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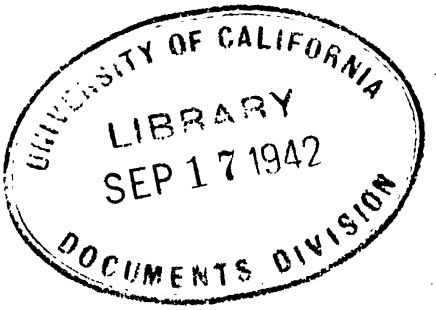
TM 5-400

WAR DEPARTMENT

TECHNICAL MANUAL

MILITARY RAILWAYS AND INLAND WATERWAYS

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TECHNICAL MANUAL

MILITARY RAILWAYS AND INLAND WATERWAYS

CHANGES No. 1

WAR DEPARTMENT,
WASHINGTON, March 4, 1942.

TM 5-400, November 30, 1940, is changed as follows:

16. Troop movements by train.—*a.* For moving troops in the zone of the interior, **standard** passenger **coaches or sleepers will generally be used for transporting personnel.** In movement of troops in the theater of operations, it is essential that individual and organizational equipment accompany each unit. This is best accomplished by use of type trains of a standard make-up for movement of troops and their equipment. **Composition of railway trains, grouped for planning purposes, used for troop movements in the theater of operations is as follows:**

Type train	Composition [1]						
	Pullman	Coach	Box car [2 3]	Flat car	Stock	Caboose [4]	Total number of cars
A	1	11	4	18	----	(1)	34
B	1	6	4	23	----	(1)	34
C	6	22	6	----	----	(1)	34
D [5]	1	5	2	26	----	(1)	34
E	1	5	3	----	25	(1)	34

[1] Contemplates the use of standard railroad equipment. Standard trains of specially constructed light equipment may also be prescribed in the theater of operations.
[2] Includes one combination kitchen-supply car per company.
[3] Baggage cars may be used.
[4] For train crew. Not required when coaches are used.
[5] For movement of armored units when wheel vehicles and certain personnel march separately. Personnel with this type train include two men per vehicle.

When there is an ample supply of rolling stock, type trains may be made up and held at convenient points. This permits a rapid assembly of trains at any time but immobilizes the equipment. Necessary storage tracks may not exist at the proper locations. Adoption of type trains is of great assistance in the assembly of rolling stock for

*These changes supersede Training Circular No. 57, War Department, 1941.

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TECHNICAL MANUAL
No. 5-400

WAR DEPARTMENT,
WASHINGTON, *November 30, 1940.*

MILITARY RAILWAYS AND INLAND WATERWAYS

Prepared under direction of the
Chief of Engineers

SECTION I. General. Paragraph

Purpose and scope	1
Classification	2
Employment	3
Inland waterways	4

II. Standard railways.

Definition	5
Distinctive characteristics	6
Selection and exploitation	7
Regulating station	8
Railhead	9
Organization	10
Troops	11
Construction	12
Supply	13
Operation	14
Relation with other arms and services	15
Troop movements by train	16
Armored trains	17
Facilities	18
Personnel	19
Forms, reports, and statistics	20

III. Inland waterways.

Purpose	21
Employment	22
Advantages and disadvantages	23
Plans for operation	24
Reconnaissance of streams and channels	25
Relation to other arms and services	26
Organization	27
Personnel	28
Craft and floating plant	29
Fuel and water supply	30
Landing and shore facilities	31

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III. Inland waterways—Continued. Paragraph
Signal communication 32
Traffic control 33
Night navigation 34
Operations in captured territory 35
Commercial lines and facilities 36
Records and reports 37

SECTION I

GENERAL

Paragraph
Purpose and scope 1
Classification 2
Employment 3
Inland waterways 4

1. Purpose and scope.—*a.* This manual explains the use, organization, and general operation of military railways and inland waterways in war and their relation to the other arms and services. Details of railway location and construction are covered in FM 5–10. Operation and maintenance conform closely to the use and methods employed on the commercial railways of the United States, and are covered in TM 5–405, TM 5–410, FM 5–5, and recognized handbooks in common use on commercial railways.

b. Military railways are defined as those in the theater of operations under military operation or control, and such railways in the zone of the interior as may be turned over to military authorities. When inland waterways are put to military use their status is the same as that of military railways. The organizations for operating and maintaining military railways and inland waterways are referred to, respectively, as the Military Railway Service (MRS), and the Inland Waterway Service (IWS).

c. Since actual conditions affecting military railways and waterways may vary widely from a theater of operations in which there may be but one short single track railway or one waterway to a theater of operations in which there is a complicated network of railway and waterway systems, it is not intended that a literal interpretation of these provisions be made to apply in all cases. The organizational scheme as shown herein is applicable to the more complicated systems. Modifications of this organization should be made in the interest of simplicity and economy of overhead where conditions in the field make such simplification desirable.

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2. Classification.—Railways are classified commercially by gage and in a military sense by their method of utilization.

a. Commercial railways of the world vary from 60 centimeters (23⅝ inches) to 6 feet in gage, but more than half of the total mileage is laid to 4 feet 8½ inches known as standard gage. Gages greater or less than standard are known respectively as broad and narrow.

b. A military force will normally use standard railways. These include all the railways existent in the theater of operations which are utilized as the system of railway transportation. Narrow gage railways may be used in fixed fortifications.

3. Employment.—Railways when uninterrupted are superior to any other form of land transportation for the movement of large quantities of supplies and troops over distances greater than about 75 miles. Their location may be of great strategic significance and many coutries have located their railway lines with their use in military operations as the primary consideration. Railway lines in rear of a battleline and parallel to it have a distinct strategical value for rapid movement of troops from one part of the front to another.

4. Inland waterways.—Inland waterways include navigable rivers and canals. They are used principally for transportation of bulk supplies. They will be comparatively free from the necessity of maintenance during any period of military use but their capacity may be reduced by ice or by drought. Canalized streams are vulnerable on account of damage that may be caused by destruction or disablement of lock structures and gates or appurtenant dams. Carrying capacity of vessels employed on inland waterways greatly exceeds that of any vehicles used in land transportation but their speed is considerably less. It is probable that new construction in connection with waterways after advent of a war will be limited to construction or improvement of terminal and freight handling facilities.

SECTION II

STANDARD RAILWAYS

	Paragraph
Definition	5
Distinctive characteristics	6
Selection and exploitation	7
Regulating station	8
Railhead	9
Organization	10
Troops	11
Construction	12
Supply	13

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	Paragraph
Operation	14
Relation with other arms and services	15
Troop movements by train	16
Armored trains	17
Facilities	18
Personnel	19
Forms, reports, and statistics	20

5. Definition.—*Standard railways* are the railways existent or constructed in the theater of operations which are or may be joined into an operating system for the general service of the military forces.

6. Distinctive characteristics.—Although the basic principles of operation and maintenance of standard military railways are the same as those of the railways of the United States, there are some distinct differences. Commercial railways are built and operated as any commercial enterprise with the primary object of earning profits for their owners. Economy is considered in monetary terms. Competition with other carriers and convenience of passengers and shippers are important factors. Legal requirements and restrictions, and agreements with organized labor govern operations to a large extent. These factors are lacking in the operation of military railways. Military economy is that of time, material, and manpower. Convenience is sacrificed to military necessity. Manpower is utilized to its maximum capacity and legal requirements may be superseded by military command. Some basic characteristics of military railways are—

a. Location and construction.—In construction of new lines prompt completion is of primary importance. Therefore earthwork should be reduced to a minimum even at the expense of mileage, curvature, and gradient. No attempt is made to build for permanence beyond the probable duration of the war.

b. Equipment.—Equipment existing in the theater of operations will be utilized to the greatest extent feasible. When new equipment is procured, such types are selected as will give the greatest amount of service for the duration of the war, and with least amount of maintenance. Standardization is important and simple types are preferable.

c. Roadbed and track.—Roadbed and track will be as light as is consistent with the objects to be attained, neglecting most refinements of the modern railway.

d. Operating rules and fundamentals.—(1) Train operation is governed by TM 5-415, based on the Standard Code of Train Rules of the Association of American Railways, and modified so as to apply to conditions in the theater of operations.

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(2) Rolling stock is loaded quickly to its capacity and unloaded and released promptly at its destination. In most cases trains are operated at low or moderate speeds, dependable arrival at destination being the primary consideration.

(3) Superimposing the operation of military trains upon an existing civilian train schedule, especially in a foreign theater in friendly territory, requires careful planning by officers of the railway service, strict attention and study on the parts of train and engine personnel, and use of the greatest tact by all.

e. Maintenance standards and safety rules.—Maintenance standards will be such as opportunity permits, and arbitrary safety rules become secondary to military necessity and the mission. Facilities for maintenance of equipment near the front are limited. Shops are established well in the rear to minimize enemy interference.

7. Selection and exploitation.—*a.* In a theater of operations having an adequate and highly developed system of railways for serving commercial needs it may be possible and advisable to select certain lines to exploit for military operations (see fig. 1). Selection of the lines to be thus exploited will depend primarily upon strategical considerations such as probable objectives, lines of advance, frontiers, and enemy dispositions. After these have been determined, the more detailed selection of particular railways to be utilized for supply purposes becomes a traffic problem. Desirable physical characteristics are—

(1) Yard, terminal, and shop facilities properly located.

(2) Double or multiple track.

(3) Seasoned roadbed, heavy rail, and good ballast.

(4) Light grades and curvature.

(5) Adequacy of passing tracks and side tracks.

(6) Bridges of sufficient strength for military loads, including railway artillery.

(7) Loading and unloading facilities where needed.

(8) Short mileage between important points. This is secondary to the other characteristics enumerated but must be given consideration if the mileage of a first class line is much in excess of that of a secondary line properly located for military use.

b. In estimating the capacity of a railway line each of the above elements has a weight, but one of the most vital characteristics which is sometimes overlooked is the matter of terminal facilities. Regardless of the perfection of all other characteristics, if the cars cannot be and are not unloaded and returned promptly the line will become congested, equipment supply frozen, and the plant facility rendered

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useless. An increase in terminal capacity can be secured frequently by adding tracks and driveways to permit loading or unloading by hand or mechanically.

c. When the main lines to be put to military use have been decided upon, a detour plan must be devised for routing traffic in case part of a line goes out of service either from acts of the enemy or from the usual accidents of railway operation such as wrecks and washouts. This applies especially to choke points in sections carrying the heaviest traffic.

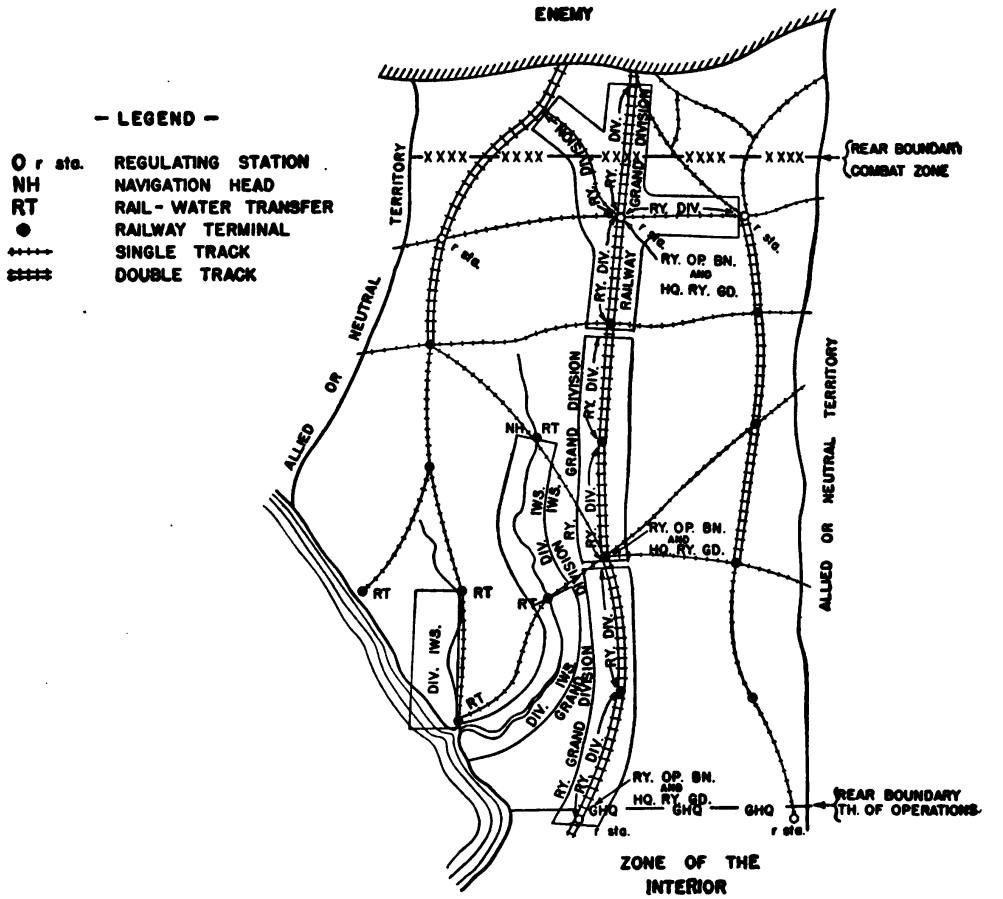


FIGURE 1.—Typical theater of operations showing military railways and inland waterways.

d. Physical characteristics constituting a source of weakness are—

(1) Tunnels.

(2) Long and high bridges or bridges over deep rivers.

(3) Terminals so situated or constructed as to become congested. This difficulty may be overcome in certain cases by construction of a bypass for through traffic.

(4) Deep cuts and high fills.

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8. Regulating station.—*a. Purpose.*—The regulating station is a traffic agency of the commander of the theater of operations through which movement of troops and supplies is controlled between communication and combat zone, and laterally between regulating stations. Its purpose is to insure necessary flexibility in the supply system, to maintain regularity of supply and smooth movement to and evacuation from the combat zone, and to avoid congestion at railheads in spite of unforeseen changes in strength and location of front-line troops.

b. Location.—Each regulating station serves a definite area of the combat zone delimited on the basis of available lines of communication, strength of forces therein, and capacity of the station. If conditions permit, these areas should be coincident with army areas of the combat zone. A regulating station should when possible be situated at the junction point of several routes leading from the various depots and installations in the rear from which supplies and replacements are drawn. Two or more separate routes should lead to the area which it serves in order to insure that there will be no interruption of traffic in case one line becomes blocked by any cause. It is desirable that the regulating station be linked by a line or lines running in general parallel to the front with other regulating stations so that while furnishing the means of regulating and directing movements in and out of the combat zone, it can also maneuver traffic laterally in order to secure requisite flexibility to meet all situations. Regulating stations are located at or near the rear boundary of the combat zone. Similar installations are located at the rear boundary of the theater of operations. A regulating station should not be so near the front as to be subject to enemy ground activity, but it should if possible be so located that locomotives can make the trip to railheads and return under cover of darkness. In a shifting military situation, regulating stations may be established at points where the necessary trackage already exists or can be installed quickly. Provision is made by planning and reconnaissance for prompt relocation of regulating stations.

c. Installations.—(1) Essential installations at a regulating station consist of—

(*a*) Receiving, classification, and dispatching tracks.
(*b*) Engine terminal.
(*c*) Accommodations for individual casuals.
(*d*) Postal facilities.
(*e*) Shelter for office space and quarters for operating personnel.
(*f*) Facilities for storage and handling of certain supplies called

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regulating station reserves. Normally these reserves consist of aircraft gasoline and oil, bridge materials, and ammunition for 1 or 2 days of fire for troops in the area served. Transloading supplies for storage and issue is not a function of the regulating station. A small amount of covered storage may be necessary for sheltering less than carload shipments and such reserves as may be required. When possible, regulating station reserves are kept on wheels in readiness for prompt movement, that is, maintained as a mobile reserve.

(2) Hospitals and depot establishments should not be located at the same point as a regulating station as their proximity has a tendency to complicate work of the regulating station.

(3) Defense against aircraft must be provided.

d. Secondary.—When enemy observation or interference prevents establishment of a regulating station at a convenient distance from the front, a primary regulating station will be established as far back as necessary to obviate enemy interference, and secondary regulating stations are established at points convenient to the front. These secondary regulating stations will be railway junction points with possibly fewer regulating station facilities, and used to extend the purpose of primary regulating stations to which they are respectively subordinate by controlling the trains after they leave the primary regulating stations. Alternate locations for secondary regulating stations will be designated.

e. Operation and organization.—(1) The regulating station is commanded by the regulating officer who is especially designated by and reports directly to GHQ. The regulating officer commands the station and all installations thereat for the operation of which use of trackage or of routes leading to the front is necessary. He is assigned a suitable staff representing the various services. He is responsible for systematic and orderly movement of supplies and reinforcements from the regulating station to the front and for evacuation of men, animals, and matèriel from the combat zone to the rear. To him are sent all orders for and information regarding transportation of men, animals, and matériel to and from the areas assigned to his station. He is advised in ample time of proposed changes at the front which may affect operations of the regulating station in order that he may make appropriate dispositions accordingly. He coordinates activities of service representatives at his station, determines amount of regulating station reserves and priority of shipments, and makes allotment of cars and drafts for supplies on depots in rear based on calls from the command he serves. The regulating officer controls all traffic on lines into and out of his station and forward

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thereof. No traffic will enter or pass through the regulating station without prior authorization of the regulating officer and, in general, movement of railway traffic in either direction between the regulating station and the advance depots in the communications zone will be made only on priorities established and authorized by the regulating officer. Assigned to the regulating station is a general superintendent or superintendent of the Military Railway Service who operates the railways at and forward of the regulating station in accordance with military requirements as ordered by the regulating officer. The general superintendent or superintendent commands railway troops operating lines controlled by the regulating officer, and is his technical adviser on railway questions.

(2) Supplies coming up to the regulating station are usually in car or train lots and the cars are classified, unloaded, or made up into trains according to requirements of the situation.

(3) Daily trains for combat divisions or units grouped for supply are made up as far as possible at advance depots on information furnished by the regulating officer, and leave the regulating station at such time as will enable them to make the run and arrive at railheads before daybreak. Load of the daily train, in addition to Class I supplies for the organization for which it is intended, may include mail, varying quantities of Class II, III, IV, and V supplies, and personnel replacements.

(4) Rearward traffic through the regulating station in addition to empty rolling stock may include hospital trains with wounded, cars or trains loaded with salvaged material, and troops en route to another front.

(5) Trains are operated by civilians under military control as far forward as safe and practicable. Forward of civilian operation and always forward of and including the receiving yards of regulating stations, operations are by railway operating battalions grouped into railway grand divisions as directed by the manager, Military Railway Service.

9. Railhead.—*a.* A railhead is an installation on a railroad designated as such in the theater of operations at which supplies for troops are discharged and from which they are distributed, or are forwarded by other means to other supply points. It may be at the actual end of rail, or it may be at a point along the line conveniently located for distribution of supplies to one or more organizations. Available sites for railheads in the combat zone are selected by the regulating officer upon advice of the senior officer of the Military Railway Service at his regulating station. Allocation of the several railheads to organi-

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zations is made by the regulating officer based on recommendations of the army commander.

b. For convenience and simplicity, a railhead should serve one (tactical) division only, but this is not always possible. For the purpose of daily supply by rail and in order that daily trains may be made uniform in size, corps and army troops are grouped to approximate the numerical strength of a division so as to be supplied by one daily train at one railhead.

c. Facilities of a railhead may range from a simple sidetrack with or without an unloading platform to a highly organized railway station with yards and storehouses.

d. The railhead is operated by a detachment of a quartermaster company (railhead), the commanding officer of which is the railhead officer. Control of operations at railheads is exercised by the regulating officer. A railway traffic officer assigned to a railhead is subordinate to the officer in charge and assists in all matters of railway operation.

10. Organization.—*a.* The railway operating battalion is the unit which actually operates and maintains a standard railway division. The direct chain of command and technical supervision for any operating battalion is: commanding general, theater of operations—commanding general, communications zone—engineer, communications zone—manager, military railway service—general superintendent, grand division—superintendent, railway division (commanding officer railway operating battalion). Traffic control is exercised directly from GHQ to the railway grand division or division operating into and out of a regulating station by the regulating officer who operates directly under the assistant chief of staff, G–4, GHQ. Actual railway construction in the communications zone or combat zone is carried on by general engineer troops assigned as necessary under the engineer, communications zone or army engineer, respectively. Technical supervision and coordination of railway construction projects is exercised by the chief engineer, theater of operations, and the railway section of his headquarters through the staffs of the engineer, communications zone and the army engineer, respectively. Figure 2 shows graphically the chains of command and technical supervision for operation, maintenance, and construction of railways and inland waterways. The organization generally follows the organization employed by commercial railways adapted to fit into the military organization. Such departments as finance, legal, and traffic normally encountered in civil railway organizations have no counterpart in militay railway organi-

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zation, their functions being absorbed by the Finance Department, Judge Advocate General's Department, and the Quartermaster Corps.

b. The chief engineer of the theater of operations exercises supervision over all military railway and inland waterway activities in the theater of operations. Railway and waterway section (see T/O 5–300–1) of his office will comprise—

(1) An engineer of construction who coordinates all railway and inland waterway construction in the theater of operations.

(2) An assistant engineer of construction (for the combat zone) who coordinates all railway construction in the combat zone.

(3) A planning officer who prepares plans for strategic and tactical utilization of railways and inland waterways in the theater of operations, and for construction and reconstruction thereof.

(4) A statistical officer who collects and disseminates railway and inland waterway statistics and intelligence.

c. The engineer, communications zone, is responsible for operation of railways and inland waterways in the theater of operations and construction of railways and inland waterways in the communications zone.

d. The manager, Military Railway Service, reports to the engineer, communications zone, and is directly responsible to him for operation and maintenance of standard military railways in the theater of operations. Control of all train movements over railways into and out of regulating stations is exercised by regulating officers who are representatives of GHQ (see par. 8). The manager, Military Railway Service, is in command of all personnel assigned to duty with the Military Railway Service. He is assisted by a staff comprising an assistant to the manager and general superintendents of operation, equipment, maintenance of way, and stores. These staff officers are heads of their respective departments and exercise technical supervision over their respective activities on the operating divisions.

(1) The general superintendent of operations designates the limits of grand divisions and divisions, supervises all train service, coordinating that service between the grand divisions and divisons, and submits recommendations for construction and reconstruction of railway facilities required for adequate railway service. He is assisted by—

(*a*) Assistant general superintendent who is responsible for coordination of schedules, preparation of train and station rules, preparation of regulations for loading cars, and make-up and movement of trains.

(*b*) Superintendent of car service who is responsible for tracing car movements, return of empty cars, and their distribution to loading points.

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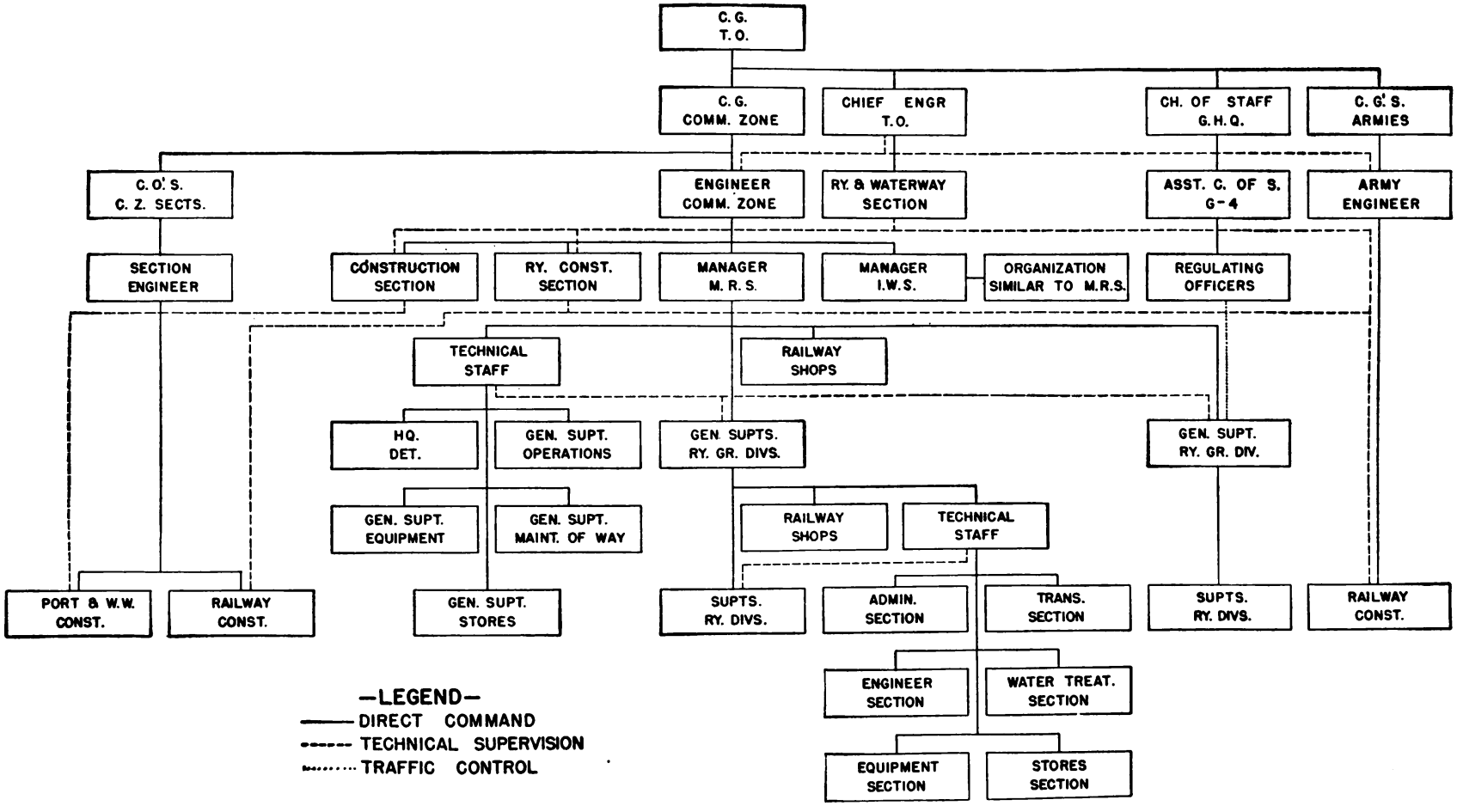


FIGURE 2.—Organization of military railways and inland waterways, theater of operations.

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(*c*) Superintendent of terminals who exercises technical supervision over operation of terminal facilities particularly with reference to assembling, assorting, classifying, and relaying trains, and prompt handling and release of cars. He prepares recommendations for construction and reconstruction of terminal facilities required for adequate railway service.

(*d*) Superintendent of telephone and telegraph who exercises technical supervision over telegraph and telephone communication on the military railway system.

(2) The general superintendent of equipment determines proper types of equipment to meet operating conditions, prescribes policies for maintenance of equipment, and formulates rules for inspection. He exercises technical supervision over all railway repair shops and maintenance of equipment by operating battalions. He is assisted by—

(*a*) General superintendent of motive power who assigns motive power to meet requirements of grand divisions and divisions, formulates rules for operation and maintenance of motive power, maintains adequate inspection service, and exercises technical supervision over operation of shop and railway operating battalions with respect to repair and maintenance of motive power.

(*b*) Superintendent of cars who reports to the general superintendent of motive power and formulates rules for maintenance of cars and worktrain equipment, maintains adequate inspection service, and exercises technical supervision over operation of shops and railway battalions with respect to repair and maintenance of cars and worktrain equipment.

(*c*) Chief mechanical engineer who exercises technical supervision over arrangement, operation, and maintenance of shop machinery and mechanical equipment of buildings.

(*d*) Assistant to the general superintendent who performs administrative and such other duties as directed.

(3) The general superintendent, track and structures, prescribes standards of maintenance for track and structures, and provides materials, supplies, and worktrain appliances as required. He cooperates with the general superintendent of operations in preparation of detail plans for construction and reconstruction of railway facilities. He arranges, when necessary, for general engineer troops to be assigned for maintenance beyond capabilities of railway operating battalions. He is assisted by—

(*a*) Superintendent of track who exercises technical supervision over maintenance of track, embankment, and tunnels on grand divisions and divisions.

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(*b*) Superintendent, bridges and buildings, who exercises technical supervision over maintenance of bridges, culverts, buildings, snow sheds, fences, coaling stations, and structural elements of water stations on grand divisions and divisions.

(*c*) Superintendent of signals who exercises technical supervision over maintenance of signals, control tower apparatus, interlocking plants, and track circuits on grand divisions and divisions.

(*d*) Superintendent of water service who arranges for adequate supply of water, coordinating railway requirements through the manager, Military Railway Service, with the water supply section, engineer headquarters, communications zone. He exercises technical supervision over distribution and operation of water stations and maintenance of all piping and mechanical appliances connected therewith on grand divisions and divisions.

(*e*) Assistant to the general superintendent who performs administrative and such other duties as directed.

(4) The general superintendent of stores who coordinates supply requirements of the railway divisions and exercises technical supervision over the general storekeepers. He is assisted by the fuel agent who maintains adequate fuel reserves on railway divisions.

e. The standard military railway system of the theater of operations is divided for purposes of administration into *grand divisions* and *divisions* (see figs. 2 and 3). Limits of a grand division are determined by the military situation, traffic to be expected, and geographical locations of lines and facilities, and will include two or more railway divisions. A railway shop battalion may be assigned to a grand division for heavy repairs to equipment.

f. Headquarters organization of the grand division (see T/O 5–602) will comprise—

(1) General superintendent who is in command of the grand division and responsible to the manager, Military Railway Service, for its efficient operation.

(2) Administration section with an adjutant and enlisted personnel for administration of the headquarters.

(3) Transportation section with—

(*a*) Assistant general superintendent (in charge) who coordinates timetables, supervises movement of trains, operation of terminals, and telephone and telegraph service on the grand division.

(*b*) Assistant superintendent, car service.

(*c*) Eight railway traffic officers who are assigned to important stations on the grand division (see pars. 9 and 14).

(4) Water treatment section with—

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(*a*) Chemical engineer (in charge) who exercises technical supervision over water supply and treatment of boiler water.

(*b*) Supervisor of water service who exercises technical supervision over distribution and operation of water stations and maintenance of all piping and mechanical appliances connected therewith on the grand division. He coordinates railway requirements with those of other units in his area.

(5) Engineering section with—

(*a*) Engineer of track and structures (in charge) who exercises technical supervision over track and equipment maintenance, coordinates all maintenance of way activities on the grand division, and assigns maintenance of way supplies and equipment to railway divisions as required.

(*b*) Engineer of structures who exercises technical supervision over maintenance of bridges, buildings, and other structures on the grand division.

(*c*) Engineer of track who is the assistant to the chief of section for maintenance of way.

(*d*) Engineer of signals who exercises technical supervision over signals, control tower apparatus, interlocking plants, and track circuits on the grand division.

(6) Equipment section with—

(*a*) Superintendent of equipment (in charge) who exercises technical supervision over maintenance and operation of motive power, maintenance of cars and worktrain equipment, and operation of engine terminals on the grand division.

(*b*) Mechanical engineer who exercises technical supervision over arrangement, operation, and maintenance of mechanical equipment of buildings on the grand division.

(*c*) Master mechanic, who is the assistant to the chief of section for motive power.

(*d*) Master car builder, who is the assistant to the chief of section for rolling stock.

(7) Stores section with—

(*a*) General storekeeper (in charge) who coordinates supply requirements of railway divisions and exercises technical supervision over activities of the division storekeepers on the grand division.

(*b*) Fuel agent who coordinates fuel requirements of railway divisions and maintains adequate reserves properly located on the grand division.

g. The railway division is the primary administrative unit for operation and maintenance of standard railways. Limits of the rail-

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way division are such that the division superintendent can maintain personal supervision over all activities on the division. Limits are determined by length of main line, number and location of branch lines, density of traffic and terminal facilities, and should be such that the division superintendent can reach any point on his division within his working day. The length of a division may vary from 50 to 120 miles.

11. Troops.—*a.* The *railway operating battalion* is the operating unit for a railway division. It is commanded by a superintendent, and consists of a headquarters, headquarters and service company, transportation company, maintenance of way company, and maintenance of equipment company. It has necessary personnel and equipment to operate trains and yards of a division, maintain track and structures, and make running repairs to equipment. It is not equipped for railway construction or heavy repairs to equipment. The superintendent reports to the general superintendent, or to the manager, Military Railway Service in cases where his division is not part of a grand division. A railway operating battalion may be assigned for operation of a large terminal or regulating station (see TM 5–405).

b. The *railway shop battalion* is the operating unit for a heavy repair and erecting shop for all classes of railway equipment. It cares for heavy repair work of from one or more grand divisions depending upon amount and condition of equipment. It consists of a headquarters, headquarters and service company, erecting and machine shop company, boiler and smith shop company, and car repair company. The railway shop battalion may report to the manager, Military Railway Service, or to a general superintendent, railway grand division, as circumstances dictate and as ordered by the manager, Military Railway Service. (See T. M. 5–410.)

c. General engineer troops will be assigned to railway divisions or grand divisions for maintenance of way when such maintenance is beyond the capacity of the railway operating battalions. Special equipment for heavy maintenance is under the control of headquarters, railway grand division, and is assigned as required.

12. Construction.—*a.* Railway construction and reconstruction in the combat zone is a function of the army engineer. Detail plans are prepared by the railway section of army engineer headquarters, and construction and reconstruction is executed under the supervision of the construction section, army engineer headquarters.

b. Similarly, railway construction and reconstruction in the communications zone is a function of the engineer, communications zone.

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Detail plans are prepared by the railway section of the headquarters of the engineer communications zone, and construction and reconstruction are executed by the section engineers under supervision of the construction division of that headquarters.

13. Supply.—Supplies for operation and maintenance of standard railways in the theater of operations and for construction in the communication zone are procured through the supply section of the engineer headquarters, communications zone. Supplies for construction and reconstruction from regulating stations forward in the combat zone are procured through the supply section, army engineer headquarters.

14. Operation.—*a.* (1) Military railways in the theater of operations may be operated by civilians, by troops, or by a combination of both. Joint operation by civilians and troops may exist in a theater of operations in friendly territory where trains for civilian needs and military trains up to a certain distance from the front may be operated by civilians, and military trains beyond that point operated by railway troops. Details of operations are worked out by military and civilian authorities jointly. Military trains have priority but needs of civilian population must be considered.

(2) With joint operation (or civilian operation under military control) as much of the Military Railway Service organization as may be required is attached to the operating agency to regulate, coordinate, and advise civilian authorities. These officers see that the railways meet the military demand placed upon them and that plans are made to take care of future operations required by the military situation.

(3) Railway traffic officers (RTO) detailed from the Military Railway Service are assigned to railway lines operated wholly or in part by civilian agencies. They are located at important shipping and receiving points to expedite movement of troops and supplies and to represent the Military Railway Service at their stations. They agree with operating authorities for trains for the movement of troops and supplies, for trackage for loading and unloading of trains, and have general supervision over these activities of their stations. They assist casuals and entraining and detraining officers with information. Their duties are only in relation to railway transportation requirements and they have no authority over operation and maintenance of railways under civilian operation.

b. (1) Military railway operation by troops will exist where military necessity is the governing factor as in a theater of operations near the front, or where civilian or joint operation fails to satisfy military requirements.

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(2) To expedite movement of troops and supplies, railway traffic officers (RTO) who are members of the staff of the general superintendent or superintendent will be located at important railway stations in addition to the station agents provided in T/O 5–129. The railway traffic officer will represent the superintendent of the railway division on which he is located. He will keep the superintendent informed of all activities and requirements at his station. He will cooperate with the transportation officer of the Quartermaster Corps (see par. 15) and arrange for prompt loading, unloading, and release of cars, furnish on proper authority all railway transportation from his station, assist casuals and entraining and detraining officers with information, and make arrangements for refreshments if required for troops en route through his station. He is in charge of all railway troops at his station.

15. Relation with other arms and services.—*a.* Tact and cooperation are essential in all dealings between military commanders and personnel of the Military Railway Service. Operation of trains is a function solely of the operating department of the Military Railway Service and no interference by other personnel is permitted.

b. (1) The Quartermaster Corps arranges for transportation of troops and supplies over military railways and inland waterways in the same manner as over any other transportation system.

(2) A transportation officer detailed from the transportation division of the Quartermaster Corps will be on the staff of the commander at each important shipping and receiving point. He arranges with the railway traffic officer, or if there is none, with the station agent of the Military Railway Service for furnishing and placing cars and for transportation of troops and supplies, issuing therefor the necessary transportation requests and bills of lading in accordance with priorities announced by the responsible commander. He is responsible for the receipt and proper storage of shipments pending their delivery to consignee.

c. Large movements of troops and supplies are arranged for by commanders concerned directly with the manager, Military Railway Service.

d. The regulating officer controls all movements by rail into and out of the regulating station in accordance with instructions received from the commander of the theater of operations. In rear of the line of advance depots in the communications zone, movements are controlled by priorities indicated by the commanding general, communications zone.

e. (1) The Coast Artillery Corps is charged with the operation and maintenance of railway artillery except when in transit when the rail-

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way operation and maintenance is handled by the Military Railway Service.

(2) Trackage assigned to or constructed by the Coast Artillery Corps for railway artillery use will be maintained by Coast Artillery Corps troops or attached personnel. Railway artillery trains will not operate on or foul tracks under military railway control without permission of military railway authorities. Military railway trains will not operate or or foul tracks under Coast Artillery Corps control except under authority of the latter.

(3) Military railway authorities will control all movements of railway artillery trains when operated over military railway tracks. This includes schedules, routing, dispatchments, and conduct of transportation. Engines and train and engine crews for such operation will normally be furnished by the Military Railway Service. When motive power is furnished by the Coast Artillery Corps, pilots will be furnished by the railway operating battalion over whose trackage the movement is made.

(4) Engines and crews may be furnished by the Military Railway Service and attached to the Coast Artillery Corps for the operation of railway artillery on tracks under Coast Artillery Corps control. The Coast Artillery Corps will be responsible for the maintenance of such equipment.

(5) Repairs to railway equipment of Coast Artillery Corps or other arms normally will be made at military railway shops by military railway troops.

16. Troop movements by train.—*a.* For moving troops in the zone of the interior passenger equipment may be used, but this is rarely possible in the theater of operations. In movement of troops in the theater of operations it is essential that individual and organizational equipment accompany each unit. This is best accomplished by use of type trains. Type trains are trains of a standard make-up for movement of troops and their equipment. As an example, the following types are based upon freight cars of 60,000 pounds capacity:

Type train	Box cars	Flat cars	Coaches	Cabooses
A	23	9	1	1
B	11	17	1	1

When there is an ample supply of rolling stock, type trains may be made up and held at convenient points. This permits a rapid assembly

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of trains at any time but immobilizes the equipment. Necessary storage tracks may not exist at the proper locations. Adoption of type trains is of great assistance in the assembly of rolling stock for any contemplated troop movement even if it is not feasible to keep the trains made up.

b. The train commander is responsible for the control and discipline of troops on trains but has no authority over the train crew or the operation of the train except during tactical emergencies. The train conductor advises him of the place and probable duration of stops and assists him with any pertinent information that will add to the comfort of the troops.

17. Armored trains.—*a.* Armored trains may be used for patrolling track in open country in hostile territory when depredations may be expected on the part of small units of the enemy. They are highly vulnerable as they cannot be expected to withstand any fire heavier than machine-gun fire, and their mobility is limited wholly by existing track. Their use interferes with traffic and in event they are disabled or cut off, the line is blocked.

b. Armored trains are attached to armies or sections of the communications zone and operate under orders of the appropriate military commander. The officer in command of the train is in command of the garrison and directs movements of the train in combat. As the operation of an armored train is quite different from that of other trains, the military railway service will assign a specially selected train crew.

18. Facilities.—*a.* Construction of new main track in the theater of operations is unusual. Existing trackage and facilities are utilized and exploited to the fullest extent, but it will be found that new facilities must be provided and existing facilities adjusted to meet the conditions of war. These facilities will include yards, sidetracks, fuel and water stations, signal systems, including telephone and telegraph lines, and engine houses.

b. As the army advances, captured enemy lines will be reconstructed as required. Availability for immediate service rather than performance is the controlling factor in the type and character of construction.

c. The following general regulations will govern in construction or rehabilitation of facilities in the theater of operations:

(1) *Yards and sidetracks.*—Care must be exercised in the location and plan of lay-outs to secure facilities required by existing military operations and future needs. In their construction necessity governs. Ballasting is used only when without it tracks will not carry rolling

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stock. General track surface should be good enough to meet immediate requirements and improved as needed.

(2) *Water and fuel stations.*—Water and fuel stations in the theater of operations will consist of any suitable facilities available or that can be adapted or improvised.

(3) *Signals, telephone and telegraph.*—The signal system on new or rehabilitated lines will be of the simplest kind. Automatic block signals and interlocked switches may be used and maintained when already existent. A crossing may be protected by a manually operated gate, and a telegraph office provided with a manually operated board or flag. Train dispatchment is preferably accomplished by telephone on account of its simplicity and the fact that trained operators are not required at outlying stations. Dispatchment by telephone has the added advantage that by equipping isolated sidings with a telephone box for use of train crews, movement of trains frequently is facilitated in emergencies. When existing telegraph lines are taken over wholly for military use, it is of advantage to convert them to telephone lines if it is expected to use them for any considerable time. Wire circuits are constructed and maintained by the Signal Corps except when used exclusively by the Military Railway Service, when maintenance is taken over by engineer railway units.

(4) *Engine houses.*—The roundhouse with its usual adjunct, the turntable, is to be avoided in any area subject to bombardment by enemy aircraft on account of its easy recognition from the air. New engine houses should be simple rectangular frame structures without complicated doors or windows, and provision should be made for turning locomotives on wyes or loops. In cases in which a roundhouse and turntable is part of existing facilities taken over for military use, precautionary measures should be taken to insure that engines will not be cut off and rendered useless in case the turntable is disabled.

19. Personnel.—Personnel assigned to railway organizations should be selected from among those who have had similar experience in operation of railways in civil life. (See pertinent T/O 5-series and TM 5–405 and TM 5–410.)

20. Forms, reports, and statistics.—Forms and reports will be kept at a minimum and no reports will be required that are not necessary for the satisfactory operation of railways. Reports will normally be confined to—

a. Operations.—(1) Train operation.

(2) Car.

(3) Waybill and transportation request.

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b. Equipment.—(1) Individual equipment.
(2) Bad order equipment.
(3) Shop.
(4) Material and requisitions.
c. Maintenance of way.—(1) Work.
(2) Water station.
(3) Material and requisitions.
(4) Track charts and maps.

In general, some of the forms and reports used on commercial railways can be adapted to requirements in the theater of operations.

SECTION III

INLAND WATERWAYS

	Paragraph
Purpose	21
Employment	22
Advantages and disadvantages	23
Plans for operation	24
Reconnaissance of streams and channels	25
Relation to other arms and services	26
Organization	27
Personnel	28
Craft and floating plant	29
Fuel and water supply	30
Landing and shore facilities	31
Signal communication	32
Traffic control	33
Night navigation	34
Operations in captured territory	35
Commercial lines and facilities	36
Records and reports	37

21. Purpose.—This section is intended as a guide in the organization and operation of an inland waterway service either in the theater of operations or the zone of the interior. No rules applicable to all situations can be formulated. Nature of water routes to be utilized, distance supplies are to be transported, quantity and kinds of supplies, and military situation will determine the most effective form of organization and plan of operation.

22. Employment.—Inland waterways whenever available should be utilized as far as practicable to supplement and relieve the load on railways and highways.

23. Advantages and disadvantages.—Advantages and disadvantages of inland water transport are—

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a. Advantages.—(1) Navigable channels in the region to be penetrated may provide a route of communication capable of being put in operation in less time than would be required to construct a highway or to build and equip a railroad.

(2) Water transport equipment generally has a greater capacity for carrying troops or matériel than has rail or highway equipment.

(3) Although water routes are susceptible to being blocked and rendered temporarily useless, complete destruction of a waterway is usually impracticable.

b. Disadvantages.—(1) Water transport is slower than other methods of mechanical transport.

(2) Water routes are subject to interruption by ice in cold climates, and their capacity may be affected by floods and droughts.

(3) Transportation to destination usually requires transfer from water carrier to some other means of transportation and may require such transfer twice, once at each end of the water route.

(4) Traffic may be blocked in narrow channels by sinking of vessels by the enemy or by accident.

24. Plans for operation.—*a.* The first step necessary after decision has been made to operate an inland waterway service is the formulation of an operation plan. In drawing up such a plan, consideration must be given to—

(1) Purpose and role.
(2) Region to be served.
(3) Water routes available.
(4) Existing commercial water transport lines.
(5) Length of haul.
(6) Probable tonnage to be moved.
(7) Kind of freight to be moved.
(8) Craft available, both cargo and towing.
(9) Railway and highway connections.
(10) Transfer facilities from or to rail or highway.
(11) Existing shore facilities such as wharves, docks, warehouses, quarters, etc.
(12) Probable duration and growth of traffic.

b. Commercial lines and existing shore facilities are utilized to the fullest extent possible. Provision is made for the acquisition or construction of additional craft and equipment to replace losses and provide for growth.

c. If the military importance of water transport is great, plans are made for the ultimate expansion expected with ample craft and all the shore facilities that the situation demands. Locations are selected for

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depots, terminals, landings, repair yards, transfer points, navigation heads, and controlling and subordinate headquarters.

25. Reconnaissance of streams and channels.—Unless reliable information regarding physical characteristics of waterways to be utilized is available, a detailed reconnaissance is made to obtain information regarding—

a. Ruling navigable depths and widths at high, low, and ordinary stages.

b. Frequency of occurrence of ice, floods, and extremely low stages, and their effects upon navigation.

c. Swift currents, obstructing bars, narrow reaches, and any unusual conditions affecting navigation.

d. If there are locks, chamber dimensions and depth over upper and lower miter sills, and time required for passing vessels.

e. Vertical and horizontal clearances at bridges.

f. Range of tides and limits of salt and brackish water on waterways near the sea.

g. Connections with railways near the water routes.

h. Existing terminals, wharves, landings, and cargo handling and storage facilities.

26. Relation to other arms and services.—The Inland Waterway Service (IWS) bears the same relation to the other arms and services as does the Military Railway Service. Its function is that of a general carrier.

27. Organization.—*a.* Organization of the Inland Waterway Service is in accordance with the principles governing military railway organization (see fig. 2).

b. The manager, Inland Waterway Service, reports to the engineer, communications zone, and is in charge of all operations and maintenance of the Inland Waterway Service. The manager, Inland Waterway Service, is assisted by a staff comprising superintendents of operation, channels and structures, equipment, and stores. These staff officers are heads of their respective departments, and each has technical supervision over activities of his department in subordinate units (see T/O 5-603).

c. In the operation of a large system, it usually will be necessary to subdivide water routes for effective control and supervision as is done in operation of railways. This is especially necessary if long and widely separated waterways are utilized. Each of these subdivisions of a waterway system adapted to control of a single superintendent is designated a *waterway division* by analogy with nomen-

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clature used by railways. Similarly a group of divisions supervised by a general superintendent is designated a *waterway grand division.* Lengths of divisions and grand divisions will vary more than on railways, and will depend upon the relative geographical position of the waterways utilized, their characteristics, length, importance, amount of traffic, ports, means available for supervision, and the military situation. Figure 1 shows such a subdivision of an area served by waterways.

d. Plans for construction of inland waterway facilities are prepared by the chief engineer, GHQ, under direction of the commanding general, theater of operations. Detailed plans to meet operating requirements of the Inland Waterway Service are prepared by the construction division, engineer headquarters, communications zone, which is charged with construction of inland waterway facilities in the theater of operations.

e. Supplies for operation, maintenance, and construction of inland waterways are procured through the supply and finance section of engineer headquarters, communications zone.

f. On account of widely varying characteristics of inland waterways and of the craft suited to their efficient use, no Tables of Organization are provided for inland waterway engineer troops other than T/O 5–603. Upon recommendation of the manager, Inland Waterway Service, through the engineer, communications zone, the commanding general, theater of operations, prescribes the troop units to be organized for this service and allots an appropriate number of noncommissioned grades and enlisted specialists to such units. Such units usually will consist of battalions of three lettered companies each, duties of the three companies being, respectively, transportation, channel maintenance, and maintenance of equipment. One such battalion is organized for each division, and additional special troops where necessary.

g. If commercial navigation companies furnish all boats, shore facilities, crews, and attendant personnel, military personnel required is only that necessary for control, liaison with the arms and services, and for keeping accounts and records. Their functions are then similar to those of railway traffic officers (see par. 14*a*(3)).

28. Personnel.—*a.* In the selection and assignment of personnel for military units for inland waterway operations, care is exercised to make the fullest use of men experienced along similar lines. Less experienced men are placed in positions in which they may receive maximum training in minimum time.

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b. It is advisable to employ local pilots although the boat crews may be made up of military personnel.

29. Craft and floating plant.—In order to put an inland waterway system promptly into operation, craft must be secured from streams to be utilized or from adjacent streams. In the design and construction of additional craft, caution should be exercised in adopting any feature of design involving departure from local types already in use.

30. Fuel and water supply.—*a.* Where fuel cannot be obtained in required quantities from civilian sources on the route, refueling points must be established as needed. These points should be provided with the best obtainable facilities for storage, and with such equipment for quick delivery to boats as can be secured. Fuel, both coal and oil, may sometimes be stored more advantageously in barges afloat than in yards on shore. Under such circumstances selection of fueling points must be considered from the standpoint of fuel capacity and consumption of vessels, facilities for shipment from depot, and mooring facilities for craft.

b. On routes near the sea where the water is salt or brackish, fresh water supply points must be provided if steam is used for power. Water supply points are operated most conveniently in connection with refueling points.

31. Landing and shore facilities.—*a.* Wharves and docks will be needed at all ports or points at which a considerable amount of freight will be exchanged between shore and vessels. Use should be made of existing wharves and docks whenever possible. In locating new landings soundings should be taken to insure that sufficient depth extends from the navigation channel to the proposed landing. When the location of a landing adjacent to shallow water is unavoidable, an approach channel of required depth must be dredged from the main navigation channel to the landing. Wooden piling surmounted by timber framing ordinarily is the best type of construction on account of speed of construction and availability of material.

b. Other facilities needed at important ports are railroad and highway connections, warehouses, loading platforms, and space for outdoor storage. Original installation should be so planned as to permit expansion when necessary.

32. Signal communication.—*a.* Efficient operation of an inland waterway system will require telephone, telegraph, or radio communication between all ports, yards, and headquarters of the system. Vessels of the service should be equipped with radiotelephones. Established commercial or military telephone and telegraph lines should

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be utilized whenever possible. If no lines exist or if existing lines are inadequate, consideration should be given to construction of lines paralleling water routes.

b. Construction of telephone and telegraph lines is a function of the Signal Corps, but the operation and maintenance of lines assigned solely for use of the Inland Waterway Service are duties of the service.

33. Traffic control.—*a.* Boats and barges may be dispatched on schedule or be dispatched as soon as towboats are available after completion of loading.

b. All equipment should be unloaded within a stated time after arrival at destination, and reports of unnecessary delays brought to the attention of the proper military authorities.

c. The officer in charge of a division will be responsible for the prompt movement or other handling of all craft entering his division.

d. Approximate position of each boat on the water route and its status as to loading always must be known to the division and higher headquarters of the service. This is accomplished by telephonic and telegraphic reports from various ports and activities on the route. A control board showing these positions will be found useful at headquarters.

34. Night navigation.—Continuous operation 24 hours per day is the rule wherever channel conditions permit, thereby expediting deliveries as well as increasing tonnage capacity of the waterway.

35. Operations in captured territory.—Upon taking over waterways in territory abandoned by the enemy, channels should be swept for removal of mines and obstacles placed by the enemy to impede and damage navigation.

36. Commercial lines and facilities.—*a.* Existing commercial lines and facilities on the water route should be utilized to the fullest extent. If a line has been functioning satisfactorily, it should be permitted to continue to operate as a carrier, goods being turned over to it for transport as is done in civil practice. Priorities are controlled as in the case of joint operation of railways. If one or more commercial lines are capable of carrying the entire tonnage to be transported, no additional craft operated by military agencies ordinarily will be needed.

b. Should commercial lines not be able to handle the entire tonnage or cover the entire distance, a service consisting of both commercial lines and military carriers may be necessary. In the organization of a system of inland water transport, utilization of existing lines, craft, and facilities is the only means of putting a system into immediate operation, and although this equipment may not be sufficient to carry

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the tonnage to be transported ultimately, if offers a nucleus which may be expanded to meet requirements.

37. Records and reports.—The following list of reports is intended as a guide to be used in this service:

a. Loading and discharging from each port, daily.
b. Vessels under repair.
c. Delays and accidents.
d. Vessel movements.
e. Storage.

[A. G. 062.11 (7–29–40).]

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

E. S. ADAMS,
Major General,
The Adjutant General.

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