROM MINES

a. Detection. Antitank and antipersonnel mines and booby traps are likely to be encountered when entering areas recently occupied by the enemy. Newly mined areas can sometimes be discovered from a study of aerial photographs. Soil from mine burial, patterns of mine field, tracks, paths, and other signs of activity may help to betray the presence of concealed mines. Dead cattle along the route or in the area to be traversed may indicate that mines are located there; straying cattle may indicate that the area is clear. However, mines may be detonated along a route that has been previously traveled; for example, when ruts wear deep enough to allow them to be detonated. Electric or magnetic mine detectors, if available, are useful for locating individual mines. Forks, sticks, grapnel lines, probes, and similar equipment are used by mine clearing parties (FM 5–31).

b. Precautions. Despite the possibility of ruts wearing deep enough to detonate mines, it is always a good precautionary measure to follow the tracks of vehicles ahead. In areas heavily mined, sandbags placed on the floodboards of vehicles are beneficial in preventing casualties in the event a mine is exploded.

Vehicles moving through a doubtful sector should proceed slowly and at widely spaced distances.

c. Removal. Engineers or pioneer parties should be specially trained to discover and remove mines from the roadway. Cleared paths or roadways should be marked with tape on either side of the cleared area. Inexperienced personnel who locate a mine should not disturb it, except in an emergency, but should post a sentry or sign to warn passing traffic until trained personnel are available to remove the mine or destroy it. Special mine sweepers, such as tanks with special detonating attachments, provide a method for destroying antitank mines. Bangalore torpedoes and detonating nets made of detonating cord can be used as a rapid means of clearing a path through mine fields (FM 5–31). Fuzes of mines should be removed only by competent personnel. If it is impossible to clear the entire road of mines, one lane should be cleared and the other well-marked. Holes caused by removal of mines should be refilled to restore the road surface to proper condition for vehicular use.

214. AIRCRAFT WARNING

Speed of air operations makes it desirable to obtain adequate warning of the approach of hostile aircraft. When practicable the column commander should have a radio tuned to the area anti-aircraft artillery intelligence dissemination frequency. He should be able to determine the approach of hostile aircraft in time to give adequate warning to the column. Sufficient warning is needed to conform to existing orders for such situations, for example, to allow the column to leave the road and disperse.

Section II. GENERAL SECURITY MEASURES

215. DEFENSE OF MOTOR TRANSPORT

When convoys must pass through areas where ambush is a possibility, it is the duty of the responsible commander to furnish security detachments capable of clearing the route of effective resistance. These detachments may precede, accompany, or follow convoys or may occupy successive positions along the route. Convoys traveling alone are subject to ambush attacks. Where contact with the enemy is possible, both active and passive defense measures should be utilized. Active measures to be taken normally require a knowledge of the immediate tactical situation; passive measures should be second-nature to well-trained and disciplined troops and effected whenever there is even a remote possibility of attack.

216. CAMOUFLAGE
(figs. 38, 39, 40, and 41)

a. General. Camouflage can be accomplished by hiding, blending, or deceiving (FM 5–20 series).

b. Stationary Vehicles.

(1) Vehicles can best be camouflaged when stationary. However, when stationary they are not performing their function of moving troops and cargo. While security is of the utmost importance, it should be realized

that it is secondary to accomplishing a military mission.

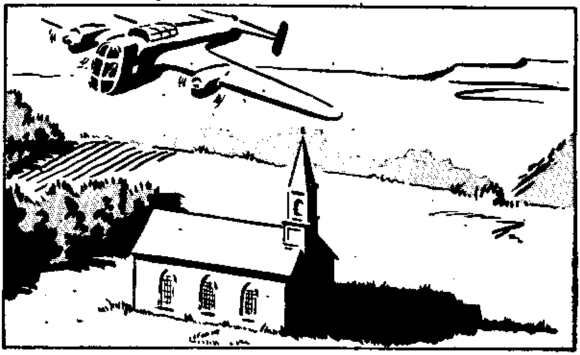
(2) Stationary vehicles can best be camouflaged by placing them under natural vegetation in such a way as to break up the regular pattern of shadows produced by vehicles and by covering all parts likely to cast a noticeable reflection of light. When natural concealment is not available, some protection can be obtained by using fish nets or chicken wire properly garnished with artificial material of natural vegetation. Care must be taken, however, that color and texture blend with the surrounding area (FM 5–20B).

c. Moving Vehicles. Moving vehicles cannot be successfully camouflaged artificially. However, movements may often be routed over roads which are concealed by natural vegetation. If dusty roads are avoided, the chance of the enemy's detecting a motor movement will be lessened. In a stabilized situation, artificial road screens may be of some value in concealing the nature and extent of road movements from hostile ground observers. Such screens are, however, seldom very effective against aerial observers. Unless the concealed road is new and not on published maps, attempts to camouflage may be an indication to the enemy of a heavy traffic flow over the sector.

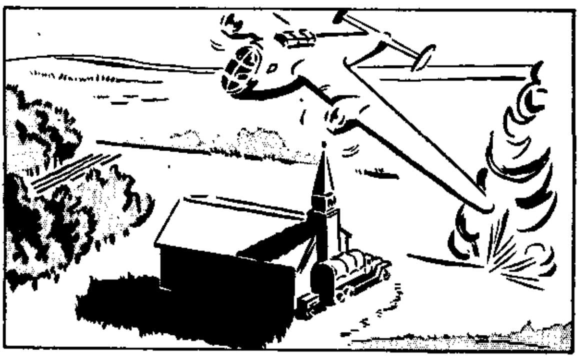
d. Bivouac or Terminal Areas.

(1) Strict camouflage discipline must be maintained to prevent the formation of tracks or paths indicating the location of camouflaged vehicles and terminal installations.

Existing paths should be marked to prevent changes that would be readily apparent to enemy observation. Tracks made by vehicles which cannot otherwise be concealed should be continued beyond the planned position of the vehicles so as not to end abruptly and thus call attention to the pres-



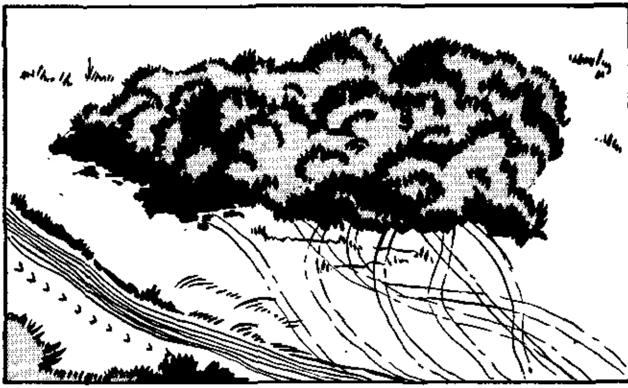
RIGHT: SHADOWS HELP HIDE THE TRUCK.



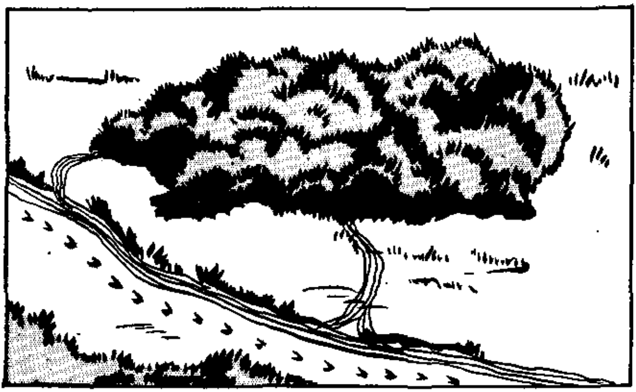
WRONG: THE TRUCK SHOULD BE MOVED AS SHADOWS LIFT.

Figure 38. Use of shadows.

ence of the vehicles. Any tendency toward formation of geometric patterns in the parking of vehicles should be avoided. It is helpful if all visible movement can be stopped



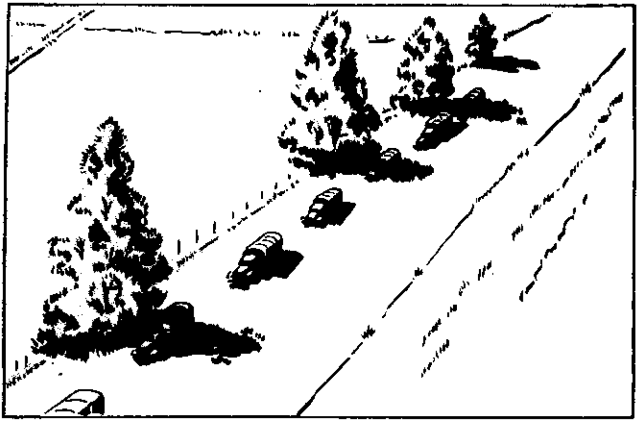
WRONG: NUMEROUS TRACKS ARE LIKE ROAD SIGNS.



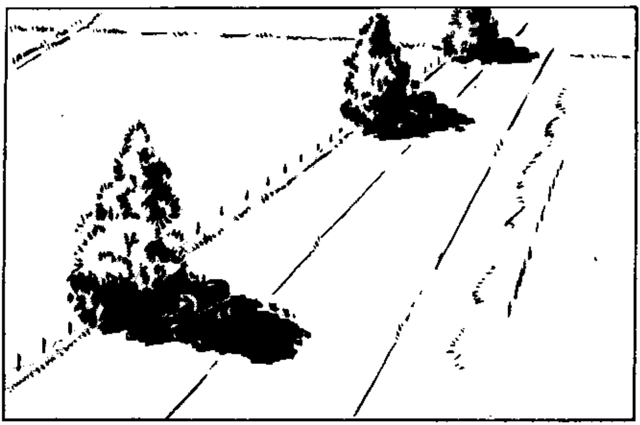
RIGHT: DRIVE INTO CONCEALMENT FROM ONE SPOT.

Figure 39. Tracks entering concealment.

when enemy aircraft are in the vicinity. However, when aerial attack is from a flank or perpendicular to the column it may be de-

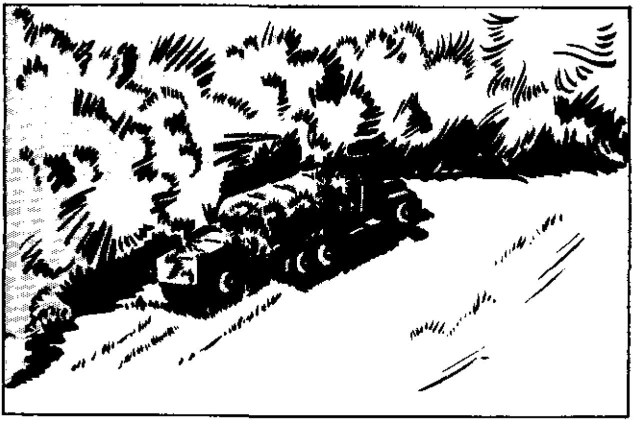


WRONG: HALF CONCEALMENT.



RIGHT: INDIVIDUAL CONCEALMENT DOES THE TRICK.

Figure 40. Partial and full concealment.



WRONG: OUTLINE OF TRUCK ISN'T BROKEN UP.

RIGHT: BREAK UP OUTLINE AND SHADOW.

Figure 41. Outline and shadow.

sirable to keep the convoy moving until the aircraft has completed its pass.

(2) When snow is on the ground, white sheets may be of some value for camouflage purposes. Their use is effective, however, only when strict camouflage discipline is enforced, since wheel tracks, paths, and discoloration show up very readily on snow.

217. CONTROL OF COMMUNICATIONS

a. Enforcement of strict radio silence may often be necessary in order to prevent hostile radio intercept service from locating motor transport movements. Even when strict radio silence is not essential, care should be taken that radios do not provide important information to the enemy. Communication by wire is likewise often subject to enemy interception, especially when enemy mechanized units or undercover agents are known to be operating in the area. When the urgency of the situation does not require otherwise, it is desirable to use code in transmitting information of traffic movements.

218. DEMOLITION OF VEHICLES TO PREVENT ENEMY USE

a. When necessary to prevent the enemy from using or salvaging automotive equipment, commanders should destroy or damage beyond repair all parts essential to the operation of the vehicle, including essential spare parts. They should select a location for destruction that will cause greatest obstruction to enemy movement and observe appropriate safety precautions.

b. Methods of destruction employed are:

(1) *Smashing*. Use sledges, axes, handaxes, pickaxes, hammers, crowbars, or heavy tools.

(2) *Cutting*. Use axes, handaxes, or machetes.

(3) *Burning*. Use gasoline, kerosene, oil, flame throwers, or incendiaries.

(4) *Explosives*. Use firearms, grenades, or other explosives.

(5) *Disposal*. Bury parts in slit trenches, foxholes, or other holes. Throw in streams. Scatter.

c. Three methods of destroying the vehicle are outlined below in the order of their effectiveness. Whichever method is used, the sequence outlined will be followed to assure uniformity of destruction among a group of similar vehicles.

(1) *Method No. 1.*

(*a*) Puncture fuel tanks. Remove and empty fire extinguishers.

(*b*) Using an ax, pick, sledge, or any other heavy object, smash all vital elements, such as distributor, carburetor, air cleaner, generator, ignition coil, fuel pump, spark plugs, lights, instruments, and controls. If time permits and a sufficiently heavy object is available, smash the engine cylinder block and head, crankcase, transmission, and axles. Slash and destroy tires.

(*c*) Pour gasoline or oil over entire vehicle and ignite.

(2) *Method No. 2.*

(*a*) Puncture fuel tanks. Remove and empty fire extinguishers.

(*b*) Use tanks, artillery, antitank rockets, or grenades to fire on the vehicle. Aim at the engine compartment, axles and wheels. If a good fire is started, the vehicle may be considered destroyed.

(3) *Method No. 3.*

(*a*) Puncture fuel tanks. Remove and empty fire extinguishers.

(*b*) Prepare charges of explosive with a nonelectric blasting cap and appropriate length of safety fuze for each charge. Place one charge on top of the clutch housing and one as low as possible on either side of the engine. The second charge should be placed to insure destruction of the engine block and crankcase.

Caution: If charges are prepared beforehand and carried in the vehicle, keep the blasting caps and safety fuzes separated from charges until they are to be used.

(*c*) Ignite the charges and take cover. The danger zone is approximately 200 yards. The fuze will burn approximately 1 minute for each 2 feet of fuze.

d. Destruction of pneumatic tires, including the spare, must always be accomplished, even if time will not permit destruction of any other part of the vehicle. The following methods may be used.

(1) Incendiary grenades may be employed to destroy tires. Ignite one grenade under each tire. When this method is combined with the destruction of the vehicle by other ex-

plosives the incendiary fires must be well started before the charge is detonated.

(2) An axe, pick, or machine-gun fire may be used to damage tires. They should be deflated first, if possible. Gasoline may be poured on the tires and then ignited.

219. GUERILLA ACTIVITIES

a. A guerilla attack on a supply convoy may result in a disrupted line of communications and a shortage of supplies. Such an attack may also yield supplies to the enemy.

b. The column commander must instill a courageous attitude among his drivers so that column personnel, alert to the situation confronting them, will act promptly. Though the enemy may act on ground of his own selection, he may be deprived of some of the advantages of surprise attack if alert personnel are ready to enforce countermeasures.

c. The scheduled route of march and any change thereto must be scrutinized for possible guerilla activity attempting to lead the convoy into ambush. Guerillas may alter directional signs, impart misleading information, construct road blocks, and mine road and shoulder areas so as to delay and harass the mission.

d. Convoy personnel must be alert for ambush if the lead vehicle should become immobile as the result of a mine or other action. The column's defense may possibly be best accomplished by continuance of the march.

e. Enemy action is likely to occur in defiles or heavily wooded areas or while fording streams or crossing bridges. Strict march discipline is enforced so that continued movement of the column may be maintained when possible. The unity of the column is especially important in supply columns where a minimum of personnel is available.

f. Sentries and outguards must be maintained at motor parks and bivouacs, and they should be inspected continually to insure a state of alertness (FM 31–20).

CHAPTER 15

EFFECTS OF TERRAIN AND CLIMATE

Section I. OPERATIONS UNDER DIFFICULT CONDITIONS

220. EFFECTS OF TERRAIN AND CLIMATE

a. Proper Use of Vehicles. The fact that tactical vehicles are usually designed with all-wheel drive and have low and powerful gear ratios does not warrant abuse through excessive wear and tear imposed by operations over rough or hazardous terrain when it can reasonably be avoided.

b. Operating Over Minor Roads. The danger of a driver losing his way is increased on minor roads which are unmapped and unmarked. If a convoy is lost in strange country and the location cannot be established by other means, time and effort will often be saved by having the main body halt while a reconnaissance party is dispatched to determine where a wrong turning was made or where the route being followed leads.

221. OFF-ROAD OPERATIONS

When moving off the road, under difficult conditions, the following precautions should be taken:

a. The leading vehicle should have a selected driver. He should be the best driver available.

b. The front axle drive should be engaged before leaving a hard surface road.

c. Guides on foot may be dispatched in advance and personnel may be dropped to caution drivers in the rear concerning particularly difficult places.

d. When a vehicle is stalled, the driver should be given advice and help. A decision is required at once as to whether the stalled vehicle can be moved under its own power, by the next vehicle, or by men at hand. If the vehicle cannot be moved without holding up the column, it is left for the trail party. So far as practicable, the column should be kept moving and a detour route should be started.

Section II. STEEP GRADES, CURVES—MOUNTAIN OPERATIONS

222. GENERAL

This section deals with the effects of topographical features such as sharp curves, steep grades, and other conditions normally encountered in hilly or mountainous regions.

223. NEGOTIATING TURNS WITH A TOWED LOAD

In making a curve with a towed load the tendency of the trailer is to "jack-knife" unless the reduction in speed is very gradual. When the towed vehicle has brakes, trailer brakes should be applied first. Sudden stops should be avoided. If a curve is too sharp for a truck and towed load, it is usually possible to uncouple the truck, drive it around the turn, and then manhandle the towed load or pull it around the turn by use of a tow rope or block and tackle. When tractor-semitrailer combination cannot negotiate a turn, "dolly-converters" may be stationed at sharp curves, with a tractor crew to pull the converted semitrailer around the curve.

224. ASCENDING STEEP SLOPES

a. Increasing or Decreasing Load. If power fails at the lowest gear ratio, the load may have to be decreased. However, if failure to make ascent is due to loss of traction, causing the vehicle to slip, sufficient traction may sometimes be gained by increasing the load. This may be done by loading men over the driving axle or axles. This solution is frequently successful on vehicles with two-wheel drive, and on empty vehicles moving heavy towed loads. On nontowing vehicles having front-wheel drives, the addition of more than the normal load is seldom advisable, because these vehicles usually have sufficient traction to pull to the limit of their power.

b. Towing and Pushing. Towing may be the most expeditious method of getting over a difficult ascent if the vehicle cannot negotiate the hill on its own power. If the grade is not too steep, the use of manpower either towing or pushing may be the quickest and most practical method. If pushing is resorted to, precautions should be taken against the vehicle's rolling back. Chocks should be placed under the wheels and moved forward with the vehicle. Winching or towing by another vehicle may have to be resorted to. If a winch truck is available it should, if possible, make the ascent first. This may require winching of the vehicle with its own gear, perhaps even by steps, using block-and-tackle and deadman methods. After the first vehicle has cleared the critical ascent it may assist in towing or winching other vehicles up the grade. Or each vehicle in turn may be connected with tow rope or cable to assist vehicles following. In the case of truck-trailer operations, towed loads may be disconnected and pulled up separately. If necessary, several vehicles may be connected in tandem to pull up a towed load.

225. DESCENDING STEEP SLOPES

a. Choosing Descent. If there is a choice of descents the one which allows the best traction and the most graduated slope should be selected. Otherwise, steep slopes should be descended straight down, so that in case sliding occurs the vehicle may be brought under control more quickly without danger of overturning. Before descent of dangerous slopes all personnel except the driver should be dismounted.

b. Assistance. When necessary, outside assistance should be given to vehicles descending very steep slopes. It may be applied as follows:

(1) By manpower through the use of tow ropes, or block and tackle to prevent too sudden descent. A tree or post may be used for snubbing the rope and to allow personnel to gain a new hold or to let the weight down gradually.

(2) By use of another vehicle connected by chain, cable, or rope to the vehicle descending, both descending in low gear. This is accomplished best when the rear vehicle has a more gradual descent or can obtain better traction. It may also be accomplished by connecting vehicles in series or in relays.

(3) By use of the winch on assisting vehicle, the cable being attached to the descending vehicle and run out in gear, the descending truck operating in the lowest gear.

(4) By setting brakes on towed loads of the descending vehicle and attaching a safety rope or tackle between the vehicle and its towed load. Weight of the braked trailer is used to retard the descent of both units. When necessary, towed loads should be disconnected and let down separately.

226. MOUNTAIN OPERATIONS

a. Motor Operations in Mountainous Terrain.

(1) The rules for ascent and descent of steep slopes obviously apply in mountain operations.

(2) General reconnaissance of the available road net will usually determine the type and the number of trucks that can profitably be employed in a mountain operation. Mountain roads or trails often are unimproved. Bridges are often narrow and of a flimsy construction and require reinforcement before they are adequate for military traffic.

(3) Motor transportation in mountainous terrain may have to be drastically reduced or dispensed with. Some areas may be accessible only to pack trains in which case trucks may be halted at a designated truckhead and loads transferred. When trucks may proceed only with great caution it may be advisable to establish marshalling yards

so as to hold some and allow high priority shipments to move first. As the congestion is relaxed or as the road net branches out as a result of combat successes, the convoy held can be moved forward.

(4) Nevertheless, full advantage must be taken of motor transportation to move supplies as far forward as practicable in order to reduce the handicap imposed by pack trains and portage.

b. Traffic Control. Because of narrow one-way roadways and other hazards often encountered in mountainous areas traffic control must be rigidly enforced in order to prevent congestion and delay. Wherever possible alternate routes should be available for ascents and descents, otherwise regulatory measures should be employed which allow alternating flow of traffic.

c. Mountain Daylight Driving. In daytime driving on mountain roads vehicles should maintain greater than normal distances. If traveling in a governed column a speedometer multiplier should be specified which is large enough to require safe distances and yet not cause vehicles to straggle or become lost (normally SM 3 to 5). In addition, minimum distances (gaps) may have to be specified. Extreme care must be exercised on mountain roads because of the many sharp, blind curves and steep grades. All curves must be taken at a speed which will enable the driver to halt the vehicle in less than the visible space ahead. Either up or downhill grades should be taken in a gear ratio that will enable the vehicle to take the entire hill without shifting. Caution must be exercised to see that the speed of the vehicle does not exceed the speed (listed on the plate in the cab of the vehicle) for that particular gear ratio. Hills should be descended with a combination of breaking by brakes and engine. Neither should be used alone in driving a vehicle downhill. Sufficient personnel and pioneer equipment should precede the column in order to meet emergencies such as landslides, overturned vehicles, etc. Guides should be posted at dangerous places, especially when backing and turning are required, to give directions to each driver before he starts to negotiate the difficult section.

d. Maintenance. The normal maintenance of motor transportation assumes extra importance in mountain operations. Before and during operations in steep terrain, the safety devices of all vehicles should be checked continually, since failure on the part of any may have disastrous results. Proper adjustment of brakes is especially important. The emergency brake must be adjusted so that it is capable of holding the vehicle on slopes without the aid of gears or foot brakes. One failure which is extremely dangerous when vehicles are descending steep slopes and depending on the braking power of the engine is slipping out of gear. Winches should be carefully checked for proper lubrication and proper adjustment of the automatic brake.

e. Winching Operations in Mountainous Terrain. Grades should be negotiated, as far as practicable, by driving; winching should be considered a last resort. Chains are frequently necessary because of the presence of snow or mud on the road surface. Short, steep slopes may be climbed by building up as much momentum as possible with a slow, steady pull in low gear. When this procedure is followed, the vehicle will normally go higher before traction fails and winching must be resorted to. When winching is necessary, the route selected should provide frequent anchor points in the form of trees or rocks. The more frequent the anchor points, the greater the mechanical advantage that can be obtained by the use of snatch blocks. When trees or other anchorage is not available, the deadman can be used. At each point where winching is necessary, the use of one vehicle to winch other vehicles in turn as they arrive at that position is recommended. When guns are being winched up or down, the trails of the weapons should be downhill. When winching on steep slopes, every effort should be made to keep the cable taut and to avoid sudden jerks which may break the shear pins. Care must be taken at all times to clear obstructions from the route in front of the wheels.

Section III. MUD, SWAMPY GROUND, GUMBO

227. MUDDY ROADS

The usual muddy road is soft and slippery on the surface, but underneath it may be hard or may pack sufficiently to support a vehicle. Soft spots will allow spinning wheels to dig in quickly. The following suggestions are applicable to negotiating this type of muddy going:

a. Traction Aids. Skid chains usually give aid to traction and reduce skidding.

b. Gear. In general, the highest gear that will give sufficient torque is selected. As the loss of momentum and the sudden aplication of increased power at a critical point starts the wheels to spin, the need for a gear reduction must be anticipated.

c. Momentum. Momentum should be maintained across slippery places and up grades by keeping the vehicle moving until stalled or until slipping occurs. Usually when slipping occurs, the speed should immediately be decreased so that the wheels can take hold.

d. Choice of Track. Old ruts are the hardest packed and should generally be followed. This principle usually holds for all vehicles of the same axle width following the first, except in grassy areas which may give way after the first vehicle has passed. Where road centers are high or ruts are too deep to be cleared by the vehicle body, ruts should be straddled, or a new track should be made.

e. Procedure on Becoming Mired. Once a vehicle has come to a complete stall in mud, the clutch should be disengaged at once. No new attempt to move forward should be made until an outside check-up is made. Proper procedure for quickly extricating a mired vehicle is dependent upon judgment and experience. The following possibilities are offered:

(1) *Selecting best way out.* Often a vehicle can be moved backward for a new trial more easily than it can be moved forward. Hard ground may be gained by turning to one side or the other.

(2) *Dismounting personnel.* If personnel are carried, they should dismount and try to push the vehicle out with the aid of the engine. Often the lightened load and applied

power of the men will be sufficient. In making a try with outside aid, the driver should apply power to the wheels gradually by easing in the clutch and slow acceleration. This trial should not be continued to such an extent that the wheels dig in.

(3) *Use of manpower.* If sufficient men are available, an immediate attempt should be made to move the vehicle by manpower either by pushing or towing. Personnel should be careful to avoid positions in which they may slip and fall under the wheels. Because of the danger of vehicle overturning, personnel should be cautioned against pushing on the side of a moving vehicle that has slipped into a ditch from a high crown road, or a vehicle that is off balance in deep ruts.

(4) *Applying nearest suitable tow.* If a light tow will probably succeed, the next suitable vehicle, ahead or behind, may be used. Often the next vehicle can be detoured and used for a tow. Where the vehicle has skidded off a highly crowned road, men with tow ropes attached to the sides of the vehicle may assist in helping the vehicle back into the road.

f. Extracting Stalled Vehicle. Where the above expedients will not suffice and towing assistance from another vehicle is not available, the driver and any personnel that may be with him may attempt one of the following methods of extricating it:

(1) *Improving traction.* Additional traction devices, such as wheel mats or skid chains,

may be applied. Often drive wheels may be jacked up (sufficient base being available for the jack) and traction and flotation increased by placing brush, boards, rocks, or similar material under the wheels. If a pole is available, it may be used as a lever and inserted under the hub or axle in order to raise the wheels.

(2) *Digging out.* Ditches dug in the direction that the wheels are expected to move may aid in moving the vehicle out. When wheels are in deep ruts, ditches dug at an angle to the ruts may be necessary in order to make it easier to get the wheels back to a straddle position over the rut. In this case the ruts should be filled.

228. SWAMPY OR BOGGY GROUND

Where water has been standing for a considerable time and swamp grass has grown, a surface crust will usually have formed over accumulated dead vegetation. Certain variations in principles and procedure apply in this type of muddy going.

a. Avoid Swamps if Possible. Boggy or swampy soil may be avoided. Every effort should be made to move over the highest ground available.

b. Unload Personnel. Personnel should dismount and assist with tow ropes at critical points.

c. Maintain Momentum. The main requirement in moving over a boggy piece of ground is to move over the soft spots rapidly if possible. Wheel spinning should be kept at a minimum.

d. Follow Separate Tracks. The grassy crust may carry one vehicle but may not support another in the same track. Therefore, each vehicle should follow a separate track. A guide should precede each vehicle on foot, locating the hard ground and guiding the driver carefully over the best route.

e. Stalling. When a vehicle comes to a stall, the clutch should be disengaged at once to avoid "digging in" of the wheels. No attempt should be made to move it without outside power.

f. Deflating Tires. Flotation may be increased by deflating tires.

229. GUMBO AND OTHER STICKY SOILS

Gumbo and other sticky soils present a problem similar to that of boggy ground. In addition, these soils give little traction and stick to the tires and wheels in great masses. Boards, shovels, knives, and the like may be fastened to the truck body to scrape the mud from the wheels. Whenever possible, old, hard-packed roads should be selected through these areas.

Section IV. CROSSING DITCHES, STREAMS, AND OTHER EXISTING OBSTACLES

230. GENERAL

a. This section deals with measures taken to negotiate natural and other existing obstacles such as defiles, ditches, streams, rivers, etc.

b. Special precautions are taken to avoid congestion and delay during the passage of obstacles and defiles. The massing of troops in the vicinity of an obstacle or defile, is especially hazardous in combat areas and must be avoided.

c. Provisions are made in advance to avoid confusion at crossings or detours around obstacles. These provisions include adequate measures for traffic control and security. Where practicable obstacles will be avoided by the preparation of turn-outs and detours or their hindrance may be lessened by the selection and preparation of additional crossings. The limits of a hazardous crossing and the road leading to or around it are approximately marked or warnings are placed at dangerous points.

d. Major obstacles such as rivers may act to prevent or retard movements. They may require the temporary breaking up and rerouting of columns or the holding and rescheduling of vehicles and other elements. Troops may have to be detrucked or supplies unloaded at crossings. Traffic conditions or the tactical situation usually requires that troops or vehicles delayed by such obstacles be moved off the road and into concealed areas until called forth to make the crossing. See paragraphs 158–160 for control measures required by these conditions.

231. CROSSING DITCHES

a. Narrow or Shallow Ditches. Ditches with width approximating the diameter of the wheel should be traversed diagonally by two-wheel drive vehicles so that the drive wheel on one side will take hold of the far edge of the ditch at the same time that the opposite wheel is going into it. As this angle of crossing is a strain on the frame, springs, and driving mechanism, the ditch should be crossed slowly.

Front and rear drive vehicles can usually cross ditches at a right angle without unnecessary strain on the frame and body.

b. Wide Ditches or Ravines. When a ditch is wider than the diameter of the wheel and has slopes deeper than the running board or undercarriage clearance, no attempt should be made to pass it until the banks are cut down or the bottom filled with solid material. Such ditches should be crossed at right angles. If they are wet, they should be approached slowly and the vehicle speeded up, but without causing wheel slipping, just as the front wheels cross the lowest point.

232. FORDING SHALLOW STREAMS

Fordings should be attempted only after careful reconnaissance. Maximum fordable depths are given in paragraph 233 below. The following points should be observed when fording a shallow stream:

a. Cross Slowly. As a rule nothing is to be gained by attempting to use momentum in crossing streams because the force of the water may stall the vehicle or the water may drown the engine. Streams should be crossed slowly in a low gear.

b. Disconnect Fan. If there is any danger of the water's surging into and being splashed by the fan, the fan should be disconnected for the crossing.

c. Dry Brakes. After crossing a stream brakes should be applied intermittently to make sure they will hold and will not grip.

d. Check Lubrication. At the first opportunity, wheels, crankcase, universal joint, differential, transmission, and subtransmission should be checked for proper lubrication and evidences of water or rust.

e. Exhaust Manifold. If streams are wide, disconnect the exhaust manifold. See paragraph 233 and TM 9–2853 regarding waterproofing methods.

233. FORDABLE DEPTHS FOR VEHICLES

When it is necessary to ford streams, the following data on fordable depths of vehicles are generally applicable for unwaterproofed vehicles when moderate current and hard bottom exist:

Depth in feet	*Unit*
4 to 6	Heavy tanks and tractors
3 to 5	Pack transportation
2 to 4	Medium tanks and tractors
2 to 4	Trucks and trucks with towed loads
1 to 3	Light tanks and tractors

234. DEEP STREAM CROSSING (TOWING)

When the situation demands that streams too deep for fording be crossed and bridges or other facilities are not available in the vicinity, the first consideration should be to obtain or improvise bridges, ferries, or rafts. However, even if none of these can be made available, it is possible to tow vehicles across streams of almost any depth without serious damage provided suitable limited waterproofing is accomplished. The tackle and tow indicated in figure 42 are used. The vehicle must be properly prepared for submersion (but not for running under water) by closing appropriate openings and removing such parts as will be seriously harmed or rendered inoperative by moisture (TM 9–2853). After crossing, the vehicle should be thoroughly serviced and all water removed.

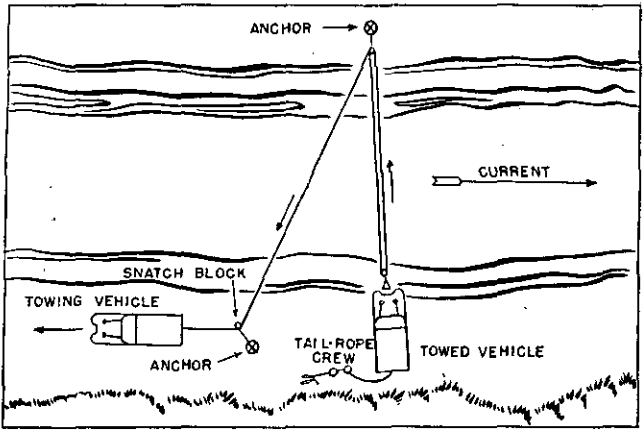


Figure 42. Tackle for deep stream crossing.

235. BRIDGES

a. Weakened or damaged bridges may present a major obstacle to a movement or a bottleneck to highway traffic. Speed, caution, and bridge capacity signs should be carefully observed.

b. The capacity of bridges can be estimated only by competent engineers. An engineer officer in charge of any bridge is responsible for its structural adequacy and the safety measures to be taken in passing over the bridge. Instructions issued by the engineer officer and the bridge guards relative to the use of the bridge are strictly obeyed. March commanders are responsible for seeing that vehicles exceeding the maximum load capacity of the bridge are removed from the column for crossing at some other point or in a manner which will not endanger other vehicles.

c. The tactical situation or other emergency may require that bridges be used by vehicles which exceed the bridge capacity or before safe capacity can be determined. In such cases, when the capacity is in doubt, bridges should be tested by a single vehicle of medium weight. Then, after a successful crossing, other vehicles of progressively greater weight should proceed in turn after the vehicle ahead has cleared the critical span. When the capacity of a bridge is not believed sufficient to carry both the power unit and towed load, the towed load may be uncoupled and pulled across by a tow line longer than the dangerous span of the bridge.

d. In crossing a dangerous bridge, motor vehicles travel slowly, holding to the center of the bridge and maintaining the distance essential to prevent overloading. Track-laying vehicles should be started across a bridge so that they will not have to be turned on the approach or on the bridge, because turning them places a severe strain on the bridge.

Section V. FOREST, BRUSH—JUNGLE OPERATIONS

236. GENERAL

a. Obstruction to military movement due to vegetational growth may exist in combination with other terrain barriers. In temperate climates forests with heavy overhead growth and lesser underbrush offer less handicap generally than the dense tropical growth of jungles. Motor transport cannot operate in heavy brush or jungles unless roads exist or are cleared by bulldozers. It cannot operate efficiently unless the cleared roads are improved.

b. Overhead foliage often affords many advantages to military operations because of the concealment afforded. Many troops may be bivouacked in wooded areas without disclosing their presence to the enemy. Overhead foliage may occasionally conceal roads which are wide enough to permit movement. Furthermore, if underbrush in a forest is light, limited cross-country vehicle operations may often be made to advantage. Such movements usually require close reconnaissance on foot and should be made only when the area is well known and return exits are available.

c. Where swamps and rugged terrain exist along with dense vegetation, consideration must be given to the combined effect of such conditions.

237. JUNGLE TRANSPORTATION

(FM 72–20)

a. The basic means of jungle transport is portage (hand carry); also pack animals are frequently employed.

b. Wheeled transportation is generally impracticable except on roads, or in the dry seasons on wide trails, and in areas where the jungle growth is light and free of intertwined vines and large trees. However, engineer or pioneer troops using bulldozers frequently can improve trails sufficiently to permit movement of light trucks and trailers. Trails suitable for pack animals frequently are also suitable for operation of ¼-ton trucks. Track-laying vehicles can sometimes be used in jungle operations and may furnish one means of logistic support.

c. Operations of larger wheeled vehicles are, for the most part, restricted to coastal regions and around plantations or settlements where adequate roads and wider trails are available.

238. JUNGLE MARCHES

a. Even when motor vehicles can be used jungle trails usually restrict the formation of an organized column. To facilitate control, to improve security measures, and as an aid to rapid movement, march units should normally move as compactly as possible. Close column formations permit easier following of trail breaks; however, in tactical situations such formations increase the danger of ambush. Open column or other extended formations (that is, infiltration) lessen the danger of a general ambush but increase the possibility of an element's becoming separated or cut off and ambushed. The type of formation selected should be based on a careful evaluation of the existing conditions. Prescribed distances should be maintained at the cost of reduced speed. Close liaison between elements of the march should be maintained at all times.

b. Movement over unmarked and uncharted jungle trails may have to be made with the aid of compass, and reconnaissance elements far in advance of the main body. Lateral trails should be reconnoitered for possible alternate routes; in tactical situations these should be covered by patrols until the column has cleared.

c. March discipline is particularly important in jungle operations. Alertness is essential. At halts, men relax but adequate outguards must remain alert.

d. Whenever practicable bivouac sites should be on high ground, should be defensible, and should be near fresh water. A native village should never be selected as a bivouac site or motor park.

239. SUPPLY AND EVACUATION

a. Because of limited facilities normally available in jungle operations, the transportation and evacuation functions must be closely planned, supervised, and integrated. Requirements must be anticipated well in advance of actual needs.

b. Special provision must be made to protect supplies against spoilage caused by climatic conditions. Additional tarpaulins, or other coverage, may be necessary for vehicles in order to provide protection from heavy rains and hot, tropical sunshine.

c. Standard ambulances may not be practicable on jungle trails. For this reason, other types of vehicles may be used for transportation of the sick or wounded. Empty supply vehicles returning to the rear must be utilized for evacuation purposes.

d. Supply and evacuation movements in the jungle require more than normal assistance and protection. Tactical troops may have to be committed for this purpose.

Section VI. HEAT AND SAND—DESERT OPERATIONS

240. GENERAL

a. The terrain in deserts is not always flat. There are hills and valleys, mountains, sand dunes, shale, and salt marshes as well as great expanses of sand.

b. Extreme heat, dryness and dust resulting in lack of vegetation, and the sandy or rocky barrenness of deserts are conditions which may or may not exist *in combination.* Each condition requires special measures to maintain efficiency of troops and equipment, and in some desert-type operations a combination of measures is required for military success. When properly modified and provided with special equipment, almost every type of military vehicle can be used in desert operations.

241. DIFFICULTIES TO BE ENCOUNTERED

The heat, sand, and rough surfaces encountered in arid regions all combine to shorten the life of motor vehicles and increase the need for skilled operation and thorough maintenance. Some of the more frequent motor transport difficulties experienced in the desert are mentioned below. By foresight and careful driver and mechanic training many of these difficulties can be prevented, overcome, or reduced.

a. Overheating. Overheating may often result from driving in the heat of the day, in lower gears, or from loss of water through evaporation and steaming; and if not corrected at once, it may cause serious damage and disable the vehicle. Cracked blocks will occur much more frequently in desert operations than under normal conditions.

b. Excessive Wear Due to Dust and Sand. There is always some dust and sand in the desert air, more is stirred up by the passage of vehicles, and during a sandstorm the amount may be such as to prohibit movement. Without adequate protective measures the sand will choke carburetors, plug feed lines, score the cylinders, damage the distributor, and increase the wear on all bearings.

c. Damage Resulting from Shock and Vibration. The constant shock and vibration caused by passage over unstable ground frequently causes damage to tires, body, and electrical systems. The rough going encountered in many deserts is very hard on springs and they may be broken by overloading, improper distribution of load, or shifting of load while moving.

d. Operational Difficulties. The actual operation of a vehicle in this terrain requires extra physical exertion and mental concentration with resultant fatigue. The lack of water and the constant danger of becoming stranded or lost in desert regions make vehicle failure a threat to the lives of all personnel with the vehicle. Under combat conditions supervision of maintenance and other functions may be difficult, as vehicles cannot as readily be brought close together for inspections and other checks.

242. DESERT DRIVING

a. General. Desert driving calls for high skill and requires a high degree of individual effort. It will take a great deal of experience to develop the quick eye necessary to select the best ground and the proper gear, the skill required to make maximum use of momentum and to shift gears rapidly, and the care to avoid sudden driving or breaking thrust. Even with the most skilled driving, vehicles will frequently be stuck in the sand. Practice in driving through stretches of soft sand and among sand dunes is necessary for all vehicle operators.

b. Driving in Sand. Usually sand will support a vehicle moving at a moderately rapid speed. However, traction is limited because the loose granular material tends to slip beneath the wheels. As soon as drive wheels begin to spin they dig in quickly. The driver must be taught to give up all efforts to get out of the sand by means of his motor the instant the vehicle has *ceased to move.* Otherwise, the driving wheels will merely sink deeper into the sand and extrication will be made more difficult.

c. Overcoming Traction Failures. The following expedients may be used in overcoming traction failures in sand:

(1) *Avoid changing gears.* As it is imperative that momentum be maintained need for changing of gears must be avoided by selection of proper gear before passing over the sand.

(2) *Keep moving.* Flotation of some sands tends to increase below the surface. When the sand is compacted below the surface, the wheels may spin but the vehicles continues to creep. As long as the vehicle continues to move, the wheels may be kept slowly spinning, allowing the vehicle to dig itself out.

(3) *Choose firm tracks.* In order to reduce slipping vehicles should follow compacted

tracks of the vehicle ahead. If tracks are worn so deep that underparts of the vehicle will scrape the ground between them, it may possible to ride one rut to gain traction and form a new track with the wheels on the opposite side of the vehicle. However, there may be cases when the surface sand provides better ground than worn tracks. Only with experience can the driver gain the necessary skill in selecting the proper course for sand driving.

(4) *Increase tire surface.* Air pressure in the tires may be decreased to increase flotation. Certain vehicles are equipped so that the driver may change air pressure from the cab.

(5) *Improve surface.* Chicken wire fencing nets or heavy burlap staked down on the surface of sand will usually make a temporarily satisfactory surface for movement of motor vehicles. For heavy traffic more than one thickness may be used.

d. Extracting Vehicle from Sand. When a vehicle is stuck the driver or one of the crew must reconnoiter the ground both ahead and to the flanks for the nearest patch of firm surface. While this is being done, mats or other devices and shovels available for such purposes should be unloaded (par. 244). Based on careful reconnaissance, a decision must be made whether to go ahead or to back out. Adequate excavations should be made in front (or, if backing out, in rear) of the wheels so that the near ends of the mats are on a level with the bottom of the tire tread. If this is not done the engine will be unable to set the vehicle in motion up the initial slope so as to enable the wheels to begin to drive against the firm surface of the extricating equipment. Once in motion, the vehicle should be driven to firm ground or stopped headed down a slope to avoid getting stuck again.

243. MAINTENANCE IN THE DESERT

a. General

(1) Maintenance as prescribed in present manuals will keep vehicles in condition to operate in the desert. The importance of maintenance must be impressed on all concerned, with special emphasis placed on first and second echelon maintenance. Drivers must be impressed with the importance of taking every opportunity to inspect the vehicle, to follow prescribed "during operation" and "at halt" maintenance procedures and to assure themselves after every operation that the vehicle is ready to move again at a moment's notice.

(2) Regardless of who performs preventive maintenance services, emphasis should be placed on overcoming or reducing those difficulties resulting from overheating, excessive wear due to dust, and damage from shock and vibration.

b. Overcoming Difficulties Due to Heat. In preventing overheating the following items should be observed:

(1) *Hood.* The hood should be kept closed while the vehicle is in operation in order

that the efficiency of the fan and cooling system is not reduced.

(2) *Fan belt.* Fan belts must be examined frequently to be sure that the fan is operating properly with the belt at proper tension—not too loose and not too tight. If the fan belt shows wear, it should be replaced immediately, otherwise it may break and cause serious overheating.

(3) *Radiator.* Special care must be taken to be sure that radiators are kept clean and free of bugs, grass, leaves or anything else that clogs the air spaces and reduces ventilation. Any obstruction which cuts off air and keeps the radiator from cooling effectively should be removed.

(4) *Water.* Water should be checked frequently. Provisions of water for cooling systems should be considered in estimating over-all water requirements for a movement. The drain cock of the cooling system should be replaced with a screw cap, flush with the end of the pipe. It will seldom be necessary to drain the radiator, and there is serious danger of the drain cock being knocked off by stones thrown up by the wheels and all the water being lost, a real calamity in the desert. Drivers must be trained to watch the ammeter carefully since overcharging always results in loss of battery water, which is particularly difficult to obtain in the desert. Drivers must be warned that the

high salinity of water issued for drinking and for radiators forbids its use in batteries.

(5) *Oil and lubricants.* Engine oil should be of the proper viscosity for hot weather driving. Oil level should be checked often. Standard lubricants for all-weather use may be used.

(6) *Engine.* Should serious overheating occur, the vehicle should be stopped as soon as possible and allowed to cool. When cool, the engine should be kept running while radiator is refilled.

c. *Overcoming Difficulties Due to Sand and Dust.* In preventing excessive wear due to excessive dust and sand in the desert air, the following measures should be taken:

(1) *Air filters.* The oil bath air filter now standard on all military motor vehicles, if kept clean, will protect the motor. Constant, close supervision and daily inspection of air filters are the only ways of insuring that sand will not get into the motor. They must be cleaned more frequently than under normal conditions.

(2) *Oil filters.* Cartridges of oil filters must be renewed after about one-fifth the distance usually prescribed or whenever oil shows indication of excessive pollution.

(3) *Fueling procedure.* Sand may enter the crankcase and fuel lines when replenishing the oil or refueling unless great care is used during these operations. The driver must make it an invariable habit to wipe all sand

off caps before removing them and off the spouts of oil and gasoline containers before they are used.

(4) *Protective covering of parts.* It may be necessary to make canvas boots to protect front wheel joints, distributors, and other parts. Sand and dust will cause failure of panel instruments if they are not carefully sealed. Tape may be used for this purpose.

d. Overcoming Difficulties Due to Jolts and Vibration. The following items should be observed in preventing difficulties resulting from jolts and vibration due to operation over rugged terrain or unstable ground.

(1) *The body.* Excessive jolting makes it necessary to tighten all body bolts and nuts. Organizational maintenance personnel must be trained to make this a regular part of their daily routine. Proper load distribution and lashing of loads will help reduce shock and body abuse.

(2) *Electrical system.* Constant shock and vibration may cause cable clips to shake loose. Cables may be broken or shorted. Frequent inspection of cable clips should be made and spring washers inserted under the nuts if possible. Voltage control units may cause trouble because of breaking of wire in shunt winding or sticking of regulator points.

(3) *Tires.* Tires should be suitable for the type of surface which will be encountered in the desert. Experience indicates that oversize balloon sand tires are desirable for wheeled

vehicles. Air pressure must be varied to suit the type of ground surface. Over sand or soft powdered clay, the ground pressure per square inch should be reduced to the minimum. By deflating the tires, the area in contact with the ground is increased and the tire fits itself to the irregularities of the sand without breaking through the crust. The minimum pressure must be determined by test for each type of vehicle. In rocky or boulder-strewn ground, tires must be as fully inflated as age and condition will permit. It must be remembered that fully inflated tires will result in an increase in the shock transmitted to the vehicle and its load when moving over rough or rocky ground. At low pressure the innermost layers of canvas will be broken by the violent inward bending when a sharp rock is struck. The resulting chafing at the break will wear through the inner tube even though no danger is apparent from the outside of the tire. Since a normal day's march will take a vehicle over different kinds of ground, strict tire discipline is necessary. The life of tires, as of all rubber, will at best be short because of heat, sand, and rough ground surfaces. Provision must be made for tire replacements greatly in excess of expectations for normal terrain. Since tires will deteriorate very rapidly from heat and dryness when stored in the desert, special covered, ventilated, storage facilities should be provided when possible.

244. SPECIAL EQUIPMENT

Wheeled vehicles operating in deserts must be provided with special equipment necessary to extricate them from soft sand. This equipment normally consists of devices which may be improvised or manufactured locally.

a. Channels. For vehicles with single tires on driving wheels, an excellent solution is the provision of a pair of steel channels 4 or 5 feet long, carried on the sides of the vehicle body. In cross section the channel should have a curved bottom wide enough to take the whole width of the tire at low pressure. It should be bent up sharply at the sides to prevent the tires from running off, and then down again to form a rounded flange on each side to strengthen the channel. Two angle irons projecting from the underside and holes punched in the bottom will prevent the channel from slipping under driving thrust. Heavy dual-tired vehicles, which will be stuck in sand much more frequently than single-tired vehicles, should be provided with a pair of double channels.

b. Mats. Mats should be provided to form a roadway for front wheels. Canvas strips, stiffened by lateral rungs of steel sewn between two thicknesses of canvas, have been found excellent for this purpose. Such mats can be rolled up for transport and rolled out in front of each front wheel when needed.

c. Spars. Lightweight and mediumweight dual-tired vehicles may be provided with a single round wooden spar instead of channels. The spar should be placed between the dual tires and used as a rail.

d. Miscellaneous Equipment. All vehicles should be equipped with at least two short-handled shovels for digging out of soft sand. Tow hooks and tow cables should be provided for every vehicle. Power-driven winches to extricate stalled vehicles will be of great value in traversing bad stretches of desert.

Section VII. COLD WEATHER, SNOW, ICE—ARCTIC CONDITIONS

245. COLD WEATHER MARCHING—GENERAL

a. General. Ice, snow, and extreme cold modify the usual effect which terrain features have on motor marches and present special problems. Normally they create difficulties to be overcome, but in many cases they may constitute important aids to movement. Lakes, rivers, and swamps, when covered with sufficiently strong ice, cease to be obstacles to motor movement, and may make movement possible in territory which otherwise could not be traversed. Muddy roads, otherwise impassable, may bear heavy traffic when frozen. However, possible effects of changes in temperature, resulting in thaws, must be considered.

b. Use of Vehicles, General.

(1) Under some conditions stoves in the body of the truck, and specially designed tarpaulins, are necessary to prevent discomfort and possible serious effect on troops being transported. When such expedients are used, due precautions must be taken to eliminate the hazards of fire and carbon monoxide poisoning.

(2) Tires should be freed from ice and engines warmed up at moderate idling speed to a temperature prescribed for each vehicle before beginning a march in cold weather.

(3) Under conditions involving thawing and freezing, vehicles heavily encrusted with mud (particularly track-laying vehicles) should have the mud removed from working parts while still unfrozen. Vehicles should not be parked on soft ground or in pools of water or slush when freezing may be expected, otherwise they may be frozen there. Planks, logs, or brush may be used to provide dry standing under such conditions.

c. *Traction Aids.* Skid chains on all wheels are usually the best safeguard in normal winter driving. However, on glare ice, skid chains add little or no traction and are apt to give a false feeling of security. Deflating tires to a lower than normal pressure will assist in preventing skidding under such conditions.

d. *Moving Over Fresh Snow.* When breaking freshly fallen snow, manpower should be readily available to push or tow the first vehicle where the snow is deep. Other vehicles follow in track and usually can move under their own power provided they are able to gain sufficient momentum in approaching difficult slopes and crossings. Alternate shifting from reverse to forward gears often will rock a vehicle out of a hole in snow, but to prevent vehicle abuse this practice should be limited.

e. *Braking.* In slowing down or descending hills, the engine should be used as a brake. The driver should select the proper gear for braking before descending hills, but may shift if he finds a lower gear is needed. Foot brakes, when used, should be applied lightly with a pumping motion and released quickly if skidding begins.

f. Accelerating. Rapid acceleration should not be attempted, as it may cause one drive wheel to spin, thus losing traction or causing skidding.

g. Overcoming Skidding. If skidding occurs, the brake or clutch should not be touched. The accelerator should gradually be released. The front wheels are turned in the same direction the rear wheels are skidding, so that the vehicle will be carried forward by its momentum in a straight line parallel to its original path. This method will ordinarily result in reobtaining control.

h. Holding Vehicles on Road. If traffic conditions allow, vehicles should keep the center and ride the crown of the road. Where necessary, men with tow ropes may be used to hold vehicles on dangerous icy roads.

246. CARE OF EQUIPMENT, WINTERIZATION

a. Preventive maintenance acquires added importance in extreme cold weather. Proper engine care is absolutely essential to prevent early ruin of motors. Proficiency in winterization of vehicles should be stressed. Technical publications applying to oversnow and other cold weather operations of the type of vehicle issued should be carefully adhered to.

b. In extreme cold motor vehicles require special equipment, special lubricants, and special maintenance attention to insure proper vehicle protection and satisfactory operation.

c. Information concerning winterization kits is available in appropriate technical publications pertaining to the vehicle. The important factors in the winterization of vehicles is in the replenishment of cold-weather lubricants and in carrying out of proper lubricating procedures.

d. Winterization also includes making the vehicle comfortable for operating or using personnel. All command and liaison vehicles should be inclosed if practicable. Plywood and shipping cases may be used for the purpose of improvising cab inclosures.

247. ROAD MARKING

a. In winter, snowfalls, fog, and snowdrifts frequently make roads and terrain features unrecognizable. Therefore, careful route marking is essential. If possible, through roads must be uniformly marked before the first snowfall. Special road designations must be known to troops who will use the routes. Permanent routes should be designated by durable markers.

b. In open country, poles about 8 feet high with direction markers, snow markers, brushwood, rock cairns, and flags serve the purpose. Their use should be set forth in standing operating procedures.

c. Orientation is facilitated if unit markers are numbered in sequence in the direction of march and placed at equal distances from each other. Markers must be erected about three feet off the trail in order to avoid damage by traffic. In wooded terrain, tree trunks are marked with blazes, placards, or paint;

branches are bent; boards, paper, or cloth remnants are fastened to trees.

d. If complete unit marking is impossible, arrow signposts should be erected at prominent points to indicate the direction of a march and distance to the objective. For short distances, direction arrows will be sufficient.

e. Simple marks in the snow, trail markers, and similar signs are adequate for the marking of temporary roads, such as those used by patrols. If strange trails cross the route, they should be obliterated within the immediate vicinity of marked tracks so that elements of the march will not go astray. It is frequently advisable to leave guards at such points in order to keep units on the proper route.

248. CROSSING FROZEN WATER

a. General. Contrary to general opinion, not all streams freeze over in extremely low temperature. Streams may have open water or very thin ice in temperature as low as 60° below zero. Frozen lakes and water courses, while often aids to a march, may be turned into obstacles if ruptured by use, by current, or by explosives. Running water, at low temperature, is one of the most dangerous types of obstacles and may cause the loss of personnel and equipment if adequate precautions are not taken. For more complete discussion of stream-crossing expedients see FM 5–10.

b. Carrying Capacity of Ice.

(1) A large part of the supporting value of ice is derived from its pressure on the water below. When the water level falls, the bear-

ing capacity of the ice decreases. In extreme cold, streams often have layers of ice interspersed with layers of running water. In any crossing of ice, ice reconnaissance is necessary to insure that its bearing quality is adequate for men and vehicles. Rotten ice can be detected by its dull color and honeycombed structure. It has very little supporting power. In judging ice thickness, the layers of rotten ice on top and bottom should not be considered. Sample blocks should be cut and thickness at the crossing site measured. In general, troops crossing ice should not halt, nor should vehicles turn around thereon. Traffic onto and on the ice should be controlled.

(2) The following is a general guide as to minimum thicknesses of new sound ice in floating contact with water required to support loads indicated:

Thickness of ice in inches	*Capacity*
3 to 5	Men on foot.
5 to 7	Light vehicles.
7 to 12	Medium vehicles.
9 to 16	Light tanks and vehicles up to 10 tons.
16	Loads over 10 tons.
20	20-ton loads.

c. Increasing Carrying Capacity of Ice.

(1) Planks may be used to distribute weight of wheeled vehicles and thus increase bearing power of ice for short distances.

(2) In freezing temperatures, thickness of ice may be increased by flooding surface of ice. Water applied to the surface may be confined to the desired area by means of low earthen dams. The belt of ice thickened by the application of water should be at least three times the width of roadway to be used. Piling of snow on the surface of ice and flooding the snow with water will accomplish the same result with the application of less water.

(3) When a river is frozen on each side with an opening in the middle due to a swift current, boats or other surface obstacles placed across the interval may check the current enough to permit freezing.

249. ARCTIC OPERATIONS

a. General. During the winter months in arctic areas effective surface transportation, with present types of equipment, must await the periods of the year when ice and snow conditions are sufficiently strong to provide passage over the many water crossings. During the summer months, extremely soft ground surfaces and other terrain obstacles preclude the full use of land transportation. Effective year round transportation service in the Arctic requires a balanced employment of several modes of transportation including air and different kinds of equipment.

b. Wheeled Vehicles. Truck transportation may be used in areas where adequate road nets exist or where conditions are such as to allow the preparation of adequate trails. Maximum truck transportation in arctic areas in the winter is over snow compacted roads. During the thaw, open, and early freeze periods, wheeled vehicles are limited to roads or improved trails, of which there may be few. Extensive use of available routes requires careful selection, and continuous maintenance of existing ways.

c. Tracked Vehicles. Track-laying vehicles, particularly those designed or modified to exert the least ground pressure, are effective in areas where few, if any, roads exist (TM 9-775). Track-laying vehicles have been successfully used to draw loaded sleds of various types over snow compacted to form trails. Sled trains are effective in open, barren areas where the depth of snow is limited and frozen lakes and streams are numerous.

d. Maintenance, Recovery, and Evacuation of Material.

(1) The problems inherent in transporting and preserving supplies under conditions involving low temperatures—snow, ice, and tundra, together with the lack of road nets, railroads, or similar transportation facilities—place an abnormal burden on those responsible for provision of maintenance services.

(2) Major maintenance problems often arise from careless or negligent use and operation of equipment. Often these problems must be met on-the-spot by available personnel of the march unit and may require the delay of a column to recover or repair a single item of equipment.

(3) Normally, maintenance activities will be limited to first and second echelon levels in units operating outside the base camp proper. Third or higher echelon maintenance will of necessity have to be performed by service troops in close support. Here, also, adequate shelter or proximity of base camps to fixed installations will influence the extent to which activities of this kind are engaged in.

(4) Valuable data concerning special care of weapons and equipment in arctic operations is contained in FM 70–15.

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CHAPTER 16

EMERGENCY EQUIPMENT AND EXPEDIENTS

Section I. USE OF EQUIPMENT AND EXPEDIENTS IN MEETING EMERGENCIES

250. GENERAL

a. Field expedients are the techniques used to overcome emergencies arising from conditions of terrain and climate, or employed to prevent or correct deficiencies or breakdowns in roadways and equipment.

b. Field expedients may be used in correcting minor deficiencies of vehicles, in assisting vehicles in crossing obstacles, in extracting them from difficult sections of terrain, and in reclamation and towing of damaged and disabled vehicles. They are the means by which drivers or crew of vehicles or other march personnel take action to assist themselves and keep convoys rolling when more adequate aids, or more qualified assistance, is not available.

c. Expedient methods normally require the use of vehicle equipment or improvised devices for towing, winching, obtaining traction, lifting, anchoring, and for limited repair.

251. VEHICLE EQUIPMENT

a. Military vehicles are constructed and equipped so as to be able to meet many of the emergencies arising in the field. Most tactical vehicles are equipped with a front wheel drive, which may be engaged when necessary, and with a wide selection of gears for negotiating grades and other difficult terrain. Administrative vehicles and vehicles designed for long hauls over improved highways have less need for these mechanical aids to meet such difficult conditions; and in order to conserve weight, parts, and expense, they are usually not provided.

b. In most units some vehicles are equipped with winches, and many units have wreckers, wrecking hoist, towing sets, and other equipment for use in meeting emergencies.

c. Military vehicles are further provided with a limited supply of mechanics' tools and pioneer equipment for use in emergency repair and in overcoming obstacles which may delay movements. Drivers should be familiar with all such tools and equipment, make sure of their proper care, and know how to use them properly.

d. Traction devices, including anti-skid chains, are important items of vehicle equipment for use in inclement weather. They are the means of giving more ground pressure and/or traction to the wheels of a vehicle.

e. No amount of equipment, tools, or devices can take the place of the ingenuity of officers, noncommissioned officers, drivers, and mechanics. Skill in basic techniques in the use of ropes, knots, chains, and other devices will assist immeasurably in accomplishing expedient measures required to overcome emergencies arising in the field.

Section II. USE OF WRECKER SETS AND WINCHES

252. GENERAL

a. Wreckers are normally special purpose vehicles used in extracting, hoisting, towing, and otherwise assisting disabled vehicles. Wrecking sets are special equipment which is mounted on general purpose vehicles, so they can be used as wreckers. Winch trucks are any vehicles, including wreckers, which have mounted winches for use in pulling or towing.

b. A wrecker, wrecking or winch truck, normally marches near the rear of each unit in order to assist vehicles which become disabled or otherwise require such assistance.

c. If the column is marching over a difficult route, at least one winch truck, if available, should march at the head of the unit so as to be in a position to assist vehicles which follow in crossing any obstacles encountered.

d. Wreckers and wrecking sets are primarily for use by maintenance personnel. Wrecking sets are normally mounted in a maintenance vehicle which has a winch. Drivers of vehicles having mounted winches or other wrecking equipment should have a good working knowledge of that equipment. At military posts and other areas of military activity, and along dispatch or other supply routes, emergency wrecker service may be provided by "on call" or "patrol" methods.

253. WRECKERS

a. Wreckers are normally provided units having sufficient motor transport to require them. Their operation requires special training in the use of wrecking equipment mounted on the vehicle. In addition, wrecker operators should always be qualified automotive mechanics.

b. The wrecker equipment is a unit assembly mounted on brackets attached to the frame rails. The assembly consists of the wrecker transmission, winches, booms, winch cables, boom cables, and the necessary sheaves to guide the cables. In addition, wreckers are normally provided with necessary anchors, blocks, tow bars, clamps, etc.

c. The following general rules should be observed in use of the wrecker:

(1) Never race engine when operating wrecker, especially when wrecker is operating without a load or with a very light load.

(2) Always use moderate speeds when pulling heavy loads; use low speeds until the load starts to move.

(3) When pulling over rough ground, crowbars may be used to ease over rocks or other obstructions.

(4) Whenever possible to replace an overturned vehicle on its wheels this should be done as early in the operation as possible.

(5) Watch the cables to see that they do not chafe on sharp edges. Keep cables free of kinks.

(6) Anchor lines must always be at least as strong as a service or hauling line.

(7) Cables should always be wound tight on drums. Whenever possible wind them up under tension of a load.

254. USE OF HOISTS AND TOWING DEVICES (fig. 43)

a. A suitably mounted hoist can be used to tow a disabled vehicle with one end in an elevated position when damage requires it, especially when the steering mechanism or the axle is damaged. The hoist attachment may be of use in giving a towing lift to a mired vehicle.

b. Care must be taken not to throw the hoisting vehicle off balance in the attempt to lift too heavy load. Where lift only is necessary, upsetting of the hoisting vehicle may be prevented by placing short posts under the truck frame at the end nearest the hoist, or by installing a temporary brace under the hoist booms, or by placing weight on the part of the vehicle at the opposite end from the hoist.

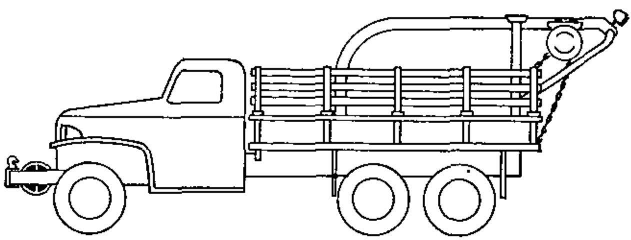

Figure 43. Hoist of tool set, second echelon set No. 7 (mounted).

255. USES OF THE WINCH

a. A truck may be taken across an obstacle under the assisting power of its own winch, with the cable attached to a deadman or tree. The power of the drive wheels should assist the winch. Gears should be so chosen that the wheels will cover ground at the same speed as the winch cable is pulled in.

b. After the winch truck has crossed an obstacle with the assisting power of its own winch, it may be used in helping other vehicles over the obstacle by either straight pulling or winching operations. The cable may be run out, the winch locked, and the truck used as a towing vehicle, or the winch truck may be halted and blocked and the winch alone utilized.

c. When pulling a vehicle with the winch of another, the towed vehicle should assist with its maximum traction. The best power combination generally results if the winch is operated in the highest gear that will give sufficient power, and the truck being winched is pulling in lowest gear.

d. When the winch is used on a difficult pull, the winch truck may be held in place by use of the brakes and wheel blocks, or by anchoring to a tree or deadman. When the lead is not too heavy, traction devices will assist in holding the vehicle in place. A snatch block may be used to increase the mechanical advantage of the winch when pulls are too heavy for the winch alone (fig. 44).

e. Overturned vehicles cannot always be righted by manpower alone. When this is impossible, a rigging similar to that shown in figure 44 may be used. Parking brakes on the overturned vehicle should be applied before the vehicle is righted. Any of the towing or winching means may be used to pull on the rope. Holding lines should be used to prevent damage to the vehicle from its settling too rapidly. When the vehicle has been righted, a careful inspection must be made to determine the extent of damage

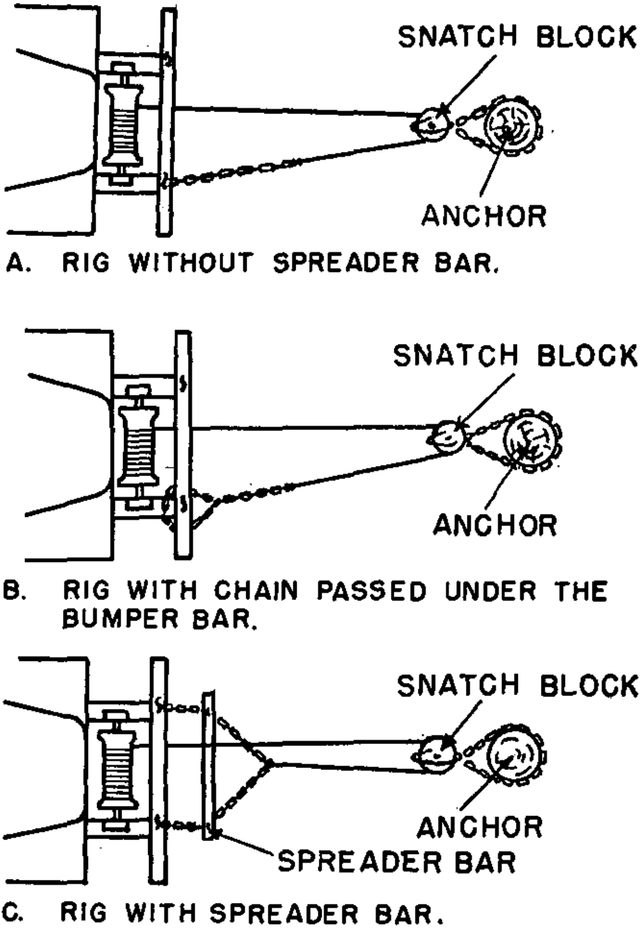

Figure 44. Rig for use of the snatch block.

caused by the accident. The axles may be bent, the frame twisted, the wheels bent or broken, or the steering mechanism damaged. Such damage requires that the vehicle be evacuated for repair as soon as possible, since driving the damaged vehicle invites other and perhaps more serious damage or accidents. Before the vehicle is moved under its own power, necessary oil and gas, battery acid, and radiator water should be replaced.

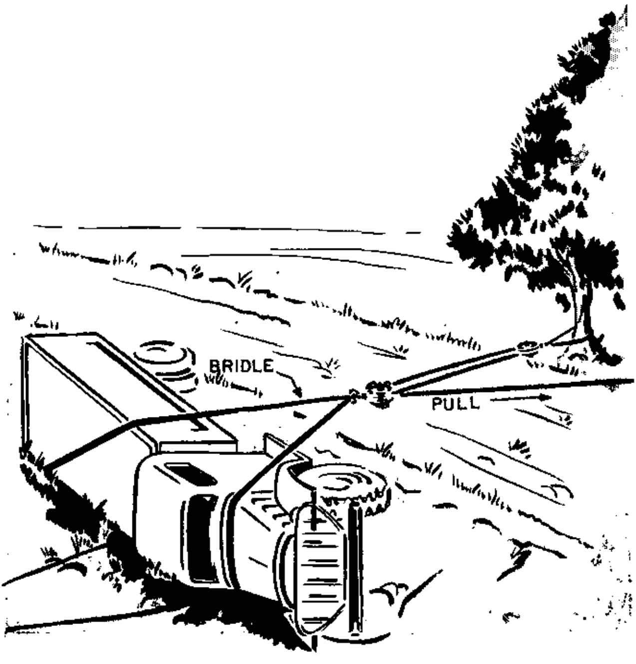

Figure 45. Righting an overturned vehicle.

256. SAFETY PRECAUTIONS

a. Certain precautions are necessary in the proper use of the winch cable. Whenever the winch cable is slipped over the ground, it should be protected by placing pieces of wood under it. Power must be applied to the cable gradually. Kinks and twists must be removed at all times. Cables should not be tied in knots, except for emergency repair. They should not be rigged around an angle in such a manner as to bend them. Vehicles with metal tracks or tires should not be permitted to run over the cable.

b. Most winches are provided with a shear pin which is designed to break off under any strain which might snap the cable. Nevertheless, when a steel cable is tightened it may break and snap back with enough force to seriously injure, or kill, a man. Personnel should stand clear before the cable is tightened. Makeshift shear pins should not be used.

c. Rewinding of the cable should be done slowly, with a moderate load so as to prevent kinking. It should be wound evenly on the drum. When cable is rewound on drum after use, care must be taken to see that it is wound in neat layers that run entirely across the drum. Otherwise, the cable may be tangled and damaged when the next pull is made. Again, it is important that all kinks are taken out of the cable before it is used or rewound on the drum.

Section III. MISCELLANEOUS DEVICES AND EQUIPMENT

257. TOWING AND PULLING DEVICES

a. Tow Chains or Cables. Tow chains or cables should be about 16 feet long and should have a hook on one end and a ring or loop on the other. Cables and chains of approximately ½ to ¾ inch give sufficient strength. In addition, double tow ropes 150 feet in length will be found helpful. Safe tension limits for larger or smaller ropes will vary roughly as the square of either diameters.

b. Towing Bars. Towing bars provide a temporary coupling device for use when a vehicle is to be towed a considerable distance.

c. Block and Tackle. A block and tackle is a useful piece of equipment for use as a snatch block as well as for lifting and other purposes. A block and tackle attached to a tree, anchored stake, or deadman is useful for increasing pulling ability.

d. Spreader Bars. To prevent the frame of the vehicle being towed from being bent or otherwise damaged improvised spreader bars should always be used between ends of a double cable or tow chain attached to both tow hooks of the vehicle.

258. IMPROVISED A-FRAME (UNMOUNTED)

An improvised A-frame (fig. 46) is an expedient device which combines both a lift and tow. It is easily constructed with two poles approximately 12 feet long and two tow chains or cables. Holes are dug as supports for the foot of the frame, and a cross chain or plank is used to prevent the poles from spreading. Care must be taken to place the A-frame far enough away from the vehicle to be moved so that, when it is lifted over, the legs will not damage the front of the vehicle. This simple device is useful when a wrecking hoist attachment is not available to lift a vehicle out of and over a ditch or hole, or when a heavy vehicle is badly mired.

259. DEADMAN INSTALLATION
(fig. 47)

a. General. The "deadman" is a log, railroad tie, or other similar object sunk into the ground in such a manner as to afford anchorage. To get the best results in installing a deadman the following procedure should be used.

b. Position. The best position for the deadman is behind a natural crest or mound where as much surface of undisturbed earth as possible may be utilized. It should be placed far enough away from the vehicle being winched or towed so that it will not interfere when the vehicle clears the obstacle. If the deadman is too close to the vehicle, an upward pull may cause the anchorage to become dislodged.

c. *Digging.* A trench is dug deep enough so as to place the top of the deadman a foot or so below the ground surface, and long and wide enough to hold the deadman. The bank in the direction of pull is undercut at an angle of about 15° from the vertical. The bottom of the hole is cleared at a right angle to this bank. To assist in strengthening the top edge of the hole in the direction of pull, two stakes are usually driven on either side of the cable at a slightly greater angle to the vertical than the angle made by

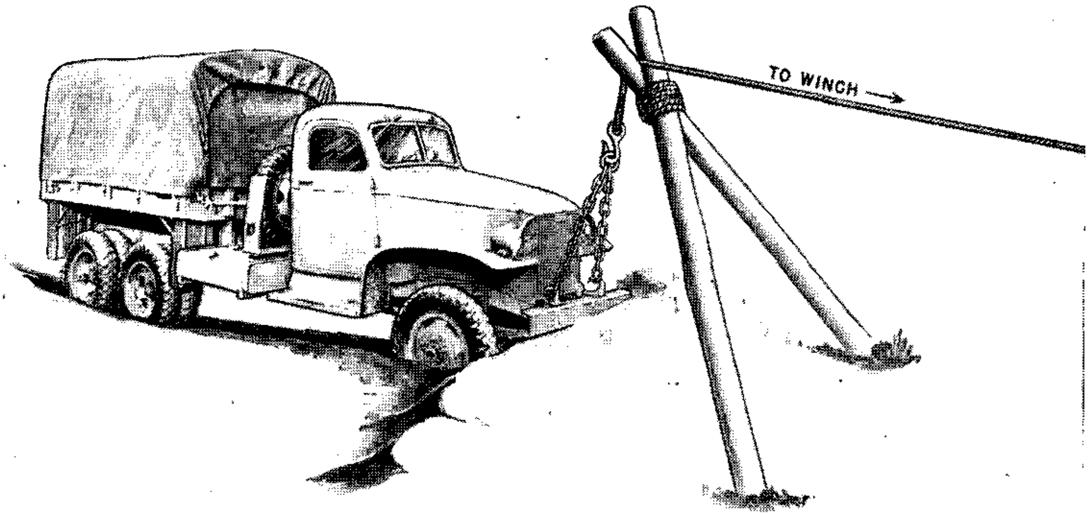

Figure 46. Improvised A-frame for giving a towing lift.

the bank, and so as to be flush with the slanted bank near the top. A trench for the cable is cut from the hole through the crest of the hill or mound. This should be slightly deeper than the bottom of the hole at the beginning and should continue out in an ascending slope.

d. Cable Attachment. A rectangular railroad tie or larger timber is most suitable for the deadman, since it presents the maximum surface to oppose the direction of pull. The cable or chain is attached to the deadman so that the largest area of the deadman is against the forward bank, and so that any tendency of the deadman to rotate acts downward and not upward.

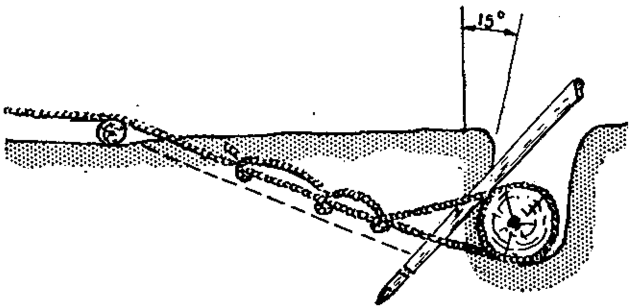

Figure 47. Deadman installation.

260. ANCHORED STAKE
(fig. 48)

Two stakes and a rope lashing may be used to install an anchored stake which will withstand considerable pull. The first stake is driven into the ground at a little greater than a right angle from the direction of pull; the second stake at an angle slightly closer to the ground and 3 to 6 feet to the rear of the first stake. A rope is used to anchor the top of the first stake to the bottom of the second. In order that this rope will not slip down on the first stake, it is first tied to the bottom of the second, then wrapped over itself with a one-half clove hitch at the top of the first stake. The rope then is passed around the second and another half clove hitch is completed over the first, wrapping the rope around below the first hitch. This lashing is completed a number of times before the rope is secured to the second stake. A third stake may then be used to twist the lashing tight, after which the stake is driven into the ground. The operation may be continued with an additional stake to give a still stronger anchorage.

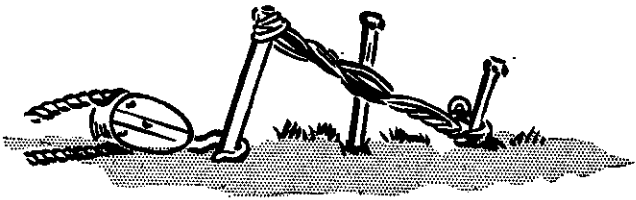

Figure 48. Anchored stake.

APPENDIX I

REFERENCES

1. FIELD MANUALS

FM 5–10	Routes of Communication.
FM 5–20 Series	Camouflage, Basic Principles.
FM 5–20B	Camouflage of Vehicles.
FM 5–25	*Explosives and Demolitions.*
FM 5–31	Land Mines and Booby Traps.
FM 19–5	Military Police.
FM 19–10	Military Police in Towns and Cities.
FM 19–25	Military Police Traffic Control.
FM 21–8	Military Training Aids.
FM 31–20	Operations against Guerilla Forces.
FM 70–10	Mountain Operations.
FM 70–15	Operations in Snow and Extreme Cold.
FM 72–20	Jungle Warfare.
FM 100–10	Field Service Regulations, Administration.
FM 101–5	Staff Officers' Field Manual. Staff Organization and Procedure.
FM 101–10	Staff Officers' Field Manual. Organization, Technical and Logistical Data.

2. TECHNICAL MANUALS

TM 9–2800	Military Vehicles.
TM 9–2853	Preparation of Ordnance Matériel for Deep Water Fording.
TM 9–2900	Military Explosives.
TM 21–300	Driver Selection and Training.
TM 21–305	Driver's Manual.
TM 37–2810	Motor Vehicle Inspection and Preventive Maintenance Services.

3. ARMY REGULATIONS

AR 750–5	Maintenance Responsibilities and Shop Operations.

4. SPECIAL REGULATIONS

SR 110–1–1	Index of Army Motion Picture Kinescope Recordings and Film Strips.
SR 310–20–3	Index of Army Training Publications.
SR 310–20–4	Index of Technical Manuals, Technical Regulations, Technical Bulletins, Supply Bulletins, Lubrication Orders, and Modification Work Orders.
SR 310–20–5	Index of Administrative Publications.
SR 310–20–6	Index of Blank Forms, and Army Personnel Classification Tests.
SR 320–5–1	Dictionary of U. S. Army Terms.
SR 320–50–1	Authorized Abbreviations.
SR 385–155–1	Prevention of Motor Vehicle Accidents.

APPENDIX II

MARCH DATA

1. MARCH FACTORS AND FORMULAS

March factors and formulas are explained in paragraphs 48 through 63.

2. USE OF SIMPLE FORMULAS IN COMPUTING MARCH DATA

a. If the commander or control officer of a column is familiar with the basic formulas, it is usually possible for him to keep constantly abreast of the march situation by computing the data he needs as he travels. For example:

(1) There are 12 vehicles in a commander's convoy. Vehicles average 10 yards in length. The speedometer multiplier (SM) is 2 and the vehicles are averaging 20 miles per hour. This is the basic information.

(2) Multiply the speed by the SM (20×2), to find the average intervehicular gap (40 yards).

(3) Add the vehicular length to the gap (10+40) to obtain the average lead (50 yards).

(4) Multiply the lead by the number of vehicles (50×12) to find the road space (600 yards).

b. To continue these computations, the march commander may make use of certain conversion factors (par. 3 of this app.).

(1) Multiply the miles per hour by the factor 30 (20×30) to determine the speed in yards per minute (600 yards per minute).

(2) Divide the road space (in yards) by the speed (in yards per minute) to determine the time length of the column (600 divided by 600 equals 1 minute).

c. The time length of the column can be checked by pulling ahead of the column and clocking its passing. If the tail of the column clears the check point in less than a minute, the march commander will know that proper distances are not being maintained. If it requires longer than a minute, he knows someone is straggling.

d. Assuming that the time length of the column is correct, further information regarding the march may be computed as follows:

(1) The march orders are that the head of the column should clear Jones Junction at 1200 hours. It is now 0950 and the junction is 40 miles away (road distance).

(2) At 20 mph it will require 2 hours for the head of the column to reach Jones Junction (40 divided by 20). This is the time distance.

(3) The tail of the column should clear 1 minute later or in 2 hours 1 minute.

(4) Since the march commander has 2 hours 1 minute to go (0950 to 1200), he knows that he is running on schedule and should clear Jones Junction at the time specified in his orders.

3. EXPLANATION OF CONVERSION FACTORS

a. Factor 30 for Converting Miles Per Hour (mph) to Yards Per Minute.

(1) To convert miles per hour to yards per minute, multiply the speed (mph) by the factor 30 or, for exact computations, 29.33. *Example:* 20 mph × 30 = 600 yards per minute.

(2) This factor is arrived at by dividing the yards in a mile by the minutes in an hour as follows:

1,760 yards ÷ 60 minutes = 29.33 or approximately 30 yards per minute.

(3) The use of this factor may be checked against standard methods of computation as follows:

Test: 20 miles (per hour) × 1,760 yards (per mile) = 35,200 yards (per hour); 35,200 yards (per hour) ÷ 60 minutes (per hour) = 586.66, or approximately 600 yards per minute ((1) above).

b. Factor 2 for Converting Miles Per Hour to Yards Per Second.

(1) To convert miles per hour to yards per second, divide the speed (mph) by the factor 2 for a rough approximation as follows:

30 mph ÷ 2 = 15 yards per second.

(2) This factor is based on the fact that there are approximately twice (2.045) as many seconds in an hour as there are yards in a mile:

3,600 seconds ÷ 1,760 yards = 2.045, or a little more than double.

(3) The use of this factor may be checked against standard methods of computation as follows:

30 miles (per hour) × 1,760 yards (per mile) = 52,800 yards (per hour);

52,800 yards (per hour) ÷ 3,600 seconds (per hour) = 14.66, or approximately 15 yards per second ((1) above).

c. Factor 2 for Converting SM to Time Gap (TG).

(1) To convert the SM of any governed column to the time gap (in seconds) between individual vehicles, multiply the SM by 2:

SM 3 × 2 = 6 seconds (TG)

(2) This is based on the fact that gap in yards (as determined from speed in miles per hour by the SM) when divided by the speed in yards per minute (as computed by the 2 divisor factor in subpar. *b* above) will result in the time gap in seconds:

SM 3 × 30 mph = 90 yards gap; 30 miles (per hour) ÷ 2 (divisor factor) = 15 yards (per second); 90 yards (gap) ÷ 15 yards per second = 6 seconds (TG).

(3) This may be verified as follows:

(*a*) At 30 miles per hour a vehicle travels 52,800 yards per hour (30 miles per hour × 1,760 yards per mile) or 14.66 yards per second (52,800 yards per hour ÷ 3,600 seconds per hour).

(*b*) At 90 yards gap (30 mph with SM 3), the TG will be 6.14 seconds (90 ÷ 14.66 yards per second), which is approximately twice the SM.

Table IX. Rates and Lengths of Marches [a]

Unit	Average rates of march (mph)				Day's march miles
	On roads		Across country		
	Day	Night	Day	Night	
Foot troops	2½	2	1½	1	12–20
Trucks, general	25	25 (lights) 10 (no lights)	8	5	175
Cars, passenger	35	35 (lights) 10 (no lights)	8	5	250
Tanks, light or medium.	15	25 (lights) 10 (no lights)	5	5	150
Cars, armored	35	35 (lights) 10 (no lights)	10	5	200
Truck-drawn artillery.	20	20 (lights) 10 (no lights)	8	5	140
Tractor-drawn artillery.	5	5	3	2	40
Animal elements	6	5	5	4	35
Pack animals	3½	3	3	2	20
Animal-drawn trains.	3½	3	1½	1	20

[a] This table is for general planning and comparison purposes. All factors given are variable in accordance with the situation. Rates shown apply primarily to movement in close column, and may be increased for small commands under favorable conditions, or for movement in open column. For movement over mountainous or very difficult terrain, additional allowances should be made.

Table X. Infiltration Rates [a]

SPEED	DESIRED (per lane)		DISPATCH RATE		
	DENSITY (vehicles per mile)	FLOW (vehicles per hour)	LEAD (yards between veh)	TIME LEAD (between veh)	
				min	sec
10 mph	10	100	176	------	36
	5	50	352	1	12
	4	40	440	1	30
	3	30	587	2	------
	2	20	880	3	------
20 mph	10	200	176	------	18
	5	100	352	------	36
	4	80	440	------	45
	3	60	587	1	------
	2	40	880	1	30
30 mph	10	300	176	------	12
	5	150	352	------	24
	4	120	440	------	30
	3	90	587	------	40
	2	60	880	1	------
40 mph	10	400	176	------	9
	5	200	352	------	18
	4	160	440	------	22½
	3	120	587	------	30
	2	80	880	------	45
50 mph	10	500	176	------	7
	5	250	352	------	14
	4	200	440	------	18
	3	150	587	------	24
	2	100	880	------	36

[a] The purpose of this table is to establish rates of dispatch in time (time lead) and space (lead) between vehicles when the speed and density or flow are known. After vehicles are dispatched, it will be undesirable and impractical for vehicles to maintain exact leads and time leads.

Table XI. Density and Flow of Governed Columns [a]

Speedometer multiplier ((SM) and time lead (TL) in seconds)	VEHICULAR		TRAFFIC (maximum)	
	SPEED (mph)	LEAD (yards per vehicle)	DENSITY (vehicles per mile)	FLOW (vehicles per hour)
CLOSE COLUMN				
SM 1 (TL 2)	10	10	176	1,760
	20	20	88	1,760
	30	30	59	1,760
	40	40	44	1,760
SM 2 (TL 4)	10	20	88	880
	20	40	44	880
	30	60	29	880
	40	80	22	880

[a] This chart is to be used in establishing an SM within the limits of a prescribed density or traffic flow. The vehicular column is based on a *lead* SM; the traffic column is based on maximums which do not take into consideration gaps between march units or columns or the effects of other traffic.

Table XI. Density and Flow of Governed Columns [a]—Con.

Speedometer multiplier ((SM) and time lead (TL) in seconds)	VEHICULAR		TRAFFIC (maximum)	
	SPEED (mph)	LEAD (yards per vehicle)	DENSITY (vehicles per mile)	FLOW (vehicles per hour)
OPEN COLUMN				
SM 3 (TL 6)	10	30	59	587
	20	60	29	587
	30	90	19	587
	40	120	15	587
SM 4 (TL 8)	10	40	44	440
	20	80	22	440
	30	120	15	440
	40	160	11	440
SM 5 (TL 10)	10	50	35	352
	20	100	18	352
	30	150	12	352
	40	200	9	352
SM 6 (TL 12)	10	60	29	293
	20	120	15	293
	30	180	10	293
	40	240	7	293

a This chart is to be used in establishing an SM within the limits of a prescribed density of traffic flow. The vehicular column is based on a *lead* SM; the traffic column is based on maximums which do not take into consideration gaps between march units or columns or the effects or other traffic.

Table XII. Vehicle Fuel and Lubricant Data

1	2	3	4	5	6
Vehicle	Vehicle fuel tank capacity (gal)	Fuel per 100 miles (gal)	Oil per 100 miles (gal)	Gear lubricant per 100 miles (lb)	Miscellaneous grease per 100 miles (lb)
Automobile, sedan, 5 passenger	16	6. 4	0. 2	0. 1	0. 1
Car, armored, utility, M20	56	14. 3	1. 5	. 5	. 9
Carriage, motor (twin 40-mm), M19	115	100. 0	4. 0	1. 0	2. 4
Carriage, motor (105-mm how), M37	115	100. 0	4. 0	1. 5	2. 4
Carriage, motor (155-mm gun), M40 or (8-in. how) M43	215	200. 0	5. 0	1. 6	2. 8
Carrier, cargo, M-29	25	20. 0	1. 5	. 8	. 5
Carrier, cargo, M-29C	35	20. 0	1. 5	1. 0	. 5
Carrier, half-track	60	30. 0	1. 1	. 7	1. 2
Compressor, air, trk-mtd	40	13. 3	. 3	. 5	. 3
Crane, trk mtd ¾-yd capacity	50	40. 0	. 4	. 8	. 4
Grader, road, mtzd, diesel	27	72. 0	. 8	12. 5	2. 0
Shop equipment, mtzd, GP	45	20. 0	. 4	. 8	. 4
Motorcycle, solo	3. 5	2. 4	. 2	. 1	. 1
Motor, scooter	2. 0	2. 0	. 2	. 1	. 1
Tank, light, M24	110	63. 0	3. 2	1. 0	1. 5
Tank, medium, M4A3 (76-mm)	175	125. 0	4. 0	1. 5	2. 4
Tank, medium, M26	183	166. 0	4. 0	1. 6	2. 8
Tractor, medium, high-speed, 13T, M5	100	80. 0	1. 0	1. 1	. 5

1	2	3	4	5	6
Vehicle	Vehicle fuel tank capacity (gal)	Fuel per 100 miles (gal)	Oil per 100 miles (gal)	Gear lubricant per 100 miles (lb)	Miscellaneous grease per 100 miles (lb)
Tractor, medium, high-speed, 18T (M4)	125	70. 0	1. 4	1. 2	. 6
Tractor, heavy, high-speed, 38T (M6)	300	200. 0	2. 0	1. 8	. 5
Truck, ¼-ton	15	7. 0	. 2	. 2	. 2
Truck, ¾-ton	30	12. 5	. 3	. 3	. 3
Truck, 1½-ton, 4 x 4	30	13. 3	. 3	. 5	. 3
Truck, 1½-ton, 6 x 6	30	12. 5	. 3	. 5	. 3
Truck, 2½-ton, 6 x 6	40	17. 9	. 4	. 8	. 4
Truck, 4-ton, 6 x 6	60	40. 0	. 6	1. 2	. 8
Truck, 6-ton, 6 x 6, prime mover	75	50. 0	. 9	. 7	1. 0
Truck, 7½-ton, 6 x 6, prime mover	160	40. 0	. 8	. 8	1. 0
Truck, amphibian, 2½-ton (amph trk)	40	16. 7	. 6	. 9	. 3
Truck, crane, M2	100	66. 7	. 7	. 7	. 5
Truck, wrecking, M1A1	100	40. 0	. 9	. 8	1. 0
Truck, tractor (tank transporter) M26	120	62. 5	1. 5	. 9	1. 1
Truck, tractor, 4–5 ton (7-ton semitrailer)	60	3h 3	. 6	1. 2	. 8
Truck, trailer, 5–6 ton (10-ton semitrailer)	90	18. 9	. 8	1. 0	. 9
Vehicle, landing, tracked LVT (4) LVT (A) (5)	162	82. 0	2. 4	1. 3	. 8
Vehicle, tank recovery, M32A1	172	172. 0	2. 0	1. 6	2. 8
Vehicle, engr, armd	140	166. 6	4. 0	1. 5	2. 4
Vehicle, utility, armd, M44	110	55. 0	2. 8	. 9	1. 2

Table XIII. Standard Types and Capacities of Trucks and Trailers

Type of container	Unit pack	Cases or units per load [a]			
		1-ton trailer (capacity)	2½-ton cargo (capacity)	5-ton cargo (average)	10-ton semitrailer (average)
Full					
US 55-gallon drum	1	6	15	24	49
US 5-gallon can (gasoline)	1	50	125	250	500
US 1-quart can (oil)	12	60	145	290	581
US 25-pound pail (grease)	1	70	170	245	690
Empty					
US 55-gallon drum	1	6	23	23	55
US 5-gallon can (gasoline)	1	88	320	320	750

[a] When overloads are authorized, these quantities may be increased to the cubic capacity of the vehicles or to 100 percent overload, whichever limit is reached first.

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