FM 4-01.41 (FM 55-20)

ARMY RAIL OPERATIONS

DECEMBER 2003

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HEADQUARTERS
DEPARTMENT OF THE ARMY

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Field Manual
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HEADQUARTERS
DEPARTMENT OF THE ARMY
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PREFACE

This manual describes the organizations, processes, procedures, and systems involved in the rail operations across the military spectrum. The focus of this manual is for the reader to gain an understanding of the Army rail system and how it functions. Rail transport operations in developed nations are considered to be a HN-provided service. In contingency areas, US rail units may have to be employed to support the theater of operations. This FM sets forth transportation rail doctrine and organizational structure. It is written to explain the functions of rail transport operations service in a theater of operations. It provides basic information for commanders and staffs of supporting units and for staff officers of higher HQ. It is also intended to serve as a text for student instruction and training of rail unit personnel.

This manual remains consistent with Army operations, logistics doctrine, and concepts currently published or in the process of being published. However, the reader is cautioned that logistics doctrine is changing — and changing rapidly. The on-going efforts to reduce the Army logistics footprint and move to the Objective Force will require doctrinal change. Users acting within the scope of their authority may vary from this doctrine in this manual when such variation will result in improved operations.

The Army's environmental strategy into the 21st century defines its philosophy and commitment in protecting and preserving the environment and natural resources for present and future generations. Sound environmental practices and considerations must be integrated into all Army documents, missions, and operations. In keeping with the Army's vision to be a national leader in environmental stewardship, commanders and leaders must ensure that all local, state, federal, and host nation laws and regulations pertaining to the environment are included in the planning process and followed to an extent consistent with operational considerations.

The proponent of this publication is the United States Army Combined Arms Support Command (CASCOM). Send comments and recommendations on Department of the Army (DA) Form 2028 to Commander, US Army Combined Arms Support Command and Fort Lee, ATTN: ATCL-T, Fort Lee, Virginia, 23801.

Unless this publication states otherwise, masculine nouns and pronouns do not refer exclusively to men.

Chapter 1

Rail Transport Operations

There are four primary functions of rail transport operations for military and commercial railways. These functions include the following:

- Train operation.
- Maintenance of way.
- Maintenance of equipment.
- Train Control.

OPERATIONS

1-1. NATO and US war plans involves extensive rail use. Rail transport operations in Europe is a HN-provided service.

RAILWAY SERVICE IN THE THEATER

1-2. Each potential HN in NATO (with emphasis on Germany, the Netherlands, Belgium, and France) operates a sophisticated, modern railway system. The western area of Europe offers multiple routing possibilities, plenty of marshaling yards, and discharge/loading terminals. Rail line repair and equipment maintenance facilities are dispersed throughout the system. The European railway system poses the following potential limiting factors:

- Primary dependence on electrified train operations.
- Civilian dependence on uninterrupted rail support.
- Improbability of civilian rail personnel being used in the CZ (corps and division).

1-3. Personnel should consult and comply with AMovP2 before moving trains across NATO borders. The Army uses the area's existing rail structure as much as possible to support the TA. The following provides the support needed to operate the rail system without extensive rail construction or major engineer reconstruction.

- Existing tracks.
- Locomotives and rolling stock
- Switching modes.
- Marshalling yards.

Extensive rail construction is beyond the capabilities of a military force, except during a prolonged war when a civilian work force would be employed to operate the railroad.

1-4. In the past, US Army transportation railway brigades, groups, battalions, and so forth; operated the theater rail system. Rail units now supplement existing HN rail systems or control and operate a

contingency area's rail system. In some cases, the service organization is much smaller than was needed in the past.

ESTABLISHMENT OF RAIL OPERATIONS

1-5. There are many similarities between military and commercial railways. Military railroads operate on the same basic principles as commercial railroads. These principles are:

- Locomotives pull railcars loaded with freight and passengers over miles of track.
- Train movements are controlled by schedule or signal communication.
- Some trains have superiority over others.

1-6. Rail operations in a theater may consist of a broad initial or preinvasion plan based on limited available intelligence data. As more detailed data becomes available, the initial plan is modified. Initial or preinvasion planning provides general estimates of the potential movement capability of a particular railway system in the theater.

PHASES OF OPERATION

1-7. Military railway operations are accomplished in three phases. These phases are normally conducted in sequence. However, depending on military requirements, a phase II or phase III operation may be initiated without progression through the preceding phases or regress to a previous phase. These phases aim to reduce requirements for military units and personnel for railway operations. Therefore, skilled local labor and HNS is a prime consideration in initiating phase II and phase III operations. In discussing these phases, the terms "civilian labor" and "host nation support" are not synonymous terms, as HNS can be other than civilian labor.

Phase I

1-8. Only military personnel conduct phase I operations. Personnel use this phase during the early stages of a military operation. Phase I is used in or near the CZ where there is a need for the military and where security restricts the employment of civilians.

Phase II

1-9. This phase is a joint civilian-military operation under direct military supervision. In this phase, military and local civilian railway personnel operate and maintain the railway lines.

Phase III

1-10. A phase III operation is normally used in the rear areas of the COMMZ. Local civilian railway personnel operate and maintain rail lines under the direction and supervision of the highest military railway echelon in the theater. The operation is established as soon as practical. Under this operation, military railway personnel may be released for duty in more critical areas.

METHODS OF OPERATION

1-11. Existing railway facilities support military operations in a theater. Communications and railway signal facilities may be damaged, destroyed, or inoperative. This may include any form of centralized traffic control, electrically-operated interlocking plants, and automatic block signal systems. Rail transport operations uses the following four methods of train operations in a theater.

Fleet Operation

1-12. This operation (Figure 1-1) is an emergency measure and is discontinued as soon as possible because it limits railway capacity. Upon entry into a theater, communications may not exist. There may be only a single stretch of track with no sidings or passing tracks. Loaded trains are run forward until the tracks at the railhead are full. Trains are then unloaded and returned to the port or point of origin. Grouped trains also make good targets for the enemy.

Block Operation

1-13. This operation (Figure 1-2) permits the train to operate from one block to the next in a station. The train operates from one block station to another under authority of the train-movement operator or station agent. The two types of block operations used are positive and permissive.

Positive Block Operation

1-14. In this operation, the use of the block is limited to one train at a time. The train can stop if it is attacked or if the line is obstructed. It can also back up to the last station passed or to a safe place and wait until the track is secure before proceeding. This operation has definite security advantages, but the permissive operation is more efficient.

Permissive Block Operation

1-15. In this operation, more than one train is moving in the same direction. Therefore, the trains may occupy the same block at the same time.

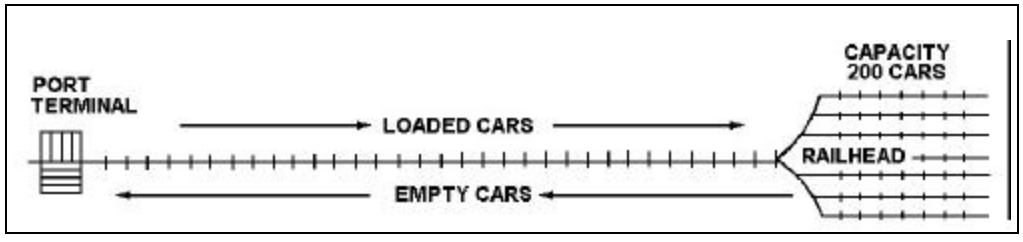


Figure 1-1. Fleet Operation

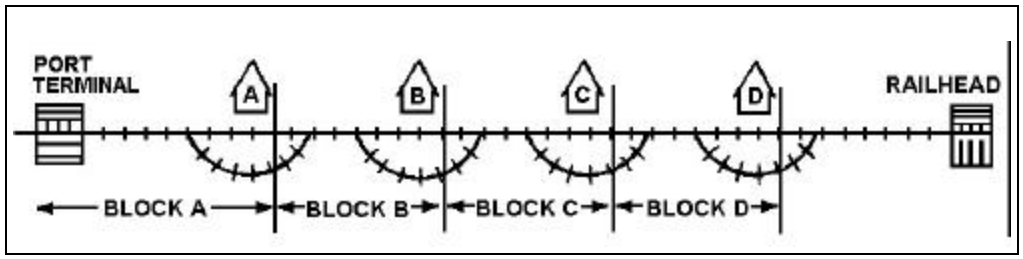


Figure 1-2. Block Operation

TRAIN ORDER OPERATION

1-16. During this operation, the communications system must be adequate and dependable. Sufficient sidings and passing tracks must also be available. The dispatcher issues train orders and controls movement. A train order remains in effect until it is fulfilled, superseded, or annulled. A train order authorizes movement of trains when not provided for by timetable. Chapter 4 describes a train order operation.

Timetable Operation

1-17. Use the timetable operation in the theater when traffic is stabilized. The timetable contains schedules and special instructions relating to train operation. It is also the authority for movement of trains. Since military train operations usually consist of extra trains not shown in the timetable, use the train order operation in conjunction with a timetable for maximum effect. See Chapter 4 for more discussion on timetable operation.

Note: The four methods of train operation are generally used in the order discussed and progress to the more flexible and precise timetable operation in stabilized rear areas.

USE OF EXISTING FACILITIES

1-18. Use existing tracks and facilities as much as possible as the theater of operations expands. Captured track is rehabilitated as needed. If possible, avoid new track construction because of the manpower required. However, when new construction would take less time and manpower than rehabilitation, it may be advisable to construct new track and facilities. You can use panel track for quick repairs and new construction in the theater. They can be built ahead of time and stored until needed. The following are those facilities that may require rehabilitation or new construction.

Main Lines, Yards, and Sidings

1-19. When new construction is required, plans for the location and layout of tracks should consider current and future requirements. For rehabilitation, the general track surface must be good enough to meet immediate requirements. Track improvement is undertaken only as necessary to meet minimum requirements for safe operation.

Service Facilities

1-20. Adequate service facilities (for example fuel, sand, and water servicing facilities) are of vital importance in railway operations. Normally, railway cars spend over half of their useful life in terminals. If proper facilities do not exist or are not fully used, congestion can occur.

Signal Systems

1-21. On newly constructed or rehabilitated lines, signals of the simplest kind are installed. Automatic block signals and interlocking switches are maintained and used only if they exist. If used, they require tight security since they are highly vulnerable to sabotage.

Telephone and Telegraph Lines

1-22. The most dependable and fastest method of dispatching trains is by telephone. Existing telegraph lines are easily converted for telephone operations. If sidings are equipped with telephone boxes, train crews help the train dispatcher to move trains in emergencies.

Enginehouses

1-23. Roundhouses and turntables are easily recognizable from the air. In an area subject to enemy attack, enginehouse facilities may have to be avoided. If roundhouses and turntables do exist, precautions should be taken to ensure that locomotives would not become useless if the facilities were disabled. Newly constructed enginehouses should be simple frame structures without complicated windows and doors.

RESPONSIBILITIES

1-24. Rail units are responsible for the security of railway installations, equipment, and rail shipments. Security measures of railway installations, equipment, and rail shipments at all levels of rail transport operations are command responsibilities. However, commanders of rail units do not have adequate organic personnel to provide necessary active security along rail lines or to guard bridges, tunnels, yards, and so forth without hampering the primary rail mission of maintaining and operating a military railroad.

SECURITY

1-25. Commanders must take all active and passive security measures that are within their capabilities. Commanders of rail units must then cooperate and coordinate with area commanders and local security agencies to the maximum extent consistent with performance of the rail mission.

BATTLEFIELD SECURITY

1-26. Army operations will be fought deep, close-in, and in the rear. The enemy will attack on the entire depth and width of the battlefield to obtain victory. These attacks will introduce threat forces with tremendous destructive capabilities in a rear battlefield composed mostly of CS and CSS units.

Main targets for enemy forces are the rail lines and facilities. Units must protect against attempts to disrupt their operations. Since supporting combat operations is the primary requirement for all CSS operations, units must not divert assets to security and defense that would significantly reduce their support capability.

Enemy Detection

1-27. Detecting the enemy is the responsibility of every soldier in the rear area. Detection is achieved by observation, reconnaissance, and surveillance. It is performed during all weather and light conditions and on any terrain throughout the rear area. Report any unusual or suspected activity. Use active and passive measures to stop the enemy. Detection efforts include the following:

- Use of day and night observation devices.
- Communications and intelligence.
- Radar.
- Remote sensor.
- Chemical and radiological detection equipment.

These efforts provide early warning of enemy infiltration attempts or the use of chemical or nuclear weapons. They also aid in preventing reactions to false alarms (such as movements by friendly persons, defectors, or refugees).

Train Security

1-28. You may use armored trains to patrol track where sabotage is expected. Locomotives are preceded by two or more cars loaded with sandbags or hard-packed dirt for protection against mines and obstructions. On a single-tracked rail division subject to attack, employ the positive block method of operation. This method allows the train to move forward or backward if the track is blocked. If the train is unable to move or complete its mission, the escort commander must defend the train with all available personnel. If there is no escort, the senior occupant (who is appointed before departure) must defend the train.

Shipment Security

1-29. The consignor (shipper) must ensure that carload freight is secure until the car is coupled to a locomotive and leaving the loading site. Personnel must inform shippers of their responsibilities. Before loading a car, the shipper should thoroughly inspect it to see that it meets security requirements. The shipper must properly stow and brace the load and close and seal boxcars and closed cars. Improperly braced or stowed loads are susceptible to damage by train movement and pilferage. For best protection when sealing closed cars, the shipper will tightly twist 10-inch lengths of number 8- or 10-gauge wire through the locking eyes and closely snub off the wire ends. Numbered seals add no additional protection, but do indicate tampering if broken. Use securely fastened tarpaulins to cover shipments in open-top cars when protection is required. Small items shipped on flatcars should be securely fastened to the car deck. Personnel will inspect open-top carloads before movement to ensure that they are properly loaded and that the loads meet clearance requirements.

1-30. Personnel are responsible for security of shipments from point of origin to destination consignee delivery. Personnel must document rail shipments to effect prompt movement and prevent cars from going astray. When operationally feasible, group cars containing security shipments or freight (subject to pilferage) together in trains and/or yards to reduce the number of guard personnel required. Yardmasters and chief dispatchers must coordinate with yard or train crews when the escort or guard personnel ride in or on cars containing sensitive material. Guard crews check car seals or door fastenings at every stop. They must also keep a trip record (by car number and lading) of all cars guarded. They should record deficiencies or events that occur en route. Relief guards take over and sign this record, which also serves as a delivery receipt. The trip record is transmitted through MP channels to the unit at the end of the trip or when the record is completed. When a car containing critical or pilferable supplies is set off en route, one or more of the train guard crew must be detailed to remain with the car. MP units will provide proper security for freight in transit. Based on assets available, MP units may provide security for freight in railway yards.

1-31. Consignees assume responsibility for the security of loaded freight cars at the time they are placed at the designated depot or other unloading track. Unload cars as quickly as possible to reduce the chance of pilferage. Use care when removing wire or seals from closed cars to avoid breaking the car door latches.

COMMUNICATIONS AND AUTOMATIC DATA PROCESSING

1-32. The TA is responsible for reconstruction and rehabilitation of railway communications landlines. Use cable as the primary means of communication for train operations. However, you may use a radio as a backup or as a primary means of communication when construction and/or rehabilitation of landlines are not feasible. Rail units must perform the following:

- Operate and maintain railway communications circuits used only for operation and administration of the transportation railway system. Rail units are not responsible for maintenance of ADP equipment.
- Install organizational communications (such as local switchboards, telephones, radios, and teletypewriters in yards, way stations, shops, and dispatch offices) for normal administrative and operational communications.

The transportation railway battalion installs, operates, and maintains organizational communications for administrative use.

Wire Communications System

1-33. The railway battalion uses wire facilities as one of its primary means of communication to dispatch trains in a theater of operations. The following are the three communication circuits provided for operations within each railway division.

- Dispatcher's circuit.
- Message circuit (station-to-station circuit).
- Teletypewriter circuit.

Dispatcher's Circuit

1-34. Use this exclusively to control train movements by train order and to control trains through towermen and station agents within a division. The division dispatcher may call each way station independently or all stations simultaneously. The division dispatcher monitors the line at all times. Way station personnel may talk to the dispatcher on this circuit without signaling.

Message Circuit (Station-to-Station Circuit)

1-35. Use this with the block system operation within a division. Also use this for the following:

- Operational supervision and control.
- Daily and special reports.
- Car distribution.
- Distribution of movement orders to operating personnel.
- Operational matters between stations.

Way stations are connected to each other and to the division dispatcher. Any station may contact another station through code signaling.

Teletypewriter Circuit

1-36. This joins a division dispatcher with the adjacent division dispatcher. Use this for written transmission of train consists, operational orders, movement programs, general instructions, and miscellaneous messages. This circuit may be superimposed upon the message circuit.

Radio Communications

1-37. Mobile and fixed radio communications increase efficiency, control, coordination, and safety of train movements. Radio equipment is organic to railway operating units and its use is a normal part of rail operations. Use radio communications in yards, main track, and other operations. As an insecure means of communication, radio is subject to exploitation by hostile communications intelligence and EW activities. Radio communications in yard operations have the following advantages:

- Yard crews can notify the yardmaster when assignments are complete and immediately receive new assignments.
- Delays at the interlocking plant can be eliminated by knowledge of train location.
- Special movements (such as hospital trains) can be expedited.
- Delays caused by derailment or damage to cars or cargo can be reported immediately.
- Arrival time can be determined more accurately through communication with incoming trains.
- Changes in train movements or orders can be rapidly dispersed.

1-38. Radio communication equipment mounted in road engines and in way stations extends communications from the way station to the moving train. This is not intended to take the place of

any communications systems for which C-E units are responsible on a planned project basis. Main track radio communications furnish contact between trains and the dispatcher, between trains and way stations, and between stations. Using this equipment has the following advantages:

- The train engineer, in an emergency, can call the way station operator. If the train has to stop, other trains within range of the radio frequency can be advised to take necessary precautions.
- Train speeds can be regulated to ensure proper meetings at passing points.
- Derailments can be reported immediately and repair crews can be quickly dispatched.
- Crossing accidents can be reported and MP and medical assistance can be expedited.
- Train crews, to reduce time at stops, can request fuel or other supplies before arrival.
- The train engineer can be informed of the condition of the tracks as a result of snow and rock slides, flash floods, and bridge washouts.
- Train crews can promptly report guerrilla operations, sabotage attempts, and air attacks.

Automatic Data Processing System

1-39. If an ADP system is to be used in a theater, and if the system is available, it will be employed by the railway service. The type of ADP system used is of small importance to the railway operators, as long as it is responsive to the railroad's needs. However, the communications system must be able to provide uninterrupted service 24 hours a day. The failure of the communications system to provide this service will completely destroy its value for railway operations.

Chapter 2

Railway Train Operations

There are many hazards that exist during railway train operations. The following have always been hazards of railway operations:

- Human errors.
- Recklessness.
- Mechanical failures.
- Collisions.
- Wrecks.

OPERATING AND SAFETY RULES

2-1. The design of operating rules to prevent these hazards has been formulated gradually. There are now rules to cover all situations, which conceivably present a potential accident hazard. These rules, published in the "Standard Code" by the Association of American Railroads, are the basis for nearly all railroad rules currently used in the US. Many railroads have altered the rules slightly or dropped those that do not apply to them due to local conditions and types of operations. However, the rule numbers have not changed. For instance, Rule 99 means the same thing to railroaders in California as to those in Connecticut. All railroads have also developed safety rules. While safety rules do not have the general uniformity of operating rules, they are similar in that they prohibit dangerous practices and prescribe safety procedures. See FM 55-21 for detailed explanations of these rules.

OPERATING RULES

2-2. Train operations are governed by current railway operating rules adapted from the Standard Code of Train Rules issued by the Association of American Railroads. These rules are modified to meet military railway requirements and are published in FM 55-21. The battalion commander must ensure that all operating personnel have a copy of the timetable and be familiar with the operating rules. Periodic examinations are given to ensure that personnel completely understand the rules. Personnel must always obey operating and safety rules.

2-3. Do not randomly use vehicles equipped with road-rail devices on railroad tracks or without proper authority from the train dispatcher. When a vehicle equipped with a conversion device operates on the tracks of a railroad that is under the supervision of the rail unit, it constitutes a train and must be considered as such. Operate such a vehicle according to FM 55-21.

SAFETY RULES

2-4. Railway shops, yards, and trains have always been places of potential personal injury and property damage. Safety rules simply requires applying common sense precautions when performing duties in hazardous surroundings.

Safety Conditions

2-5. The following are only a few of the changes that has eliminated many conditions that once caused injury and death on the railroad:

- Automatic couplers.
- Electric signals.
- Rolling-stock improvements (steps, grab irons, running boards, and so forth).
- Use of diesel motive power instead of steam.

On many foreign railroads, safety conditions and safety devices vary considerably from the standards of US railroads. In many foreign countries there is not enough clearance on bridges, buildings, tunnels, and overhead lines and obstructions for personnel riding the tops and sides of cars. There is also a lack of uniformity in the safety devices (such as the number and location of grab irons, ladders, sill steps, braking devices, and couplers). These conditions require a constant watch by rail personnel unaccustomed to them.

Accidents

2-6. Many accidents are caused by people from outside agencies who have not had the safety training given to rail personnel and/or who ignore posted warnings and all rules of common sense. Some common examples of accidents are those resulting from the following:

- Other agencies mishandling dangerous articles into and out of cars on railroad premises.
- Improper loading of dangerous material.
- Vehicles loaded with explosives.
- Flammables crashing into locomotives and trains at crossings.

Extensive safety campaigns, safety rules, and supervisory discipline have helped. However, the human factor still remains and injuries and deaths do occur.

Warning Signs

2-7. The design of warning signs and labels is to prevent accidents. Railway personnel must think and live safety. Applicable safety rules are in FM 55-21. Members of rail units must know and obey these rules. Supplementary instructions are issued for unusual situations as required. SAFETY IS EVERYONE'S RESPONSIBILITY–ALL THE TIME.

COMMUNICATIONS SYSTEM

2-8. The railway communications system consists of two major parts. The first part is for the efficient operation of the railways. The second part is for routine administration, communication, and logistical purposes. The second part is connected to all rail units, including transportation railway operating battalions and lateral and higher HQ. The rail communications system normally consists of two pairs of open wire pole lines for telephone and teletype circuits. You may use radio relays (see paragraph 2-13) before wire lines are rehabilitated or established in an oversea theater of operation.

Train Dispatcher's Circuit

2-9. The train dispatcher, station operators, and tower men, mainly use this circuit. Its use is for the control of trains by train order, block signals, and special instructions issued by the train dispatcher. A terminal operator not only controls trains entering the terminal from his own division, but he also receives and releases trains to the adjacent dispatcher in the connecting division. He also coordinates all train movement responsibilities between connecting divisions for the dispatcher concerned. The train dispatching circuit has a selective ringing device that permits the dispatcher to call stations separately or simultaneously. The train dispatcher is responsible for strict wire discipline and issues orders and instructions in compliance with the rules for movement of trains by train order (see FM 55-21).

Station-to-Station Circuit

2-10. Use this circuit to distribute general information, reports, and records needed for efficient operation. Information obtained must implement orders or instructions issued by the train dispatcher.

Teletypewriter Circuit

2-11. This simplex circuit connects the battalion with adjacent battalions and higher HQ. The circuit transmits operating policies and directives to coordinate the movement of troop, hospital, and VIP trains. It is used at the battalion level to transmit routine matters to higher HQ.

Pole and Line Maintenance

2-12. Planned and continuous preventive maintenance prevents frequent service interruptions (particularly after heavy storms and in areas subject to enemy action or sabotage). Regular patrols are established to detect and correct faulty conditions. The nature and frequency of inspection depend on the age and type of poles and lines and the terrain, weather, and other conditions. Regular inspections can normally be made from the ground. However, pole-top inspections should be made often at points in the line where defects are most likely to develop. Inspection crews are equipped with tools and equipment for making minor repairs and for trimming small branches and vegetation. Unsatisfactory poles, crossarms, and so forth should be replaced.

Radio Communications

2-13. The rail unit may need radio communications during the early stages of an operation. Communications may be required when wire lines are cut down, destroyed, or nonexistent. They are also required when rebuilding or building does not keep pace with the reconstruction of tracks. The communications command, TA installs unit radio-communication facilities. It also assigns call signs, radio frequencies, radio power, and type of emission to be used. Radio communication is normally established only when conditions warrant its use, when wire lines are not available, and when the appropriate commander approves the installation (see FM 55-21). A radio repair team is provided by the communications command, TA. The team is attached to the transportation railway battalion. The repair team supervises installation of radio equipment and maintains it while in use. Such allocation of equipment is on a "when conditions warrant, class IV" basis and is operated by railway battalion

personnel. When equipment is made available, the rail unit uses the following three general systems of radio communications.

- Train operational control, en route.
- Between dispatcher and stations.
- Between train crew members.
- Between stations.
- Between dispatcher and trains (if range is adequate).
- Between stations and trains.
- Between crews of different trains.
- Operational control in yards and terminals, yard offices, switch crews, and yard personnel.
- Administrative and technical control.
- Operating units.
- Administrative units.

OPERATION OF TRAINS

2-14. Railroad main line operations are complex. They involve the movement of freight, passenger, and mixed (freight and passenger) trains from one terminal or yard to another over a division or subdivision of track. Adding to the complexity is that rail operations are a prime target of enemy NBC weapons. Contingency plans must be developed with the capability and flexibility to continue operations in an NBC environment. Protective measures and procedures to relieve the effects of NBC weapons must be integrated into daily operations. NBC attacks will create high casualty rates and material losses, as well as contaminate terrain within the unit. Increased levels of MOPP will result in heat buildup; reduced mobility; and reduction of visual, touch, and hearing senses. Rail unit operational efficiency and productivity will be lowered.

2-15. The enemy will use contamination to cause casualties, lower performance, and restrict the use of the terrain. The enemy engages the unit with contamination, hoping that operations will either stop to decontaminate or will avoid using contaminated terrain (rail line segments) or facilities (railheads, yards and terminals, and maintenance/repair shops). If possible, bypass contaminated areas by using alternate rail routes. If train operations cannot be rerouted, operate only the least essential locomotives and railcars through the contaminated area. Cover all items on flatcars, gondolas, and open-top hopper cars with protective tarps. Use containerization to the maximum extent possible. Encapsulating and covering equipment will reduce the amount or eliminate decontamination requirements. Train personnel should be in MOPP gear and be prepared to augment inter-train communications with the use of standard rail operational hand signals. Close all doors and windows to lessen contamination. If the area is contaminated with nuclear radiation, the shielding property of the locomotive can be improved if sandbags are placed on the deck. Take immediate action to determine the type of hazard and its persistency. If the hazard is a nonpersistent blood or nerve agent, the train crew continues its mission. The hazard should disappear quickly. If the hazard is persistent (nuclear fallout, suspected biological agent, or liquid chemical agent), the train crew maintains full protection, takes action to limit further exposure to the hazard, and continues the mission. If possible, once the train is out of the contaminated area, it should be decontaminated before onward movement to prevent the spread of contamination. If hasty decontamination cannot be accomplished, train personnel will remove contamination from all equipment surfaces that must be touched often and mark each railcar with the appropriate NATO NBC marker. Perform

deliberate decontamination as soon as practical. Keep a record of each locomotive and railcar to identify the date of contamination, the type of agent, and the date and method of decontamination used. FM 3-100 has more information covering operations in an NBC environment.

2-16. Depending on the phase of operations, the trains operated by the rail unit may be extra or regular trains and may be civilian or military-controlled. A regular train is authorized by timetable while an extra train is authorized by a train order issued by authority of the chief train dispatcher. Road movements are coordinated operations with successful accomplishment depending on the following factors:

- People and facilities provided.
- Adequate functioning equipment.
- Suitable trackage.
- Competent dispatchers, maintenance personnel, and operating crews.

The requirement for adherence to special orders, rules, and other operating instructions are in FM 55-21.

TRACK FACILITIES

2-17. In railway terminology, track facilities are defined as those facilities that are required to operate railway trains at a predetermined safe speed. Track facilities include the following:

- Main tracks.
- Sidings.
- Towers.
- Signals.
- Buildings.
- Fuel/lube, sanding, and water points.
- Shops.
- Enginehouses.
- Communications system.

Main Track

2-18. The main track is a track that extends through yards and between stations. The timetable, track warrant, train order, or block signals determine its operation. A main track consists of a single track or two or more tracks on which the current of traffic may run in either direction. Figure 2-1 shows the schematic layout of a typical railway battalion's AOR. The following paragraphs discuss the three types of main track operations.

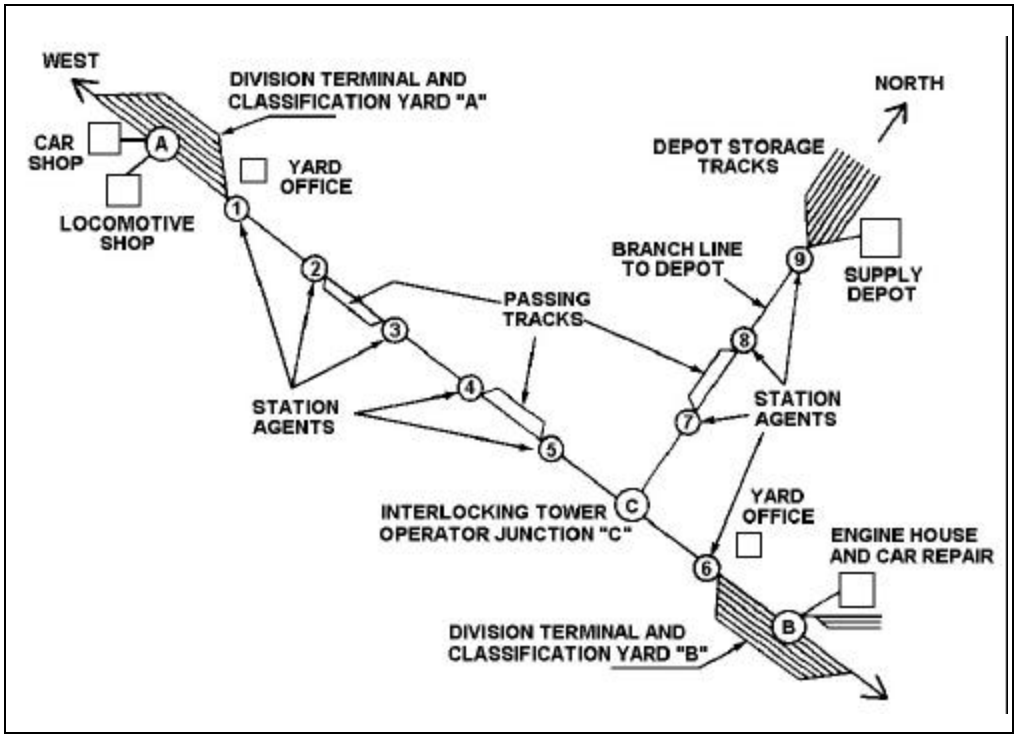


Figure 2-1. Schematic Layout of a Typical Railway Battalion's AOR

2-19. Although a single-track line permits trains to run in opposing directions, provisions for their meeting or passing must be made either by train order or timetable schedule authority. When operating on a single track by the timetable method of train operation, the inferior trains must be in the siding 10 minutes before the scheduled arriving time of the opposing superior train unless otherwise directed by train order. When a train dispatcher authorizes an extra train to run over a single-track rail line, he must make provisions for the new extra train to meet all opposing extra trains en route in the train order authorizing the new extra to run. Single-track railway operation not only requires that all operating personnel know, understand, and comply with all provisions of the operating rules, but that they also strictly comply with all train orders issued by the authority and over the signature of the chief train dispatcher.

2-20. A double-track rail operation consists of two main tracks with the flow of traffic being in the direction specified in the special instructions of the timetable. The train dispatcher has a firm base on which to control scheduled trains. The existence of a double-track rail line operated by timetable authority does not relieve the train dispatcher of the many details inherent in a single-track operation, since only first-class trains are normally listed in a timetable schedule. While the flow of traffic is specified in the timetable, facing and trailing point switches permit the dispatcher to use either track at any time to relieve congestion or interruption on one of the lines.

2-21. Multiple-track operation is found where the train density is great (near and through large transportation centers). Since movement is controlled by towers (as directed by the dispatcher) the flow of traffic is determined by the dispatcher for each train in order to provide greater movement flexibility and track use.

Siding

2-22. A siding is a track auxiliary to the main track. It is connected by switches at both ends and is used for the purpose of meeting and/or passing trains. To prevent delays when two opposing trains contain a greater number of cars than a siding can accommodate, sidings should be long enough to contain the longest train that can be run over the railway line. NEVER use a siding as a loading and/or unloading point except for a serious interruption to traffic or in an extreme emergency.

Spur

2-23. A spur is a dead-end track auxiliary to the main track. It is connected to the main track at one end and is used to load and/or unload railway equipment. Spurs used as loading and unloading points must be easily accessible to adjacent roads or highways. When two locomotives "meet" face to face, the spur provides a place for one to get out of the way. However, this operation requires train crews to be very vigilant because the train must be headed out or vice versa.

Switch

2-24. A switch consists of moveable rails which can be positioned to allow cars or trains to move from one track to another. Power-operated switches are usually found in busy terminals, at interlocking plants, and in CTC installations on the main line. Manually operated switches are normally equipped with locks for safety purposes (a switch usually is opened to the main track and closed to the spur or siding). The position of a switch is indicated by colored panels or blades by day and lights by night. The universal code has a green aspect for a closed switch and a red aspect for an open switch.

Branch Line

2-25. A branch line may be either a double- or single-track railway line connecting main lines. It may also be designed to serve relatively remote places, such as industrial plants or sparsely settled areas. Usually a branch line is constructed of lighter rail and has fewer crossties and poorer ballast than a main line. You may use branch lines during phase I operations to meet military needs until the main lines can be rehabilitated.

CAR ALLOCATION AND DISTRIBUTION

2-26. Cars are allocated for loading based on priorities set by TA and other higher HQ. Necessary rolling stock to fill requirements is authorized in the movement program. Movements not included in this program must be specifically authorized on a "spot" or immediate requirement based by appropriate rail unit or logistical command HQ.

Distribution

2-27. Furnish a copy of the program to the chief dispatcher. He directs the car distributor in issuing orders for the prompt movement of all available empty cars to the loading site or areas to meet movement requirements. For example, there may be a known and constant daily requirement for 10 tank cars to move POL from depot A, 10 boxcars for ammunition from depot B, 10 flatcars for equipment from depot C, and so forth. The car distributor issues these orders based on information

he has received from situation, current station or empty car status, train and yard reports, and reports from adjacent divisions. Yardmasters and/or station agents have switching crews place the empty cars for loading according to programmed and authorized nonprogrammed requirements.

2-28. A daily operational and movement conference makes car distribution easier for a port, depot, or other large loading point. Car distribution requirements for the next 24 hours are stated and coordinated with the movement program. The chief dispatcher is responsible for informing the operations superintendent (battalion commander) of the empty car situation and inability to meet loading requirements. In such cases, the changes in priorities are made through movement control channels.

Unauthorized Uses

2-29. Units, depots, or services must not hoard or be given cars without proper authority. Using railcars for mobile or storage keeps them out of service, upsets the flexibility of car supply, and disrupts the distribution program. Such practices result in confusion and shortage of equipment already committed for other uses. Agents, field transportation officers, yardmasters, and unit personnel must report any unauthorized use or hoarding of rail equipment to higher HQ. The report is then forwarded to the required command level for corrective action.

RECORDS AND REPORTS

2-30. Records and reports are essential in the unit. The transportation railway battalion, as the basic operating unit, reports the following information to group HQ for relay to logistical planners at all command levels.

- Total tonnages moved.
- Number of empty and loaded cars on hand at midnight.
- Number of serviceable locomotives.
- Delays and interruptions to traffic for the preceding 24 hours.
- Fuel requirements.
- Operational reports required by higher HQ and transportation movement control agencies for daily planning.

The records and reports discussed in this section are typical of those pertaining to the administration, maintenance, and operation of military railways. Space limitations preclude full discussion of all forms used by the unit. Unnecessary paperwork and the accumulation of voluminous reports should be avoided.

Preparation, Forwarding, and Retention

2-31. Reports are prepared, forwarded, and/or retained according to the SOP of the next highest echelon of command requiring the information. At each echelon, reports are reviewed, information extracted, and consolidated reports prepared and forwarded to the next higher HQ. Reports are forwarded (as applicable) by telephone, teletype, mail, or messenger service. Reports and records prepared or received, particularly those containing personnel and statistical information, are considered as permanent unit records. These records are filed, maintained, and disposed according to instructions issued by the highest unit command echelon.

Daily Installation Situation Report (DA Form 5620-R)

2-32. All rail activities prepare this report (Figure 2-2, page 2-12) at depots, railheads, yards, terminals, ports, or other points where loading, unloading, or movement of cars takes place. They prepare this report at a fixed time each day. This report is completed and consolidated at each level of command. It reflects the situation as of the hour it is compiled and the progress of operations over the preceding 24 hours for the entire division. The report is based on data obtained by a thorough physical check of all yards, stations, depots, docks, warehouses, loading and unloading tracks, or other tracks where cars are stored. The report is then filed as a permanent station record. Appendix A contains a blank copy of a DA Form 5620-R. Instructions for completing this form are also shown in Figure 2-2, page 2-10.

Maintenance of Way Reports

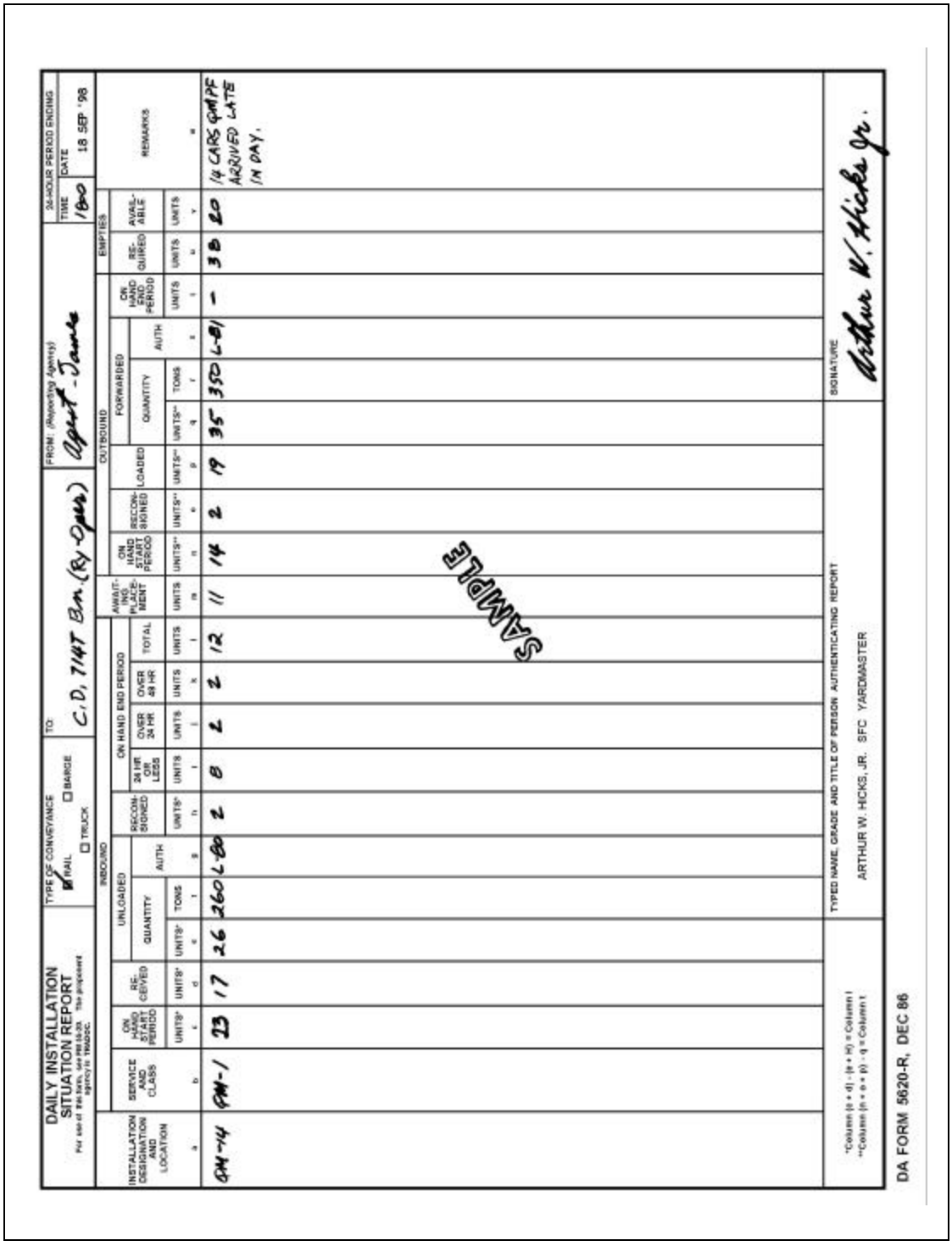
2-33. The transportation railway engineering company prepares maintenance of way reports. These reports cover normal operations in repair and rehabilitation work and are used by the battalion commander and higher HQ. Special reports are promptly made by electrical means on the extent of damage to bridges, buildings, tracks, and tunnels resulting from enemy or guerrilla action, floods, sabotage, slides, wrecks, or other causes. All personnel casualties are reported. If tracks are obstructed, an estimate is made as to the time required to restore traffic. Progress reports are made periodically, as directed, until repairs are completed and the line is open for train movement.

Equipment Maintenance Reports

2-34. Equipment maintenance reports, made by the transportation equipment maintenance company, include the daily enginehouse reports. The equipment maintenance reports show the following:

- Available motive power.
- Number of locomotives undergoing repairs.
- Estimated time when each will be ready for service.

Reports include information about any new motive power placed in service and the fuel situation. Car reports give the number of cars repaired, the number of cars awaiting repairs, and the car numbers of loaded cars. Reports of wrecked cars and locomotives should include the extent of the damage. Prepare other equipment reports in the format and frequency prescribed by higher HQ.



DAILY INSTALLATION SITUATION REPORT

For use of this form, see AR 55-38; the proponent agency is TRADOC.

TYPE OF CONVEYANCE: ☑ RAIL ☐ TRUCK ☐ BARGE

TO: C, D, 714T Bn. (Ry Opns)

FROM: (Reporting Agency) Agent - James

24-HOUR PERIOD ENDING: TIME 1800 DATE 18 SEP '98

INSTALLATION DESIGNATION AND LOCATION	SERVICE AND CLASS	INBOUND										OUTBOUND								EMPTIES		REMARKS
		ON HAND START PERIOD	RECEIVED	UNLOADED				ON HAND END PERIOD				AWAITING PLACEMENT	ON HAND START PERIOD	RECONSIGNED	LOADED	FORWARDED			ON HAND END PERIOD	REQUIRED	AVAILABLE	
				QUANTITY		AUTH	RECONSIGNED	24 HR OR LESS	OVER 24 HR	OVER 48 HR	TOTAL					QUANTITY		AUTH				
		UNITS*	UNITS*	UNITS*	TONS		UNITS	UNITS	UNITS	UNITS	UNITS	UNITS	UNITS**	UNITS**	UNITS**	UNITS**	TONS		UNITS	UNITS	UNITS	
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w
GW-4	FW-1	23	17	26	2601	80	2	8	2	2	12	11	14	2	19	35	350	L-81	-	30	20	14 CARS GMPF ARRIVED LATE IN DAY.

SAMPLE

*Column (c + d) - (g + h) = Column i
**Column (n + o + p) - q = Column r

TYPED NAME, GRADE AND TITLE OF PERSON AUTHENTICATING REPORT: ARTHUR W. HICKS, JR. SFC YARDMASTER

SIGNATURE: Arthur W. Hicks Jr.

DA FORM 5620-R, DEC 86

Figure 2-2. Sample DA Form 5620-R

Type of conveyance. Check proper block (rail, barge, or truck).

To: Indicate destination of form.
From: Self-explanatory.

Inbound

a. Installation Designation and Location. Self-explanatory.

b. Service and Class. Enter primary class of supplies.

c. On Hand Start Period. Enter number of in-bound freight cars on hand.

d. Received. Enter number of freight cars received during unloading.

e. Quantity Units. Enter number of freight cars unloaded during time period.

f. Quantity Tons. Enter tonnage unloaded during time period.

g. Auth. Indicate consignee.

h. Reconsigned. Enter the number of cars that have changed their original destination or consignee.

i. through l. On Hand End of Period. Indicate the number of cars that have been at your location for 24 hours or less; over 24 hours; or over 48 hours. Show total of cars in block l.

m. Awaiting Placement. Indicate number of cars awaiting placement instructions from consignee.

Outbound.

n. through t. Follow instructions for b through l above.

Empties.

u. Required. Indicate projected need for out-bound loads for next time period.

v. Available. Indicate number of empties available for outbound load.

w. Remarks. Enter any additional comments.

24-Hour Period Ending. Enter time period ended and date.

Typed Name, Grade, and Title of Person Authenticating Report. Self-explanatory.
Signature. Self-explanatory.

Figure 2-2. Sample DA Form 5620-R (continued)

CAR LABELS AND PLACARDS

2-35. Use car labels and placards to ensure proper handling of certain types of shipments. They also inform yard personnel, inspectors, and switching and train crews of a car's contents. Affix labels or placards in conspicuous or prescribed places to either both sides of a car or the end of a car. In overseas theaters, labels and placards are usually multilingual and are used as prescribed by theater SOPs.

Urgent-Expedite Labels

2-36. Use these labels for priority shipments only. They inform rail personnel of the shipment's importance so that it is expedited through yards and junctions.

General Car Labels

2-37. These labels usually have a colored stripe through the middle. They inform railway personnel at a glance what type of commodity or supplies the car contains. They also help local personnel who cannot read English to quickly identify shipments by color association. These labels also give general information such as contents, weight, consignor, consignee, seal numbers (if used), and so forth. The consignor places car labels on both sides of the car. Figure 2-3 shows examples of car labels used by railroads in Europe.



Figure 2-3. Examples of Warning Signs as Railway Car Placards, USAREUR

Re-icing Placards

2-38. Use these placards only on refrigerator cars carrying perishable items. Place these placards at eye-level on both sides of the car and near the ice bunkers. These placards show when ice and salt (date and time) were placed in the bunkers at origin and include instructions on any re-icing en route.

Special Placards

2-39. Special placards (Figure 2-4, page 2-16) indicate requirements for special handling, easy coupling, and so forth. These placards identify the following:

- Explosives.
- Flammable articles.
- Fragile or perishable cargo.
- Missile components.
- Radioactive materials.
- Any other potentially hazardous items.

Such placards include DO NOT HUMP instructions if applicable. These special placards are usually printed in various color schemes to emphasize their meaning and importance. The consignor or loading activity affixes these placards to each side (or end) of a car before the car is released to the railway service for movement.

Standard NATO NBC Markers

2-40. Place standard NATO NBC markers (Figure 2-5, page 2-17) on both sides of railroad rolling stock to indicate contamination. Railroad personnel will take appropriate actions to separate rolling stock for decontamination

FORECAST MOVEMENT REQUIREMENTS

2-41. When operating within the territories of NATO nations of continental Europe, American forces must submit forecast movement requirements, including movement requirements based on contingency plans or wartime needs, to the nations concerned in such movement. The standard format used in forecasting movements is shown in AMovP3.

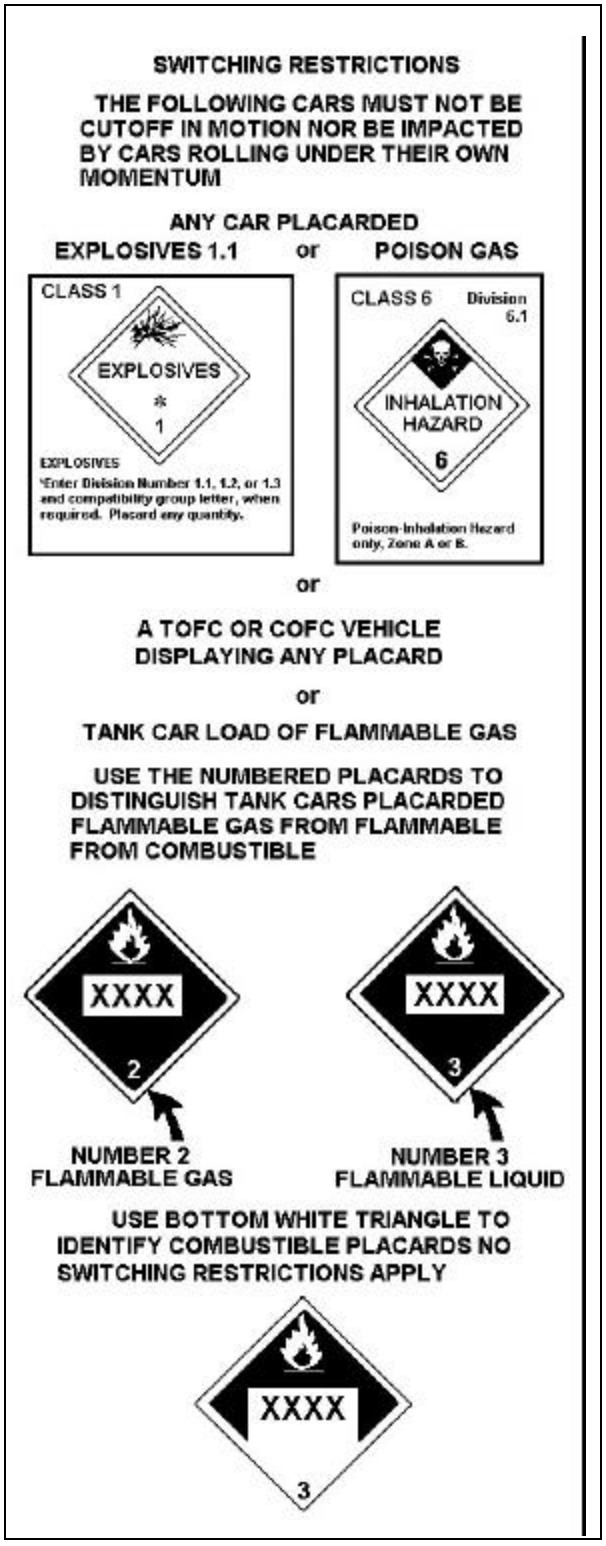


Figure 2-4. Special Placards

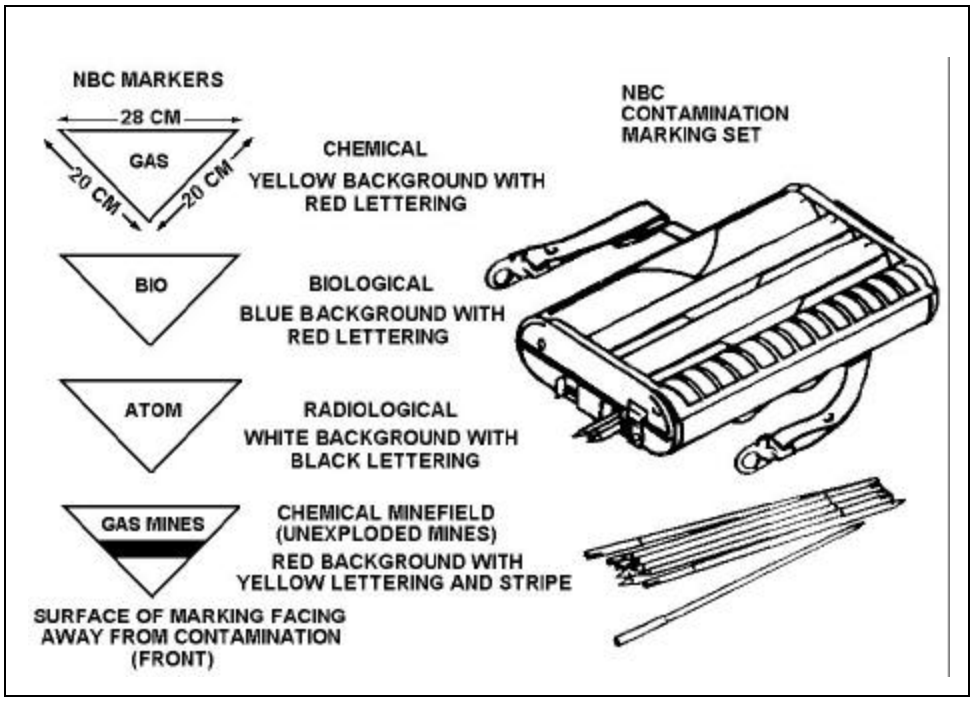


Figure 2-5. NBC Marking Devices

PORTS

2-42. Close coordination is required between rail unit personnel serving ports and port operating personnel. A large percentage of the tonnage from a port is moved by rail. The smooth operation of a port depends on prompt cargo clearance from the port area. The railway yardmaster must attend the port operations, meeting daily to coordinate the receipt and disposition of cargo that has been designated by the MCT to move from the port area by rail.

Port Clearance

2-43. Port capacity depends on prompt movement of cargo from the port area. Since depots, dumps, and storage areas are located within a 20- to 25-mile radius of the ports, MCTs do not designate rail as the best mode to accomplish port clearance for short distances. Railways are characterized by their capability to move large tonnages over long distances. Movements personnel coordinate rail movements with the shipper, the receiver, and railway operating personnel. Coordination will expedite port clearance and prevent congestion at yards and/or terminals at origin and destination. Coordination ensures that rail equipment is placed at the desired location, promptly loaded or unloaded, and promptly released to railway operating personnel. Special coordination with all interested agencies is required when ammunition or dangerous commodities are handled.

Car Inspection and Repair Facilities

2-44. Local maintenance facilities may be established when the number of cars used in shuttle service between ports and depots or dumps justifies such action. Car inspectors and maintenance personnel from a car repair platoon, transportation railway equipment maintenance company are stationed in the port area. They perform the following:

- Inspect cars for mechanical defects.
- Make minor repairs (such as replacing air hoses or brake shoes).
- Repair door fastenings, brake rigging, couplers, and so forth.

Inspectors inspect loaded cars, particularly those containing dangerous commodities, to ensure compliance with clearance requirements and safe loading regulations. Promptly report cars with defective loads to the yardmaster.

Border Crossings

2-45. When operating within territories of NATO nations of continental Europe, American forces must be prepared for crossing international borders and border crossing requirements. The format used by movement agencies responsible for relaying information at border crossing points is shown in AMovP2.

Pier Operations

2-46. A pier can be considered one long highway grade crossing. The crew should be on the lookout for parked or moving vehicles, walking or standing personnel and areas on or near the track being used for purposes unrelated to the track operation. Due to close clearances in much area, reduced speed limits should be strictly observed. Due to the type of material stored and moved on piers, special attention should be paid to how the cars are secured for loading and unloading. Care should be taken not to couple into any car before those authorized to do so give their permission. Also, the need for rapid evacuation to the pier during any fire must be considered.

Chapter 3

Rail Operations In Smaller Scale Contingencies

Smaller-scale contingencies (SSCs) encompass a wide range of joint and multinational military operations that fall between Major Theater War and Peacetime Military Engagement. While not all-inclusive, Army forces committed to SSCs protect American lives and interests, support political initiatives, facilitate diplomacy, promote fundamental American ideals, or disrupt illegal activities. As in MTWs, the JFC assigns supported and supporting relationships to components of the joint force to best accomplish the mission.

ROLE OF THE RAIL UNIT

3-1. The rail unit monitors or provides technical assistance to the operation of the HNs railroad system. Rail unit's assistance may include providing resupply to US forces to the actual operation of the rail system to maintain the credibility of the host government.

UNCONVENTIONAL OPERATIONS

3-2. Unconventional operations are predominately of a military nature and are characterized by extensive use of unorthodox tactics conducted by irregular forces. The most potent weapon of this type force is surprise. Rail personnel, especially train crews and those at outlying points, must stay alert at all times in case of an attack. Rail personnel at small stations, yards, enginehouses, and maintenance of way detachments along the line of road must also stay alert.

Sabotage

3-3. Constant vigilance is necessary to prevent or reduce sabotage. Sabotage is any willful act intended to aid the enemy by destroying, impeding, or interrupting any person or function. Some acts of sabotage include placing sand in car journal boxes, water in fuel tanks, or bolts in a machine gearbox. Identifying acts of sabotage are not as easy as unconventional operations, but the effects are the same. These acts are done secretly making them more difficult to prevent. Inspect trains frequently for concealed saboteurs or guerrillas who may cut air hoses or train lines to force an emergency stop where guerrillas wait to attack. If tonnage can be handled with locomotive brakes only, operating trains without air brakes rules out this type of sabotage.

Objectives

3-4. Level I and II threat operations (see FM 100-20) most commonly use fire and explosives against railway lines and installations to disrupt train traffic. Conduct threat operations to perform the following:

- Destroy bridges and tunnels.
- Destroy track (derailments and wrecks).
- Destroy buildings, shops, and terminal facilities.
- Destroy communication and power lines.

- Destroy locomotives and rolling stock.
- Capture and/or destroy equipment and supplies.
- Capture weapons and ammunition. Weapons and ammunition are especially critical items and are primary objectives. They must be either in the hands of using personnel or properly secured at all times.
- Capture personnel and/or inflict personnel casualties.

DEFENSE MEASURES

3-5. Military planning includes the possibility of frequent and continuing military actions of special warfare occurring during LIC. This chapter outlines some of the conditions which may be encountered and some of the methods that the rail personnel may adopt to counter the tactics irregular forces design to wreck trains or delay train movements. The type of defense that may be used varies with local conditions, degree of isolation, proximity of other troops, and so forth. Experience shows that aggressive attacks can cause considerable damage despite apparently foolproof security measures. Trip wires, sentry dogs, barbed wire, land mines, and similar measures give some protection against surprise.

Guidelines

3-6. Guidelines differ depending on the circumstances of the attack and the geographical area in which it occurs. Hard and fast rules cannot be made. Whenever unconventional forces attempt to derail or wreck a train, rail operating and maintenance personnel must attempt to forestall it by suitable countermeasure.

Plans

3-7. Any counter plan must consider the mentality of the enemy, the changing physical characteristics of the particular line, and the terrain. Plans must always be flexible and changed frequently as conditions warrant.

ATTACKS ON THE RIGHT-OF-WAY

3-8. Irregular forces, possessing a minimum of arms and explosives, may concentrate their efforts on train derailing and wrecking. In many instances, their primary goal may be stealing and pilfering supplies and ammunition after a wreck occurs. Delay may be secondary, but both goals may be accomplished simultaneously. To wreck trains, action must be directed against the track, switches, ballast, and bridges along the right-of-way.

Track

3-9. Tampering with the track and fastenings is the simplest way to cause a derailment. Removing enough spikes from rails will cause them to spread under the weight of a locomotive or buffer cars. Removing nuts and bolts from the joint bars is another method of causing rails to spread. Continuous welded rail lessens the danger of rails spreading, but it is doubtful that this type of rail will be found in many undeveloped areas. Ordinary track tools are enough to pull spikes and loosen joint bars. To make the work of the saboteur more difficult, joint bars have sometimes been welded into place and track spikes have been tack-welded to the rails. The consistent denial of track tools to

the irregular forces is the first step to be taken. Tools are removed from the large toolboxes normally spaced along the right-of-way for worker convenience. Track tools should be safeguarded more zealously than their monetary or salvageable value warrants.

Roadbed

3-10. Unless the opposing forces have large stores of explosives or the tools and ability to make improvised mines and bombs, extensive damage to ballast and subballast will probably not be attempted. Crews should be alert for mines and bombs when rounding sharp curves or at the bottom of steep grades where stopping in short distances may be difficult. The absence of a quantity of ballast or dirt is not an easy condition to detect until the observers are quite close to the spot. Crews should be watchful for any piles of scattered ballast or dirt along the track in areas where they would not normally be found.

Track Barricades

3-11. Barricades thrown across the track may serve many purposes. Small, poorly armed bands may drop trees across the track to bring trains to a halt. Generally, when train guards are superior in number and arms, guerrillas will disperse and leave the crew to remove the blockade. In undeveloped countries, unconventional forces and terrorists block the track with anything available. They will often leave false evidence that the barricade has been boobytrapped. This makes removal much slower than usual. Guards must be constantly alert and careful because the terrorists leave the same evidence at barricades that they did not boobytrap.

RIGHT-OF-WAY CONCEALMENT

3-12. In areas where sniping is common or where heavy small arms fire is experienced or expected, brush and green growth along the right-of-way should be cut back as far as practicable (at least 20 feet on each side). Use chemicals to kill jungle growth that serves as enemy concealment. Concealment is also important to small working groups. Where action is light and confined to sniping and trains are carrying guards or troops, it may be desirable to try to trap the guerrillas.

BRIDGES

3-13. Bridges and trestles are naturally vulnerable. Until repaired, their destruction can stop all movement. Irregular forces may not be interested in total destruction of such important rail facilities. Their primary mission may be to delay, pillage, and try to prevent certain types of cargo from reaching their destination. These same trains may be carrying freight important to their ultimate goal or cause. The average political or military group of a country with a limited rail network, wants to achieve its goal without destroying transportation facilities.

3-14. Bridges and high embankments are excellent points for train wrecking and derailing. Bridges often span rivers and deep ravines. Therefore, efforts are often made to derail trains near these points in the hope that part of the train will topple to the ground or into the river below. It may prove profitable to keep guard forces in areas where simple derailments may have serious results.

3-15. Rail lines running through deep rock cuts offer good targets. The lack of operating space along the sheer cliffs makes cleaning up a wreck slow and extremely difficult.

3-16. There is a great possibility of a derailment where there are many bridges and high embankments. The engineman must be prepared to stop immediately upon derailment. One method that has been tried is mounting a white disk on each corner of the foremost buffer car. The engineer watches the disks constantly for any noticeable movement. Movement denotes a derailment and brakes are applied promptly. Another method is one that causes the brakes to be applied, independent of the engineman's actions, as soon as a derailment occurs. A method of doing this is to bring the brake pipe down to the wheels, 2 or 3 inches above the rails, with a glass tube installed in the line. When the wheels of the leading car leave the track, the glass tube drops down and breaks and the air brakes are applied.

Wayside Communications Facilities

3-17. Telephone and utility poles and lines are often targets for disrupting communications. Since these facilities are easily sabotaged, it may not be practical to keep these LOC open. If radio communication is not available, trains can be dispatched with reasonable safety and expediency by using manual block operations. Where an attempt is made to keep lines open, enemy forces can often cut wire faster than breaks can be repaired. Cuts may also be made for the sole purpose of attacking repair crews for their tools and weapons when they arrive to repair breaks. Armed escorts should usually accompany repair personnel.

Wayside Signals

3-18. Wayside signals are in the same category as communications when it comes to tampering. Guerrillas can switch electrical leads and cause a signal to display a false aspect. The displayed aspect on main-track switch lights should not be depended on completely. It is a relatively simple matter to turn the lamp or to reverse the roundels and display false aspects. Switch points should always be observed to make sure that they agree with the aspect displayed. It is doubtful whether electric signals should be relied on by the rail unit in guerrilla-infested territory.

Hand Signals

3-19. Railroad crews moving along a main track are always on the alert for hand signals displayed on the track ahead. Open stations will display "stop" or "proceed" signals depending on whether or not the station has any orders or instructions for the crew. When operating in adverse territory, hand signals observed between stations are regarded with suspicion. A red flare or fuse waved violently across the track is a universal stop signal. Opposing forces in possession of fuses and red lanterns can stop trains with little effort. The only countermeasure to use against unauthorized signals is to specify the exact manner in which a signal is to be given. The average nonrailroader usually holds a fuse at arm's length and waves it over his head in a half circle. A railroader usually swings it across his knees in a lower half-circle. There are many signaling combinations that can be worked out. They should be classified, coded, and changed daily or as necessary.

False Reporting

3-20. Because trains must be reported by each station they pass, precautions must be taken against guerrillas cutting in on a dispatcher's telephone circuit and reporting false information. Although the dispatcher may know and can recognize all voices of his division, he must always call a station back

and verify the report. Such tactics can be overcome by using approved CEOI. COMSEC procedures should be used at all times.

TRAIN OPERATIONS

3-21. Operations over a division experiencing frequent disruption of supply and passenger transport must change with the aims and tactics of the opposing forces. Trains should be operated at irregular intervals. In areas subject to guerrilla warfare, trains should not move on schedule or use traffic patterns that can be anticipated. If logistical considerations permit, all movement should be made in daylight with several freight (supply) trains running close together, at random intervals, for mutual protection. At night, frequent roving patrols or armored trains should move over the lines at irregular intervals to prevent sabotage to tracks and structures. If irregular forces know when to expect trains, they can operate effectively against railroads with very little interruption. In a conventional war, the operation of passenger trains continues for military use but usually diminishes for civilian use if it can be done without disrupting the economy.

Precautions

3-22. Depending on the tactics and goals of the aggressors, special precautions must be taken for passenger train operations. Where irregular forces are well organized and well armed, countermeasures must be similar to those used in conventional warfare. If passenger trains are kept in operation, it may be necessary to install steel plates over the windows and pile sandbags up to the bottom of the windows. Cover windows with steel-meshed wire to prevent grenades from being thrown into the cars. Doors are closed and secured to prevent guerrillas from boarding. When tracks are torn up or bridges blown, the train should back away if time and conditions permit. When enough motive power is available, a locomotive operated at the rear of the train is used to pull undamaged portions of the train back to safety if the locomotive or cars at the front end are derailed. Troop trains may carry a supply of ammunition and grenades for the crew and passengers to use in case of attack. Locomotives and train guard cars will be equipped with fire extinguishers and first aid kits. The security objective is to save personnel and equipment from capture, damage, or destruction.

Pilot and Inspection Trains

3-23. Conditions may require the operation of a pilot train to travel over a section of track a short time ahead of a following train. This train may be operated as a pilot train, as an escort to a troop or supply train, or as a security patrol train to prevent sabotage. A pilot train running interference for a troop or supply train moves ahead as short a distance as is feasible, safe, and consistent with operating conditions. The pilot train will move 2 to 5 minutes ahead of the second train. After the pilot train passes, the guerrillas do not have enough time to obstruct the track, remove a rail, spike a switch, and so forth, before the train they seek to derail has passed. A pilot train may consist of any combination of rolling stock. For night operations, the lead car can be rigged with a headlight powered from the locomotive generator. This car may be partially armored with boiler-plate steel and carry a small machine gun or rifle crew for protection against small guerrilla groups or wayside snipers. Additional cars, similarly equipped and manned, may be pulled behind, carrying enough troops or guards for protection against attacks on the train if it is stopped. Depending on the firepower of the opposing forces, armor plates may be installed on the locomotive to protect the cab crew. Plating may also be necessary to cover key auxiliaries on steamers and along the power plant area of diesels. These trains could be quite heavy. The locomotive may also have two cars attached to

the front. These cars should be heavily loaded with anything that provides enough weight to explode a buried mine or to test the stability of the track by derailing before the locomotive reaches the spot. If the pilot train can safely pass over a given track section, an ordinary train should also be able to safely pass. It would be useless to have individual (light) engines act as pilot trains. They might safely pass over a track that had been tampered with, but a train of more weight would be derailed. If time delayed or remote controlled mines are used, then patrols must be increased to deny the opposing forces the opportunity of employment.

Emergency Supplies and Equipment

3-24. Aside from necessary weapons and first aid equipment, equip locomotives with a full set of track tools in addition to those normally carried for emergency repairs. Track fastenings, spikes, jacks, sledges, crowbars, and even a limited number of ties and rails may be needed. Engine and train crews and security guards aboard trains should have flare pistols for firing signals to indicate unauthorized stopping or attack. Train crews, security guards, and patrols may be furnished portable telephones that can be hooked to wire lines along the track to report attacks, derailments, location of interruptions, and similar information. Where the equipment is available and weather conditions permit, railway personnel and guards may be equipped with radio-telephones for similar purposes and communication between enginemen and train crews at the rear. DO NOT place cars containing explosives or flammable materials next to locomotives or cars containing troops or guards. Fire directed toward personnel might explode or set fire to the hazardous material.

ARMORED TRAINS AND CARS

3-25. The tempo may change from sniping, wrecking, and pilfering to organized attack with heavy firepower when enemy forces and irregulars increase and possess large stores of ammunitions and explosives. Heavier armor may have to be installed on the pilot trains. Crude, improvised gondolas with mounted guns may change to armored tank-like structures mounted on flatcars. These can often be made by using 1/2-inch plates. Firing slots may be provided and revolving searchlights fitted into the roofs.

Armored Trains

3-26. Armored trains may consist of specially armored cars, flatcars, or gondolas with tanks secured to them. Tanks are particularly effective because their moveable turrets and large caliber guns give long-range protection in all directions. When equipped with flame-throwing devices, tanks are very effective in searing growth that may be used as hiding places along the right-of-way. Boilerplate steel boxes or turrets installed on flatcars provide armor for troops and gun crews inside. These turrets may rotate and be rigged with firing slots, gun ports, and swivel lights. Reinforce locomotive cabs with armor plate thick enough to withstand machine gun and rifle fire. Cover locomotive windows with steel shutters to protect enginemen, but permit visibility.

Self-Propelled Cars

3-27. Self-propelled armored railcars may be used for piloting and patrolling. They can be used in pairs so that one may assist the other in the event of attack or derailment. They are relatively light and easily re-railed by light cranes or rerailers. They can also be moved to the side of the right-of-way when seriously disabled. The short time required to clear a line of these lightweight cars, after a derailment, is lower then when locomotives have been derailed. When self-propelled cars are

wrecked and left unguarded, the guns (or at least the breech locks) must be removed. In some areas where an undeclared war is being fought, local government militia or constabulary may be taught to operate self-propelled track equipment. However, they must first be given detailed instructions about the rules of the road. Like all other rail operating personnel, they must be given periodic examinations and refresher instructions.

Derail Detection Devices

3-28. Unconventional forces may rig the track with an explosive device and permit an armored or pilot train to pass unharmed in the hope of wrecking the more valuable train. One or two idler cars, which may or may not be armed and equipped as described above, should be pushed in front of the locomotive. The derailment of the leading car warns the engine crew and often permits counteraction. The leading truck can be equipped with a spring-plunger device that starts automatic brake application in case of derailment.

COUNTERMEASURES

3-29. With extensive unconventional operations, precautions and countermeasures against attacks on rail facilities may be only partially successful. Such operations may reach such proportions that the only practical defense would be to expel them from the area.

Counterguerrilla

3-30. Counterguerrilla tactical operations may be necessary. Denial of food and supplies, occupation of areas harboring and assisting them, and even the resettlement of communities to fortified centers may be required. HN employees around shops and terminals who could sabotage equipment should be carefully screened.

Deception

3-31. Two forms of deception are used when deceiving the enemy. The first is deceiving the enemy about our intention. The second is preventing the enemy from obtaining intelligence. A number of methods may be used to deny the enemy intelligence.

Camouflage and Concealment

3-32. Make camouflage loads appear to be non-military. Break the pattern of loads through the use of netting.

Smoke

3-33. Smoke may be used to obscure the enemy's vision. However, it should not obscure the visibility of the train crew. Only use smoke when everything else has failed. When possible, conduct rail operations during periods of darkness or fog to further reduce enemy observation.

Schedule Departures and Arrivals

3-34. To the greatest extent possible, do not use schedules in railway transport. An established routine would give the enemy an added advantage. Schedule and departure times should also be encoded for transmission and the minimum number of personnel allowed access to this information.

Routing

3-35. If possible, and if parallel lines exist, vary the routes that trains will operate in the theater. There should not be any set pattern that the enemy may use to their advantage.

OPERATIONS IN AN NBC ENVIRONMENT

3-36. Conduct train operations in an NBC environment according to doctrine in FM 3-100. Conduct NBC operations the same as in other type units with the exception of operations that will be degraded from a personnel standpoint rather than from an equipment standpoint. Toxic chemicals have little effect on motive power and rolling stock. However, nuclear detonation, depending on its proximity, might detail motive and rolling stock and damage equipment components (such as brake hoses and communication equipment).

3-37. Equipment being transported by rail may have to be decontaminated. Decontamination depends on whether the equipment is being transported in closed or open-topped railcars. This decontamination will have to be done at the nearest yard or loading facility. Due to the size of the equipment being used, perform decontamination by spraying the railcars with water (see FM 3-5).

3-38. Train crews must don protective gear and stay under cover of the locomotive cab during train operations under NBC attack or when crossing a contaminated area.

REAR OPERATIONS

3-39. Rear operations assist in providing freedom of action and continuity of operations, logistics, and battle command. Their primary purposes are to sustain the current close and deep fights and to posture the force for future operations. Rear operations can be the targets of the enemy's deep attack.

General Protective Measures

3-40. Security measures of railroad operations are determined by the situation and AO. These measures may include the following:

- Route reconnaissance by Army aircraft.
- Occupation of critical terrain features.
- Using special observation cars.
- Placing the locomotive at the midsection of the train to reduce damage in the event of sabotage.

- Using two or three gondola cars (filled with rock, sand, or other ballast) in front of the engine to absorb mine detonation effects.
- Using empty and decoy trains to be ahead of critical shipments.
- Using escort or scout trains to patrol right-of-way.
- Using special armored guard cars.
- Placing mobile maintenance trains in strategic locations along the route or moving with trains.
- Movement at the highest safe speed through areas where guerrilla or partisan forces are active.
- Consolidating trains to ensure the most economical use of available air cover.
- Placing security patrols along the length of the line to be traversed.

Rear Area Operations Center

3-41. An RAOC is provided each support group and brigade within the theater of operations. The RAOC keeps the commander informed of the RAS, the ADC situation in his area, and the resources available to cope with emergencies. It represents the planning capability of the commander and performs command and control over forces designed to execute RAP missions. As rail elements will be located within or moving through the RAOC's areas of responsibility, rail units will normally have communications with and maintain plans in support of RAOC activities.

3-42. Rail units maintain communications with supporting RAOCs through the area communications system. The RAOC provides these units with current information on the following:

- Security force, artillery, and aviation support.
- Weather, terrain, and intelligence data.
- Location and level of chemical, biological, or radiological contamination.
- ADC and explosive ordnance disposal support.
- Medical, emergency repair, and other support facilities.

Those American forces operating within NATO will comply with the procedures as set forth in AMovP2.

Chapter 4

Rail Dispatching Operations and Procedures

Rail dispatching operations and procedures in a theater of operations differs from that on commercial railroads. In a theater, trains are operated by civilians and controlled by the military. Therefore, dispatching may remain unchanged if passenger train service is continued. However, troop, ambulance, and ammunition trains (used mainly for military purposes) may be assigned higher priorities than passenger trains when operated by the rail units.

DISPATCHING OPERATIONS

4-1. The method of dispatching trains may undergo radical changes. Threat forces during Army operations will attempt to disrupt operations with the destruction of trackage, bridges, signals, and other facilities. Rail operations must then be restored as quickly as possible. When service is resumed, what was formerly a double-track, high-speed road with automatic block signals may become a single track with restricted speed and an improvised signal system. Dispatching becomes more difficult and complex as single-track operations prevail. Light trains carrying less tonnage at lower speeds become the rule and circumstances determine movement priority.

4-2. Dispatching trains on a busy section of railroad is one of the most exacting tasks in the transportation field. The train dispatcher assists the chief train dispatcher. The train dispatcher must be able to make instant decisions with no margin for error. He has the same authority over train movement as the chief dispatcher. He must know the exact physical layout of the main track in his division. He must also know the capabilities of the various types of locomotives in use. He may also be required to judge the capability of individual locomotives only by their number designators. He must also be familiar with the engineer's ability to get their trains over the road.

4-3. The chief dispatcher at the division HQ keeps a record (train sheet) of the time, date, and place of each train, the dispatcher on duty, and so forth. The chief train dispatcher is responsible for the following records and reports.

Dispatcher's Record of Train Movements (DA Form 5613)

4-4. Figure 4-1 shows a sample of a DA Form 5613. As a train enters or leaves a terminal yard or station, the agent or operator notifies the dispatcher by telephone: for example, "Extra 194 by DN at 0525." The train sheet is kept in the dispatcher's office and provides a continuous, running record of all trains moving on the division. Therefore, the dispatcher can anticipate train meets and issue appropriate train orders. The following are instructions for filling out DA Form 5613.

- Trains move either east and west or north and south. The train sheet lists trains moving west or south on the left and those moving east or north on the right. The train sheet is kept for a 24-hour period, beginning with a new sheet at 0001 hours and ending at 2400

hours of each day. The train dispatcher signs his name and records his duty time in the block provided.

- The railway organization, location of the dispatcher, current date, commanding officer's name, type of track, and the chief dispatcher's name are recorded in the proper blocks.
- Four times a day the dispatcher records the condition of the weather along the division. The locomotive cannot pull as much tonnage, nor can the train maintain speed, in cold or severe weather conditions.
- The names of the stations and the reporting points on the rail line are listed in the center column. To the left of the center column, the distance is listed from the point of division origin to the end of the division, and is given in the superior direction. To the right of the station column, the siding capacity of each station is listed. This information is very important on a single-track line where trains must meet and pass. Trains should not contain more cars than the sidings can hold if they are to clear the main line and allow other trains to pass. Show the number or symbol of each train running during the record's time frame on the horizontal line headed "train symbol." Trains are listed in the blank columns beginning nearest the three center columns and extending outward in the order of their departure times. AMovP3 addresses how NATO forces will identify trains using an International Identification Code. To the immediate right of the departure time of a freight train at a station is listed the number of loaded and empty cars and the amount of tonnage in the train. In Figure 4-1, these figures are listed at the train's initial station and at other stations where changes take place.
- The contents and destination of loaded cars may also be shown in the "Remarks" block.
- Arrival and departure times of trains moving west or south are entered to the left of the station column and read from top to bottom. Those moving east or north, entered to the right of the station column, are read from bottom to top. For trains moving west or south, the arrival time at each station is shown in the upper square and the departure time in the lower square. The reverse is true for trains moving in the opposite direction. If a train does not stop at a station, only one time is shown. The time is shown in large figures written diagonally over both the arrival and departure squares. Record delays in the "Remarks" block. The chief dispatcher will stock needed copies of this form in the Dispatcher's Office. Do not request through normal publications system.

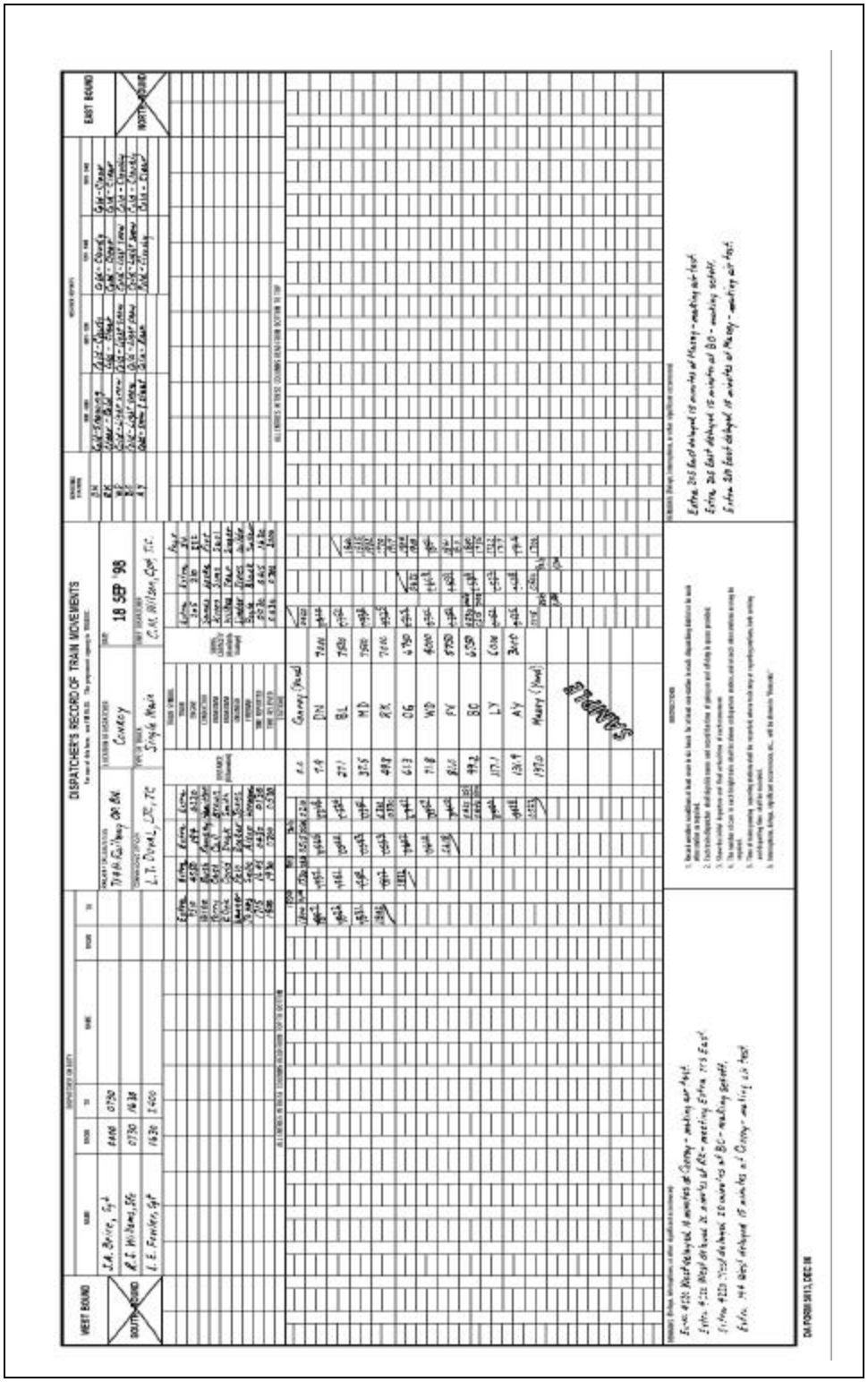


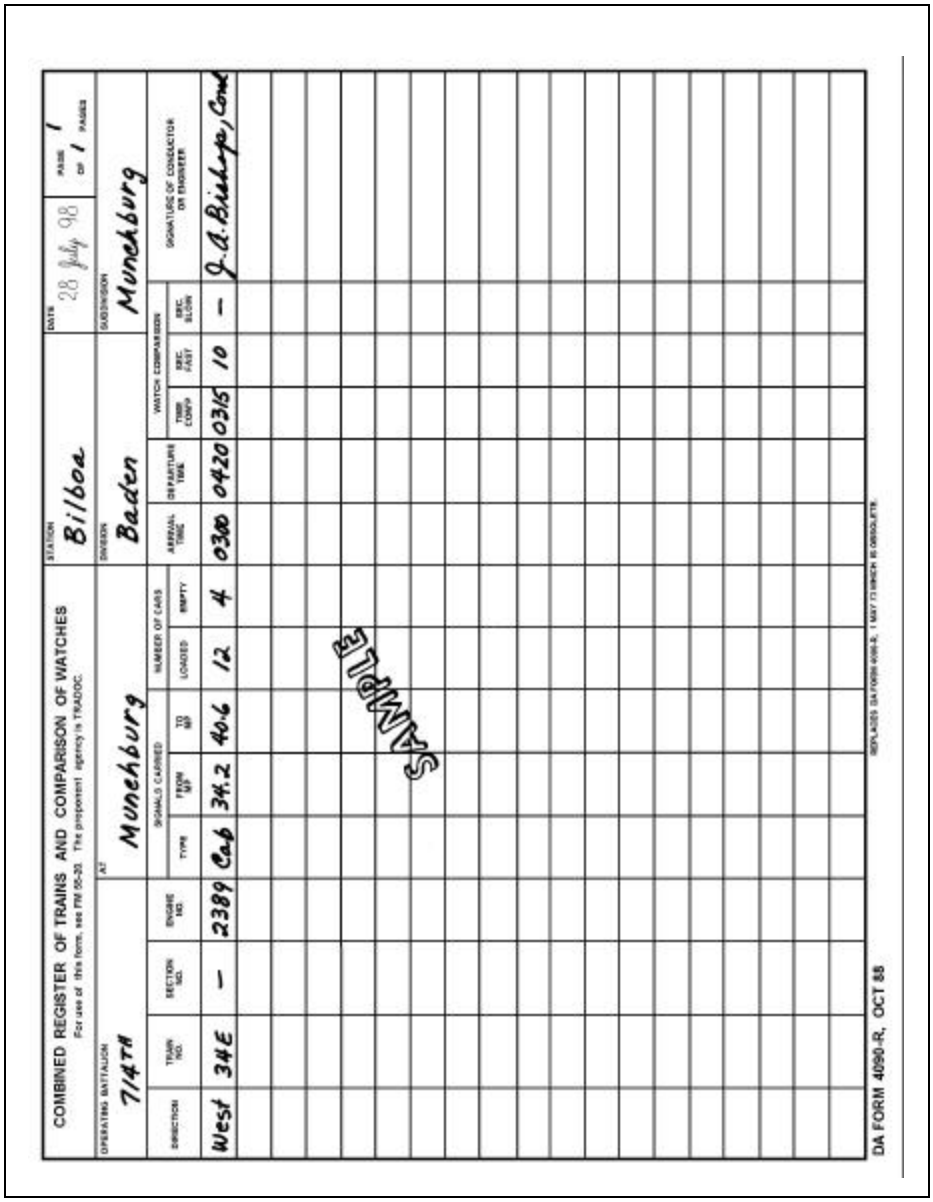
Figure 4-1. Sample DA Form 5613

Combined Register of Trains and Comparisons of Watches (DA Form 4090-R)

4-5. Train registers are located at stations designated by timetable. This register is a permanent record of the movement of trains over the division. The conductor (or the engineman if there is no conductor) must check and sign the register before departing from a register station. While this is the responsibility of the train crew, station agents (when properly authorized) may enter the required information on the register and then report the train to the dispatcher. Figure 4-2 shows a sample of a DA Form 4090-R. The use of this form is to maintain a record of time comparisons. Instructions to complete the DA Form 4090-R are self-explanatory according to block heading. You may reproduce DA Form 4090-R on 8 1/2 x 11-inch paper. See Appendix A for a blank copy of DA Form 4090-R.

TRAIN ACCIDENT REPORTS

4-6. When a personal injury occurs or when the main line is blocked and train movements are affected, a report is submitted by the fastest available means to the chief dispatcher. The conductor, track foreman, or yardmaster submits a report for any accident involving cars, locomotives, or trains. The chief dispatcher promptly forwards the report to battalion HQ.



COMBINED REGISTER OF TRAINS AND COMPARISON OF WATCHES
For use of this form, see FM 55-33; the proponent agency is TRADOC.

STATION: Bilboa
DATE: 28 July 98
PAGE 1 OF 1 PAGES

OPERATING BATTALION: 7/4TH
AT: Munchburg
DIVISION: Baden
SUBDIVISION: Munchburg

DIRECTION	TRAIN NO.	SECTION NO.	ENGINE NO.	SIGNALS CARRIED: TYPE	SIGNALS CARRIED: TRAIN ORDER	SIGNALS CARRIED: TO (BY)	NUMBER OF CARS: LOADED	NUMBER OF CARS: EMPTY	ARRIVAL TIME	DEPARTURE TIME	WATCH COMPARISON: TIME COMP	WATCH COMPARISON: SEC. FIRST	WATCH COMPARISON: SEC. CLOSE	SIGNATURE OF CONDUCTOR OR ENGINEER
West	34E	—	2389	Cab	34.2	406	12	4	0300	0420	0315	10	—	J.A. Bishop, Cond

SAMPLE

DA FORM 4090-R, OCT 88 REPLACES DA FORM 4090-R, 1 MAY 73 WHICH IS OBSOLETE.

Figure 4-2. Sample DA Form 4090-R

Superintendent's Telegraphic Report of Accident (DA Form 5614-R)

4-7. The general superintendent of transportation prepares this form (Figure 4-3) when he receives a report of a train accident. This is an essential report to higher authority or other personnel concerned. Division chief dispatchers through railway command channels must submit accurate and concise information for its preparation. The accident number and the time and date of the accident are entered at the top of the form. A blank DA Form 5614-R is in Appendix A. You may reproduce this form on 8 1/2 x 11-inch paper. Instructions for those blocks that are not self-explanatory are also shown in Figure 4-3 (page 4-8).

Station Record of Train Movements and Operator's Transfer (DA Form 4093-R)

4-8. Station operators use this form (Figure 4-4, page 4-9) to record all train movements within their jurisdiction. Each station operator records the time of his shift and specific information on train orders and signals. Instructions for use of DA Form 4093-R are included in the form heading. A blank copy of DA Form 4093-R is in Appendix A. You may reproduce this form on 8 1/2 x 11-inch paper.

SINGLE-TRACK, DOUBLE-TRACK, AND MULTIPLE-TRACK OPERATIONS

4-9. A main track may consist of a single track or two or more tracks upon any of which the current of traffic may run in either direction. The three types of main track operations are discussed below.

SINGLE-TRACK OPERATION

4-10. In a single-track operation, dispatching is carried out by written train orders. A first-class train depends on the timetable schedule for its authorization. When leaving the starting terminal, the crew is authorized to travel along the route according to the established timetable schedule. On a single-track line, the timetable specifies the superior direction. Therefore, a first-class train traveling in the superior direction would be superior to all other trains on the line. Inferior trains must clear the main track completely by going into a siding or yard and line the switch for the main track. In no way should the arrival of the first-class train be delayed.

SUPERINTENDENT'S TELEGRAPHIC REPORT OF ACCIDENT
For use of this form, see FM 55-20. The proponent agency is TRADOC.

ACCIDENT NUMBER	TIME	DATE
13	0030	2 Oct 97

TO: General Manager
3rd Transportation Railway Command
APO 301, San Francisco, CA

OPERATING UNIT: 777th TROB

TRAIN NUMBER	ENGINE NUMBER	LOCATION
126	2007	Chan siding - Mile post 132

ENGINEMEN	CONDUCTORS	BRAKEMEN
Spc Lee Chester Pfc Marion Curry	Sgt. Thomas Reagan	Pfc Fred Stone Pfc Robert Greene

TYPE OF ACCIDENT: Derailment
CAUSE: Running switch
TYPE OF TRACK: ☐ CURVE ☒ TANGENT ☐ CUT ☐ FILL
WEATHER CONDITIONS: Foggy
SPEED OF TRAIN: 5 MPH
OTHER TRACKS OBSTRUCTED BY ACCIDENT: Single main track and siding at Chan
NUMBER OF LOADED AND EMPTY CARS IN TRAIN: 20 Loaded - No empties
NUMBER OF CARS BETWEEN ENGINE AND DAMAGED CARS: None
POSITION OF ENGINE: Leading truck derailed
ENGINE DAMAGE: Traction motor housing
SECTION MEN WORKING: ☒ YES ☐ NO
CAN TRACK BE CLEARED WITHOUT ASSISTANCE: ☒ YES ☐ NO
ADDITIONAL EQUIPMENT REQUIRED; FROM WHAT DIRECTION: None
MATERIALS REQUIRED: No. 8 switch point, 2 rail lengths, 20 crossties, and proportionate OTM

TIME WRECKER ORDERED	TIME WRECKER DEPARTED	TIME REQUIRED TO CLEAR MAIN TRACK
NA	NA	2 hours

DELAYS TO OTHER TRAINS:
No. 8 - 1 hour 45 minutes
No. 127 - 1 hour 15 minutes

EXTENT OF DAMAGE TO OTHER CARS AND CONTENTS (Initials, number and type of car):
DE Locomotive, 2007, damaged front steps and No. 1 and 2 traction motor housings

WILL LIVESTOCK OR PERISHABLES IN TRAIN HAVE TO BE FORWARDED? IF YES, WHEN: NA
QUANTITY AND TYPE OF CARS REQUIRED TO TRANSFER LIVESTOCK OR PERISHABLES: None

EXTENT OF PERSONAL INJURY (Name, address, and occupation of injured) (For additional space use reverse side):
Pfc Marion Curry, Co. C, 777th TROB, APO 301, San Francisco, CA
Superficial bruise on left shoulder.

SAMPLE

TREATMENT GIVEN INJURED:
First aid

WITNESSES (Names and addresses):
Kim Boik, Station Master, Chan
No. 3, Chim Long, Chan, Korea

REMARKS (For additional space use reverse side): None
SIGNATURE: Lee T. Dunal, LTC, TC

DA FORM 5614-R, DEC 86

Figure 4-3. Sample DA Form 5614-R

To. Enter the name of organization to which report is submitted.

Operating Unit. Enter the name of railway operating unit at time of accident.

Location. Indicate where (place) accident occurred; for instance, by milepost.

Enginemen, Conductors, Brakemen. Enter names of each, respectively.

Cause. Indicate what caused accident.

Type of Track. Check box to show type of track.

Tracks Obstructed. Indicate any other tracks blocked by equipment.

Position of Engine and How Damaged. Annotate damage to locomotive.

Section Men Working. Check proper block to indicate if track repairs have started.

Track Can Be Cleared Without Further Assistance. Check proper block to indicate if help is needed to clear track.

If Not, What Required and From What Direction. Self-explanatory; if none, so state.

Material Required. Indicate what is needed to rehabilitate damaged track, rails, crossties, and so forth.

Delay to Other Trains. Indicate amount of time other trains were delayed.

When Will Perishables or Livestock Be Forwarded. Enter time and date.

Quantity and Type Cars Required. Self-explanatory; if none, so state.

Extent of Personal Injuries. Give name and address of each person injured and type of injury; if none, so state.

Treatment Given. Indicate type of treatment or comfort given to injured; if none, so state.

Witnesses. Self-explanatory; if none, so state.

Signature. Signature of official making report.

Figure 4-3. Sample DA Form 5614-R (continued)

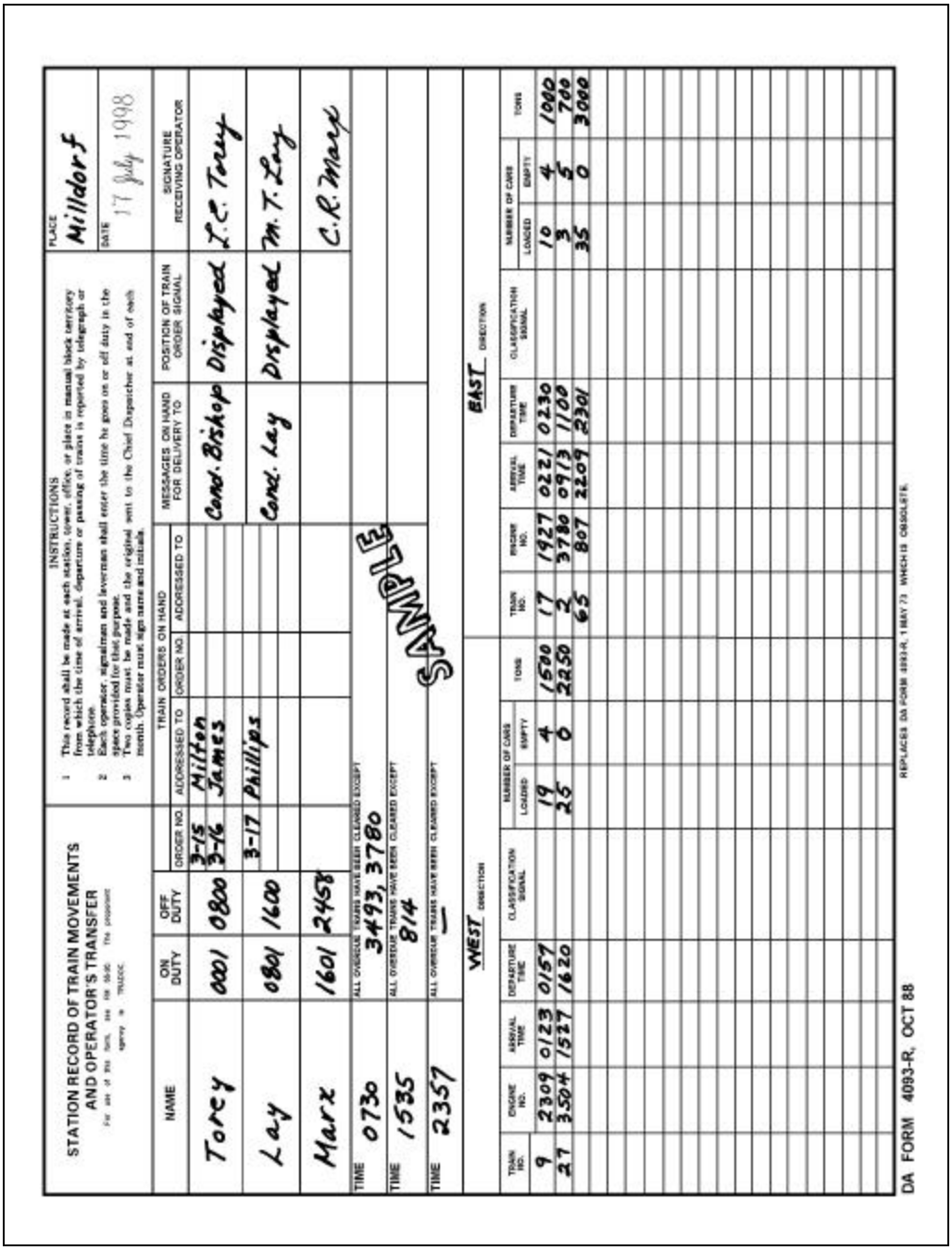


Figure 4-4. Sample DA Form 4093-R

Double-Track Operation

4-11. In a double-track operation, each track is designated a direction of traffic specified by timetable. No deviation by crews is allowed without specific orders from the dispatcher. The dispatcher must continue to ensure that inferior and superior trains do not meet and that opposing trains are

separated. Although double-track operations are simpler than single-track operations, the density of traffic is generally two or three times greater than on a single line. Most double-track lines are equipped with automatic block signals. These signals require the dispatcher to space the trains so that neither of them are hindered by the reduce-speed and stop signals of the train ahead. Proper train spacing is a delicate phase of dispatching. Too much starting and stopping results from trains being too close together.

Multiple-Track Operation

4-12. Multiple-track systems are rare in military operations. Since towers (as directed by the dispatcher) control movement, the dispatcher determines the flow of traffic for each train in order to provide greater movement flexibility and track use. On three- and four-track systems, the operating problems are even further reduced. Four tracks are ideal because they can provide high- and low-speed tracks in both directions. High-speed tracks are usually on the outside to permit passenger trains to load at stations. These tracks are often thought to be reserved for passenger trains only. However, express trains and fast freights can use them providing they can make passenger-train running time. The flow of traffic can be more rigidly enforced on a four-track system because there are two tracks running in each direction.

4-13. Some railroads make a strict distinction between the standards of low-speed and high-speed track. On the low-speed track, lighter rail is used, less ballast and subballast maintenance is performed, and tie renewal is considered less often than on the high-speed track. The tracks are designated either freight or passenger, and trains are interchanged only in emergencies. Continued operation of heavy freights over passenger tracks require constant maintenance work to keep them in the condition required to give maximum riding comfort.

4-14. Many railroads make no distinction between the standards of the low-speed and high-speed tracks. The weight of the rail is identical, and the ties and subgrade are the same. The terms "high speed" and "low speed" may be used to describe these tracks, but the timetable would refer to them as numbers 1, 2, 3, and 4. A train would generally only run against the flow of traffic if both tracks in one direction were blocked or otherwise rendered unusable.

DISPATCHING PERSONNEL

4-15. Railroad main line operations are complex, involving the movement of freight, passenger, and mixed (freight and passenger) trains from one terminal or yard to another over a division or subdivision of track. Competent dispatch personnel are needed in order to ensure that these coordinated operations are successfully accomplished.

Chief Train Dispatcher (Chief Dispatcher)

4-16. A chief train dispatcher is in charge of the dispatch office. He supervises train movement, reroutes rail traffic in emergencies, determines train tonnage, orders motive power, determines rail line capacity, and establishes train movement priority. The chief dispatcher initials all orders, messages, and instructions. In any matter affecting main-track operations, he acts as the superintendent.

Train Dispatcher (Assistant Chief Dispatcher)

4-17. The assistant chief dispatcher may be assigned at a division terminal. An assistant chief must be qualified to assume responsibility of the chief dispatcher. He must also be qualified to assume responsibility of any train dispatcher working in the particular office, on shift, or in emergencies. A large portion of work may be devoted to processing telegraphic accident reports and in preparing train delay reports. The office train master or superintendent uses these reports. He does other related work as prescribed by the chief dispatcher.

Senior Train Dispatchers and Train Dispatchers

4-18. A train dispatcher is responsible for main-line movement of passenger and freight trains on a division. His objective is to get scheduled trains from one end of the division to the other according to their published timetables. He must also get extras (unscheduled trains) over the road in the briefest (but safest) possible time.

Car Distribution Clerk

4-19. The car distribution clerk maintains visibility for all railcars (including loaded or empty cars) in the division area. The car distribution clerk will compare the car requirements for loading with the location of empty cars and will prepare the documentation for redistribution of railcars as desired. He will also report any delays in car unloading to the chief train dispatcher.

4-20. A car distribution clerk uses DA Form 5619-R (Figure 4-5, page 4-12) in performing his duties. A blank copy of DA Form 5619-R is shown in Appendix A. You may reproduce this form on 8 1/2 x 11-inch paper.

4-21. The number of empty cars shown on the various yard reports are totaled by the distribution clerk and entered on the consolidated empty car report. The forms for this report are not only different among railroads but also between civilian and military railroads. As empties move out of a yard, the distribution clerk deducts them from his master report. The next report from the yard omits those moved but includes others accumulated since the previous report. A report from a yard often does not change greatly from its previous one. The principal change is in the figures for "switched" and "not switched" cars.

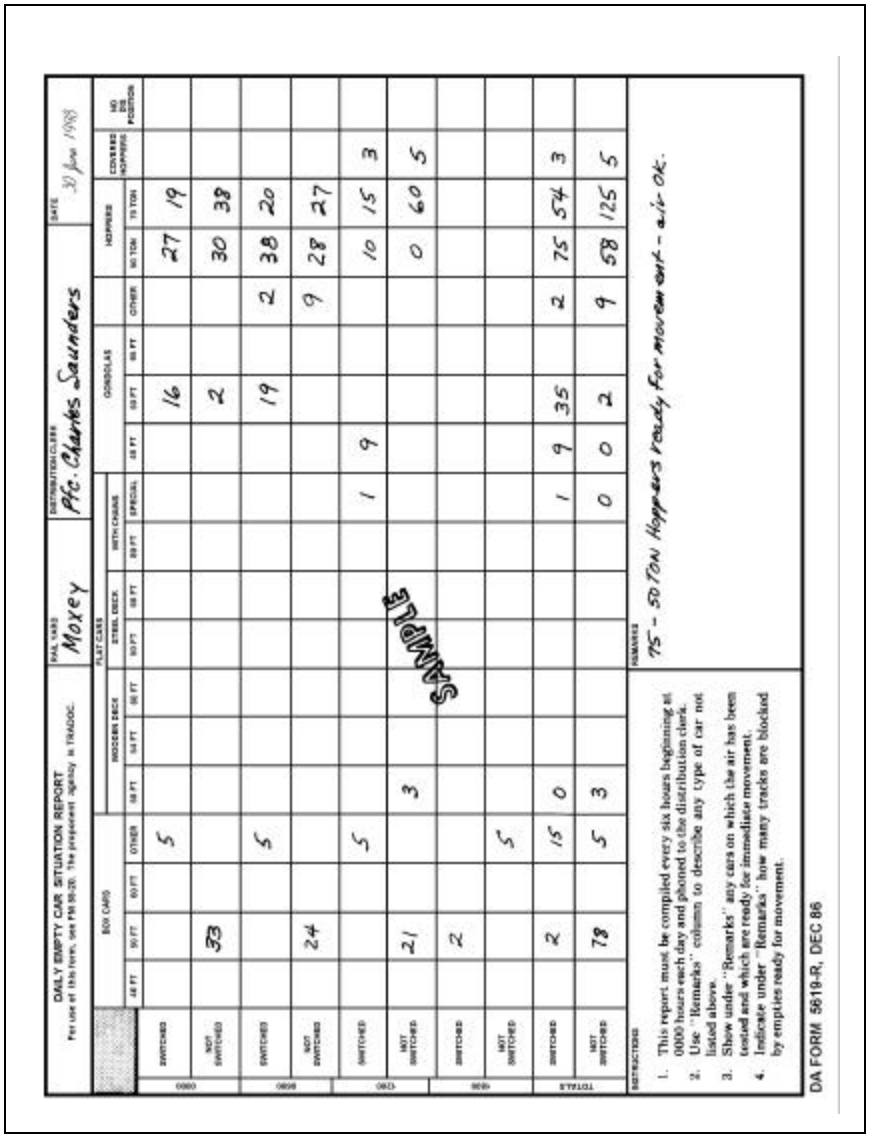


Figure 4-5. Sample DA Form 5619-R

TIMETABLE

4-22. A timetable authorizes the movement of scheduled trains. Designators in the timetable show train superiority. First-class trains are superior to all other class-designated trains. Extra or unscheduled trains are inferior to all regular trains having a class designator. No superiority or inferiority exists between extra trains. The timetable on a single track also specifies the superior direction. Division timetable pages dealing with schedules appear similar to those in the timetables furnished to the traveling public. The two timetables should not be confused because the division timetable contains much greater detail. You could use the division timetable as a supplementary book of rules to amend, supplement, extend, and even interpret many of the standing operating rules.

4-23. In addition to the schedule of trains, a typical division timetable includes a variety of information. Table 4-1 shows the various types of data and instructions that may be found in a division timetable.

4-24. When schedules are worked out for publication in a single-track timetable, the meets of scheduled trains are planned so train orders are unnecessary. However, scheduled trains may often run late. When they do, train orders must be issued to other trains on the line to assist the overdue trains in getting back on schedule or to prevent them from delaying other trains or operations.

Table 4-1. Data in a Division Timetable

Reduce speed areas	Company doctors, surgeons, and oculists.
Yard limits	
Weight limitations of-	Special signal indications by name, location, and significance.
Track	
Bridge	Passing sidings and their capacity in cars (available footage).
Trestles	
Coal tipples	Location of and special instructions regarding--
Engine restrictions	Spring switches.
Close-clearance points	Time relay switches
	Derails.
Location of-	New or nonstandard switching and signaling mechanisms.
Fuel and water facilities	
Standard clocks	Special instructions on--
Telegraph offices	Care and lubrication of journal boxes.
First aid supplies and stretchers	Handling of cars having overheated journal bearings (hotboxes).

Running Ahead of Schedule

4-25. The right of a regular train to occupy the main track at a particular time is established in the timetable. The train must travel in strict accordance with the published time figures in the train schedule. A train cannot gain time en route and arrive at the various stations before it is due. A train may gain time between any two successive stations, but it must not pass the advance station earlier than the time shown in the timetable. When yard crews desire to cross or foul main tracks, or when an inferior train occupies a track ahead of a superior one, crews must adhere strictly to the published time figures in the timetable. Yard crews must never operate on or across main tracks (unless within yard limits) without the authority of the dispatcher.

Running Behind Schedule

4-26. When a train becomes late according to its schedule, the result is many other delays to inferior trains running over the division. Likewise, yard engines required to use or cross the main tracks in doing their work may also be delayed. When a regular train becomes late, the dispatcher must be cautious in authorizing movements that might interfere with its progress and efforts to get back on

schedule. The dispatcher would likely have no way of knowing how many minutes the engineer may have gained since he reported past the last station. If the dispatcher takes no positive action, the crews on the division must respect the published time until they are otherwise directed by a train order.

LOSS OF TIMETABLE SCHEDULE

4-27. On occasion, a scheduled train may lose its right and its schedule. With a loss of schedule, the train loses its right to continue occupying the main track. Loss of schedule and restricted superiority are entirely different events and distinction must be clearly understood. A train may have its timetable superiority temporarily suspended by a train order. This suspension puts restrictions on the train. These restrictions are only temporary and the train continues on its normal schedule after the train order is fulfilled. However, on two occasions the train actually loses its schedule and therefore, its superiority.

More Than Twelve Hours Late

4-28. When a scheduled train becomes more than 12 hours late, it is said to "die on its schedule." A train will die on its schedule if it arrives more than 12 hours late at a scheduled station or departs more than 12 hours late. This means that it has lost its schedule and that all train orders, if it holds any, are annulled. The train can proceed from the point where it loses its schedule only on new train orders from the dispatcher. FM 55-21 specifies both arriving and leaving time as conditions in determining if a train will lose its schedule. In either event, the dispatcher would have to recreate the train as an extra or run it as a section of another scheduled train. Loss of schedule should not be a common occurrence because some positive action should be taken to assist a train or annul its schedule before it becomes 12 hours late.

Change of Timetable

4-29. A train may lose its schedule because a new timetable is issued. When a train is late and is going to overlap a new timetable, the train's schedule must be annulled and recreated as an extra.

SUPERIORITY AND RIGHT

4-30. "Right" as a dispatcher uses it, can be conferred by train order alone. "Superiority" is granted by the timetable based on a train's superior class or superior direction. A regular train may have timetable authorization or timetable superiority, but not necessarily superiority by right. In single-track operations, a train is generally superior to another train by right, class, or direction—with right being superior to class or direction. Direction is superior between trains of the same class. In double-track operations, a train is generally superior to another train by right or class—with right being superior to class. Direction is not significant in double-track operations since each set of tracks would normally carry traffic in the opposite direction. Direction is a factor in single-track operations since trains can travel toward each other on the same track.

4-31. Class is conferred by timetable and cannot be raised or lowered by train order. Class can be taken away by annulling the train schedule and running the train as an extra. Extra trains are inferior to all others. On most railroads, when two extra trains meet on a single track, the train moving in the superior direction holds main track, while the other takes siding.

TRAIN ORDERS

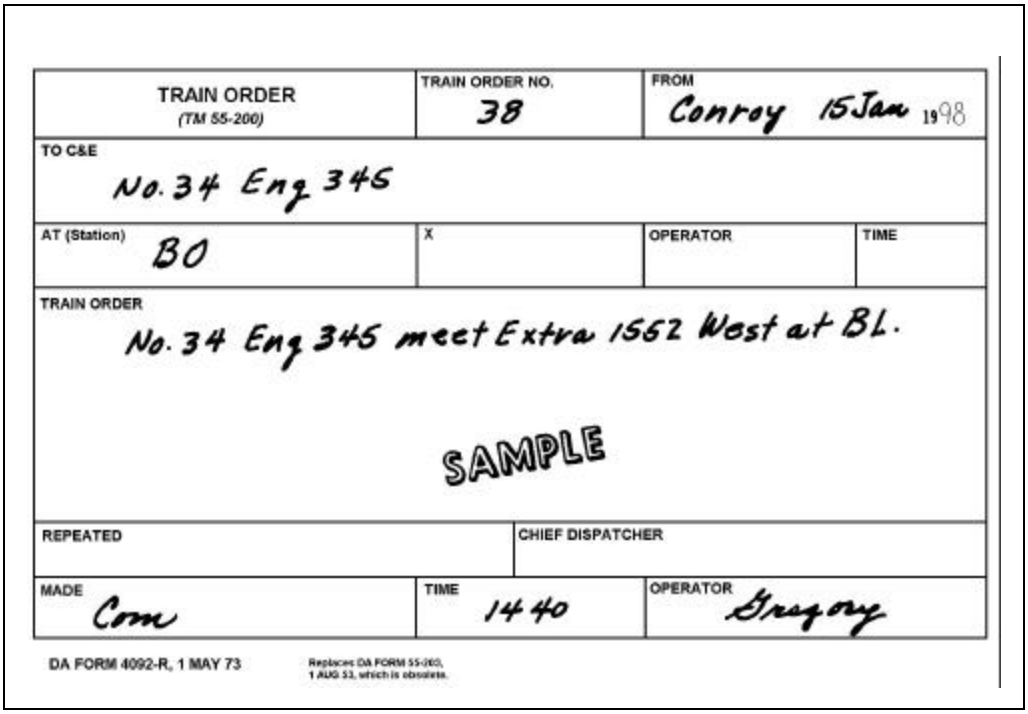
4-32. DA Form 4092-R authorizes the movement of trains not provided for in timetables. A sample of a DA Form 4092-R is shown in Figure 4-6. A blank copy of DA Form 4092-R is shown in Appendix A. You may reproduce this form on 8 1/2 x 11-inch paper. A train dispatcher issues the train order orally by radio or by telephone through a station agent. The station agent writes the order as received and repeats back the information to the sender to make sure it is accurate. The written order is handed to passing train crews. Train orders are numbered consecutively each day beginning at 0001 hours and are in effect until they have been fulfilled, superseded, or annulled. When subdivisions of a railroad are under the jurisdiction of more than one dispatching office, a different series of numbers are used by each office to prevent duplicating numbers for crews operating in more than one dispatcher's territory. Orders are addressed to station agents, conductors, enginemen, or anyone who is acting as a pilot.

4-33. A train order conveys the dispatcher's instructions to the crew. An order may amend, annul, or supersede the class and directional superiority that the timetable establishes. However, it does not waive compliance with a rule for one train unless it instructs another crew to protect the first train.

4-34. When the train order controls movements, the dispatcher's movement plan must be totally correct. Orders must be transmitted, relayed, or otherwise delivered in a foolproof manner. The language of the order must be unmistakably clear to prevent misinterpretation. Strict accuracy of stated time, engine number, station call letters, and direction is critical.

4-35. Crews receiving train orders must properly interpret and execute the orders. With involved orders or series of orders, careful reading and concentration are necessary. Crew members must read and repeat orders and then listen to others read and repeat them. It is prohibited for one member to read and interpret orders to other members. Other members may be influenced by incorrect interpretation and they, in turn, may also misinterpret the order. Discussing complicated orders is advisable, and complete and unanimous agreement should exist before acting on an order.

4-36. Dispatcher's should write train orders in clear and legible handwriting. In writing orders, even hours should not be used in stating time. Specifying time in even hours is conducive to misunderstanding. When time normally would be 1300, it should be adjusted a little ahead or a little behind (for example 1301 or 1259).



TRAIN ORDER
(TM 55-200)

TRAIN ORDER NO. 38

FROM Conroy 15 Jan 1998

TO C&E
No. 34 Eng 345

AT (Station)	X	OPERATOR	TIME
BO			

TRAIN ORDER
No. 34 Eng 345 meet Extra 1562 West at BL.

SAMPLE

REPEATED	CHIEF DISPATCHER

MADE	TIME	OPERATOR
Com	1440	Gregory

DA FORM 4092-R, 1 MAY 73 Replaces DA FORM 55-200, 1 AUG 53, which is obsolete.

Figure 4-6. Sample DA Form 4092-R

4-37. When dictating train orders, the dispatcher writes in the train-order book as he reads. He records all stations and trains to which the order is addressed. Each operator copies the entire text of the order in longhand and puts his call letters in the heading. Operators repeat the order from their copy in the same sequence as they were addressed. Figures, engine numbers, and dates are given by pronouncing the number followed by the identification of the individual digits that make up the number. For example, Eng. 345 (three hundred forty-five, three-four-five) or 14 November (fourteen, one-four). Use this procedure in dictating and repeating train orders.

4-38. After the order is copied, the first operator addressed by the dispatcher reads the order back. As the operator repeats the order, the dispatcher underscores each word. If the repetition is correct in all respects, the dispatcher completes the order by saying "complete" and giving the exact time. The word "complete" (abbreviated "com"), is written along with the time in the appropriate spaces at the bottom of the train order (see Figure 4-6). Then, in turn, each of the other operators repeats the order from his written copy.

4-39. As the order is read, the dispatcher underscores each word in his train-order book and completes the order as he did for the first operator. Train orders have no validity until they have been completed according to the superiority of the particular trains. The order for the superior train, which is being restricted, must be completed before the order for the inferior train, which the order helps. The only exception to this procedure is known as the "X" response.

4-40. When an order has been transmitted to several offices, the receiving operators must repeat the order at once. The order is repeated in the succession in which the offices are addressed. The dispatcher and all operators on the wire listen for any flaws or omissions in the repetitions. Occasionally, the last operator must repeat the order first. This is permitted when the order can be

completed and delivered to an inferior train, which would otherwise be delayed while several other operators are repeating the order to the dispatcher. When this occurs, the dispatcher directs that the operator receiving the order for the superior train give the "X" response. This allows the operator copying the order for the inferior train to repeat his order first and, when finished, to have it delivered. Once the "X" response is given, the order will be repeated and made complete to the inferior train before the operator copying for the superior train repeats his order. When the "X" response has been given, the order to the superior train becomes a holding order and cannot be delivered until it has been repeated and completed.

ORDERS AFFECTING SCHEDULED TRAINS

4-41. A run-late order has the same effect as changing the published train schedule for the particular trip. It sets back the schedule by as many minutes as the train is late. In handling late trains, the dispatcher has the following three options:

- Give the crew a run-late order to run late from origin to destination.
- Issue no restricting orders and permit the crew to make up as much of the late time as possible.
- Give the crew a wait order, which would specify the earliest time the train could depart the stations shown in the wait order.

A run-late order does not help the late train order because it does not permit the train to make up any of the lost time. However, a run-late order may be helpful to an inferior train. When a dispatcher issues a run-late order, he is amending the timetable schedule (called "putting out time") for the particular train for the particular trip. Therefore, he is granting others the use of the time represented by the difference in minutes between the advertised and the run-late time. If the dispatcher takes no train-order action, the delayed train would be free to make up some of the time. However, other trains and yard crews would not know the precise time to expect the train, and they could not depend on using the full lost time because this figure might be progressively reduced as the train travels over the division. Issuing a run-late order guarantees to all concerned that the amount of lost time will not be reduced.

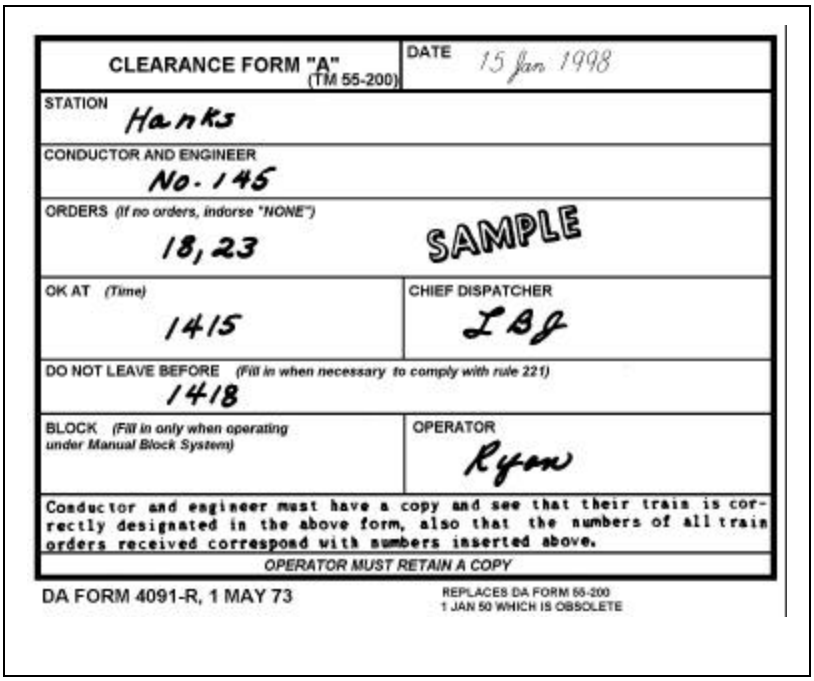
4-42. A wait order, also called a time order, may be issued instead of a run-late order. It is not popular with all dispatchers and some railroads prohibit its use. A wait order permits the engineer to make up time and tells everyone concerned about how much time will be made up. The order permits a train to make up a specified number of stations, but the train may not leave a station before a stated time. A new schedule is written for most of the run. In effect, the wait order shortens the individual running time between certain stations.

Clearance Form "A"

4-43. A train must first receive a DA Form 4091-R (Figure 4-7, page 4-20) before leaving a train order station. A blank copy of DA Form 4091-R is shown in Appendix A. You may reproduce this form on 8 1/2 x 11-inch paper. This form is not required if a train is to do station work or enter a siding. Information entered on the form must be accurate and correct without any erasures or alterations. The number of orders for the train and the number of each order must be entered on the form and checked with the train dispatcher. The number must be identical with those entered in the dispatcher's train-order book. The dispatcher gives the station agent the okay, the time the clearance

form was checked for accuracy, and he initials for the chief train dispatcher. He makes a record of the clearance in his book. The station agent enters the information received on the clearance form. The clearance form and train orders are then given to the proper personnel to be carried out.

4-44. Before leaving, the conductor and engineman must know that the numbers shown on the clearance form correspond with the orders received and that all information required on the form is correct. Notice in Figure 4-7 that a space headed "do not leave before" is provided on the form. This space is used for many purposes, but the most important one is the spacing of trains. By designating the time the train should leave, the dispatcher controls the distance and time between trains. See FM 55-21 for more detailed information.



CLEARANCE FORM "A" (TM 55-200)

DATE 15 Jan 1998

STATION Hanks

CONDUCTOR AND ENGINEER No. 145

ORDERS (If no orders, indorse "NONE")

18, 23

SAMPLE

OK AT (Time) 1415

CHIEF DISPATCHER IBJ

DO NOT LEAVE BEFORE (Fill in when necessary to comply with rule 221) 1418

BLOCK (Fill in only when operating under Manual Block System)

OPERATOR Ryan

Conductor and engineer must have a copy and see that their train is correctly designated in the above form, also that the numbers of all train orders received correspond with numbers inserted above.

OPERATOR MUST RETAIN A COPY

DA FORM 4091-R, 1 MAY 73

REPLACES DA FORM 55-200 1 JAN 50 WHICH IS OBSOLETE

Figure 4-7. Sample DA Form 4091-R

TRAIN REGISTERS

4-45. When a train prepares to leave its starting point, the crew has no way of knowing whether all superior trains have arrived and departed. The crew also has no way of knowing whether any superior trains that have passed were displaying signals for following sections. In some areas, the dispatcher advises a crew by an order of the superior trains for which they must wait before going out on the main track. At other areas, train registers are kept to furnish this information for all concerned. When a train arrives at a station where it has work or when it reaches a junction point, the conductor signs the register. He writes in the number, class, arrival time of his train, and the type of signals it is displaying (if any). Just before the train leaves, the conductor checks the register for other arrivals or departures that may be superior and then enters his departure time. Extra trains generally having no stops where the register is located are not stopped simply to register. Timetables of most railroads provide that extra trains may register without stopping. Instead, the crew throws off a message containing the necessary information and the operator enters it in the train register.

TRACK WARRANTS AND BULLETINS

4-46. The following rules pertain to those orders and instructions governed by track warrants and bulletins. These rules are applicable only within TWC limits. Figure 4-8, page 4-24, shows an example of a type of track warrant.

Rule 400. Authority

4-47. Where designated by special instructions or general order, use of the main track will be authorized (under the direction and over the signature of the train dispatcher) by issuance of a track warrant. Track warrants are numbered consecutively from the beginning of each calendar date. Within TWC territory, there is no superiority of trains and trains will not be authorized by train order or timetable schedule.

Rule 401. Designated Limits

4-48. The limits of a track warrant are designated by specifying the track, where required, and exact points such as switches, mile poles, or identifiable points. Station names may be used. When a station name is used to designate the first named point, the authority will extend from the last siding switch or from a station sign if there is no siding.

4-49. When a station name is used to designate the second named point, the authority extends to the first siding switch or to the station sign if there is no siding. At the second named point, authority extends to the last siding switch when specific instructions include "hold main track at last named point."

Rule 402. Requesting

4-50. Personnel requesting a track warrant must advise the train dispatcher of the movements to be made and, when applicable, the tracks to be used and time required.

Rule 403. Copying

4-51. The conductor and the engineer must have a copy of the track warrant addressed to their train or engine. The track warrant will show the date, location, name of person who copied it, and any specific instructions issued. All information and instructions are entered on the track warrant form provided and repeated to the train dispatcher. The dispatcher will check the copy and, if correct, will give an "OK" and the time. The OK time is entered on the track warrant and repeated to the train dispatcher. The track warrant is not considered in effect until the OK time is shown on it. If the track warrant restricts movement or authority previously granted, it is not considered in effect by the train dispatcher until acknowledgement of the OK has been received. Track warrants are relayed by authorized personnel, who must then record the message on a track warrant.

Rule 404. Designation of Trains

4-52. In track warrants and track bulletins, trains are designated by engine number and direction when applicable. When an engine of another company is used, it is designated by the initials or name of the company preceding the engine number.

Rule 405. Mechanical Transmission

4-53. At points designated by special instructions, track warrants and track bulletins may be transmitted mechanically. When so transmitted, repetition will not be required. OK time will be given at the time transmitted and the name of the train dispatcher will be shown in the space provided for name of copying personnel. Track warrants restricting the authority or movement of a train must not be sent in this manner unless it is known that the train being restricted will not leave the point without receiving the track warrant. Special instructions will prescribe how track warrants and track bulletins are to be delivered at these points.

Rule 406. Specific Instructions

4-54. Track warrants will include specific instructions that must be complied with by those addressed. Each track warrant must be given in the same words to all personnel addressed. Once in effect, the track warrant must not be added to or altered in any manner except as provided by Rule 411.

Rule 407. Changing Track Warrant

4-55. When a track warrant is in effect and the limits or instructions are changed, a new track warrant is issued with the instructions and will include the words "Track Warrant No_____ is void." When a track warrant of a previous date is voided, the date must be included. The previous track warrant will no longer be in effect.

Rule 408. Operating With Track Warrant

4-56. A track warrant authorizes the train or engine addressed to occupy the main track within designated limits. The train must not foul a switch at either end of the limits that may be used by an opposing train or engine to clear the main track. Movement must be made as follows:

- When authorized to proceed from one point to another, movement is authorized only in the direction specified.
- When authorized to "work between" two specific points, movement may be made in either direction between those points.

Rule 409. Occupying Same Limits

4-57. Not more than one train or engine is permitted to occupy the same or overlapping limits of a track warrant at the same time, except in the following circumstances:

- All trains or engines within the limits have been authorized to move only in the same direction and are required to provide flag protection as prescribed by Rule 99.
- Two or more crews performing switching or work service have been notified of each other and instructed that all movements must be made at restricted speed within the overlapping limits.

Rule 410. In Effect

4-58. A track warrant is in effect until a crew member reports the train clear of the limits, the warrant becomes void, or the time limit expires. The crew member must report to the train dispatcher when they have cleared the limits. If a time limit is shown on the track warrant, a train or engine must be clear of the limits by the time specified, unless another track warrant has been obtained.

Rule 411. Marking Void

4-59. The word VOID must be written legibly across each copy of the track warrant when a crew member has reported the train or engine clear of the limits, the time limit specified has expired, or the track warrant has been changed as prescribed by Rule 407.

Rule 412. Protecting Men or Machines

4-60. A track warrant permitting men or machines to occupy or perform maintenance on main track without other protection is issued in the same manner as that for trains or engines.

4-61. A track warrant must not be issued to protect men or machines within the same or overlapping limits with a train or engine, except in the following circumstances:

- All trains or engines authorized to occupy the same or overlapping limits have been authorized to move in one direction only and the track warrant specifies that it is granted behind such trains or engines.
- Trains or engines authorized to occupy the same or overlapping limits have been notified of the authority granted to the men or machines, have been instructed to make all movements at restricted speed and have been instructed to stop short of men or machines on or fouling track. The person in charge of maintenance must be so notified by a track warrant. If track is not safe for movement at restricted speed, personnel in charge must protect such track by placing red flags according to Rule 10(A).

Rule 413. Movement Against the Current of Traffic

4-62. When a track warrant authorizes movement against the current of traffic, the train or engine must use only the track designated within the limits specified.

TRACK WARRANT

NO. _____ DATE: _____

TO: _____ AT: _____

1. ☐ TRACK WARRANT NO. _____ IS VOID.
2. ☐ PROCEED FROM _____ TO _____ ON _____ TRACK.
3. ☐ PROCEED FROM _____ TO _____ ON _____ TRACK.
4. ☐ WORK BETWEEN _____ AND _____ ON _____ TRACK.
5. ☐ NOT IN EFFECT UNTIL _____.
6. ☐ THIS AUTHORITY EXPIRES AT _____.
7. ☐ NOT IN EFFECT UNTIL AFTER ARRIVAL OF _____ AT _____.
8. ☐ HOLD MAIN TRACK AT LAST NAMED POINT.
9. ☐ DO NOT FOUL LIMITS AHEAD OF _____.
10. ☐ CLEAR MAIN TRACK AT LAST NAMED POINT.
11. ☐ BETWEEN _____ AND _____ MAKE ALL MOVEMENTS AT RESTRICTED SPEED. LIMITS OCCUPIED BY TRAIN OR ENGINE.
12. ☐ **BETWEEN _____ AND _____ MAKE ALL MOVEMENTS AT RESTRICTED SPEED AND STOP SHORT OF MEN OR MACHINES FOULING TRACK.**
13. ☐ DO NOT EXCEED _____ MPH BETWEEN _____ AND _____.
14. ☐ DO NOT EXCEED _____ MPH BETWEEN _____ AND _____.
15. ☐ PROTECTION AS PRESCRIBED BY RULE 99 NOT REQUIRED.
16. ☐ TRACK BULLETINS IN EFFECT:

_____. _____. _____. _____. _____. _____.
_____. _____. _____. _____. _____. _____.

17. ☐ OTHER SPECIFIC INSTRUCTIONS:

_____
_____
_____

OK _____ DISPATCHER _____.
RELAYED TO _____ COPIED BY _____.
LIMITS REPORTED CLEAR AT _____ BY _____.
(Mark "X" in box for each item instructed)

Figure 4-8. Type of Track Warrant

TRACK BULLETIN (DA FORM 5706-R)

4-63. Within TWC territory and other territories designated by special instructions; the train dispatcher, as required, will issue DA Form 5706-R (Figure 4-9, page 4-24). Bulletins contain information as to all conditions affecting the safe movement of trains or engines. When track

bulletins are authorized, trains and engines must receive a track warrant at their initial station unless the train dispatcher instructs otherwise. All track bulletins, which affect their movement, must be listed on the track warrant. The conductor and engineer must have copies of all track bulletins listed. Each crew member must read and understand the requirements of any track bulletin he receives. Figure 4-9 shows a completed copy of DA Form 5706-R. A blank copy of DA Form 5706-R is shown in Appendix A. You may reproduce this form on 8 1/2 x 11-inch paper. Instructions for completing this form are also shown in Figure 4-9, page 4-24.

EXTRA TRAINS

4-64. An extra train is a train not designated by timetable. These trains are designated as extra, extra passenger, and extra work trains. Since extra trains are not authorized by timetable, they are identified by the number assigned to the locomotive pulling the train. For example, when locomotive 310 is used to move a train eastward, the train is numbered "Extra 310 East" or "Work Extra 9220."

Work Trains

4-65. Work extras are work trains from which personnel perform track maintenance and construction along the right-of-way between specified points. Since these trains move in both directions, no directional designator is used when referring to them. Unless provided in a train order, a work extra must clear all regular trains and protect against other extras in both directions. A work extra may not protect against a regular train; that is, work on the time of an overdue scheduled train under flag protection unless instructed to do so by a train order. A train is "protected" when the crew stations a flagman adequately ahead or to the rear of the stationary train to stop any approaching train. Since work trains are almost always stationary, it is practical to have them protect themselves against all trains. Work trains are located fairly close to a siding so that they can enter the siding to clear the main track as another train approaches. The work train's conductor ensures that his train clears all regular trains as specified by the rules. When a wayside dispatcher telephone is near, the conductor maintains almost constant contact with the dispatcher regarding the approach of extras. A work train that occupies a main track has a flagman who must flag the main track to alert any approaching train. He is relieved from flagging only when his train clears the main track. A number of blasts sounded on the locomotive's whistle signals that the track is clear.

Work Train Orders

4-66. When a work train must frequently move back and forth, it is impractical to have the flagman walk ahead of the train. The dispatcher, knowing the kind of work being done and the extras moving in the area, may issue an order that permits the work train to move unhampered. If no extra is to arrive at the work limits before a specified time, the dispatcher may issue a train order that will permit the maintenance personnel to carry out their tasks without protecting the extras until that time.

TRACK BULLETIN
For use of this form, see FM 55-20. The proponent agency is TRADOC.

NUMBER: 7-30 | DATE: 30 June 1998

DIVISION: Rocky Mount | TO: Smith | AT: Morton

This bulletin supersedes bulletin number: 7-29 dated: 30 June 1998

LINE NO.	LIMITS MP – MP	BETWEEN STATION AND STATION		EFFECTIVE TIME FROM – TO	TRACK NO.	AT MP	DIRECTION	SPEED MPH (KM)	FLAGS	FOREMAN OR GANG NO.
1	34.1–38.2	Morton	Baker	0600-1500	1	34	East	10	Yes	George
2	27.4–26.8	Slay	Wombat	0700-2330	2		West	15	No	Ester
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										

SAMPLE

OTHER CONDITIONS
Line #1 – Watch out for trackmen on track #1.

OK 0100 30 June 1998
COPIED BY Smith
DISPATCHER Roy
RELAYED TO

DA FORM 5706-R, OCT 88

Figure 4-9. Sample DA Form 5706-R

Number. Enter track bulletin form number.
Date. Enter current date.
Division. Enter territory in which train is operating.
To. Identify train for which bulletin is issued.
At. Enter location of train that will receive the bulletin.
This Bulletin Supersedes Bulletin Number. Enter number of bulletin which is being superseded.
Dated. Date of superseded bulletin.
Line No. Place number for each additional instruction or order pertaining to bulletin. Include information from any previous superseded bulletin or bulletin that has not been superseded and pertaining to new track bulletin.
Limits MP to MP. Enter the milepost numbers between which the bulletin is in effect.
Between Station and Station. Enter the names of the stations between which the bulletin is in effect.
Effective Time From-To. Enter times which bulletin will be in effect.
Track No. Enter number or name of track on which the bulletin is in effect.
At MP. Enter number of milepost at which flag is displayed.
Direction. Enter direction(s) for which bulletin is in effect.
Speed MPH (KM). Enter maximum speed which may be used over territory which the bulletin covers.
Flags. Enter YES if protective flags are displayed. Enter NO if protective flags are not displayed according to Rule 10.
Foreman or Gang No. Enter foreman's name or gang number under whose authority bulletin is imposed.
Other Conditions. Enter any additional instructions or additions to track bulletin that are not covered in previous columns.
OK. Enter time bulletin was copied.
Copied By. Enter name of person copying bulletin.
Dispatcher. Enter name of dispatcher.
Relayed To. Enter person to whom bulletin was relayed.

Figure 4-9. Sample DA Form 5706-R (continued)

Protecting Against Work Trains

4-67. Trains of superior class do not protect against work trains. On double track, all operating crews know the location of the work train's work area. Notices posted in crew offices along the line specify the work area, the number of days the work will be in progress, and a reduced-speed limit for the area. On single track, all trains in each direction are given copies of the work extra's train orders. Instructions generally require all work extras to clear the trains without delay. However, no approaching train, regardless of superiority, tonnage, or importance will run past a work train flagman.

Military Work Trains

4-68. In a theater of operations, it may be necessary for all trains to protect against work trains– signifying that the work train has a higher priority than the trains hauling troops or supplies. In civilian practice, a work train may be in a particular location to do work solely to improve passenger comfort or to make long-range repairs necessary to protect capital investment. Under these conditions, it is much more economical for a work train to protect against and clear the time of all trains. A military work train may be found blocking the main track because of more pressing reasons. In a theater, passenger comfort and long-range maintenance are not main priorities. Work trains operate only when absolutely necessary to keep trackage reasonably fit for supply and troop trains. Failure to do track work quickly could result in a blockage in which no trains would be able to move.

Proper Work Train Flagging

4-69. Work train flagging is almost impossible to over-emphasize. When the train is on the main track, the flagman protects its rear by stationing himself far enough back to stop any approaching train. On single-track lines, the forward end of the train must be protected in a similar manner. When the work train pulls into a siding and clears the main, an appropriate number of blasts are sounded on the whistle. This is called "whistling in" the flagman. Before the train again blocks the main, a specified number of blasts are sounded and the flagman goes out to flag. This is called "whistling out." The number of blasts varies according to the direction in which the train is headed and to the number of main tracks. The alternate whistling in and whistling out, which occurs when a train clears and blocks the main, involves a hazard that operating rules do not stress and one that safety spokesmen seldom point out. The danger that occurs during flagging is that the flagman may forget whether he is on the main track or in the siding. To keep track of his position, the flagman maintains radio contact with the work train conductor.

Sections

4-70. Running additional sections are often necessary when handling passenger trains. A section is one of two or more trains running on the same schedule. Technically speaking, there is no such thing as a passenger train. A train either has a class designator or it is an extra. While it appears logical that if there are no passenger trains, there could be no extra passenger trains. Some railroads require all trains be designated by class or extras. Other railroads recognize the need for the extra passenger train designation and use it for trains that cannot be run on another train's schedule. This designator receives more respect from yard crews and from crews of trains

of equal class. However, crews of scheduled trains must regard the extra passenger as inferior to their own.

4-71. The dispatcher, when required, could authorize an additional train and call it a section. To give this section first-class standing, the dispatcher can run it as a continuation of a first-class scheduled train and call it a "second section." The dispatcher can give this section right over other trains that would otherwise be superior by calling the section "Second 87" or some other train number. By doing so, the regular train becomes "First 87." Both trains would receive train orders, and the engine of the first section would have to display signals for another section.

CENTRALIZED TRAFFIC CONTROL

4-72. Operating a rail division controlled with CTC is much simpler than operating by the other methods. The dispatcher merely flips a switch on the CTC panel. The switch opens a yard switch and lights a proceed signal for the train. The dispatcher does not advise the train crew of his plans and written orders are not necessary. Tracks have signals facing in each direction and there is no established flow of traffic in CTC-controlled areas. This gives the dispatcher complete flexibility of train movement. He may run trains on any track in either direction. Regardless of the class of a train, it can continue to move against or ahead of trains of a superior class as long as a signal tells it to do so.

4-73. The CTC system eliminates reading, repeating, interpreting, and remembering the provisions of many train orders that would ordinarily be received. The crew receives visual orders from the signal lights at the time and point where they are to be executed.

4-74. Many foreign railroads use electric interlocking (an early form of CTC). The layout may extend for several kilometers on each side of the control tower from which the interlocking plant is operated by a towerman. However, his control ends where the tracks join the area under the control of the dispatcher. Generally used at congested junctions and terminals, such installations allow the dispatcher and the tower operator more flexibility in handling trains and yard movement in yard limits.

4-75. The dispatchers control panel or board has diagrams representing the track layout. All areas under his jurisdiction controlled by CTC are shown on the panel. Small indicators, mounted at intervals along the board, light up as the train reaches the point on the railroad represented by each particular indicator. A dispatcher can watch the progress of any train within his jurisdiction merely by observing the lights. He can also check the speed of a train by timing it between two lights. He knows when a train makes an unscheduled stop or when it is losing time. The engine crew never knows its exact path of travel until a short distance before reaching a point of divergence. Reduce-speed signals are displayed enough in advance of a change of track to give an engineer time to slow down. The engine crew relies on the permissive and restrictive aspects of the signals automatically displayed when the dispatcher opens or closes the switches.

4-76. The CTC system has a safety feature that makes it impossible for a dispatcher to suddenly take away a permissive route for a train after the engineer comes in sight of the signal. Although the dispatcher can take away the displayed permissive signal and flash a restrictive signal "in the face" of the crew, the switches controlling the track route cannot change if the engineer lacks enough time to comply with the change signal. The system is wired so that the dispatcher cannot set up conflicting moves. Single-track installations are connected so that if a train fails to make a

stop specified by a signal, other signals in advance of the train are automatically displayed to stop a train that may be approaching on the same track from the opposite direction.

4-77. CTC is used mainly on single-track sections. Some railroads have converted double-track sections to a single-track layout. The results have been reduced maintenance-of-way costs and accelerated freight train schedules. Using CTC often permits an increase in train density because the delay caused by wait-and-meet orders is reduced. With CTC, a dispatcher is often able to get two trains by a given point without stopping either one. This is done by keeping one moving through a siding while the other passes on the main track. If a siding is long enough, or if a single track branches for several kilometers into a double track, a dispatcher may also have a train pass another in the same direction without reducing the speed of either.

Chapter 5

Main Line Operations and Procedures

Main line operations and procedures are complex. They involve the movement of freight, passenger, and mixed (freight and passenger) trains from one terminal or yard to another over a division or subdivision of track. In addition to their complexity, main line operations are a prime target of enemy NBC weapons. Contingency plans must be developed with the capability and flexibility to continue main line operations in an NBC environment.

TRAIN OPERATING COMPANY PERSONNEL

5-1. In military railroading, the train operating company of the transportation railway battalion provides crews for operating locomotives and trains. These crews operate either freight or passenger trains over a main line or engines in rail yards. Certain terms are used to distinguish between crews. Use of the terms "yard crew" and "road crew" refers to the crew's place of employment. The term "ground crew" applies to a yard conductor and his brakemen.

5-2. A road crew normally consists of the following:

- Conductor.
- Locomotive engineman.
- Senior brakeman.
- Brakeman.

If steam motive power is used, a fireman will be added to the crew. One of the two brakemen normally assigned accompanies the engine or rides the train near the head end. He is known as the forward or head brakeman. The other brakeman is permanently assigned to rear-end flagging duties. The rear brakeman is known as the flagman. A third brakeman may be assigned when the work load demands his service. The engineman and the fireman (if one is assigned) are called the engine crew. The rest are known collectively as the train crew. The conductor is in charge of the full crew (both trainmen and enginemen).

5-3. Military railroads in theaters of operations often needs armed security guards to accompany a train to help protect shipments against pilferage. Such personnel are not a part of the crew. All personnel will have their MOPP equipment with them during main line operations.

CALLING AND REPORTING

5-4. When a road crew is called for duty, each member should receive a written or a verbal notice giving the time called, the train's destination, and its type or symbol number. Depending on the distance they are from their duty stations, crews receive notice from 1 to 2 hours ahead of the time that they are called for work.

5-5. Upon reporting for duty, crew members sign a register and read and sign an acknowledgment of any newly posted general orders or bulletins that may affect operations over the portion of railroad their train will travel. They are told the engine number for the trip. Crew register offices have standard clocks with which all crew members must synchronize their watches. The conductor finds out from the yardmaster the track number the train is on and what track the road engine is to use to go to that track.

Train Crew Duties

5-6. The locomotive engineman (or engineer) operates the locomotive and runs the train according to the following:

- Operating rules.
- Timetable.
- Train orders.
- Other general notices or directives.

Although a locomotive located "first out" on a ready track is practically guaranteed to operate properly, the engineman should inspect the fuel, sand, water, and lubricating and valve oil. He should also inspect and oil (if necessary) the running gear of the locomotive. The engineman and the head brakeman move the locomotive or road engine from the ready track to the departure yard. A hostler is a person who moves engines around yards and enginehouse areas. On some railroads, a hostler may take the engine from the ready track to the yard track.

5-7. The brakemen line switches at their respective ends of the train. They couple and uncouple cars, connect and disconnect air hoses, set hand brakes, and relay hand signals (as does the conductor). The brakemen also takes every opportunity to inspect the train for malfunction of equipment or shifting of cargo.

5-8. The senior or head brakeman gives signals (by hand, lantern, flag, or verbal orders) for the movement of trains. He should ride on or near the engine for the entire trip and do all front-end flagging. He repeats signal aspects as the engineman calls them to ensure that concerned personnel are reading them the same way. The head brakeman observes trains for any errors that may be displayed in signaling.

5-9. When the head brakeman and engineman take a road engine from the ready track, they bring it to the departure yard and back it against the train. After the engine is coupled to the first car of the train, a road test should be made of the air brake system. Signal flags identifying the class of the train are mounted when required.

5-10. The flagman checks his flagging equipment (which includes flags, fuses, torpedoes, and lanterns with red and white lights). He mounts the marker lanterns, disks, or flags on the rear car to give the train official standing, after it is on the main line.

5-11. The conductor is responsible for the whole train. The conductor compares watches with the engine crew and briefs them on the orders they hold and the work they will do en route. He reports to the yard office for waybills and train orders governing his trip on the main line. The conductor performs the following at the yard office:

- Checks the waybills against the train consist.
- Prepares the wheel report.
- Supervises the disposition of cars set off.
- Surveys accidents or mechanical failure of equipment (including reporting damages or delays).

The conductor, along with the other crew members, observes signals from towers, stations, and from other trains. He receives and acts on any additional train orders en route. The engineman will not move the train until he receives the signal from the flagman to depart. When the train leaves the yard and enters the main line, the dispatcher controls its movement. However, the conductor must see that his train runs according to operating rules and that it does not run ahead of time.

5-12. If the train is not a through train, the conductor will usually make a penciled lineup and call the dispatcher regarding setoffs en route. The dispatcher may tell the conductor what stations have pickups for the train. If both telephone and dispatcher circuits exist, the conductor may call two or three stations ahead. When contacting a distant yardmaster or station agent, the conductor does the following:

- States what cars he has to set off and determines on which tracks they should be placed.
- Determines what cars will be picked up; the track number; and, if pickup will be some distance from the yard office, the location of the waybills and wheel report. When a train must pick up cars some distance from a yard office, the waybills may be delivered to the moving train by a message hoop to prevent the train's stopping twice. If weighted and protected against bad weather, bills may be left on the end of the first car of the pickup.
- Asks the yardmaster where waybills should be left if the train is setting off cars some distance from the yard office. A yard receiving a setoff of only a few cars may station someone along the track to catch waybills thrown off the moving engine. Bills should be wrapped securely around a rock or other heavy object to prevent the possibility of a vacuum drawing them under the car wheels.

Departure Procedures

5-13. Before a train leaves the yard, the crew makes a road test of the air brake system. Upon coupling the locomotive to the train, the engineman starts the locomotive's air pumps to bring the trainline or brake-pipe pressure within not less than 5 pounds below the standard pressure prescribed for the train. When this figure is reached, the flagman signals the engineman to apply the brakes and to reduce pressure by 15 pounds on the brake-pipe gauge. This is called a service reduction. The amount of brake-pipe leakage must not exceed 5 pounds per minute as noted on the brake-pipe gauge. When the brakes are applied, it indicates the flow of air is uninterrupted on the entire length of the train. A signal is then given to release the brakes. After this test, the reduction must be increased to 25 pounds. If the brakes apply and release, it is assumed that they have performed the same on the entire length of the train. This assumption is based on the fact that car inspectors have previously made a terminal air test and have walked the entire length of the train to ensure the brakes have applied and released on all cars. If car inspectors are not on hand, a conclusive air test can be made by a crew member walking beside the train and observing each car. After the air test, and if train-line or brake-pipe leakage is within permissible limits, the train is ready to pull.

5-14. At the head end, the conductor will brief the head brakeman and engineman on the type of train and at what yards they will have setoffs and pickups. He will advise the head brakeman how to handle waybills at each stop and will pass verbal orders from the dispatcher. If there are many stops to be made or if instructions are involved, instructions may be given in writing. Waybills and sections of the wheel report for cars that will be set off en route are given to the head brakeman. Through waybills are kept by the conductor for additional clerical work.

Locomotive Instruments and Controls

5-15. The engine crew assumes the chief role in the safe and expeditious progress of a train on the main line. A number of locomotive controls are used to keep a train running smoothly, speedily, and safely. The objective of the engine crew is to take the train over the road safely in the scheduled time, using the least amount of fuel with minimum wear on the rail equipment.

5-16. The engineman's principal controls on a diesel-electric locomotive are as follows:

- Throttle lever that regulates the engine's speed.
- Reverse lever that controls magnet valves in the reverser.
- Independent and automatic brake valves that control the locomotive brakes only, and locomotive and car brakes, respectively.

AUTOMATIC SIGNAL SYSTEMS

5-17. Railway signals are devices, indications, and signs that control the movement of trains along tracks and into and out of stations, terminals, and yards. These signals may be given by hand or by a complex, automatically operated electrical system. Signals may be fixed such as whistle posts, speed, and yard limit signs.

Block Signal System

5-18. The automatic block signal system permits faster train speeds than any other signal system. It is designed to maintain predetermined intervals between trains by means of the track circuits and appropriate electrical equipment activated by the trains. A section of track is divided into blocks; each block is governed by a three-position light or semaphore signal. An approach aspect displayed in each block indicates the situation in the next (succeeding) block. Therefore, each train is protected to its rear by a signal indicating that the following train must proceed at restricted speed and be prepared to stop if the block is occupied. The system may be used on single- or multiple-track to control following or opposing trains. On single-track routes, controlled movement, from siding to siding, sustains opposing traffic flow.

Central Traffic Control

5-19. A refinement of electric or pneumatic interlocking, this system permits the moving trains through an extended area (200 to 300 miles) over tracks and blocks controlled from a distant point. Division dispatchers have control over all switches and signals in the area. On a panel board or wall before them, they have an electrically lighted diagram that shows all locomotive or train locations, switch positions, and signal indications on the controlled sections of track. Using a control machine, they can change switch positions and signal indications as required.

Interlocking Plants

5-20. Foreign railroads often use interlocking plants and/or switch towers. Unit personnel may be required to control, operate, and maintain them in a phase I operation or to furnish supervisory personnel in phase II and III operations. Conditions in a theater of operations seldom are stable enough to justify installation of new interlocking plants. However, if possible, existing plants should be used in areas of heavy traffic. Figure 5-1 contains a list of definitions that personnel should be familiar with in order to understand further discussion.

Control tower (interlocking station) -- The place from which the interlocking plant is operated.
Interlocking machine -- An assembly of manually operated levers or push buttons used to control mechanically or electrically operated lights, signals, switches, derails, and other units.
Electric lock -- A device which prevents movement of a lever, switch, or other moveable object until properly released.
Foundation -- A fixed support for signal devices.
Lead out -- Mechanical connections between the interlocking machine and outside equipment.
Pipelines -- Connections made with pipe or tubing and the supporting apparatus leading fromthe operating lever to the operated unit.
Switch mechanisms -- Fittings for equipping a switch.
Signals -- Home, distant, and dwarf signals of an interlocking plant.

Figure 5-1. Definitions

Operation

5-21. Interlocking plants may be operated manually, electrically, or electro-mechanically. The interlocking machine consists of a series of devices (so interconnected that they can be manipulated and operated only in a predetermined order) which control traffic from a central point by operating a series of signals and switches. Latches in the control levers activate interconnecting bars, crosslocks, and dogs that prevent incorrect order of operation. A lever in the machine or a button in the control panel regulates all signals and switches of that particular interlocking. The switches and signals are interlocked electrically and mechanically to ensure that the proper signal is displayed for a specific route and that the switch points match the displayed aspects.

Location

5-22. An interlocking plant is centrally located in a large terminal or junction at a point of maximum visibility. Specifically, interlocking installations usually are found at the following:

- Entrance or exit of large freight and passenger terminals.
- Large receiving, classification, and switching yards. Railroad crossings for trains traveling in different directions or for trains of different railroad lines.
- Junctions with the main line.

Inspection and Maintenance

5-23. Since railway signaling equipment is complex and varied in design, concise instructions covering its maintenance and repair cannot be included within the scope of this FM. Manufacturer's manuals contain specific details of construction and design. In oversea theaters, these publications normally are not available for the signal equipment that rail units may encounter. Therefore, whether or not this equipment can be used depends on its similarity to American equipment, the possibility of repair or replacement with like items, and the ingenuity of rail signal personnel. Maintenance required is directly related to the quality and frequency of inspection. Constant, careful inspection and testing greatly reduce maintenance requirements.

Safety Procedures

5-24. When defective elements or parts of a signal system are removed, the signal devices must be arranged to display the most restrictive aspects. Under no circumstances should agents, operators, or train personnel make any but the most minor repairs. Railway signal equipment is intended to provide the fastest train movement possible under safe operating conditions. If repair is not rigidly controlled, signal equipment deteriorates until it becomes unreliable and unsafe.

SIGNALS AND MARKERS

5-25. The three fundamental aspects to all railway signaling are: stop, caution, and proceed. The following describes the signals and markers used in railway operations.

Fixed Signals

5-26. Fixed signals are defined as any signals of fixed location that affect the movement of a train or engine. They may be in many sizes and shapes. The three basic fixed signals that are commonly found are semaphore, color light, and position light (see Figure 5-2). Aspects of fixed signals are shown by the position of semaphore arms, color of lights, position of lights, or a combination of color and position of lights.

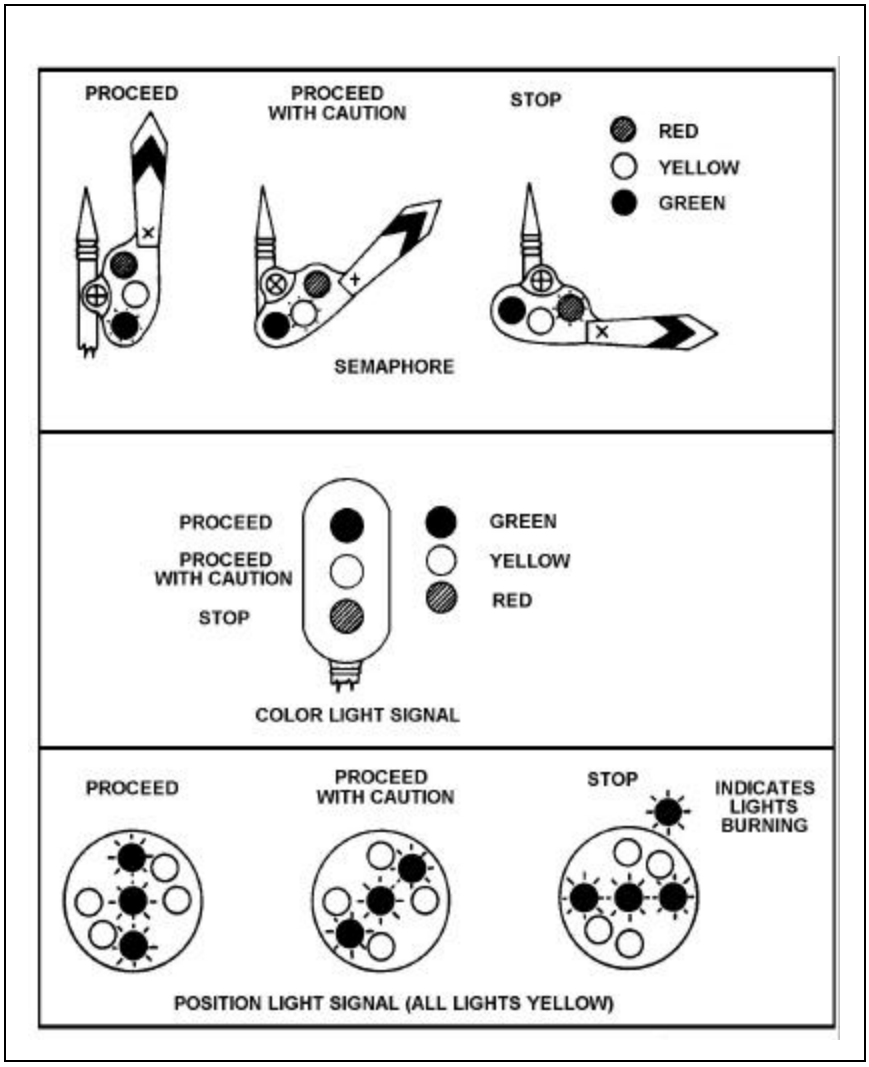


Figure 5-2. Fixed Signals

Semaphore

5-27. The semaphore consists of an arm or blade secured by a moveable mechanism to a vertical pole or mast. When the arm is in a vertical position (straight up) the train may proceed. When it is in a horizontal position (straight out from the post) the train must stop. If the signal is in approximately a 45-degree angle (between straight and straight out) the train may proceed with caution at a reduced speed. If the signal is in any position other than the three named positions, the train must stop. A signal imperfectly displayed or the absence of a signal must be promptly reported to the train dispatcher. This measure protects against defective signals endangering the movement of trains. During nighttime operations, the semaphore also has lights that can be seen as the arm is raised or lowered.

Color Light

5-28. The color light signal has three lights: red, yellow, and green. It is similar to traffic-control lights at street intersections.

- The train must stop if the light is red.
- The train may proceed if the light is green.
- The train may proceed with caution, but at a reduced speed, if the light is yellow.

As a safety precaution, the train must stop if two or more lights are burning at the same time or if all the lights are out.

Position Light

5-29. The position light signal is used extensively worldwide. Therefore, it is likely to be present in a theater of operations. This signal has yellow lights arranged in a circular pattern around a central light that burns in rows representing semaphore arm aspects. A vertical row of lights mean proceed; the next two blocks are clear. A diagonal row means proceed with caution at reduced speed; the next block is clear, but the one beyond it is occupied. A horizontal row means stop; the next block is occupied. The position of the lights rather than their color denotes the command signal. Any combination of light positions other than those stated means to stop.

Signaling Procedures

5-30. As a train leaves the yard, the engineman should begin calling and repeating signals. The engineman calls each signal indication along the main line by name. The head brakeman (or the fireman if steam active power is used) will answer the engineman as he reads the signal. All signal interpretations must agree between the engineman and head brakeman. Calling and repeating signals is essentially a safety measure.

5-31. Main-line tracks equipped with automatic block signals are divided into sections which have signals to show whether the two or more block sections immediately ahead are clear or occupied. You should try to space signals at uniform distances. However; curves, sighting distances, bridges, tunnels, traffic congestion, and speed limits frequently prevent this from happening.

5-32. The signal name, when it is first seen, is called and repeated. The engineman must watch the signal for possible changes until the train has passed the signal. Aspect 1 may change to a more restrictive aspect if a switch is opened in one of the two blocks immediately ahead. Aspect 2 cannot change to a more restrictive aspect unless a switch is opened between it and the next signal, but it may return to clear (aspect 1). Aspect 3 cannot change to aspect 1 without first changing to aspect 2, unless the train causing the indication has left the main track for a siding. The stop indication must be observed and the train must not pass.

5-33. For dispatching, the ideal arrangement for train movement is to have trains spaced so that no train will be hampered in its progress by the stop or approach signals caused by the train

ahead. However, this is not always possible, but it is a condition that dispatchers should not forget.

5-34. Besides warnings, the engineman will use the locomotive whistle or horn for a variety of signals. Operating rules prescribe certain whistle signals that must be sounded in various circumstances. These whistle sounds include the following:

- Calling for signals from towers and stations.
- Whistling persons flagging a train in and out.
- Acknowledging signals from other trains.
- Calling attention to signals the train may be displaying for one or more sections.

The engineman must whistle for all public and private road grade crossings. The final whistle must be timed to occur when the engine is actually on the crossing.

Classification Signals and Markers

5-35. Even though markers are not signals, they do convey information about the train to operating personnel. Classification signals are placed on the front of the engine. These signals identify what type of train it is. The signals are flags during daylight hours and remain visible by the addition of lights at night. Flags and lights placed on the rear of the train are called markers. Every type of train must display markers to qualify as a train and to show that the train is complete.

Classification Signals

5-36. A regular train displays no classification signals in front unless it is being run in sections. The first (or leading) section of a regular train displays green flags by day and green lights by night on the front of the locomotive (Figure 5-3). Each section carries these same classification signals, except the last section, which carries none. For example, if a train is being run in three sections, the first two sections display the appropriate green classification signals and the last section runs as a regular train showing no classification signals in front. If there are only two sections, the first section displays the green classification signals; the second section does not. Extra trains are not run in sections. Extra trains always display white classification signals on the front of the locomotive (also shown in Figure 5-3). White flags are used during daylight; in addition, two white lights are used by night.

Markers on the Rear of Trains

- 5-37. Markers are displayed on the rear of all trains. Because train operation in a theater usually takes place on single-track main lines, the discussion of train markers is confined to single-track operation. The markers displayed on a train on the main line (see Figure 5-4) are red and green flags used by day and red and green lights used at night. When red lights are displayed on the rear, it means that the main track is obstructed. A following train must approach at reduced speed. When a train is in the siding and clear of the main track with the switch lined for a through main line movement, it displays green flags by day and, in addition, green lights by night on the last car of the train (see also Figure 5-4). A single engine authorized by train order to run as an extra train must display white classification signals on the front of the engine and markers on the rear.

Color Indications

5-38. Color signal indications are standard for all railroads. Not only does the position of a signal give information to a railroader, but the color of the signal also has a specific meaning. Table 5-1 lists standard color indications.

Figure 5-3. Train Classification Signals

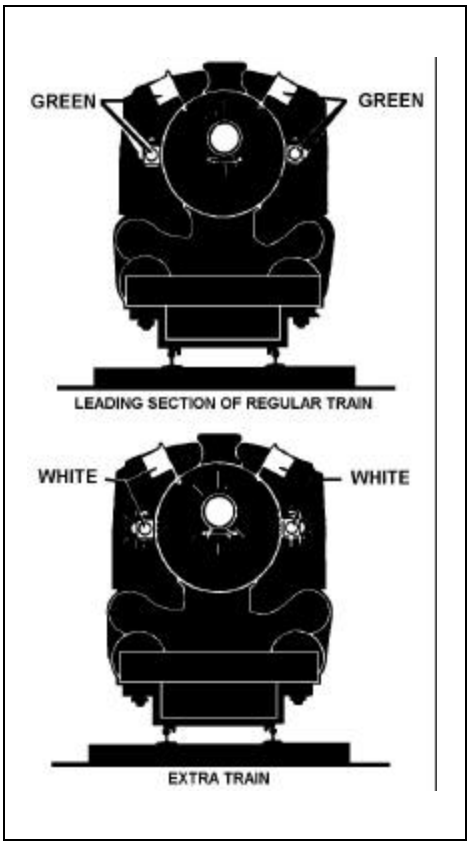


Figure 5-4. Rear Markers for Trains

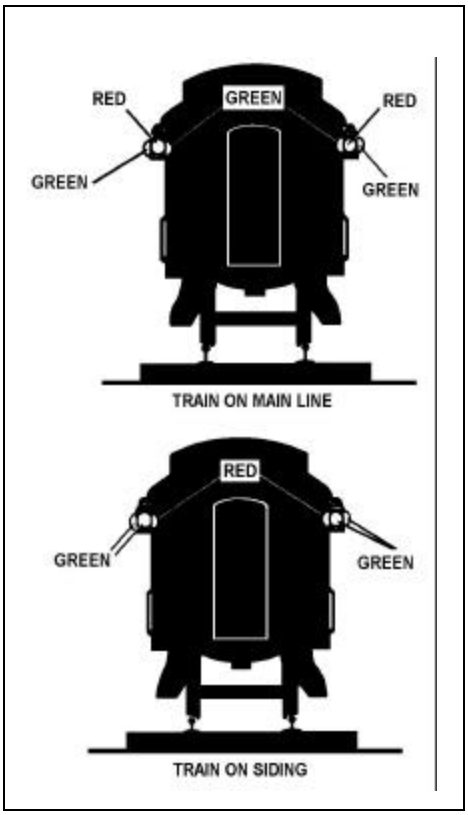


Table 5-1. Standard Color Indications

Red	Stop.
Yellow	Proceed at restricted speed. Other uses prescribed by the rules.
Green	Proceed. Other uses prescribed by the rules.
Green and White	Flag stop.
Blue	Protect workmen.
Purple	Stop (indication for siding derails).

5-39. These colors may be displayed in different ways or by different devices. A yellow disk denoting a zone of restricted speed may have the authorized speed printed on it in black numerals. A blue metal disk on a portable stand by day or a blue lantern or blue light by night, are used as a signal by maintenance personnel. It is displayed at one end or at both ends of an engine, car, or train to show that workmen are under or above it. No one except the person placing the sign in position can remove it. A green and white signal near the right-of-way on an approach to a station means that the station is a flag stop. If no signal appears at the station, the train may continue without stopping.

NATO Train Identification

5-40. During operations in the NATO theater, identification symbols are assigned to trains to help standardize the procedures for moving forces within the territories of NATO nations of continental Europe. The procedures for obtaining these train identification numbers are found in AMovP4.

CLERICAL WORK AND CAR MOVEMENTS

5-41. Other duties that the crew is responsible for include receiving messages, making reports, and setting off and picking up cars en route.

Messages

5-42. When a train is moving, the head brakeman must be on the lookout for messages at all open towers and telegraph stations. Messages are generally delivered "on the fly" by a message hoop, or loop, to which they are attached. The hoop is handed to the brakeman as he stands on the bottom locomotive step. He removes the message immediately and throws the loop to the ground as the train continues on its way. Messages may also be provided by radio if the locomotive is equipped. COMSEC procedures must be used at all times.

Delay and Accident Reports

5-43. If the train is delayed en route, the conductor records figures for a delay report, showing every stop the train makes. The information includes the time stopped, time started, elapsed time, reason for the stop, and exact location. Should the delay involve an accident; the time and date, weather, names and addresses of the injured, witnesses, and damage estimates must also be noted. This information is telegraphed in a separate report to the dispatcher or superintendent. When a stop is made and the conductor does not have enough time to get to the head end before the train starts up again, the head brakeman notifies the conductor of the reason for the stop before the delay report is filed.

Conductor's Wheel Report (DA Form 5618-R)

5-44. The wheel report (see Figure 5-5) is a record of the train's run. It also contains most of the information shown on the train consist. The conductor prepares the report and completes the proper blanks to show the following:

- Train and engine numbers.
- Times of departure and arrival.

- Cars handled and where picked up and set out.
- Names of yards and stations where stops were made or the mileage/kilometer point if the place is undesignated.
- Names of the crew members.
- Unit designation in military railroading.

Any special comments are recorded in the Remarks column. At the end of the trip, the wheel report is completed and sent to the chief dispatcher or to the superintendent of work involved in setting off and picking up car service. Additional reports made by the conductor may include forms dealing with such freight as explosives, flammables, and perishables (see Figure 5-5). A blank copy of the DA Form 5618-R is in Appendix A. You may reproduce this form on 8 1/2 x 11-inch paper.

CONDUCTOR'S WHEEL REPORT
For use of this form, see FM 55-20. The proponent agency is TRADOC.

TRAIN NO.	DIRECTION	UNIT	PAGE	OF	PAGES
3	West	714th	1	OF	1 PAGES

ENGINE	CABOOSE OR BRAKE VAN	DEPARTING STATION	DEPARTING TIME	DEPARTING DATE	ARRIVING STATION	ARRIVING TIME	ARRIVING DATE	CONDUCTOR
1819	995	James	0815	1 FEB '99	Hanks	0845	1 FEB '99	J. M. Gray

INITIAL	NUMBER	TYPE	TAKEN AT	LEFT AT	DATE	LINE	CONTENTS	DESTINATION	REMARKS
USA	82130	B	James	Chessie	1 Feb	1	MTY	WYE	NONE
USA	93241	G	James	Hanks	1 Feb	2	CL IV	HANKS	NONE
USAX	67096	F	Chessie	Hanks	1 Feb	3	CL II	HANKS	#3 WHEEL-FLAT
USAX	25463	B	Chessie	WYE	1 Feb	4	CL V	WYE	NONE
DCDX	14001	T	James	Chessie	1 Feb	5	POL	Chessie	NONE
						6			
						7			
						8			
						17			
						18			
						19			
						20			
						21			
						22			
						23			
						24			

SAMPLE

DA FORM 5618-R, DEC 86

Figure 5-5. Sample DA Form 5618-R

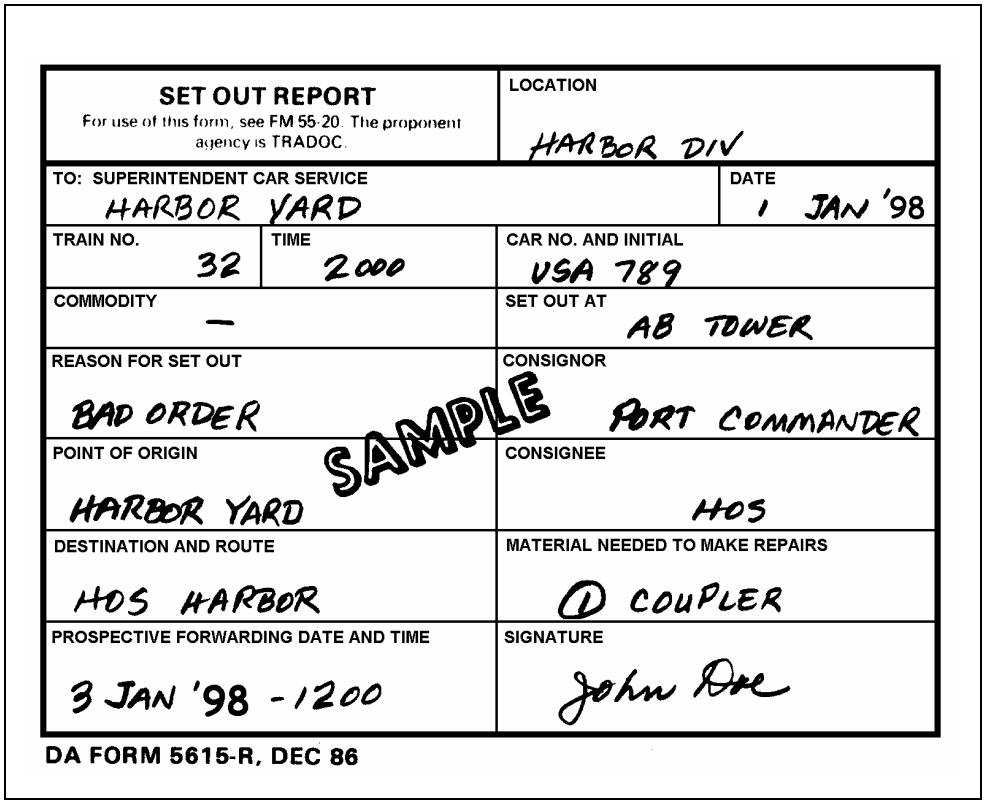
Setoffs and Pickups

5-45. The head brakeman usually does the work involved in setting off and picking up cars en route. He gets permission from the yardmaster or dispatcher when making these car movements at yards and stations, and delivers and gathers waybills for cars that the train leaves and picks up. When necessary to cross main tracks against the current of traffic, the head brakeman must assume head-end flagging duties. When the train leaves the area, switches and derails must be relocked and left in their original or normal positions.

5-46. The conductor is responsible for the set out report. It is normally prepared in triplicate and routed to the division superintendent (battalion commander) through the chief dispatcher and the division master. The division superintendent and chief dispatcher will retain a copy. The master mechanic ensures that all repairs are made and the dispatcher arranges pickup.

5-47. DA Form 5615-R (Figure 5-6) shows the following information:

- Location. Self-explanatory.
- To. Indicate closest car repair facility.
- Date. Enter current date.
- Train No. Indicate train number.
- Time. Show current time.
- Date. Show current date.
- Car No. and Initial. Self-explanatory.
- Commodity. Indicate class of supply carried by freight car.
- Set Out At. Indicate where car was set out.
- Reason for Set Out. Self-explanatory.
- Consignor. Self-explanatory.
- Point of Origin. Self-explanatory.
- Consignee. Self-explanatory.
- Destination and Route. Self-explanatory.
- Material Needed to Make Repairs. Indicate quantity and type of repair parts.
- Prospective Forwarding Date and Time. Indicate date and time that car is expected to reach destination.
- Signature. Self-explanatory.
- Note: A blank copy of DA Form 5615-R is shown in Appendix A. You may reproduce this form on 8 1/2 x 11-inch paper.



SET OUT REPORT For use of this form, see FM 55-20. The proponent agency is TRADOC.		LOCATION HARBOR DIV
TO: SUPERINTENDENT CAR SERVICE HARBOR YARD		DATE 1 JAN '98
TRAIN NO. 32	TIME 2000	CAR NO. AND INITIAL USA 789
COMMODITY —		SET OUT AT AB TOWER
REASON FOR SET OUT BAD ORDER		CONSIGNOR PORT COMMANDER
POINT OF ORIGIN HARBOR YARD		CONSIGNEE HOS
DESTINATION AND ROUTE HOS HARBOR		MATERIAL NEEDED TO MAKE REPAIRS ① COUPLER
PROSPECTIVE FORWARDING DATE AND TIME 3 JAN '98 - 1200		SIGNATURE John Doe

SAMPLE

DA FORM 5615-R, DEC 86

Figure 5-6. Sample DA Form 5615-R

NATO Rail Transport Requests

5-48. When operating in the NATO arena, request rail transport to move US troops and equipment according to AMovP2.

SAFETY MEASURES

5-49. The safe movement of a train depends on the untiring watchfulness of the entire crew. The responsibility of watching for signs of trouble rests equally on each crew member. The engine crew is responsible for observing the track ahead and the conductor and flagman (rear brakeman) are responsible for protecting the train from collision at the rear. Crew members (at each end of the train) are also responsible for the following:

- Looking for hot journals.
- Shifting loads.
- Opening doors on boxcars and refrigerator cars.
- Dragging rigging.
- Other safety hazards.

These duties are best performed when the train is rounding curves and 30 to 50 percent of either end of the train is visible alternately from the engine. Other activities of the crew to keep a train safe and prevent accidents are discussed in the following paragraphs.

Flagging

5-50. From a safety standpoint, the flagman's duties and responsibilities are equal to those of the engineman. Proper flagging and prompt compliance by enginemen are the only known means of preventing rear-end collisions on sections of railroad not protected by automatic train control.

Signal Lamp Markers

5-51. An important duty of the flagman is to light, hang, and turn train markers. Markers are signal lamps displayed on the rear of a train. They have four opposing lenses: one is red and the others are yellow or green. The markers are placed on hangers and may be turned to show any of the colors or a combination of them. The flagman mounts the markers to show red to the rear when running on the main track with the current of traffic. When the train takes a siding, he reverses the markers to show yellow or green to the rear. If the flagman drops off the moving train to do flagging duties when entering a siding, the conductor must reverse the markers. The marker colors indicate to the engineman of a following train whether the train ahead is on the main or in a siding.

Train Observation

5-52. The conductor and flagman spend much of their time looking over the train, the adjacent tracks, and the right-of-way. The observer is continually on the alert for smoke, the acrid odor of a hotbox (an overheated journal), or sticking brakes. A hotbox gives off brown smoke, while sticking brakes give off bluish smoke. If a hot journal is discovered, the train must be stopped and the car examined. It is often necessary to cool the journal, add fresh oil and packing, and set the car off at the next opportunity. Damage to the bearing and journal is not the chief danger resulting from a hotbox. If permitted to run unattended, it may become so hot that the axle could break, drop to the ties, and derail the train. The dispatcher must be notified when a hot journal is set off en route, and the waybill must be endorsed showing the trouble and the disposition of the car. To keep the waybill and car together, the waybill must be left at the next office following the point where the car was set off. The head brakeman keeps watch from the head end. When trains are met or passed on adjoining tracks, the engine crew has little clearance to observe the other train. If one or two clear tracks separate the trains, the head-end crew scans the other train when passing. They watch for signs of hotboxes, dragging brake rigging, contents leaking from cars, shifted loads, and open doors on boxcars and refrigerator cars. They also watch for pilferers and trespassers.

Hand Signals

5-53. A unique system of hand signals has developed on most railroads to inform other crews of safety hazards. They are not found in the operating rules or in the timetable, but they are well understood by road crews who often use them to their advantage. When trains meet, the conductor or flagman of each train stands on the rear platform looking over the other train. As the trains pass, the crews wave an okay or give a stop sign. The stop sign is often followed by another signal denoting the specific trouble. These signs are usually peculiar to a particular

railroad. One that appears to have fairly wide acceptance is squeezing the nose between the thumb and forefinger to indicate the unpleasant odor of a hotbox. Another is holding the hands at arm length and sliding one palm across the other to signify a sliding wheel.

Emergency Stop Signals

5-54. When a train is passing a defective train, a signal must be given to the engine crew when passing the engine. If the defect is serious or if there is any doubt that the signal is clearly understood, someone on the passing engine may throw off a lighted fuse in the path of the overtaken train. This will cause the train in question to stop and investigate the trouble before proceeding. The crew throwing off the fuse may throw off a written message at the next station advising the dispatcher of their action and of the trouble with the train they passed.

Chapter 6

Yard and Terminal Operations and Procedures

Railway cars normally spend over half of their useful life in yards and terminals. The major portion of battalion personnel and equipment are involved in yard and terminal operations. Efficient yard and terminal operations are required if the railway battalion is to exploit its maximum capabilities.

RAIL YARDS

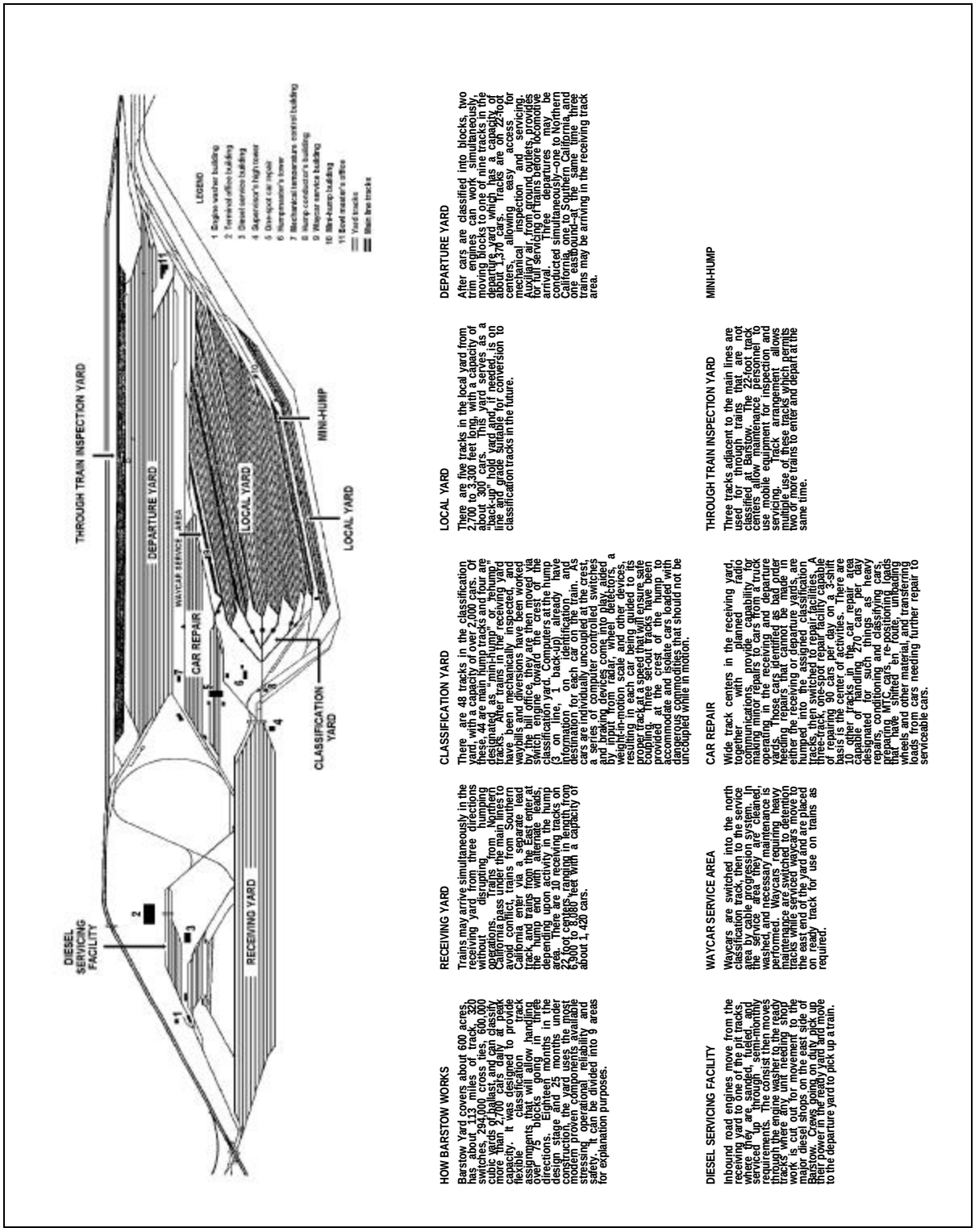
6-1. A rail yard is a system of tracks within defined limits used for making up and breaking up trains, storing cars, and allied purposes. Movements not authorized by timetable or train order may be made over these tracks. Yards may be located at railheads, depots, interchange points, ports, or terminals. Yards may also contain any number of tracks. The number and length of inbound and outbound trains determines the number and length of tracks. Railroad yards are natural bottlenecks in the movement of freight from one geographical area to another. In theory, cars may enter the receiving end of a yard as fast as they arrive. However, in practice, they can only depart as fast as the yard personnel can inspect, repair, classify and switch, and double them according to their setoff order. Depending on the density of traffic, the number of rail lines, and the geographical location, a yard may be one of two types: a progressive or a combination. Each of these types has certain characteristics and facilities that distinguish it and determine its operation. A typical civilian yard is shown in Figure 6-1.

Progressive Yard

6-2. A progressive yard is located at busy terminals and has tracks running east and west. A progressive yard is subdivided into receiving, classification, and departure yards. Cars move through each of these subyards in a progressive manner.

Receiving Yard

6-3. The purpose of the receiving yard or tracks is to clear trains promptly on arrival to prevent main line congestion. As a train approaches the terminal area, it enters the yard by a lead track and clears the main line so that other traffic is not tied up. The road locomotive is uncoupled and goes to the enginehouse for inspection and repair. At this point, the train loses its identity and becomes a draft of cars. A yard clerk collects the freight waybills and makes a track check from which a switch list is prepared. On the track check, he records the initials, numbers, seal numbers, and kinds of cars in the order they stand (from front to rear) and shows whether the cars are loaded or empty.



HOW BARSTOW WORKS

Barstow Yard covers about 600 acres, has about 13 miles of track, 220 switches, 294,000 cross ties, 600,000 cubic yards of ballast, and can classify more than 2,700 cars daily at peak capacity. It was designed to provide flexible classification track segments, that will allow handling of blocks going in three directions. Eighteen months in the design stage and 25 months under construction, the yard uses the most modern known components available and stressing operational reliability and safety. It can be divided into 9 areas for explanation purposes.

RECEIVING YARD

Trains may arrive simultaneously in the receiving yard from three directions without disrupting operations. Trains from Northern California pass under the main lines to avoid conflict, trains from Southern California enter via a separate track and trains from the east enter at the hump end with alternate leads depending upon activity in the hump area. There are 10 receiving tracks on 22,000 centers, ranging in length from 4,500 to 7,000 feet with a capacity of about 1,420 cars.

CLASSIFICATION YARD

There are 48 tracks in the classification yard with a capacity of over 2,000 cars. Of these, 44 are main hump tracks and four are designated as "mini-hump" or "rehump" tracks. After trains in the receiving yard have been mechanically inspected, and waybills and switch lists have been worked by yard clerks, they are humped over the switch engine "toward" the crest of the classification yard. Computers at the hump (3 on line, 1 back-up) already have information for each identification and destination for each track. Cars are individually uncoupled at the crest of a series of computer controlled switches and braking devices come into play, aided by input from radar, wheel detectors, a weight-in-motion, scale and other devices, resulting in each car moving out to its proper track at a speed that will ensure a safe coupling. Three set-out tracks have been provided at the crest of the hump to accommodate and isolate cars loaded with dangerous commodities that should not be uncoupled while in motion.

LOCAL YARD

There are five tracks in the local yard from 2,300 to 4,200 feet long with a capacity of about 300 cars. This yard serves as a "back-up" hold yard and, if needed, is on line and grade suitable for conversion to classification tracks in the future.

DEPARTURE YARD

After cars are classified into blocks, two room, ground crews work simultaneously moving blocks to one of nine tracks in the departure yard which has a capacity of about 1,370 cars. Tracks are on 22-foot centers, allowing easy access for mechanical inspection and servicing. Auxiliary air from ground outlets provides for full servicing of trains before locomotive arrival. Three departures may be conducted simultaneously--one to Northern California, one to Southern California, and one eastbound. At the same time, three trains may be arriving in the receiving track area.

DIESEL SERVICING FACILITY

Inbound road engines move from the receiving yard to one of the pit tracks, where they are sanded, fueled, and serviced up. Through semi-monthly requirements. The consist then moves through the engine washer to the ready tracks where any unit needing shop work is cut out for movement to the major diesel shops on the east side of Barstow. Crews going on duty pick up their engines and then move the train to the departure yard to pick up a train.

WAYCAR SERVICE AREA

Waycars are switched into the north classification track, then to the service area by cable progression system. In the service area they are cleaned, weighed, and necessary maintenance is performed. Waycars requiring heavy maintenance are switched to detention tracks while serviced waycars move to the east end of the yard and are placed on ready track for use on trains as required.

CAR REPAIR

Wide track centers in the receiving yard, together with planned communications, provide capability for making minor repairs to cars from a truck mounted welding machine operated by car repair personnel. Those cars identified as bad order needing repairs that cannot be made in either the receiving or departure yards, are humped into the assigned classification tracks, then switched to repair facilities. A track with 22-foot centers is established for the purpose of repairing 90 cars per day on a 3-shift basis is the center of activities. There are 10 other tracks in the car repair area capable of handling 270 cars per day. Repairs conditioning and classifying cars preparing MTC cars re-positioning loads wheels and other material, and transferring loads from cars needing further repair to serviceable cars.

THROUGH TRAIN INSPECTION YARD

Three tracks adjacent to the main lines are used for through trains that are not classified at Barstow. The 22-foot track centers allow maintenance personnel to use mobile equipment for inspection and servicing. This arrangement allows multiple use of these tracks which permits two or more trains to enter and depart at the same time.

MINI-HUMP

Figure 6-1. Typical Civilian Yard

(Santa Fe Southern Pacific Corporation - Barstow Yard)

6-4. After removing the locomotive, car inspectors place a blue safety flag or marker at each end of the draft of cars and makes a thorough inspection of each car. Inspections include complete checks of the following:

- Brake system and rigging.
- Journal boxes (including journals, packing, and lubrication).
- Wheels and axles.
- Couplers, draft gear, and underframe.
- General state of the car body and its load.

Car inspectors should start at both ends of the draft of cars and walk along each side while making the inspection. In some yards, a pit may be dug beneath the tracks. While in the pit, an inspector can observe the underside of a car and its wheels and axles. When a defective car is found that cannot be immediately repaired in the receiving yard, a bad-order car is prepared with defects noted and attached to the car. The car is then placed on a bad-order track to await movement to the repair tracks. When the inspectors complete their work, the blue safety flag or marker is removed and the draft of cars is ready for switching to the classification yard.

Classification Yard

6-5. The classification yard is next to the receiving yard. In the classification yard, cars are sorted or classified according to destination and priority of movement. The destination may be to a local depot or supply point, a branch or connecting line points farther up the line, or a neighboring station or local industry. In classifying by destination, the yardmaster designates by number, the tracks in the classification yard to be used for the cars for each destination. If there are a large number of cars for a particular station, tracks may be designated by station. For example, cars are blocked consecutively in the draft so that the first cars to be set out en route are directly behind the locomotive. This prevents delay when the blocks of cars are set out along the line. Individual cars or groups of cars are switched to the various tracks according to a switching list that specifies the track number for each car.

6-6. When an artificial hill is built in the classification yard, the entire yard is called a hump yard. In hump switching, a switch engine pushes a draft of cars from the receiving yard up the hill or hump. At the crest of the hump, they are individually cut off and permitted to roll by gravity down the hump to the designated classification track. The conductor or brakeman positioned on the hump cuts off the cars in switch-list sequence as they go over the crest. Control of the car speed is either by handbrakes operated by brakemen riding the cars or by retarders controlled by a tower operator. The advantage of hump switching is the quick and efficient way in which cars can be switched and classified with a minimum use of active power. Hump switching is much faster than flat-yard switching because the movement is in a forward direction only and does not involve the back-and-forth movements of the locomotives. An entire train can be switched at one time, the train length being limited only by the pushing power of the switching locomotive. However, hump yards are expensive to build and are usually used only in large progressive yards where there is enough traffic to justify their expense.

Departure Yard

6-7. Once cars are classified, they are switched to the departure yard to be made up into trains. The cars are grouped from front to rear in the order in which they will be set off en route or in the order

that will make switching easier at the next terminal. After a train is assembled, the train consist is repaired and sent to the yard office. Car inspectors make the departure or terminal airbrake test and another general inspection. While they are checking the cars, the road engine crew switches the engine from the engine ready track to the front end of the draft of cars. The train conductor must get the waybills and the train consists from the yard office and train orders and Clearance Form "A" from the train order office. Train orders give the priority of movement on the main line and the Clearance Form "A" gives the exact time the train is authorized to occupy the main line. When the brake tests are completed and the inspectors are satisfied that the equipment is in good shape and ready to operate, markers are placed on the rear of the last car and the draft of cars officially become a train. The train may leave the yard when the chief dispatcher gives the signal.

Combination Yard

6-8. Railroads frequently incorporate the receiving, classifying, and departure facilities into one yard. This may result from insufficient volume of work to justify three separate yards or from a lack of land to expand the yard layout. In combination yards, the number of tracks depends on the volume of traffic. The established length of inbound and outbound trains determines the track length. These yards are generally flat. Switching is accomplished by the back-and-forth movement of a yard engine with cuts of cars. Since this method prevails in most small yards, flat-yard switching is generally done in combination yards. In a combination yard, it is impossible to arbitrarily assign specific tracks for receiving only. Road trains must be taken into the yard without delay to prevent blocking the main track. The yardmaster decides which track to use. However, in a crowded yard, the yardmaster may be forced to accept a train on any track that is able to accommodate it. It may be necessary to use two tracks if the clear tracks are too short to accommodate the entire train. The longer tracks shown at A, Figure 6-2, are used interchangeably for inbound and outbound trains and the remaining tracks are used for classification.

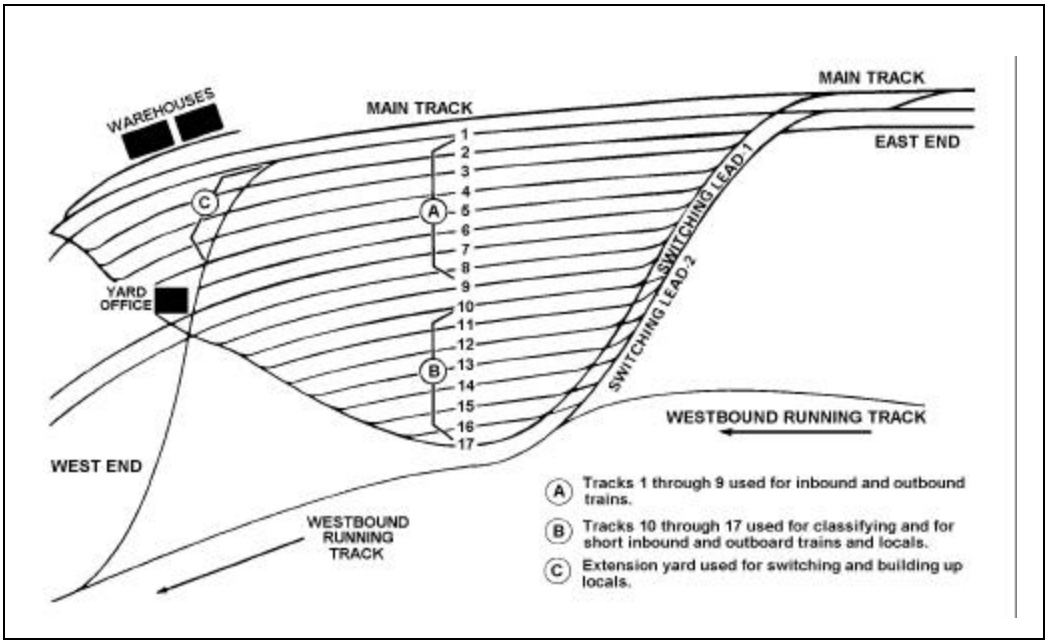


Figure 6-2. Typical Combination Yard

TERMINAL FACILITIES

6-9. A railway terminal is a large installation at the beginning and end of a rail line for delivering and receiving freight or loading and unloading passengers. In a theater of operations, a military rail line will generally have a terminal at the beginning of the line but more often than not the forward end of the line will end at a railhead. Adequate terminal facilities are of vital importance in railway operations. Congestion can occur if facilities are not properly used or if they do not exist. The following can result if congestion occurs:

- Cars cannot be moved.
- Cars cannot be promptly loaded and/or unloaded.
- Tactical forces may be deprived of urgently needed supplies.

Service Facilities

6-10. Every railway terminal includes one or more of the types of yards discussed above plus other installations which may include inspection and repair tracks; locomotive ready tracks; fuel, sand, and water service facilities; ash pits; scale tracks; and so forth. Buildings within the terminal include the following:

- Sand houses and supplies which are located near service tracks.
- Shop buildings at the repair tracks.
- Yard offices and towers near the center of the yard for the control of classification and switching operations.
- Other buildings that provide billet and mess facilities for train crews.

Consider the protection afforded by each building against NBC attack when selecting each site. Certain types of buildings offer excellent shelter from nuclear hazards and require a minimum of time and effort to adapt for use. The stronger the structure, the better the protection against blast effects. An overpressure system, such as the SCPE, can be used to convert existing structures to provide rest and relief for personnel from NBC hazards. The SCPE is a field expedient system. Gas and particulate filters remove any NBC contamination from the air. The overpressure system stops leakage of contaminated air into the enclosure. Personnel enter and leave through a protective entrance. This entrance is an air lock; it prevents contamination from entering the enclosure. FM 3-4 provides more information on the other types of systems and their uses.

Freight Stations

6-11. Freight stations are named buildings, sheds, or warehouses. These stations provide facilities for the receipt, loading, unloading, or storage of equipment and supplies. Loading and unloading areas preferably have separate routes for vehicles to enter and depart. End ramps are provided for wheeled and tracked vehicles. When not available and when time does not permit the construction of end ramps, vehicles and tanks may be loaded on flatcars using field expedients discussed and shown in C4, TM 55-2200-001-12. The named freight station and consignees should be clearly shown on waybills or other documentation to permit prompt placement of cars by yard operating personnel.

Passenger Stations

6-12. Facilities for moving personnel by rail should include one or more tracks on which cars can be placed before boarding time. Where facilities allow, cars used for the movement of troops should be cleaned, inspected, and watered before being placed for loading. When cars are equipped for steam heat, they should be heated (during cold weather) before troops board by using a station line, heater cars, or locomotive. Space, free of vehicular traffic, should be available adjacent to the loading track. This will allow personnel to assemble according to plan and permit ready handling of baggage and equipment. Station facilities should include office space for field transportation officers and battalion operating personnel, waiting rooms, storage sheds, car cleaning and watering tracks, and so forth.

Enginehouses

6-13. Enginehouses (roundhouses) are quite vulnerable to air attack because they, with the usually adjacent turntable, are easily identified from the air. Where enginehouses are not available or are not usable for tactical reasons, tracks adjacent to the yard should be constructed or set aside for servicing locomotives. Such facilities should include fuel and water supplies, a pit for inspection and minor underneath repairs, ash pits for cleaning fires if steam locomotives are used, and a Wye track for turning locomotives in the absence of a turntable. Any new enginehouse constructed should be a simple, rectangular, functional, shed-like structure. If necessary, store needed equipment and tools in boxcars. A mobile workshop, operating from a mobile machine shop car, may be used at outlying points where no facilities exist and new construction is not feasible or justified. Personnel of the transportation railway equipment maintenance company operate the enginehouses.

TRACKS AND YARD CHARACTERISTICS

6-14. To expedite yard work, certain tracks are necessary. These include main tracks outside the yard tracks, divided leads, running tracks, switching leads, sufficient track length, and so forth.

Outside Main Tracks

6-15. When main tracks are outside the yard tracks, time may be saved in switching cars. When a main track separates a main yard from an auxiliary yard, crews are delayed in crossing from one yard to another. Yardmasters have no control over the main tracks, and crews must obtain the dispatcher's permission before crossing the tracks. For example, a yard crew of 30 or 40 cars crossing the main track will interrupt the entire switching operation for 15 to 30 minutes depending on main line traffic. An ideal arrangement is to have the main tracks located several kilometers from yards or yard tracks. A main track with a low train density may not restrict yard work significantly. One with a high density of traffic may deal with yard operations to the extent that it might be advantageous to relocate the main track.

Divided Leads

6-16. Divided leads may be located at each end of a yard. This enables two yard crews to work at the same time. Where only a single lead exists and two crews are employed, one crew must generally couple cars and make room on tracks while the other uses the lead in switching cars.

Running Tracks

6-17. Running tracks extend the entire length of the yard and provide a route of travel to any point in the yard independent of the switching leads and classification tracks. When two running tracks exist, they are assigned directional designations. Most railroads permit road and yard crews to use these tracks without prior permission from the yardmaster. However, their movement must be in the direction specified by the track designator. With the exception of yard facility tracks, running tracks are generally the only ones that may be used without permission.

Long Leads and Approaches

6-18. Switching leads provides access to any point within a yard. They must be long enough to handle the longest length of cars normally handled. They must also lead out of the yard to running tracks or to the main line. Long approaches to the switching leads are desirable so that yard crews can move long cuts of cars from one track to another.

Track Length

6-19. Tracks should be long enough to handle inbound and outbound trains without doubling or moving cars off one track and coupling to cars on another. For example, if a 100-car train enters a yard on a track that can hold only 65 cars, the train must double 35 cars to another track and block the lead while making the double. When an outbound train is built up on two or more tracks of limited length, delay will occur in doubling the train. When the train is on one track, the air test, which must be made only after the train is complete, can be made before the train moves out to block the lead. Pusher engines may be used to help reduce the delay by pushing the train out of the yard.

Other Trackage and Yard Facilities

6-20. Ready tracks are located near enginehouses and are used when moving locomotives waiting to go on the road. When a locomotive is ready for road or switching service, it is moved to the ready track. When the locomotive is needed, it is moved through the lead track to the front of the assembled train. Facilities to inspect, water, fuel, and sand locomotives are located alongside the ready track.

6-21. Repair tracks (rip tracks) are located in the receiving yard. They are used during inspection to repair cars with mechanical defects. Light and heavy repairs are made to cars in a large rail yard and therefore require both light and heavy repair tracks. If the volume of traffic is great, rebuilt facilities may be required. In any small yard, there will always be light repair tracks. Mechanically defective cars are switched from trains and placed on bad-order tracks leading to the repair tracks. If extensive repairs are required on a loaded car, transfer tracks are used to transfer the freight from the defective car to another car to prevent long delays. If perishables are being handled, facilities for re-icing cars or servicing mechanical refrigerator cars are required.

6-22. Inspection tracks are used to inspect locomotives and cars. The tracks may be equipped with a pit and floodlight so the inspector can examine the underframe of cars, trucks, and locomotive running gear.

6-23. Team tracks or spurs provide a place for loading and unloading railcars and must be accessible to motor vehicles. They are frequently near ramps to allow for easier loading and unloading of vehicles on flatcars for piggyback movement. Shippers provide their own vehicles for loading and unloading cars on team tracks.

6-24. Dangerous commodity tracks are provided for handling ammunition, explosives, and POL products. These tracks are isolated from other tracks in the yard. Other tracks may be identified for the deliberate decontamination of locomotives and railcars.

6-25. Miscellaneous tracks include special tracks such as wreck train and work train equipment tracks and storage tracks for cars loaded with sand, gravel, rails, crossties, and other maintenance of way materials. They are functionally located within the yard and are readily accessible when cars are switched out and placed in trains. If a railroad handles livestock and perishable freight, it must have facilities for feeding, watering, and resting livestock, and for re-icing refrigerator cars containing perishable shipments.

6-26. The enginehouse contains repair equipment, materials, and tools used to inspect, service, and make running repairs on locomotives that operate on the railway division. The railway equipment company operates the enginehouse. When inspections, services, and repairs are finished, the locomotives are ready for road or yard service.

YARD PERSONNEL DUTIES AND RESPONSIBILITIES

6-27. The operation of a yard at a rail terminal requires a large number of workers assigned to a variety of duties. The following describes the duties of the yardmaster, yard clerks, yard switch crews, and car inspectors.

YARDMASTER

6-28. The yard office is the workshop from which the yardmaster supervises and coordinates all yard and clerical work. The yardmaster is in complete charge of all workers and all activities within the yard. He is responsible for safely, speedily, and economically switching inbound trains and building up and forwarding outbound trains. These duties include distributing cars in the yard, assigning tracks for loading and unloading cars, assigning work to switching crews, and calling train crews. The clerical work in yard operation is also the yardmaster's responsibility. This work consists of the following:

- Making track checks.
- Notifying local consignees of cars arriving for them.
- Maintaining car record books.
- Compiling train consists.
- Sorting and distributing waybills.
- Preparing any other documentation necessary for dispatching trains from the yard to their destination.
- The yardmaster is also responsible for the following records and reports.

Yardmaster's Journal

6-29. When planning the switching of trains, the yardmaster must consider freight on hand. When a yardmaster reports for duty, he should check the lineup of incoming trains and the cars already in the yard. He should immediately begin to plan the make up of trains to clear the yard for inbound trains. The check is made using the yardmaster's journal.

6-30. The yardmaster's journal, sometimes called a "turn-over book," provides information needed in planning the switching and make up of trains. It is an up-to-date, permanent record maintained by each yardmaster on each shift. It is used to inform each yardmaster of the status of every track in the yard. Figure 6-3 shows a sample page from the journal that might be kept for the combination yard.

Yardmasters

Lewis
(name)

West Yard
CONROY

Date 1 Jun 98

Time 2300

Inbound Line-Up

Engine	Conductor	Cars	ETA
3076	Brown	76 (to switch)	2330
3220	Bristol	125 (60 north route) (50 south route)	0200
194	Sands	115 (15 miscellaneous to switch)	N.F.

Track	Situation
1.	Clear
2.	Clear
3.	Clear
4.	Clear
5.	Engine 3076 ordered in – 76 to switch
6.	30 DW (east end)
7.	100 empty 70-ton hoppers (air OK)
8.	Clear
9.	85 EV (coupled; at west end)
10.	10 BR (coupled)
11.	9 MO
12.	Clear
13.	12 AY
14.	27 Elwood locals
15.	12 Red River
16.	14 CP-12 OW(mixed)
17.	12 Hold & Miscellaneous

SAMPLE

Extension Yard	Shop Tracks
1. Clear	1. 25 shops (spaced)
2. Clear	2. 18 shops (spaced)
3. Clear	3. 17 shops (unspaced)
4. Clear	shop lead -- clear
5. 10 cs coal	

Regular Crews	Extra Crews
Eng. 9332 Comdr. Frank	Eng. 9552 Comdr. Jones
(coupling #9 at west end)	(at switch tenders; due off duty at 2330).
Eng. 9332 Comdr. Williams	Extra crew due off dock at 0001.
(spacing #3 shop track)	Will call for instructions.

Watch for and expedite these cars: MDT 19086; PRR 425003; SAL 19522. Car distributor promises to take the 100 mty hoppers about 0700.

Figure 6-3. Sample Page of Yardmaster's Journal

The actual form may vary among railroads but information found on journals are basically the same. In a theater of operations, journals are kept as simple as possible and show only essential information. In addition to the name of the yardmaster, the terminal or yard name, the date, and the time, the journal may also show the following:

- A consist or lineup of inbound trains due in the next several hours. If there is no figure for the estimated time of arrival, the dispatcher will estimate the arrival time later.
- The listing of every track in the yard including cars and their contents.
- The status of every track in the yard to include whether the cars are coupled, whether they are at the east or west end, or whether the cars on the shop tracks are spaced or unspaced. An appropriate notation is also made if the air has been tested and okayed on any track.
- A list of the yard crews and locomotives that will be working during the oncoming shift, exactly what each crew is doing at the time of the yardmaster's change, and where each engine is awaiting relief. Yardmasters usually change shifts a half or full hour before yard crews change.
- A list and consist of trains ready for departure.
- Other data pertinent to yard operations. The journal pages have wide margins to allow for additional entries as work progresses. After 2300 hours, all cars switched to the tracks from the west end of the yard will be entered on the right side. Figure 6-4 shows a sample of a journal page with all entries posted. These entries should be consulted and checked after the switching operation is completed.

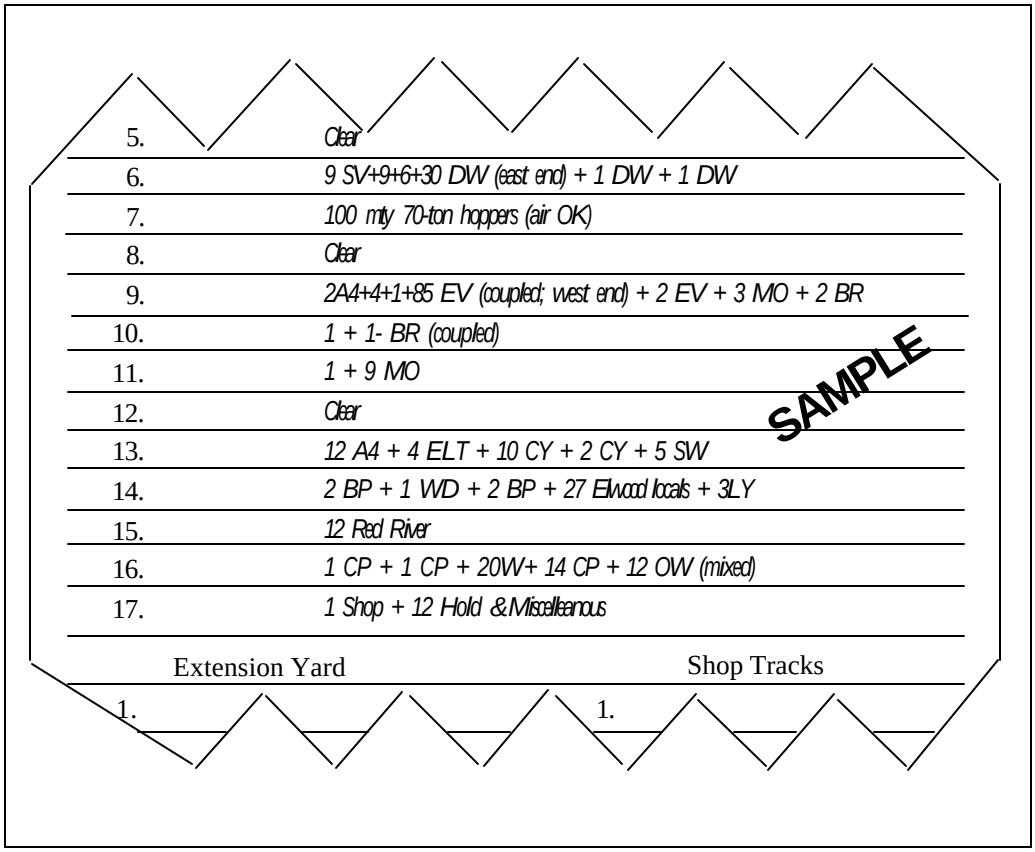
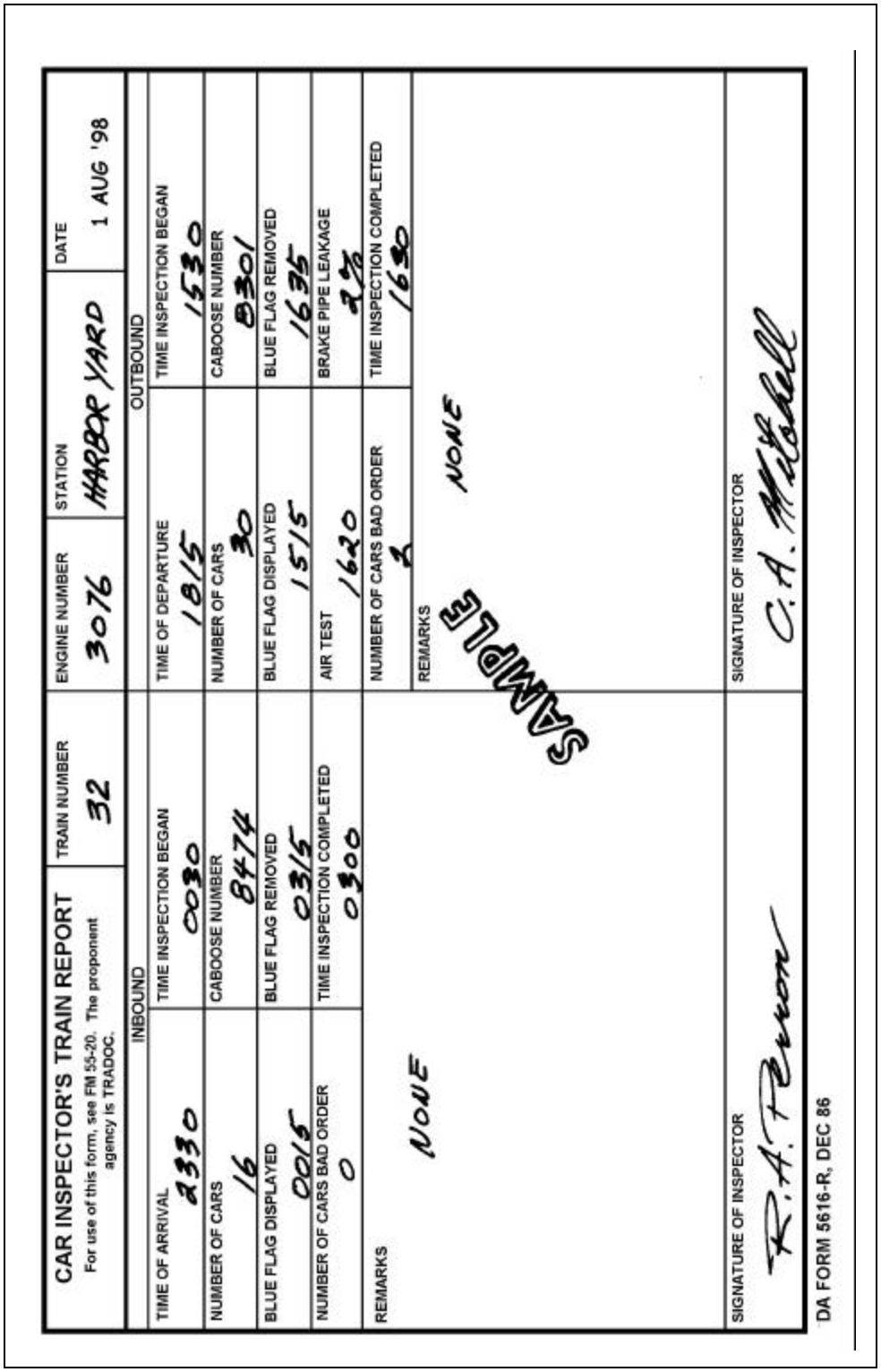


Figure 6-4. Part of Journal Page After Switching

Car Inspector's Train Report (DA Form 5616-R)

6-31. Prepare this report for each train that is inspected when it enters or leaves a yard or terminal (Figure 6-5). A blank DA Form 5616-R is in Appendix A. You may reproduce this form on 8 1/2 x 11-inch paper. Indicate the train number, engine number, station, and date at the top of the form. Show the date, brake pipe leakage, and time of air test in the proper blocks. Indicate the percent of brake pipe leakage. A "Remarks" block is provided for any other additional information. All other blocks are self explanatory.



CAR INSPECTOR'S TRAIN REPORT
For use of this form, see FM 55-20. The proponent agency is TRADOC.

TRAIN NUMBER: 32
ENGINE NUMBER: 3076
STATION: HARBOR YARD
DATE: 1 AUG '98

INBOUND		OUTBOUND	
TIME OF ARRIVAL: 2330	TIME INSPECTION BEGAN: 0030	TIME OF DEPARTURE: 1815	TIME INSPECTION BEGAN: 1530
NUMBER OF CARS: 16	CABOOSE NUMBER: 8474	NUMBER OF CARS: 30	CABOOSE NUMBER: 8301
BLUE FLAG DISPLAYED: 0015	BLUE FLAG REMOVED: 0315	BLUE FLAG DISPLAYED: 1515	BLUE FLAG REMOVED: 1635
NUMBER OF CARS BAD ORDER: 0	TIME INSPECTION COMPLETED: 0300	AIR TEST: 1620	BRAKE PIPE LEAKAGE: 2%
REMARKS: NONE		NUMBER OF CARS BAD ORDER: 2	TIME INSPECTION COMPLETED: 1650
		REMARKS: NONE	

SAMPLE

SIGNATURE OF INSPECTOR: R.A. Brown

SIGNATURE OF INSPECTOR: C.A. Mitchell

DA FORM 5616-R, DEC 86

Figure 6-5. Sample DA Form 5616-R

Daily Statement of Cars On Hand (DA Form 5617-R)

6-32. Station agents and yard clerks prepare this report using information obtained from the car-record book and/or from a physical check of the cars on hand in the yard or station sidings (Figure 6-6). A blank DA Form 5617-R is in Appendix A. You may reproduce this form on 8 1/2 x 11-inch paper. This form shows the car number, date received, type of contents, consignee, and length of and reason for any delay. The report is forwarded daily through channels to the battalion commander (division superintendent) for his information and his reports to higher authority.

Yard Clerks

6-33. Yard clerks prepare train consists, switch lists, and do other administrative jobs assigned by the yardmaster. They also make yard checks, maintain an exact up-to-the-minute location of all cars, and check car numbers of all arriving and departing trains. The number of yard clerks required depends on the type and volume of work to be done. Three clerks are usually required on each shift. One clerk handles the inbound clerical work, one does all outbound clerical tasks, and the third is assigned to checking cars. When there is a large number of tracks, two or more clerks may be required to check cars. Clerical duties may vary considerably among railroads in different localities.

Inbound Clerical Work

6-34. During inbound clerical work, the initials and numbers of all cars arriving in the yard must be entered in the car record book. The inbound clerk checks the waybills against the completed track check and makes sure that the numbers on the track check agree with those on the waybills. They must also make sure that there is a car for every waybill and vice versa.

6-35. Many other reports are often necessary. These include arrival notices to local consignees, hold notices, reweigh reports (necessary when bulk-loaded cars have lost part of their lading), and seal reports. All yards stamp each waybill on the back with a junction stamp showing the time and date of arrival and the name of the yard. Clerks are then able to check the time interval of cars in and between various yards. These notations also enable yardmasters to inquire or start corrective actions concerning cars that are subjected to unreasonable layovers between point of origin and destination. Most yards maintain an inbound and outbound train sheet that shows the engine number, conductor's name, arrival or departure time, and the number of loads and empties in each train or drag. A drag is generally a long, slow freight train handled by a yard engine on a main track. The train sheet is usually maintained from 0001 through 2350 hours.

DAILY STATEMENT OF CARS ON HAND
For use of this form, see FM 55-20. The proponent agency is TRADOC.

STATION
AGENT
PAGE _____ OF _____ PAGES

INITIAL	NUMBER	KIND	DATE RECEIVED AT STATION	CONTENT	CONSIGNEE	NUMBER OF DAYS DETAILED				REASON FOR DELAY
						UNLOADING	EMPTY	LOADING	WAITING MOVEMENT	
USAX	34763	B	24 DEC	Ce II	AY					
USA	45874	R	24 DEC	Ce II	AY					
USA	56985	F	24 DEC	Ce II	EY					
USAX	67096	F	24 DEC	Ce II	EY					
USAX	78107	B	25 DEC	Ce V	MO					
USA	89108	B	25 DEC	Ce V	WO					
USA	93241	G	26 DEC	Ce IV	SIG					
USAX	14352	G	26 DEC	Ce IV	SIG					
USA	25463	B	27 DEC	Ce V	CWS					
USA	36574	F	28 DEC	Ce II	FO					
USAX	47685	B	30 DEC	Ce II	CD					
USA	57896	B	31 DEC	Ce II	CO					

SAMPLE

DA FORM 5617-R, DEC 86

Figure 6-6. Sample DA Form 5617-R

Outbound Clerical Work

6-36. When an outbound train has been called, the clerk assigned the outbound duties computes the gross tonnage. The following forms help the clerk to keep an accurate account of all trains and freight leaving the yard.

6-37. **Train Consist.** A train consist is prepared by showing a list of the cars which make up a train. The report shows the initials, number, contents, weight, origin, and destination of each car in the order (from front to rear) in which the car stands in the train. Immediately after a train is dispatched, the train consist is sent by telephone or teletype to the yard at the train's destination. No standardized form is prescribed for the train consist. Four copies of the train consist are required for distribution. Distribute the consist as follows:

- Original is sent to the car records office for posting and filing.
- A copy goes to the transportation movements officer at point of origin.
- A copy is kept by the yardmaster at train origin.
- A copy goes to the yardmaster at train destination.

The yardmaster uses it to plan his switching operations and track allocations. The train consist is also placed in permanent files for use in financial accounting.

6-38. **Commercial Freight Waybill.** A commercial freight waybill authorizes a common commercial carrier to move a railway car. The shipper prepares a waybill. The commercial freight waybill shows the following:

- Car number and initials.
- Contents.
- Weight.
- Consignor.
- Consignee.
- Origin
- Destination.
- Date of issue.
- Number of seals used (if any).
- Any special instructions or information required for the movement.

This information is used to trace the shipment if it is lost, stolen, or damaged while en route. Similar systems may be used in overseas areas where the HN railroad is used.

Note: A home route card will be used and attached inside the waybill when the railcar is to be returned to the origin point. This would normally be used for special type cars to handle specialized cargo.

6-39. **Transportation Control and Movement Document.** Where military standard transportation and movement procedures are prescribed, all documentation must be according to MILSTAMP

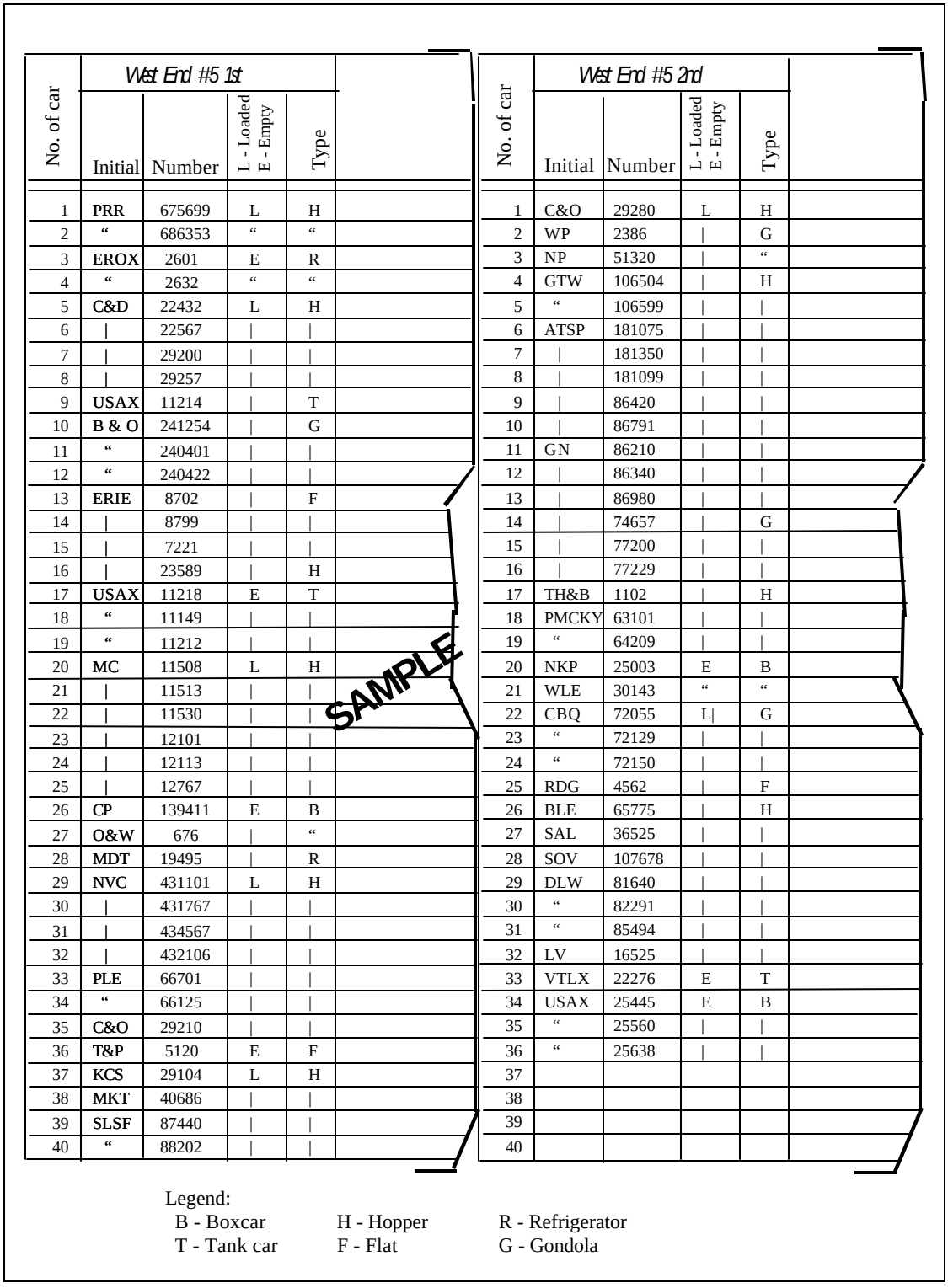
directives in DOD Regulation 4500.32-R, Volume 2. The TCMD is used for all shipments from military activities and may be used as a freight waybill. The number of any seals used, routing, and any special instructions are inserted on the form.

6-40. **Track Check.** The outside clerk ensures that information on the track check corresponds to the waybill and that the train is in station order. The clerk formats the track check and must show the initials, number, contents, and type of each car (box, tank, hopper, or flat). He also records the seal number of each car, applies new seals when necessary, and makes a record of the seals used. No seal numbers are shown in the sample format (Figure 6-7, page 6-18) because the cars are empty. If seals were required, an additional column would be added and the seal numbers recorded. The clerk indicates at the top of each sheet at which end of the train the check was started.

6-41. **Switch List.** The switch list can be prepared using the same format used for the track check (except a column for destination and track are added). The clerk prepares the switch list using information on the track check. In turn, the switch list shows the destination of each car, whether it is empty or loaded, the track to which a car must be switched, and the number and size of the cuts to be made in breaking up the train. Figure 6-8, page 6-19, shows a track check converted to a switch list.

Yard Switching Crew

6-42. A yard crew is generally composed of four members: the engineer, the conductor, and two brakemen. The brakemen may also be called switchmen. The brakeman working farthest rearward from the engine is known as the rear brakeman. If workload requires, additional brakemen may be assigned. Where a long lead with a large number of switches exists, an extra brakeman or a switchtender may also be assigned. The yard conductor, sometimes called the switch foreman, is in complete charge of the crew and is responsible for carrying out the yardmaster's instructions in a safe and expeditious manner. The yardmaster usually delivers instructions in writing if verbal instructions are complicated or would be confusing. The conductor must fully inform his crew what to do and how to do it. The yard conductor normally uses a switch list. The switch list will be developed from information obtained from the track check.



West End #5 1st

No. of car	Initial	Number	L - Loaded E - Empty	Type
1	PRR	675699	L	H
2	"	686353	"	"
3	EROX	2601	E	R
4	"	2632	"	"
5	C&D	22432	L	H
6	|	22567	|	|
7	|	29200	|	|
8	|	29257	|	|
9	USAX	11214	|	T
10	B & O	241254	|	G
11	"	240401	|	|
12	"	240422	|	|
13	ERIE	8702	|	F
14	|	8799	|	|
15	|	7221	|	|
16	|	23589	|	H
17	USAX	11218	E	T
18	"	11149	|	|
19	"	11212	|	|
20	MC	11508	L	H
21	|	11513	|	|
22	|	11530	|	|
23	|	12101	|	|
24	|	12113	|	|
25	|	12767	|	|
26	CP	139411	E	B
27	O&W	676	|	"
28	MDT	19495	|	R
29	NVC	431101	L	H
30	|	431767	|	|
31	|	434567	|	|
32	|	432106	|	|
33	PLE	66701	|	|
34	"	66125	|	|
35	C&O	29210	|	|
36	T&P	5120	E	F
37	KCS	29104	L	H
38	MKT	40686	|	|
39	SLSF	87440	|	|
40	"	88202	|	|

West End #5 2nd

No. of car	Initial	Number	L - Loaded E - Empty	Type
1	C&O	29280	L	H
2	WP	2386	|	G
3	NP	51320	|	"
4	GTW	106504	|	H
5	"	106599	|	|
6	ATSP	181075	|	|
7	|	181350	|	|
8	|	181099	|	|
9	|	86420	|	|
10	|	86791	|	|
11	GN	86210	|	|
12	|	86340	|	|
13	|	86980	|	|
14	|	74657	|	G
15	|	77200	|	|
16	|	77229	|	|
17	TH&B	1102	|	H
18	PMCKY	63101	|	|
19	"	64209	|	|
20	NKP	25003	E	B
21	WLE	30143	"	"
22	CBQ	72055	L|	G
23	"	72129	|	|
24	"	72150	|	|
25	RDG	4562	|	F
26	BLE	65775	|	H
27	SAL	36525	|	|
28	SOV	107678	|	|
29	DLW	81640	|	|
30	"	82291	|	|
31	"	85494	|	|
32	LV	16525	|	|
33	VTLX	22276	E	T
34	USAX	25445	E	B
35	"	25560	|	|
36	"	25638	|	|
37				
38				
39				
40				

Legend:

B - Boxcar	H - Hopper	R - Refrigerator
T - Tank car	F - Flat	G - Gondola

Figure 6-7. Sample Format of a Track Check for Inbound Train

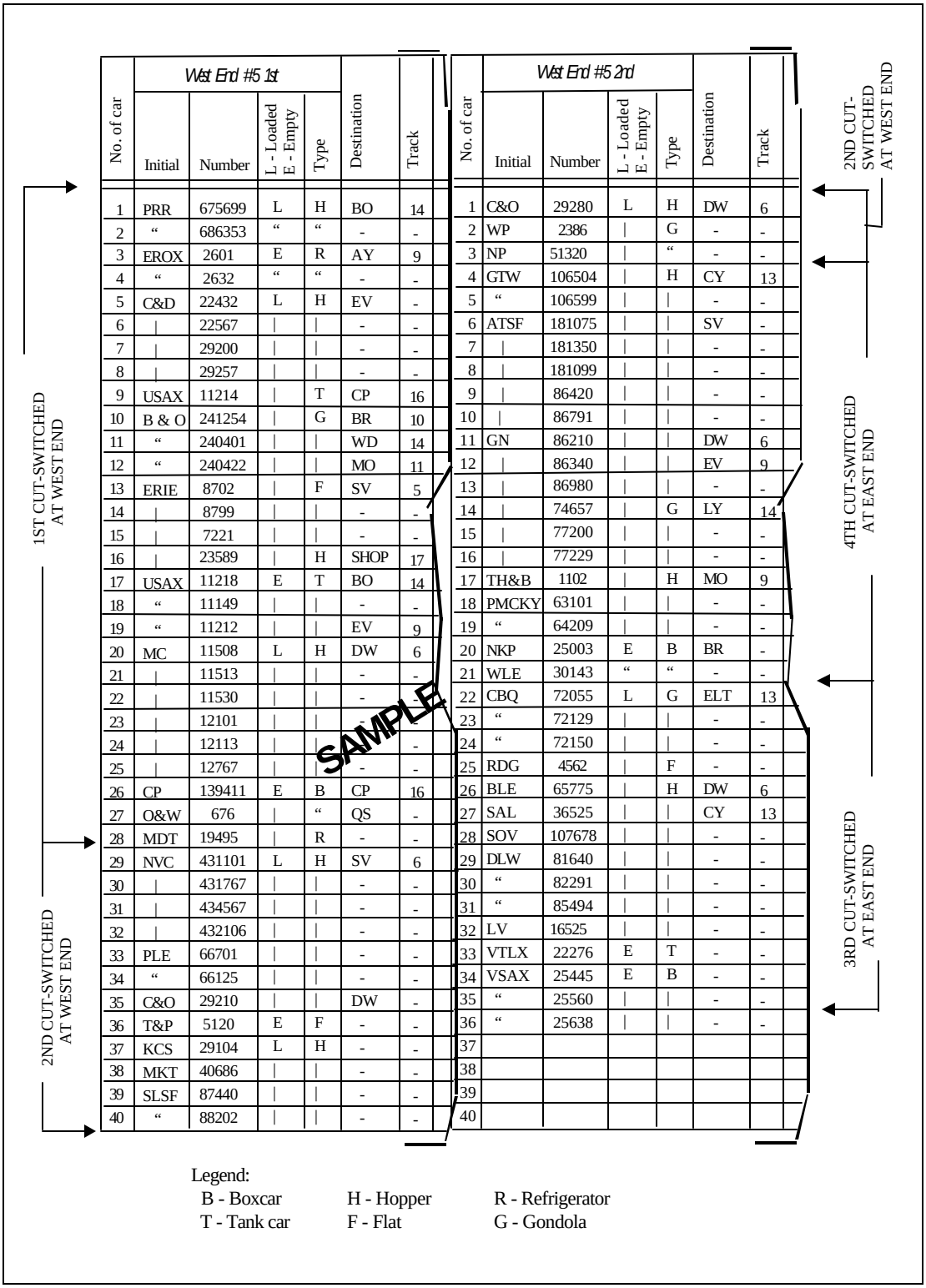


Figure 6-8. Sample Format of a Track Check Converted to a Switch List

Engine Crew

6-43. The engine crew consists of an engineer. The engineer works under the direction of the yard conductor. The engineer and conductor are both responsible for safe and efficient operation of the locomotive. The engine crew is also responsible for certain duties in switching operations. These duties include the following:

- Executing signals given by the ground crew.
- Interpreting hand signals and refusing any signals not clearly understood.
- Calling and repeating hand signals, switch-light colors, and signal-light aspects to each other to ensure signals are read properly.
- Answering the whistle signals of main-track trains with the appropriate whistle signals of the yard engine.
- Complying with timetable instructions in crossing main tracks.
- Questioning a signal when it may be unsafe to obey.
- Periodically inspecting and lubricating the locomotive's running gear

Inspectors

6-44. In military railroading, personnel of the car repair platoon of the railway equipment maintenance company are assigned to yards as inspectors. Car inspectors examine and make running repairs to cars entering a yard. Air inspectors test the air brake equipment of trains after they are built up and before their departure from the yard. All inspectors must be cautious when inspecting inbound cars. Chemical contamination may be present and unknown to the train crew. Suspicious liquid concentrations should be tested and all contaminated rolling stock marked using standard NATO NBC markers.

Car Inspectors

6-45. One of the most important jobs in the movement of trains is that of the car inspectors. Car inspectors must check each car for over 200 possible defects. Inspectors are required to make close inspection of wheels and flanges, journals and bearings, underframes, brake rigging, handbrakes, air brake equipment, grab irons, sill steps, draft gear, and many other parts. If defects are not noticed and corrected, serious consequences may result. A defective car in a train could cause a derailment or a lengthy delay in setting the car off en route. Roof sheets, ladders, and running boards on closed-top cars must also be inspected. Experienced personnel can inspect a car in a short amount of time.

Air Inspectors

6-46. Inspectors, although qualified in all phases of inspection, are frequently detailed to air inspecting and testing only. When a train is coupled, it is moved to a point where the air hose on the first car is over the hose connected to the ground air line. Inspectors couple air gauges between these hoses and walk the length of the train, coupling the hoses between cars as they progress. When all hoses are coupled and enough pressure is attained in the train line and reservoirs, brakes are applied on the train. Inspectors examine the piston travel to determine if enough braking force is being exerted on the wheels of each car. Linkage may need to be adjusted so that brake shoes will exert proper force. Every car is inspected for excessive air leakage and gauges are checked to determine the entire train line leakage. If leakage is within permissible limits, the train is reported to the yardmaster

as ready for movement. The car inspectors will write a "shop" or bad-order tag for those defective cars that cannot be immediately repaired. These cars are cut out by the train yardmaster.

FREIGHT GROUPING AND CLASSIFICATION

6-47. The governing principle throughout the grouping or blocking process is to group each cut of cars by destination so that its position in the outbound train requires a minimum of handling in setting it off. Classifying cars involves assigning them to a particular destination grouping and switching them to a track having the same grouping. When enough cars accumulate on the same track, either of one group or a combination of groups, an outbound train is ordered. Cars consisting of several groupings or blocks are set into the train in the order that they will be set off along the route. The first block to be set off is placed immediately behind the engine, followed by the next setoff grouping, and so on. Placing the blocks directly behind the locomotive involves the least amount of movement in setting them off. In special cases, there may be exceptions to this sequence. For example, a group of expedite cars may be carried next to the engine (a location out of their normal standing). This position would enable the yardmaster at the receiving terminal to remove them from the train before car inspectors blue-flag the track on which they arrive. The cars would then be placed on the head end of a departing train (again out of their normal standing) and handled identically at the next division terminal. The cars would be kept on the head end of all trains until they arrived at their destination. This method could save as much as 48 hours over an 800-kilometer haul. It might be equally convenient to have a setoff at either end of the train in a yard where the engine is to be changed.

Bill Rack

6-48. A bill rack is another method of keeping track of waybills. However, it should never take precedence over the entries in the journal. The rack always contains a separate section for every track that the yardmaster has jurisdiction over. Waybills are put in the sections in the exact order that cars enter and stand on the tracks. When a crew switches loaded cars in the yard, the yardmaster switches the waybills to the appropriate slots in the bill rack (Figure 6-9). In a westbound yard, when cars are switched to the west end of a track, the bills are usually placed in front of those already in the particular track slot. When cars are switched to the east end, bills are placed behind those already in the rack. Do not assume that because a slot is empty, the track is clear—too many people use it. Careful switching of bills is as important as switching of the cars. When bills are correctly switched, one may see that the exact standing of a track makes it a simple matter to estimate or compute the tonnage of any track when planning an outbound movement. The journal, never the bill rack, is the authority for determining the clear tracks. A particular slot in the bill rack may be empty but a mistake may have been made in switching the bills.

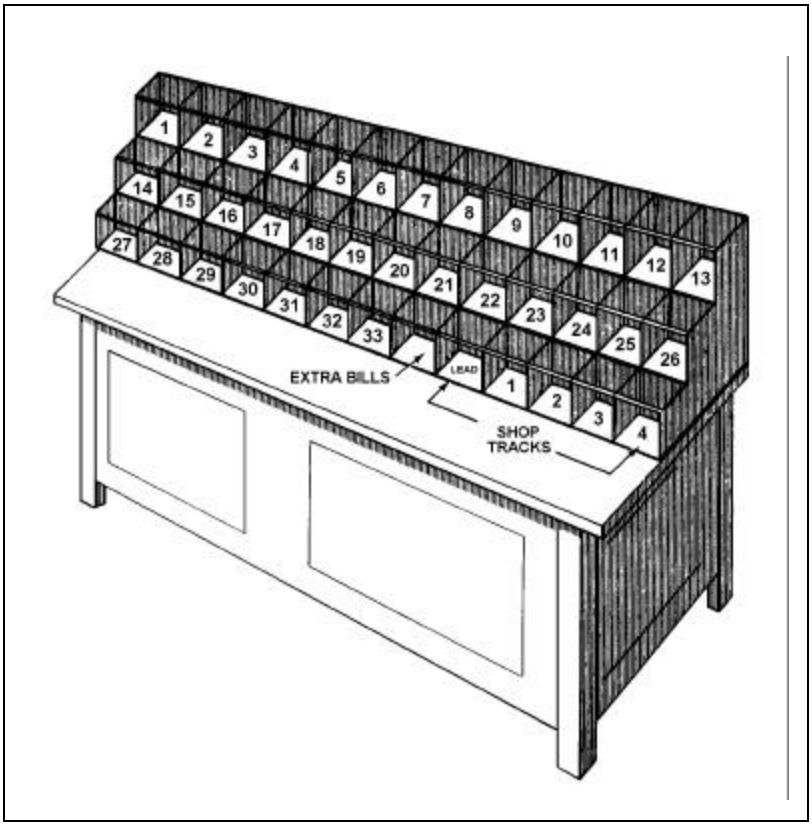


Figure 6-9. Bill Rack

Chapter 7

Railway Structure, Reconnaissance, Construction, and Rehabilitation

Railway structure is of strategic and tactical importance to the commander. Rail units are responsible for reconnaissance to determine the condition and characteristics of track, rolling stock, yards, terminals, shops, and other facilities. The highest unit headquarters determines requirements for rehabilitation and new construction after the original reconnaissance is made.

TRACK AND STRUCTURES

7-1. The track is the most important and most vulnerable part of a railway system. It usually crosses many miles of undefended territory. The track and structures are composed of many items designed to provide a smooth and strong riding surface for rail traffic.

COMPONENTS AND FUNCTIONS

7-2. Components and their relationships are described in the following paragraphs (see also Figure 7-l, page 7-2).

Subballast

7-3. Subballast consists of gravel, sand, or cinders, and it is inferior to ballast. Spread on the surface of the cut or fill, subballast provides a level surface for the ballast and other track components. It is spread about half the depth of the total ballast section and should never be less than 6 inches deep. Using subballast does the following:

- Saves higher quality stone for the ballast.
- Seals off contact between the ballast and the subgrade, which allows better drainage.
- Prevents indentation in the subgrade caused by ties under the weight of the train.

Ballast

7-4. Ballast is gravel or broken stone laid on the ground to provide support for the track. The two types of ballast are mainline and yard ballast. Mainline ballast is larger in size (3/4" to 2" square) while yard ballast is smaller in size (3/8" to 1" square). Wooden, concrete, or steel crossties are laid across the ballast to support the rail. Tie plates and rail anchors are laid on the crossties. The rail is then secured to the crossties with spikes or screws. Sections of rail are then connected at the ends and the joints are bolted or welded to complete the track.

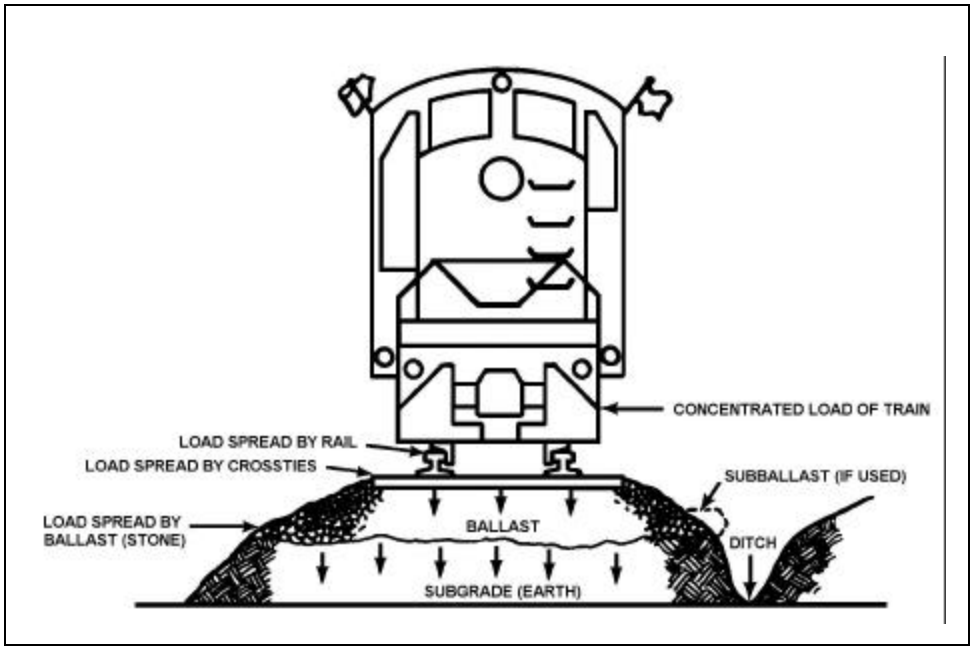


Figure 7-1. Main Components of a Railroad Track

7-5. Materials most commonly used as ballast are trap rock, granite, blast furnace slag, limestone, and graded gravel. For heavy tonnage and/or high speed traffic, broken or crushed stone is the most desired ballast. Blast furnace slag is almost as good as crushed rock. Ashpit cinders may also be used as ballast, but cinders are low in resistance to crushing. Other common but poorer ballast material are pit-run gravel, engine cinders, oyster shells, decomposed granite, and sand. However, sand may be used for light traffic lines. It is easily obtainable and drains reasonably well; but is difficult to tamp when dry, erodes easily from wind and rain, and collects dirt quickly. Ballast is usually locally available materials.

7-6. In order to perform its function, ballast must be resistant to water and weather, coarse for rapid drainage, fine enough to facilitate handling, and angular to resist movement. Using ballast does the following:

- Distributes the weight of the trains on the track.
- Keeps the track from moving under the weight of the trains.
- Provides adequate drainage for the track.
- Maintains proper track leveling and alignment.
- Retards growth of vegetation.
- Reduces dust.
- Distributes the load of the track and train to prevent overstressing the subgrade.
- Restrains the track laterally, longitudinally, and vertically under dynamic loads imposed by trains and thermal stress induced in the rails by changing temperatures.

Cross and Switch Ties

7-7. Crossties are currently used mainly on conventional track. Regardless of their shape, dimensions, or composition, crossties perform many functions necessary for an operational railroad track.

- The timber crosstie is used most often. The tie is cut from mixed softwoods and hardwoods and is treated with creosote, creosote-coal tar, or creosote petroleum solutions to prevent or retard fungi, bacteria, insects, borers, and decay. The treated timber tie varies in dimensions: 5" x 5" to 7" x 10" in cross sections, 8 feet to 9 feet in lengths for standard crossties, and 9 feet to 23 feet for switch ties and crossover ties. The standard US mainline crosstie (7" x 9" x 8'6") weighs approximately 250 pounds.
- The concrete crosstie has the same general dimensions as the timber crosstie, but is almost twice as heavy. Most concrete crossties have direct fixation fastenings with a cushioning pad between the tie and the rail base. These fastenings can be either a threaded type or a threadless type. In any of its forms, fastening is the weakest part of the concrete crosstie system.
- Steel crossties are tough, flexible, and resistant to mechanical deterioration. They are manufactured in a variety of shapes and include special features such as an integral fastening system. They are not normally found in trackage that has an electric current as part of a signal system or in an electrically powered railway system.

7-8. Crossties support vertical rail loads (train weight) and distribute those loads over a wider area of the supporting material (ballast). Crossties provide a smooth surface onto which the rail can be fastened, therefore resisting rail movements caused by train movement. Crossties also provide a means to fix and maintain the gauge (distance) between the rails.

7-9. Switch ties should always be made of hardwood. Switch ties are specially cut and formed crossties. Switch ties are designed mainly to support switches, switch stands, and the moveable rails of the switch.

Rail

7-10. All parts of the track are essential. However, the rail is subjected to the greatest stresses and which is basic to the energy saving efficiency of railroads.

Construction

7-11. Rail steel contains iron, carbon, manganese, and silicone. Impurities sometimes found in steel are phosphorous, sulfur, and slag. Rail is identified by its weight per yard and its cross-sectional shape design. The rail weight is referred to as its nominal weight per yard or meter, such as 115 pounds per yard and 52 kilograms per meter. Rail can be manufactured in many different lengths. In the US, the standard lengths for rail are 39 feet and 78 feet. Lengths in other countries are similar.

Joints

7-12. Rail can be constructed into a track in two ways. It may be jointed (conventional construction) or welded (continuous welded rail).

7-13. In conventional construction, the 39-foot rail sections are joined together using bolts and joint bars. The 39-foot rail sections are welded together at central rail welding plants. One quarter-mile long strings are welded in place using the thermite welding process. Normally the only welds you find in 39-foot jointed rail are found at road crossings and bridges. For continuous welded rail, the ties are normally closer together and requires more and a better quality of ballast.

Rail Anchors

7-14. Rail anchors are installed on the rail base securely against the side of the tie. Anchors are designed to resistor check the longitudinal movement of the rails under traffic. They also maintain proper expansion and contraction forces that build up in continuous welded rail (Figure 7-2). Without anchorage, the rail will run irregularly. At locations where expansion forces concentrate, the track can buckle or warp out of line or surface. At locations where contraction forces concentrate, the field welds can be broken or the bolts can be sheared.

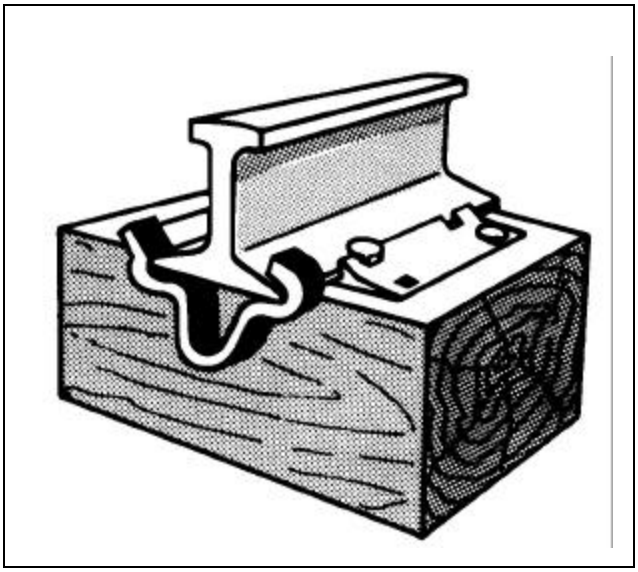


Figure 7-2. Simple Rail Anchor on Base of Rail

Tie Plates and Fastenings

7-15. Tie plates protect the wooden crosstie from damage under rails and distribute wheel loads over a larger area. They also hold the rail at the correct gauge, tilt the rail slightly inward to help counter the outward lateral weight of wheel loads, and provide more desirable positioning of the wheel bearing area on the rail head (Figure 7-3, page 7-5).

- **Application.** Tie plates are attached to the ties by spikes, screws, or other fasteners. Attachments are installed into the tie through the holes manufactured into the tie plate.

Some of the spikes (or other fasteners) in each plate also hold the rails in the rail seat formed in the tie plate (Figure 7-4, page 7-5).

- **Functions.** There are three primary functions of any rail fastening system. These functions are as follows:

? Transfers the wave motion of the rail (which precedes and follows a wheel) to the tie, which will cushion the shock.
? Provides an anchoring force to help restrain longitudinal movement of the rail.
? Holds the rail alignment, while still providing a slight vertical flexibility.

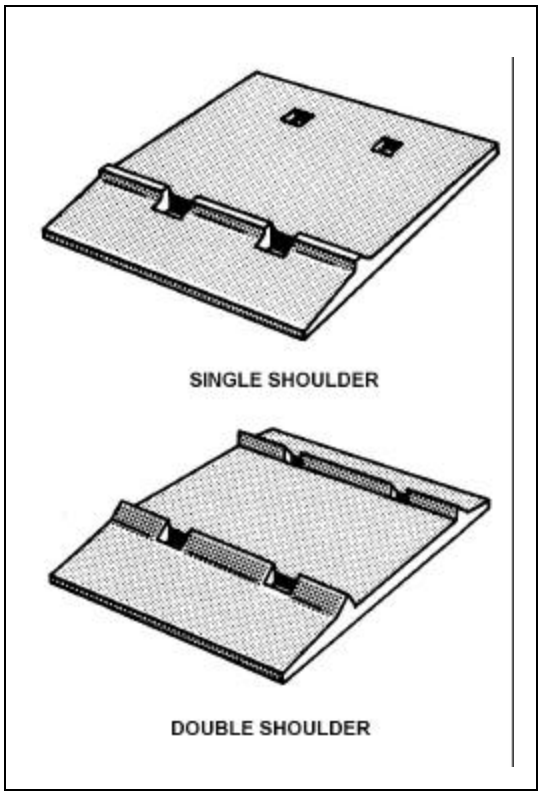


Figure 7-3. Tie Plates

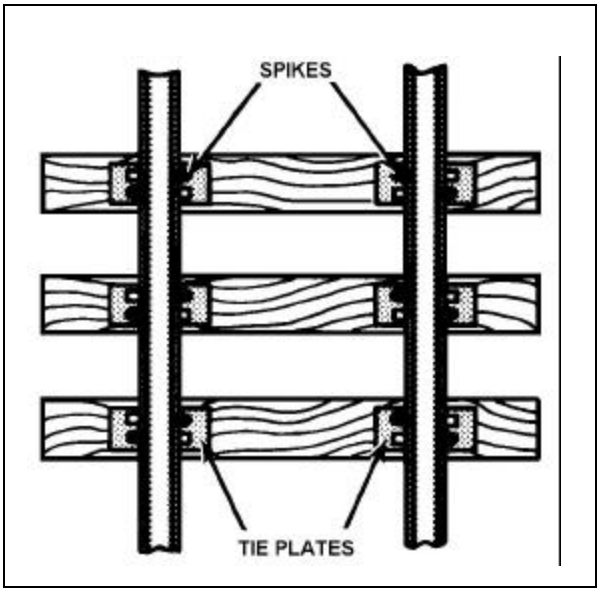


Figure 7-4. Correct Method of Setting Spikes

Track Spikes

7-16. Track spikes do the following:

- Holds the rails to the correct gauge and alignment.
- Prevents the rail from overturning.
- Secures tie plates to the ties.

Hook head or cut spikes are used extensively in CONUS and in military railroading. Screw spikes are used primarily in Europe. Four to eight spikes are used per tie. Use four spikes on straight track and eight spikes on curved track. Examples of each are shown in Figure 7-5.

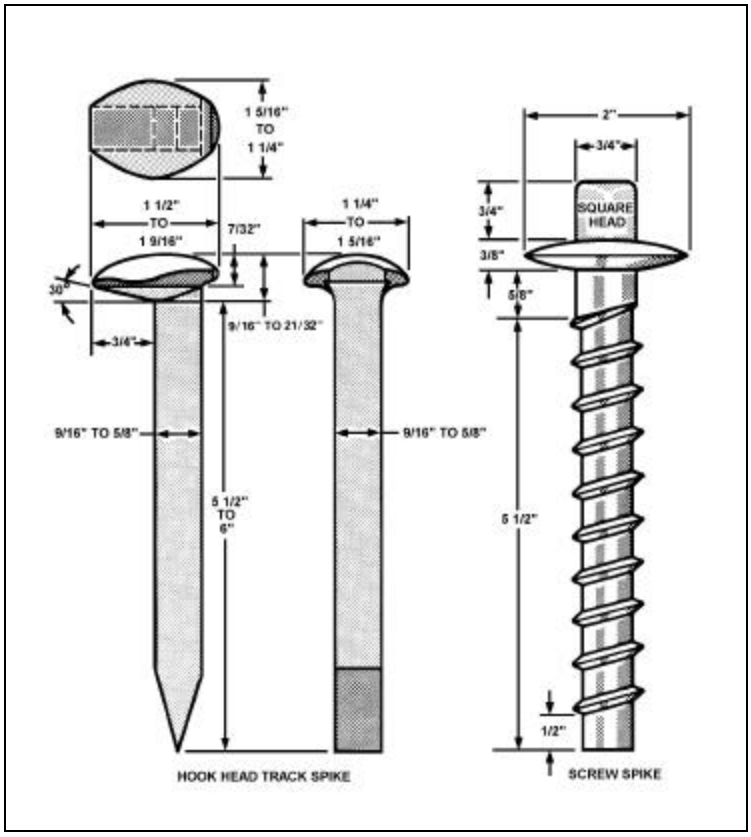


Figure 7-5. Spikes

Rail Joints and Accessories (Splice Bars)

7-17. Rails must be connected at the joints so that the rails will act as a continuous girder with uniform surface and alignment. Therefore, inspect all rail joints and accessories obtained from suppliers or storage before they are placed in track.

- **Functions.** The primary purpose of any rail joint is to maintain the fixed relationship of the abutting rail ends and to provide a structural means of transferring the wheel loads from one rail to another. If possible, the rail joint should have the same strength and stiffness as the rail. This can be done by using two steel members. They fit in the space on each side of the rail and span the gap between the two rails. These compromise angle bars are normally held in place by bolting (Figure 7-6).
- **Types.** The track bolt, spring (lock) washer, and nut are the most commonly used joint accessories. The track bolt is made from heat-treated, high-carbon steel. It has an elliptical neck under the bolt head which mates with a matching elliptical hole in the joint bar. This provides a means of holding the bolt during the tightening operation. These holes are normally alternated in the joint bar so that every other bolt is put through the assembly from the opposite side. This practice makes it extremely unlikely that all the bolts in a joint would be broken during a derailment.

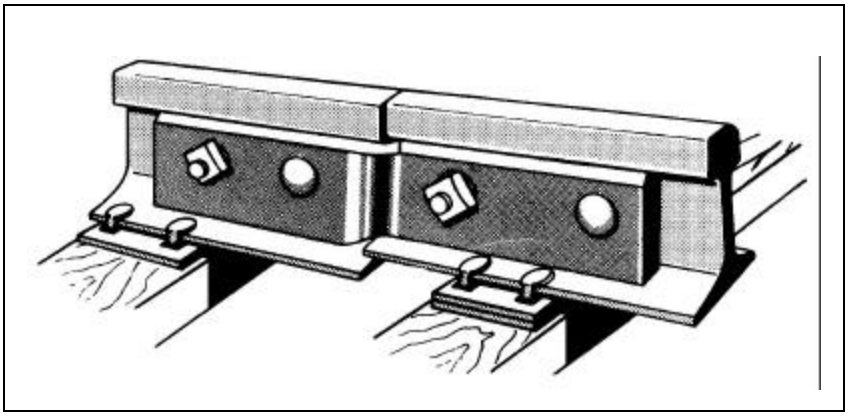


Figure 7-6. Compromise Angle Bar

Switches

7-18. Switches are mechanical devices consisting of special crossties with rails that permit a train to change tracks and therefore, change direction. Switches may be controlled either manually or electronically.

7-19. Switches have left-hand and right-hand switch points that divert the rolling stock to the proper turnout. Switches also have one or more rods to hold the points in correct relationship to each other and to prevent them from rising. A gauge and switch plates support the switch points at the same elevation as the permanent rail and maintain the correct position of the switch. Clips unite the rods with the switch points and metal guards provide foot protection (Figure 7-7 and Figure 7-8).

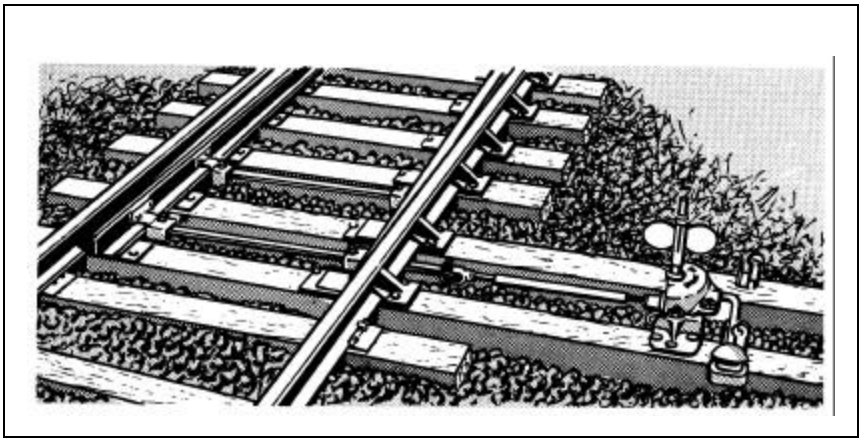


Figure 7-7. Manual Switch

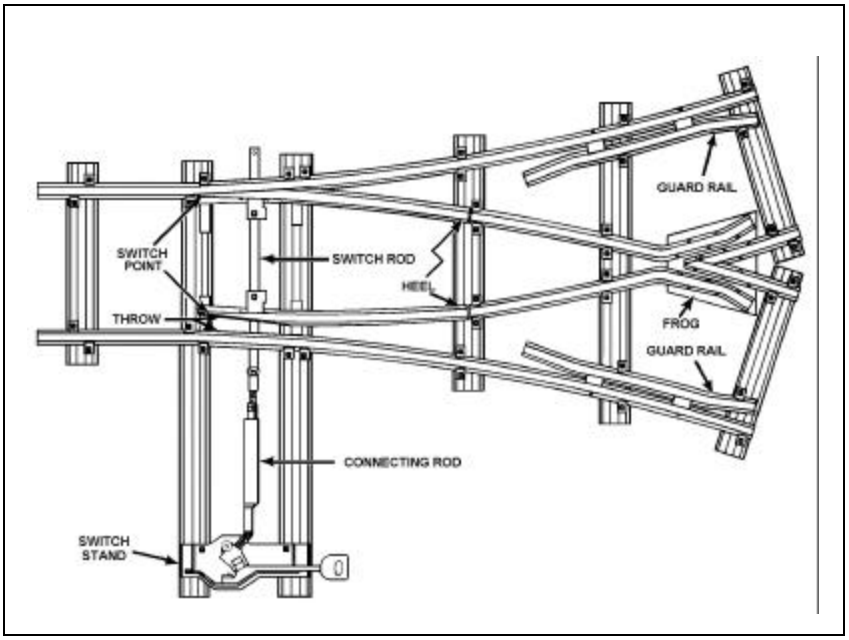


Figure 7-8. Switch Components

Switch Stands

7-20. A switch stand is the mechanism which controls the operation of the switch. The stand also shows the switch's position. The following are the two types of switch stands.

Low stands (or ground throw stands). In low stands or ground throw stands, the hand-throwing lever travels in a vertical plane.
High stands (or column-throw stands). In high stands or column-throw stands, the throwing lever travels in a horizontal plane

7-21. A switch stand consists essentially of a base, spindle, and throwing lever. These parts are assembled to form mechanisms which, by the use of cranks, gears, yokes, toggles, and other fittings, transmit the circular motion of the throw lever to a switch connecting rod. Therefore, the spindle and its associated mechanism are important parts of the switch assembly. The spindle and its associated mechanism multiplies force applied to the throw lever, delivering maximum force at critical positions in the throw. A switch stand is held in a fixed position, by the anchorage of its base to two ties (Figure 7-9).

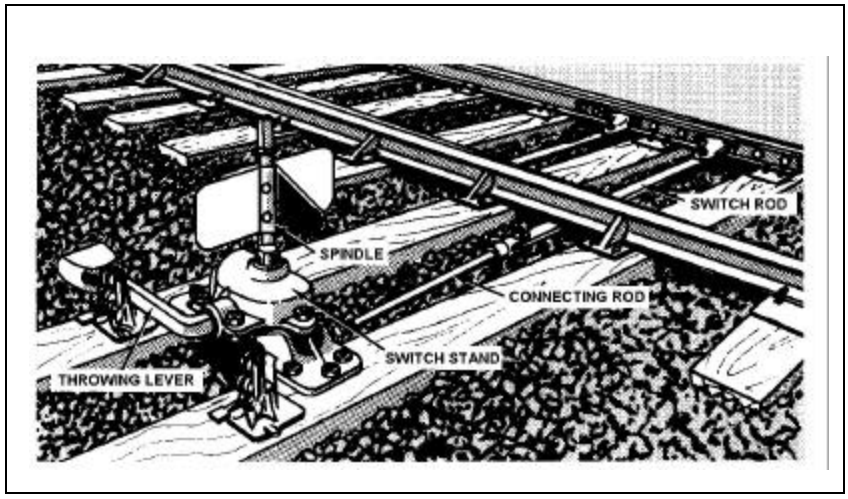


Figure 7-9. Switch Stand Assembly

Derails

7-22. Derails are safety devices designed to limit unauthorized movement of a car or locomotive beyond a specific point. The most frequent use of derails is to prevent unauthorized movement of equipment from a side track onto a main track. Derails are sometimes used to prevent the movement of equipment onto portions of a side track where it might cause an accident or damage.

7-23. Derails are also used to ensure that rules or signals are obeyed and to protect personnel and equipment against unauthorized, careless, or accidental procedures. If a train passes over an operating derail, the train will be derailed. Types of derails are shown in Figure 7-10.

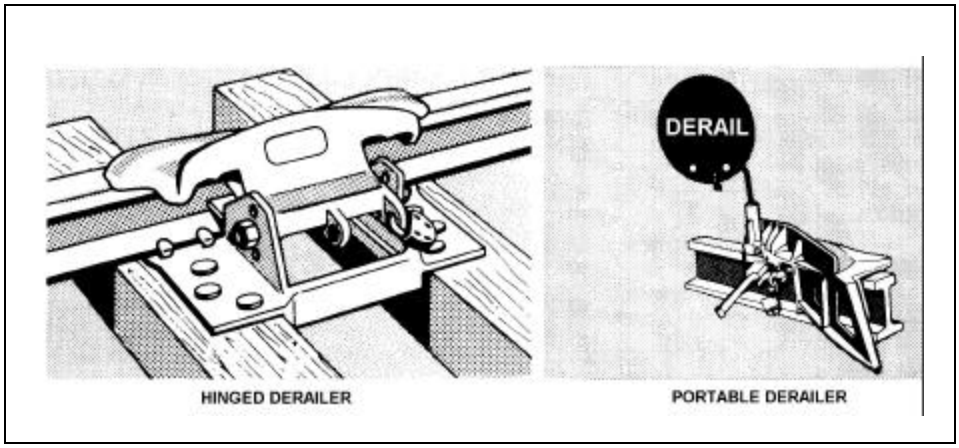


Figure 7-10. Derailers

Frogs and Guard Rails

7-24. Frogs are special pieces of trackwork that enable flanged wheels to cross from one rail onto another rail. Guard rails consist of a rail or series of rails that lay parallel to the running rails of a track (also see Figure 7-11, page 7-12).

Frogs

7-25. Frogs provide continuous channels for the wheel flanges and support the wheels over the intersection. Frogs are built of carbon or heat-treated steel rails, of carbon steel rails combined with manganese steel casings, and of solid manganese casings. Frogs do not require any mechanical operation.

Guard Rails

7-26. Guard rails helps prevent derailments. They also hold wheels in alignment and keep derailed wheels on the ties.

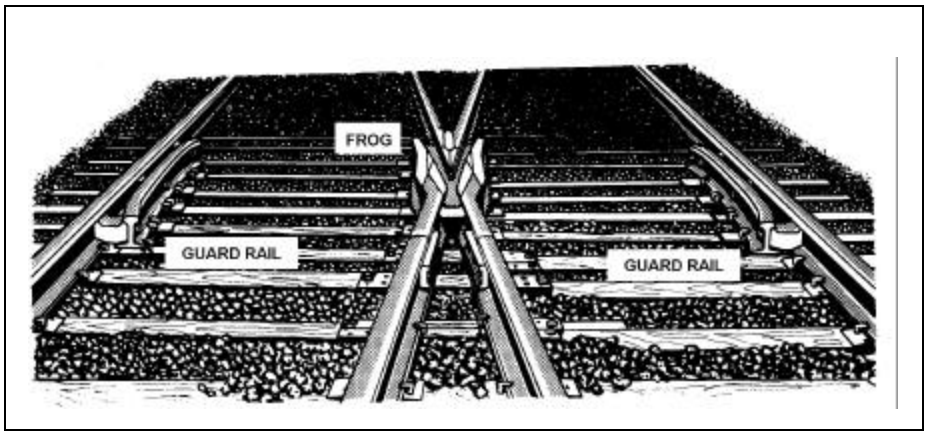


Figure 7-11. Frog and Guard Rails

7-27. There are three types of guard rails. Each type is described below.

- **Turnout guard rails.** These rails are designed and installed to prevent the flanges of the wheels from striking the points of the frogs on turnouts and crossovers.
- **Curve guard rails.** These rails are applied to sharp curves to guide the flanges of locomotive and car wheels or to support the blind driving wheels of locomotives.
- **Bridge guard rails.** These rails prevent derailed wheels from running off the ties on a trestle, bridge, or viaduct.

TRACK TOOLS

7-28. The mechanization of track maintenance equipment continually progresses in the variety of machines and equipment as well as the functions they perform. However, the basic tools designed for manual use are still required on all railroads. Such tools have a well-defined roll in specific work assignments. For example, mechanized equipment may not always be available to replace a defective rail or deteriorating ties, surface a rough spot, gauge a wide spot in a curve, replace a cracked joint bar, or effect other random maintenance tasks that can be done efficiently with a small work crew. However, there is new equipment currently being used by the railroad industry, which has greatly reduced the size of work crews and greatly increased productivity (Figure 7-12 and Figure 7-13).

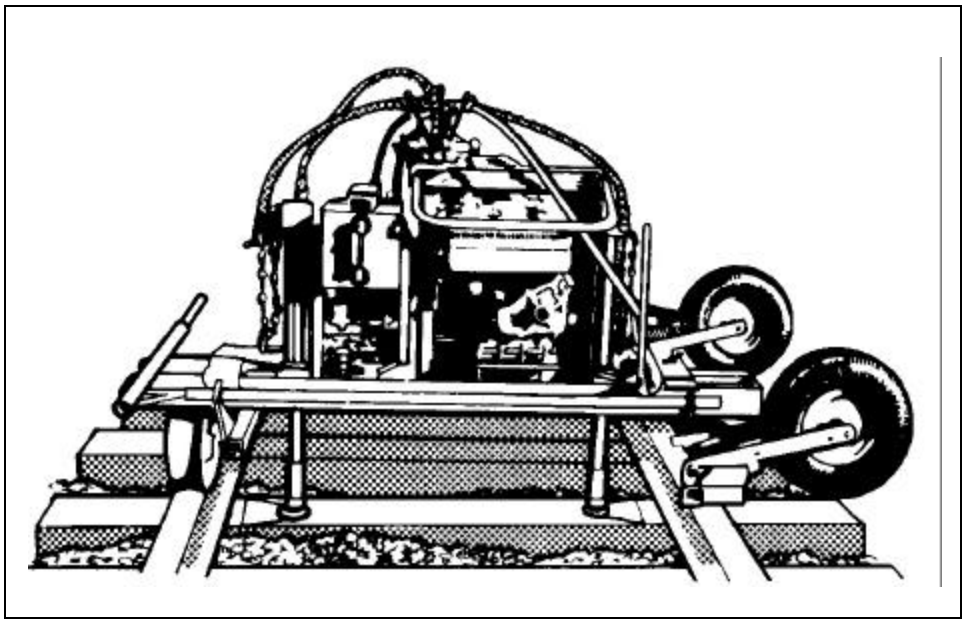


Figure 7-12. Automatic Rail Lifter / Trade Jack

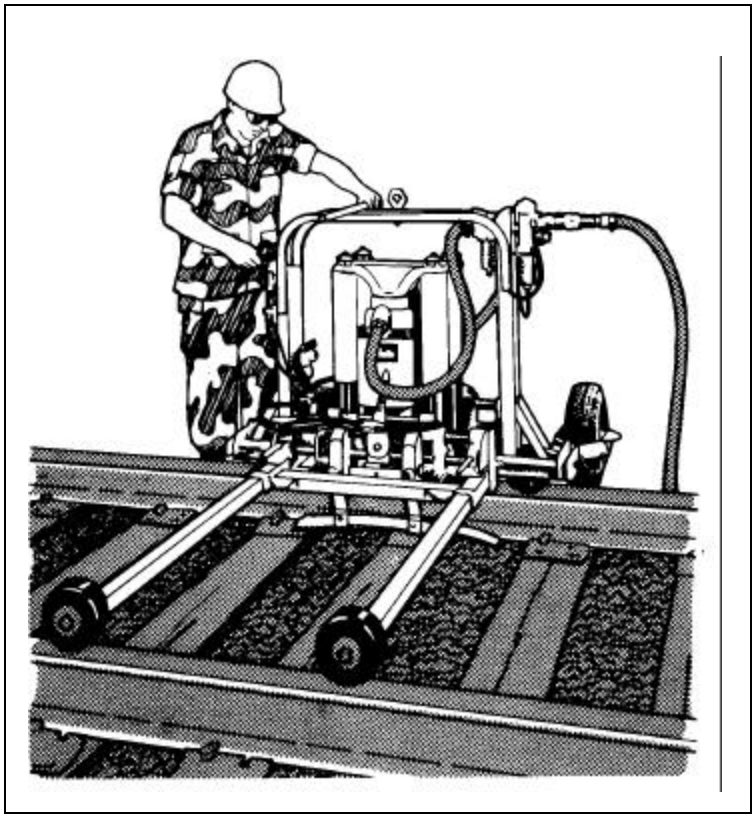


Figure 7-13. Spiker

EFFECTS OF TERRAIN ON TRACK ALIGNMENT AND PROFILE

7-29. The ideal railroad track would be on a flat terrain with no curves. Track routes are actually determined by acquisition of property, general terrain of a particular area, and locations that are served by the railroad. Other factors which determine military railroads are:

- Axis of advance.
- Main supply routes.
- Availability of existing lines and damage sustained to them.
- A unit's ability to defend the lines.

Trade-offs are made between repairing a railway to full operating capacity while neglecting others, and repairing multiple segments of lines to reduced capacity. It is almost always more important to rehabilitate a rail line so that it can operate at a reduced capacity (no signals, primitive operations, and so forth) than to hold all operations until the final spike is driven. In almost every case, trains will be operating while railroad rehabilitation and construction is taking place. Many times operations will continue over the very same track being repaired.

Track Profile

7-30. Track profile is the term applied to the vertical dimensions of the track caused by terrain features such as hills or valleys. Every attempt is made to reduce inclines or grades since they have a direct bearing on the amount of motive power needed to pull a train. From an operational point of view, boring a tunnel through a mountain may therefore be preferable to going around or over a mountain.

Track Alignment

7-31. Track alignment is the term applied to the horizontal dimension of a track (for example, curves). Curves are needed to change track direction, whether intentionally (route) or unintentionally (obstacles). The radius of the curve must be as large as possible, as curves apply rolling resistance to train movement. Since a train in motion tends to move in a straight line, it applies a lateral force against curves in the track and increases motive power requirements.

7-32. The alignment of a railroad consists of straight sections (tangents) connected by curved sections. The sharpness of a curve is measured in degrees, minutes, and seconds. Horizontal curves are classified as simple, compound, and reverse. A simple curve is a single arc connecting two tangents. A compound curve is formed by two simple curves of different radii, both curving in the same direction. A reverse curve consists of two curves that bend in opposite directions (Figure 7-14).

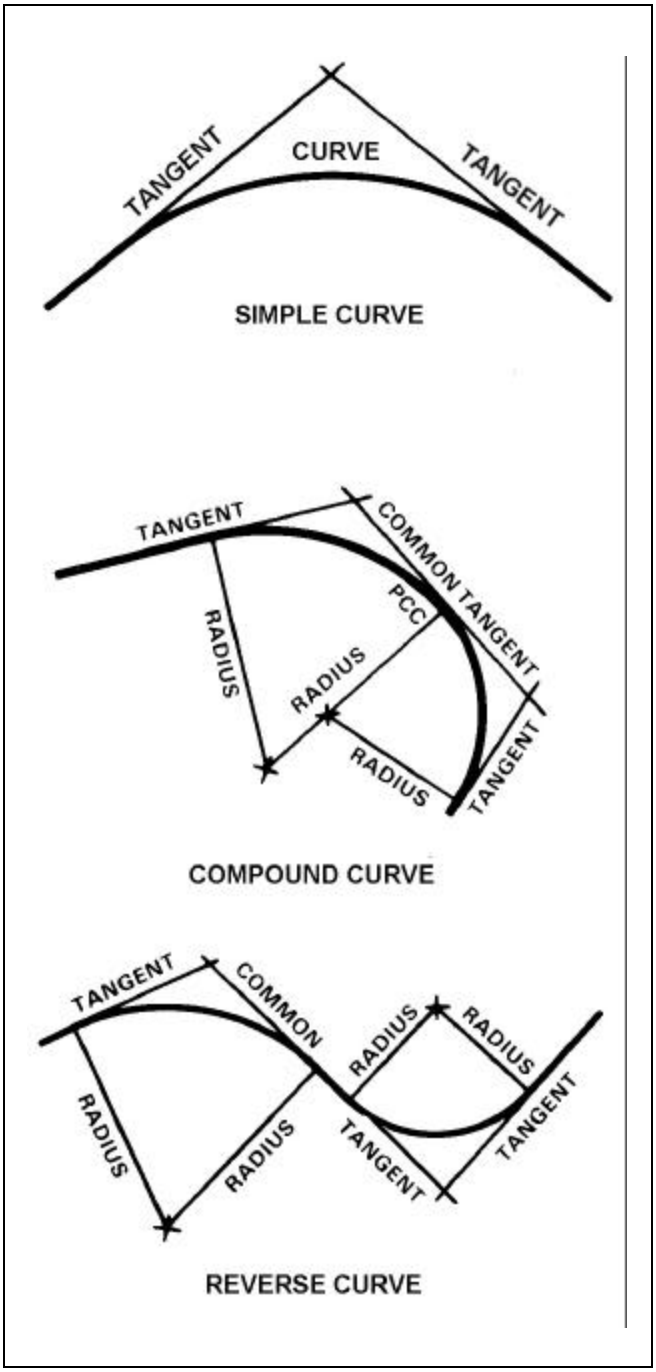


Figure 7-14. Types of Horizontal Curves

Ruling Grade

7-33. A key factor when calculating motive power requirements for a train is the ruling grade that will be encountered between the starting point and the final destination. The ruling grade calculation considers both track alignment and profile. The steepest grade might not be the ruling grade since

another location with a lesser grade, but a tight curve, could cause more rolling resistance. The higher the rolling resistance, the more motive power is needed. Higher motive power for any one train is obtained either by using a more powerful locomotive or by using two or more locomotives.

7-34. Grade lines are designated by the vertical change in 100 feet (30 meters). A grade rising 2 feet in a horizontal distance of 100 feet is called a +2.0-percent grade; one descending the same amount is called a -2.0-percent grade. Any grade from 0.0 percent (or level) to 0.4 percent is called light; from 0.4 to 1.0 percent, moderate; from 1.0 to 2.0 percent, heavy; and above 2.0 percent, very heavy.

Determining Curvature

7-35. Use either the survey method or string method to determine curvative. Each of these methods is described below.

Survey Method

7-36. When computing curvature, chord is measured as 100 feet (30 meters). Use the following formula to determine an approximate value for the radius. However, it is possible to obtain an approximate value for the radius from the following simple empirical formula:

- $R = \frac{5,730}{D}$ Where— R = Radius, D = Degree of curvature
- 5,730 ft (1,747 m) = approximate length of radius of a l-degree curve
- Likewise, D can be computed by:
- $D = \frac{5,730}{R}$

String Method

7-37. Use the string method to determine the approximate degree of curvature if a surveying instrument is not available. A portion well within the main body of the curve is selected; a chord distance of 62 feet (18.9 meters) is measured along the inside of the high rail (Figure 7-15, points A and B). A string or strong chord is stretched tightly between points A and B, and the distance M is measured at the midpoint of the chord. This distance, in inches, is approximately equal to the degree of curvature. As a curve gets sharper, this distance increases. The normal method of horizontal curve layout for railroads uses the string method.

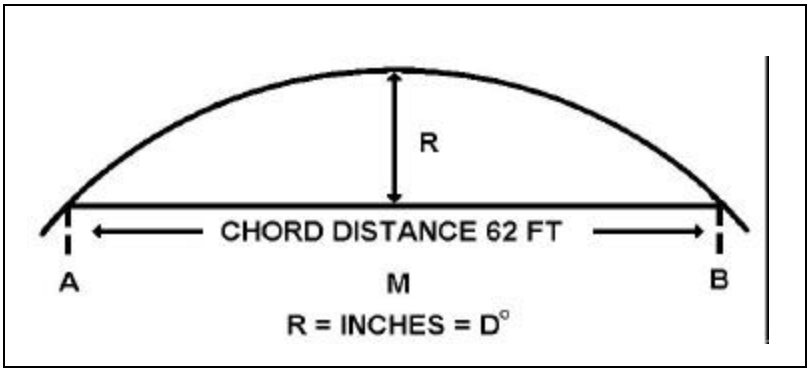


Figure 7-15. String Method

STRUCTURES

7-38. Structures can generally be divided into two classes. The two classes are minor structures or major structures. These two classes are described below.

Minor Structures

7-39. Minor structures are provided to carry the track over minor natural features (such as small streams and ditches) or over man-made drainage features (such as pedestrian walkways and pipelines). Minor structures are mainly some form of pipe-like construction. These pipes can be of corrugated metal or reinforced concrete. They are generally open-ended and cross under the track at angles varying from 45 degrees to 90 degrees. These structures are vital to the long-term stability of the track and roadbed.

Major Structures

7-40. Major structures are provided to carry the track over or through major natural or man-made features (such as over rivers or highways or through mountain tunnels). Major structures are usually considered to be bridges or trestles and tunnels.

Bridges

7-41. Bridges are normally constructed from steel, reinforced concrete, masonry, and timber. Two general types of bridges are ballast deck and open deck. A ballast deck bridge has a trough-like deck in which a layer of ballast can be laid. The track is constructed on the ballast using standard track construction techniques. The ballast deck bridge is excellent from the standpoint of fire prevention and track maintenance. This type also allows the use of normal track materials and maintenance procedures (Figure 7-16). An open deck trestle uses the bridge's ties as crossties for the track (Figure 7-17).

- Bridge Capacity. The design of bridges is to safely carry a specific concentrated load. Loads which may be placed on a structure temporarily or which may be changed in position are termed live loads to distinguish them from fixed, dead, or static loads. Live loads are the tonnage trains; static loads are the superstructure, tracks, ties, and so forth. The maximum live load consists of two coupled locomotives followed by the number of

cars that occupy the entire length of the bridge. Although various formulas have been used to compute bridge capacity, the most accurate of these is Cooper's E rating. In this formula, each driving axle on the locomotive carries a proportionate part of the total weight loaded on the drivers. A bridge designed to carry a 0-6-6-0 diesel-electric locomotive weighing 240,000 pounds (108,844 kilograms) on the drivers, must have a Cooper's rating of at least E-40 (40 equals to 40,000 pounds). A 0-6-6-0 locomotive has six driving axles. The following is the formula for computing the E rating of the locomotive:

240,000 pounds = 40,000 pounds 6 (driving axles)
or
108,844 kilograms = 18,144 kilograms 6 (driving axles)
= the amount each axle can carry

If the gross weight of a car in the train exceeds the weight of the locomotive pulling the train, then the Cooper's E rating must be computed based on the gross weight of that car. The E rating must be for the heaviest piece of rolling stock in the train.

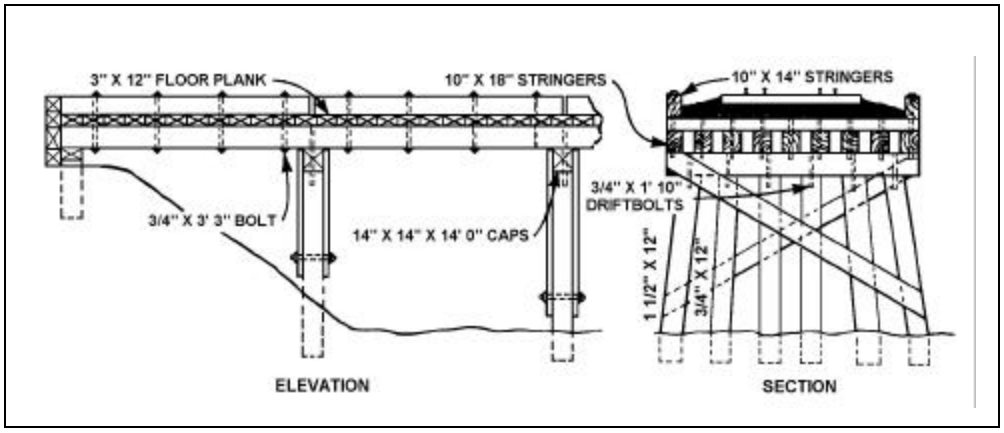


Figure 7-16. Ballast Deck Bridge

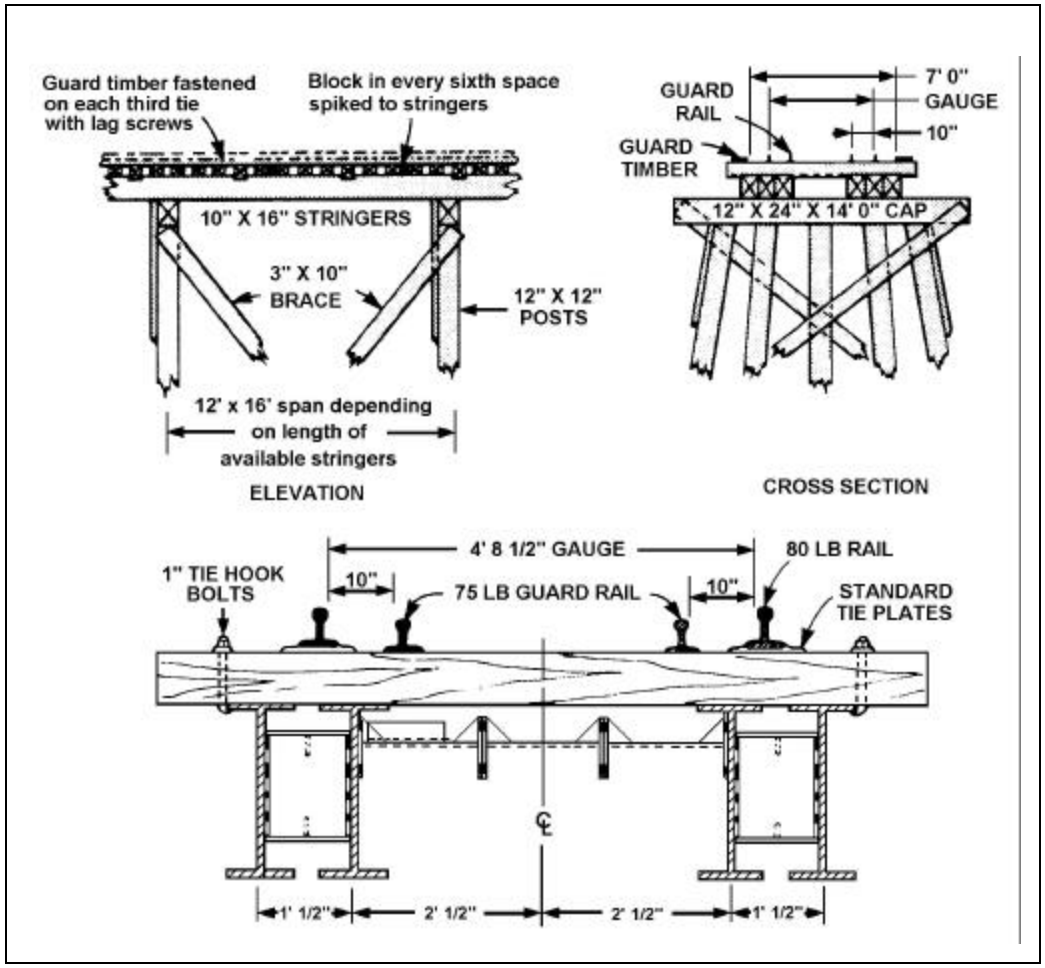


Figure 7-17. Open Deck Bridge

- **Steel and Wooden Stringer Bridges.** There usually is an economical consistency in the design of all parts of a railroad bridge. Dimensions of the floor system are related to the load for which the whole structure was designed. Table 7-1 and Table 7-2, page 7-22, show the Cooper's E rating of a number of typical railroad bridges and the stringer dimensions of their floor systems.
- To estimate the capacity of a railroad bridge with steel stringers or girders as part of the floor system, the width and thickness of the lower flange of the stringer are measured (Figure 7-18, page 7-21). The depth and the length of the stringer are also measured. The corresponding E rating of the bridge is then determined from Table 7-1.
- To estimate the capacity of a railroad bridge with wooden stringers as part of the floor system, the width of each stringer under one track is measured. The widths of all the stringers are then added together to attain the total (Figure 7-19, page 7-21). The depth and length of one stringer also are measured. From Table 7-2, the wooden stringer is selected that most nearly approximates these dimensions and the corresponding E rating of the bridge is determined.

Table 7-1. Determination of Bridge Capacity (Steel I-beam Construction) (Cooper's E Rating)

Stringer Dimensions (in)			Span Length (ft)											
Thickness	Width	Depth	10	11	12	13	14	15	16	17	18	19	20	22
3/8	8 3/8	18	E-42	E-41	E-41	E-41								
3/8	10 3/8	24		E-59	E-48	E-40	E-35	E-31	E-27					
1/2	10 3/8	30				E-61	E-59	E-51	E-46	E-41	E-37	E-33	E-30	E-27
1/2	12 1/2	30						E-62	E-56	E-50	E-45	E-41	E-37	E-31
1	14	36								E-60	E-58	E-55	E-54	E-51
1/2	12 3/8	42										E-60	E-54	E-45
1 1/8	14	42											E-63	E-60

Stringer Dimensions (in)			Span Length (ft)										
Thickness	Width	Depth	24	26	28	30	35	40	44	50	54	60	64
1/2	12 1/2	30	E-26										
1	14	36	E-48	E-43	E-39	E-34	E-26						
1/2	12 3/8	42	E-39	E-34	E-30	E-26							
1 1/8	14	42	E-57	E54	E-51	E-45							
1 1/8	16	42			E-60	E-54	E-42	E-32					
1 1/2	16	48				E-59	E-52	E-47	E-43	E-33			
1					E-66	E-57	E-45	E-35	E-30				
1 5/8	14	54					E-54	E-43	E-36	E-28			
1 3/4	14	60						E-60	E-54	E-43	E-37	E-30	E-27

Stringer Dimensions (in)			Span Length (ft)										
Thickness	Width	Depth	40	44	50	54	60	64	70	74	80	84	90
1 1/2	14	60	E-57	E-48	E-38	E-33	E-27						
2 1/8	15	66			E-57	E-54	E-46	E-41	E-34	E-31	E-26		
2	14	66			E-56	E-48	E-40	E-35	E-30	E-26			
2	14	72			E-62	E-54	E-44	E-39	E-32	E-29	E-25		
2 1/2	15 1/2	72					E-55	E-51	E-43	E-38	E-33	E-29	
2 1/8	14	78				E-64	E-52	E-46	E-39	E-35	E-30		
2 1/2	16	84						E-64	E-54	E-49	E-41	E-38	E-30
2 11/16	20	96										E-59	E-51

Table 7-2. Determination of Bridge Capacity (Wood Beam Construction)

(Cooper's E Rating)

Stringer Dimensions (in)		Span Length (ft)						
Thickness	Width	10	12	14	16	18	20	22
18	12	E-16	E-12					
18	14	E-22	E-18	E-10				
18	16	E-28	E-20	E-15	E-10			
18	18	E-38	E-26	E-18	E-14	E-12		
20	12	E-18	E-12					
20	14	E-25	E-17	E-12				
20	16	E-33	E-23	E-16	E-12	E-10		
20	18	E-43	E-29	E-21	E-16	E-13	E-10	
24	12	E-22	E-15	E-11				
24	14	E-30	E-21	E-14	E-11			
24	16	E-40	E-28	E-20	E-15	E-12		
24	18	E-52	E-36	E-25	E-19	E-15	E-12	E-10
36	12	E-34	E-23	E-17	E-12	E-10		
36	14	E-47	E-32	E-23	E-17	E-14	E-11	
36	16	E-62	E-43	E-30	E-23	E-19	E-15	
36	18	E-78	E-53	E-30	E-30	E-24	E-20	E-16
40	12	E-38	E-26	E-19	E-14	E-11		
40	14	E-52	E-36	E-26	E-20	E-16	E-12	
40	16	E-69	E-47	E-35	E-26	E-21	E-17	E-17
40	18	E-87	E-60	E-44	E-34	E-27	E-22	E-18
48	12	E-46	E-31	E-23	E-17	E-13		
48	14	E-63	E-43	E-31	E-24	E-19	E-15	
48	16	E-69	E-47	E-35	E-26	E-21	E-17	E-17
48	18	E-105	E-73	E-53	E-41	E-33	E-27	E-22
54	12	E-52	E-35	E-27	E-19	E-15		
54	14	E-72	E-49	E-35	E-22	E-18		
54	16	E-94	E-65	E-46	E-36	E-29	E-24	
54	18	E-119	E-42	E-60	E-46	E-38	E-30	E-25
60	12	E-58	E-40	E-30	E-22	E-17		
60	14	E-79	E-55	E-39	E-30	E-35	E-20	
60	16	E-104	E-72	E-52	E-40	E-33	E-27	
60	18	E-132	E-92	E-67	E-52	E-42	E-34	E-28

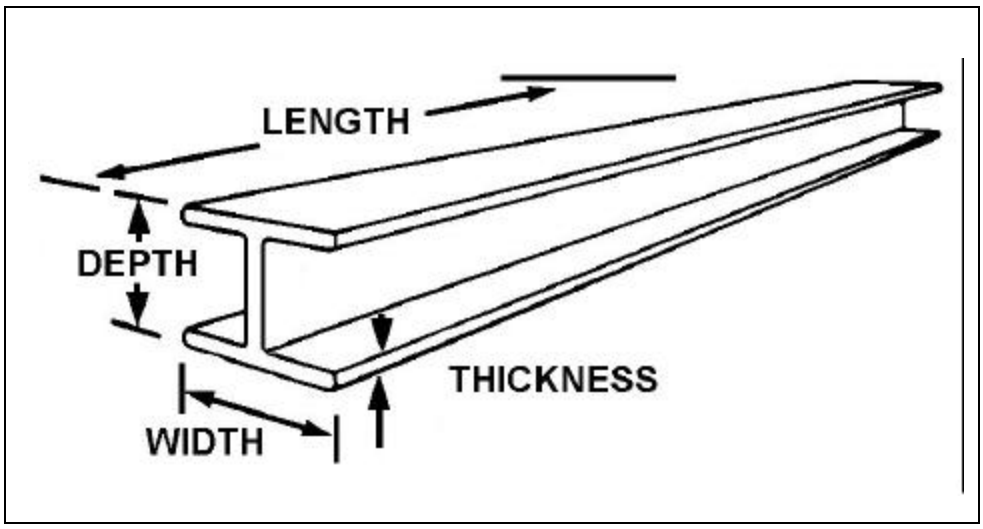


Figure 7-18. Dimensions of a Steel Stringer

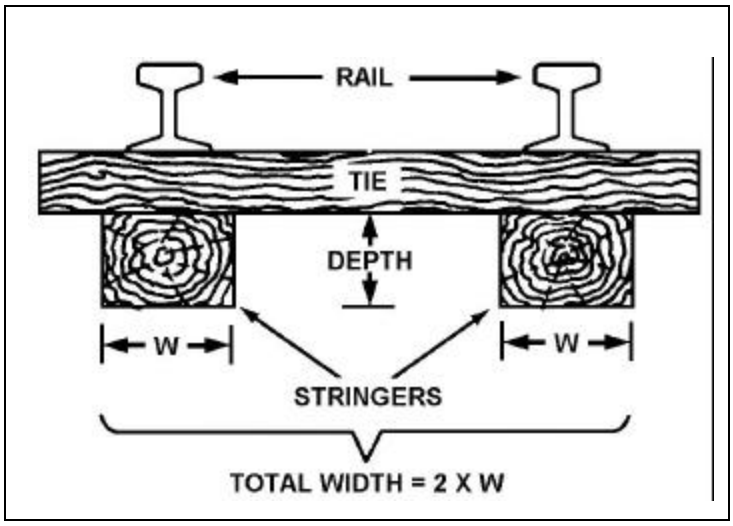


Figure 7-19. Dimensions of a Wooden Stringer

Tunnels

7-42. Two principal types of tunnels are lined and unlined. Lined tunnels are cut through unconsolidated formations. A lining is provided to prevent cave-in on these types of tunnels. These linings are usually formed from concrete or timber. Unlined tunnels are cut through solid rock formations. The rock walls and ceiling that remain, form the exposed surfaces of the tunnel.

EFFECTS OF COLD WEATHER

7-43. Cold weather conditions can impose a considerable burden on the operation and maintenance of railway service. Cold weather can effect yard switching (making it slow and difficult). It also has an effect on starting trains and making steel car parts brittle. Heavy winds (common in cold weather) can also hamper operations on the road and in the yards.

Track and Roadbed

7-44. In cold climates, having a terrain similar to that of Alaska, the elements may cause damage to the track and roadbed. Areas of this type are underlaid with permafrost through which surface water cannot penetrate and which drains off in the summer. During thaws, the water lies on top of the ground, often partially covering the ties. This can cause tie rot and disturbs alignment, surface, and gauge. In winter, the water freezes and heaves the track dangerously out of line. Maintenance must be done on the track and roadbed as soon as the weather permits.

Bridges

7-45. Frost-heaving causes extensive maintenance repair to be made on bridges and trestles constructed of wood pilings. These repairs may reduce division train density. Maintenance problems occur when water below the ground surface freezes, therefore causing the piling to rise. This in turn may raise the level of a bridge 2 or 3 inches higher than the normal level of the track. There is no known way to combat this condition except by removing the decking, track, and ties; cutting off the tops of the piling to a suitable height; and then replacing the top structure.

Pole Lines

7-46. In some areas it may be impossible to use telegraph or utility poles in the conventional manner. In warm weather, the soil in low spots becomes so unstable that the poles cannot be kept vertical. In winter, the poles may be heaved up by frost and the wires will break. Wires should never be too taut between poles because winter contraction may cause them to break. Using poles built in a tripod shape with a wide base that rests on the ground will help stabilize the poles. Nothing can be done about wires that break due to heavy ice covering. An adequate supply of wire and splicing materials and maintenance personnel must be available to keep communication functions open during the winter.

Tunnels

7-47. Tunnels are usually a simple maintenance problem. However, in cold climates, water seepage can cause extreme difficulties. Ice can form on the track, which often makes the tunnel impassable. There is hardly any way to bypass tunnels. In summer, the frozen earth under the track heaves to the extent that train movements may often be suspended. Work inside tunnels is slow and difficult because of the confined space in which men and machinery must work. In some areas, much of the difficulty has been overcome by steam heating some of the tunnels and putting doors on the portals. Workmen are assigned throughout the winter as firemen and door tenders to keep the tunnels warm and to open and close the tunnel doors for train passage. The tunnels are therefore kept at a temperature above freezing, and the water that seeps through the walls and ceiling is drained to the outside.

Track Obstructions

7-48. There are some obstructions that are either unforeseen or that anyone is able to control. Some of these are discussed below.

Snowfalls

7-49. Heavy and frequent snowfalls require the constant use of snowplows. During heavy snows, a locomotive with a plow may have to precede each main line train. At times, the snowfall may be so heavy that two trains may have to remain in sight of each other. It may be practical to equip locomotives with a small blade permanently attached to their pilots. Alaskan railroads have successfully used a notch blade that can be lowered a couple of inches below rail level. This is an expedient, which is only effective against snow a few inches deep. A snowplow, pushed by one or more locomotives, is usually needed to clear overnight snowfalls or even snowfalls of a few hours duration.

Earth and Rock Slides

7-50. Slides are a frequent source of trouble in a hilly, cold climate. They occur in deep cuts, along steep slopes, and frequently at the mouths of tunnels when frozen hillsides or mountainsides thaw in the spring. In Alaska, and similar climatic and topographical areas, the summer shifting of glacial mountains is a problem. Glacial mountains move several feet each year over a lineal distance of several hundred yards. When a rail line runs alongside a glacial mountain, the affected right-of-way may have to be rebuilt. However, there is little that can be done if moving the track is not feasible. Prudent planning includes storing materials, tools, and supplies where they are in no danger of being covered by slides. Snow slides also present a serious problem in heavy snow climates. Such slides are generally heavier in weight and greater in volume than in temperate climate areas. Off-track machinery is not practical in cleanup operations because roads to reach such areas are usually nonexistent. The extreme cold also hampers workmen. The use of high-speed rotary snowplows in cleaning such slides is usually impossible because of the debris (for example; dirt, rocks, and twigs) that may come in contact with its high-speed blades.

Wild Animals

7-51. The presence of wild animals on the track may cause temporary track obstructions and account for major delays to freight and passenger trains. Animals may get on snow-cleared tracks and remain there to escape the deep snow and because they have more of a chance to fight off other animals. All reasonable efforts must be made to clear animals unharmed from the track. For example, many moose have been killed on railroad tracks in Alaska, and trains running squarely over moose have been derailed. There are recorded cases where moose walked ahead of trains for 15 miles before leaving the track. During the rutting season, the bulls are extremely excitable and often charge a moving train. Railroad personnel working under such conditions must exercise care.

CONSTRUCTION AND REHABILITATION REQUIREMENTS

7-52. Table 7-3 lists the materials and net man-hours required for new construction of one mile of standard-gauge, single-track railroad. Table 7-4 estimates the requirements for rehabilitating a 100-mile standard-gauge, single-track division extending inland from a port using average percentage of demolition over the entire division.

Table 7-3. Construction Requirements Per Mile Standard-Gauge Single-Track Railroad

ITEM	STONs	MTONs	MAN-HOURS
Grading (includes clearing average wooded terrain)	-	-	5,000
Ballast delivered, average haul--5 miles (8.05 km)	-	-	2,500
Tracklaying and surfacing	-	-	3,400
Bridging--70 linear feet (21.34 m)	128	111	3,200
Culverts, 7 per mile--280 feet (85.34 m)	8	7	1,400
Ties--2,900	218	300	-
Rail, 90-pound--ARA--A Section	79	45	-
115-pound--ARA--E Section	103	57	-
Fastening (based on 39-foot rail) (11.89 m)	33	10	-
Total	569	530	15,500

Table 7-4. Rehabilitation Requirements Per Railroad Division

Item	Per 100 Miles (161 km)	Percent of Demolition	Rehabilitation (quantity)	Construction STONs	Material[1] MTs	Man-Hours[1] (Thousands)
Main line trackage	**100 mi**	**10**	**7.0 mi**	**2,708**	**1,033**	**36.4**
Port trackage[2]	-	**100**	**3.0 mi**	**1,368**	**1,092**	**14.4**
Passing sidings[2]	**2.4 mi**	**80**	**2.4 mi**	**1,049**	**874**	**11.5**
Station sidings[2]	**1.6 mi**	**80**	**1.6 mi**	**730**	**582**	**7.7**
Railway terminal[2,3]	**1.0 ea**	**75**	**0.75 ea**	**8,025**	**4,875**	**160.0**
Water stations	**3.0 ea**	**100**	**3.00 ea**	**135**	**210**	**9.0**
Fuel stations	**1.0 ea**	**100**	**1.00 ea**	**19**	**16**	**0.9**
Bridging (70 ft per mile)	**7,000**	**55**	**2,700 linear ft**	**2,700**	**2,672**	**70.0**
Culverts	**28,000 linear ft**	**15**	**4,200 linear ft (74 ea)**	**63**	**63**	**13.7**
Grading and ballast	-	-	-	-	-	**40.5**

[1] Tunnels require special consideration. To repair (by timbering) a 50-foot demolition at each end of a single-track tunnel (100 ft total per tunnel), allow 70 STONs or 87 MTs, and 3,000 man-hours.

[2] Estimate includes ties, rails, fastenings, turnouts, tracklaying, and surfacing. It is assumed ballast is available at work sites.

[3] Includes replacing buildings 100 percent, ties 30 percent, rail and turnouts 85 percent.

Chapter 8

Railway Equipment

Effective and adequate transportation railway support of military operations in a theater of operations requires efficient use of railway rolling stock and motive power. The trainmaster reports any misuse of rail equipment and facilities by shipping activities through the rail unit's chain of command to the commanders responsible for loading and unloading cars. Commanders must ensure that railway rolling stock is properly loaded and/or unloaded and released to the rail units.

EQUIPMENT USE

8-1. Passenger equipment is frequently limited to use in troop movements, leave trains, military casual personnel trains, and ambulance trains. Special equipment includes specially designed rolling stock for handling unusual cargo and railway work equipment and ambulance cars. If Army ambulance cars are not provided in a theater of operations, passenger equipment may be converted to ambulance cars.

8-2. When volume permits, containers and refrigerator or tank cars are handled in solid trains and given a high movement priority from origin to destination and return. The increased use of containers for the movement of military cargo provides a throughput service to the consignee. Containers so shipped must receive a high movement priority from origin to destination consignee.

8-3. When trains are exposed to enemy ground or air attack, engines and cars should be modified to provide for increased armored protection of cargo, passengers, and security elements. Armored trains may be specifically created for use by security forces in support of operations in contested areas of the railway route.

ROLLING STOCK

8-4. The worldwide inventory of Army-owned rolling stock includes locomotive cranes, tank cars, freight cars of miscellaneous types, and other equipment. It includes numerous diesel-electric locomotives stored or in use in various parts of the world. Most of the larger locomotives are designed for foreign and domestic service and are equipped with multi-gauge trucks, which can be adjusted to any gauge from 56 1/2 to 66 inches. Usually the changes in wheel gauges to suit overseas requirements are made in CONUS where wheel presses are available.

8-5. Contingency operations might require supplementary railway motive power, rolling stock, and materials. Local equipment, even if operable, would likely be inadequate to support transportation requirements of the US and allied forces under wartime conditions. The Army multi-gauge fleet, stored or used in CONUS and other parts of the world, is the basic source for supplementary items pending establishment of a procurement program. Many countries, which are potential areas of unrest, are served by narrow-gauge railroads. Equipment in these areas is often in poor condition. The locomotives and freight cars are old and in need of repair. Locomotives have low tractive effort and cars may consist largely of boxcars and a few flatcars with low-carrying capacities. These countries often have insufficient railroad facilities to serve their economic needs. Superimposing, fast moving, high-density, military tonnage would exceed local operating capabilities. The Army has

developed procurement specifications for narrow-gauge rail equipment to meet the operating characteristics of the rail lines in contingency areas. Railway equipment characteristics are shown in Tables 8-1 through 8-11. Figure 8-1 is an extract from The Official Railway Equipment Register.

Table 8-1. Characteristics of Locomotives

						Tractive Force (lb)			Curvature Minimum Radius (ft)	
Type	**Gauge (in)**	**Weight (lb)**	**Length Over Couplers**	**Extreme Width**	**Extreme Height**	**Starting at 30% Adhesion**	**Continuous**	**Horse-power**		**Fuel Capacity (gal)**
Diesel-Electric 131-T, 0-6-6-0, domestic and foreign svc	56 1/2	262,900	55'	10'0"	14'0"	75,700	37,850 at 10 MPH	1,000	231	1,600
127-T, 0-6-6-0, domestic and foreign svc	56 1/2	261,100	55'	10'0"	14'0"	75,700	37,850 at 10 MPH	1,000	231	1,600
120T, 0-6-6-0, domestic and foreign svc	561/2, 60 63,66	240,000 245,000 w/steam generator	57'5"	9'8"	13'6"	73,000	37,000 at 10 MPH	1,600	193	1,600 800 w/steam generator
120-T, 0-6-6-0, domestic and foreign svc	56 1/2 60, 63 66	240,000 245,000 w/steam generator	56'9"	9'7"	13'5"	72,000	36,000 at 10 MPH	1,600	193	1,600 800 w/steam generator
120-T, 0-4-4-0, domestic svc	56 1/2	240,000	55'9"	10'3"	14'6"	75,000	40,000 at 11 MPH	1,500	150	800
120-T, 0-4-4-0, domestic svc	56 1/2	246,000	48'10"	10'2"	14'6"	73,000	36,000 at 10 MPH	1,200	100	750
115-T, 0-4-4-0, domestic svc	56 1/2	230,000	45'6"	10'0"	14'6"	69,000	34,000 at 15 MPH	1,000	50	635
100-T, 0-4-4-0, domestic svc	56 1/2	199,000	44'6"	10'0"	14'4"	59,700	28,750 at 10 MPH	660	50	635
100-T, 0-4-4-0, domestic svc	56 1/2	200,000	44'5"	10'0"	14'7"	69,700	35,000 at 10 MPH	800	100	600
80-T, 0-4-4-0, domestic svc	56 1/2	161,000	36'10"	9'6"	13'7"	48,000	24,000 at 10 MPH	500	75	400
80-T, 0-4-4-0, domestic svc	56 1/2	161,000	36'10"	9'6"	13'7"	48,000	24,000 at 10 MPH	470	75	400
80-T, 0-4-4-0, domestic svc	56 1/2	161,600	41'0"	9'6"	13'4"	48,000	21,000 at 5.2 MPH	550	75	400
65-T, 0-4-4-0, domestic svc	56 1/2	130,000	34'0"	10'1"	13'5"	39,000	19,500 at 10 MPH	400	75	250
60-T, 0-4-4-0, domestic and foreign svc	56 1/2 60, 63 66	122,000	38'11" (Type E) 39'3" (Willison)	9'6"	13'4"	26,000	15,680 at 7.78 MPH	500	75	500
45-T, 0-4-4-0, domestic and foreign svc	56 1/2	90,000	33'6"	9'7"	12'0"	27,000	12,000 at 6 MPH	380	75	250
45-T, 0-4-4-0, domestic svc (side rod drive)	56 1/2	90,000	28'4"	9'6"	12'0"	27,000	13,500 at 6.2 MPH	300	50	165
44-T, 0-4-4-0, domestic svc	56 1/2	91,270	33'10"	9'4"	13'3"	26,400	11,000 at 9 MPH	380	75	250
44-T, 0-4-4-0, domestic svc	56 1/2	89,000	33'5"	10'1"	13'3"	26,400	13,000 at 7.1 MPH	380	50	250
25-T, 0-4-4-0, domestic	56 1/2	50,000	16'1"	8'7"	10'4"	15,000	6,200 at	150	50	75

svc							6.2 MPH			
Gasoline/Diesel-Mechanical: 10-T, single-engine, 0-4-0, domestic svc	56 1/2	262,900	55'	10'0"	14'0"	75,700	37,850 at 10 MPH	1,000	231	1,600

Table 8-2. Characteristics of Locomotive Cranes

Type	Gauge (in)	Weight (lb)	Length Over Couplers	Extreme Height	Extreme Width	Boom Length (ft)	Reach Radius and Capacity	
							Main Hoist	Aux Hoist
Locomotive, steam, wrecking, 75-T, broad gauge, domestic and foreign svc	56 1/2, 60 63, 66	191,000	30'10"	17'10"	10'4"	25 (2-piece, curved)	16" (75-T) 25' (34-T)	25' (10-T) 30' (8-T)
Locomotive, crane, diesel, mech, 150-T, domestic svc	56 1/2	291,700	31'0"	15'6"	10'4"	28 (2-piece, straight)	28' (67-T)	-
Locomotive, diesel, elec, 40-T, broad gauge, domestic and foreign svc	56 1/2, 60 63, 66	221,500	36'1"	13'6"	10'4"	50 (2-piece, straight)	12' (40-T) 50' (6 3/4-T)	- -
Locomotive, diesel, elec, 40-T, domestic svc	56 1/2	220,000	29'4"	15'1"	10'6"	50 (2-piece, straight)	12' (40-T) 50' (6 3/4-T)	- -
Locomotive, diesel, mech, 25-T, broad gauge, domestic and foreign svc	56 1/2, 60 63, 66	148,000	27'7"	13'0"	8'6"	50 (2-piece, straight)	12' (25-T) 50' (4-T)	- -
Locomotive, diesel, mech, 25-T, narrow gauge, foreign svc	36, 39 3/8, 42	152,000	32'6"	12'0"	8'6"	40 (2-piece, straight)	12' (25-T) 40' (6-T)	- -
Locomotive, diesel, mech, 25-T, domestic svc	56 1/2	155,000	30'0"	15'2"	10'8"	50 (2-piece, straight)	12' (25-T) 50' (4-T)	- -
Locomotive, diesel, mech, 35-T, domestic svc	56 1/2	167,000	30'0"	15'7"	10'4"	50 (2-piece, straight)	12' (35-T) 50' (5-T)	- -

Table 8-3. Characteristics of Railway Maintenance Motor Cars

Type	Gauge (in)	Weight (lb)	Length (in)	Width (in)	Height (in)	Capacity	Horse-Power	Fuel Capacity (gal)
Gasoline, mech, 4 wheels, solid drawbar couplers, closed cab with hand brake	56 1/2	2,950	112	65	58 w/o cab	8 person	62.6	8
Gasoline, mech, 4 wheels, solid drawbar couplers, open body with hand brake	56 1/2	1,700	103	65	50	10 person	62.6	8

Table 8-4. Characteristics of Open-Top Cars

Type	Gauge (in)	Normal Capacity		Inside Dimensions			Light Weight (STONs)
		(lb)	(cu ft)	Length	Width	Height	
Gondolas:							
High side, 8W, narrow gauge, foreign svc	36, 39 3/8, 42	60,000	940	34'5"	6' 10 1/2"	4'	13.0
Low side, 8W, narrow gauge, foreign svc	36, 39 3/8, 42	60,000	356	34'6"	6' 10 1/2"	1'6"	12.1
High side, 8W, broad gauge, foreign svc	56 1/2	80,000	1,680	40'	8' 3 3/4"	4'	18.0
Low side, 8W, broad gauge, foreign svc	56 1/2, 60, 63, 66	80,000	500	40' 4 1/2"	8' 3 1/3"	1'6"	16.0
Low side, 8W, drop ends, domestic svc	56 1/2	100,000	1.184	41'6"	9' 6 1/8"	3'	23.0
High side, std gauge, domestic svc	56 1/2	100,000	1.580	41'6"	9'6"	4'6"	25.0
Hopper Cars:							
8W, domestic svc	56 1/2	100,000	-	33'	9' 5 1/2"	9'7"	-

Table 8-5. Characteristics of Flatcars

Type	Gauge (in)	Normal Capacity	Platform Length	Platform Width	Platform Height Above Rail	Light Weight (STONs)
8W, narrow gauge, foreign svc	36, 39 3/8, 42	60,000	34' 8 1/2"	7'2"	3'7"	10.9
12W, domestic svc	56 1/2	200,000	54'	10' 6 1/2"	4' 1 1/4"	35.0
8W, domestic svc	56 1/2	200,000	54'	10' 6 1/2"	4' 1 1/4"	35.0
12W, broad gauge, foreign svc, 80-T	56 1/2, 60, 63, 66	160,000	46'4"	9'8"	4' 2 7/8"	35.3
12W, domestic svc (passenger train svc)	56 1/2	200,000	54'	10' 6 1/4"	4' 5 3/8"	-
8W, domestic svc	56 1/2	100,000	43'3"	10'6"	3'8"	25.5
8W, broad gauge, foreign svc	56 1/2, 60, 63, 66	80,000	40'9"	8' 7 1/4"	3' 6 15/16"	14.5
8W, broad gauge, depressed center, foreign svc	56 1/2, 60, 63, 66	140,000	50'7"	9'8"	NA	41.5

Table 8-6. Characteristics of Boxcars

Type	Gauge (in)	Capacity		Inside Dimensions			Door Dimensions	Light Weight (STONs)
		(lb)	(cu ft)	Length	Width	Height		
8W, domestic svc	56 1/2	100,000	3.975	50'6"	9'3"	10'6"	10' wide, clear opening 8' high, clear opening	23.0
8W, broad gauge, foreign svc	56 1/2, 60, 63, 66	80,000	2,520	40'6"	8'6"	6' 5 5/8"	6' 8 3/4" wide, 8' 3 1/4" high	18.5

Table 8-7. Characteristics of Tank Cars

Type	Gauge (in)	Length Over Tank Heads	Normal Capacity (gal)*	Inside Diameter (in)		Light Weight (STONs)
				Tank	Dome	
Nickel-clad, ICC-103-AW, 8W, domestic svc	56 1/2	31'11"	7,500	78 (approx)	45	-
ICC-103, ICC-103-W, 8W, domestic svc	56 1/2	34' (approx.)	10,000	87 (approx)	59 3/8 (approx)	-
Caustic soda, ICC-103-W, 8W, domestic svc	56 1/2	34' (approx)	10,000	88 (approx)	64	-
Petroleum, 8W, narrow gauge, foreign svc	36, 38 3/8, 42	38' 4 7/8"	6,000	62 1/2	54	16
Petroleum, 8W, broad gauge, foreign svc	56 1/2, 60, 63, 66	38' 5 3/8"	10,000	80 3/4	66 1/2	19
Nitric acid, ICC-103-W, 8W, domestic svc	56 1/2	33' 7 1/2"	7,800	78 (approx)	33 3/8	-
Phosphorus, ICC-103-W, 8W, domestic svc	56 1/	34' 8 1/4"	8,000	78 (approx)	64	-
Petroleum, std gauge, domestic svc	56 1/2	-	10,000	-	-	23
*Specific gravity of a liquid should be checked before it is loaded to avoid exceeding weight capacity of car.						

Table 8-8. Characteristics of Refrigerator Cars

Type	Gauge (in)	Normal Capacity (lb)	Length Inside End Lining	Width Inside Side Lining	Ice Capacity (lb)	Door Dimensions
8W, disassembled, foreign svc	56 1/2	80,000	38' 9 1/2"	6'11"	11,000	4' wide 7' high
8W, disassembled, broad gauge, foreign svc	56 1/2, 60, 63, 66	80,000	32' 1/2"	7'8" (approx)	11,000	4' wide
8W, mechanical, foreign svc	56 1/2, 60, 63, 66	80,000	40'9" equipment compartment	7'6" (approx)	None	6' wide 7' high

Table 8-9. Characteristics of Special-Purpose Cars

Type	Gauge (in)	Weight (lb)		Over End Sills		Height Above Rail	Remarks
		Light	Loaded	Length	Width		
Car, amb unit, 8W, domestic svc	56 1/2	157,000	167,300	78'11"	10'	13'6"	Capacity: 27 patients, 6 corpsmen, 1 nurse, 1 doctor
Car, guard, domestic svc	56 1/2	92,740	99,300	57'	9'1"	14' 2 1/2"	Air-conditioned, shower, toilet kitchen, 2 sleeping compartments
Car, kitchen, troop/amb train, 8W, domestic svc	56 1/2	100,160	NA	54' 2 1/2"	9' 5 3/4"	13'6"	Width, side door opening: 6'
Car, kitchen, dining and storage, amb train, 8W, foreign svc	56 1/2, 60, 63, 66	111,400 (avg)	NA	63' 1/4"	9'	13'	Seat capacity: 24
Car, personnel, amb train	56 1/2, 60, 63, 66	111,400 (avg)	NA	63' 1/4"	9'	13'	Berth capacity: 15 EM, 4 doctors, 2 nurses

Table 8-10. Characteristics of German Freight Cars

Type	Number of Axles	Light Weight (STONs)	Capacity							Height of Floor Above Top of Rail
			Weight (STONs)	Cube (cu ft)	Inside Dimensions			Door Dimensions		
					Length	Width	Height	Width	Height	
Boxcar:										
G	2	11.4	16.5	1,500	25' 11 3/4"	8'	7' 4 9/16"	4' 11 1/16"	6' 6 11/16"	4' 1/16"
GLMHS-50	2	13.4	23.1	2,500	36' 9 5/16"	8' 11 1/16"	9' 5/8"	6' 6 1/16"	6' 6 11/16"	4' 9/16"
GM-30	2	12.7	23.1	1,700	24' 10"	8' 10"	31' 4"	5' 6"	6'	Not avail
GMS-54	2	12.6	23.1	2,100	30' 5 11/16"	8' 8 11/16"	8' 9 1/2"	5' 10 13/16"	6' 7 1/8"	4' 1/16"
KMMKS-51	2	12/5	30.8	1,420	28' 8 13/16"	9' 5/8"	5' 6 1/8"	5' 10 13/16"	4' 10 5/8"	4' 1 7/116"
KMM8KS-58	2	14.3	29.7	1,800	28' 8 9/16"	8' 11 1/16"	7' 15/16"	12' 8 3/4"	6' 6 11/16"	4' 11/16"
Gondola:										
X-05 (low side)	2	Not avail	23.1	320	25' 7"	8' 7"	1' 4"	NA	NA	Not avail
XLM-57 (low side)	2	8.4	23.1	330	29' 7"	8' 6"	1' 4"	NA	NA	4'
OMM-37 (high side)	2	9.7	24.6	1,210	27' 7"	9'	4' 10"	NA	NA	4'
OMM-52 (high side)	2	11.0	28.6	1,200	28'	8'	4' 10"	NA	NA	4'
OMM-55 (high side)	2	11.0	27.5	1,200	28' 8 9/16"	9' 3/8"	4' 11 1/16"	5' 10 1/2"	NA	4' 7/8"
OMM-53 (high side)	2	12.1	27.5	1,200	28'	8'9"	4'10"	NA	NA	4'
OMM-33 (high side)	2	11.5	27.0	1,260	28' 7 3/16"	9' 7/16"	5'1"	4' 11 1/16"	NA	4' 5/8"
OMM-33 (high side)	2	11.5	27.0	1,260	28' 7 3/16"	9' 7/16"	5'1"	4' 1 1/16"	NA	4' 5/8"
Flatcar:										
R-10[1]	2	10.6	16.5	NA	33' 25/16"	8'9"	NA	NA	NA	4'
RM-31[1]	2	14.3	22.1	NA	34' 11 9/16"	8' 6 5/16"	NA	NA	NA	4' 11/8"
RMM-33[1]	2	11.4	27.0	NA	34' 8 3/8"	9' 2 1/4"	NA	NA	NA	4' 1 1/4"
RLMMS-56[1]	2	14.0	25.3	NA	40'	8'11"	NA	NA	NA	4'
SM-14[1]	2	11.9	23.1	NA	41' 6"	8'9"	NA	NA	NA	Not avail
SS-15[1]	4	21.5	40.2	NA	48' 2"	8'9"	NA	NA	NA	Not avail
SSLMA-44	4	22.7	44.1	NA	59' 2 7/16"	9' 1/4"	NA	NA	NA	4' 5 3/4"

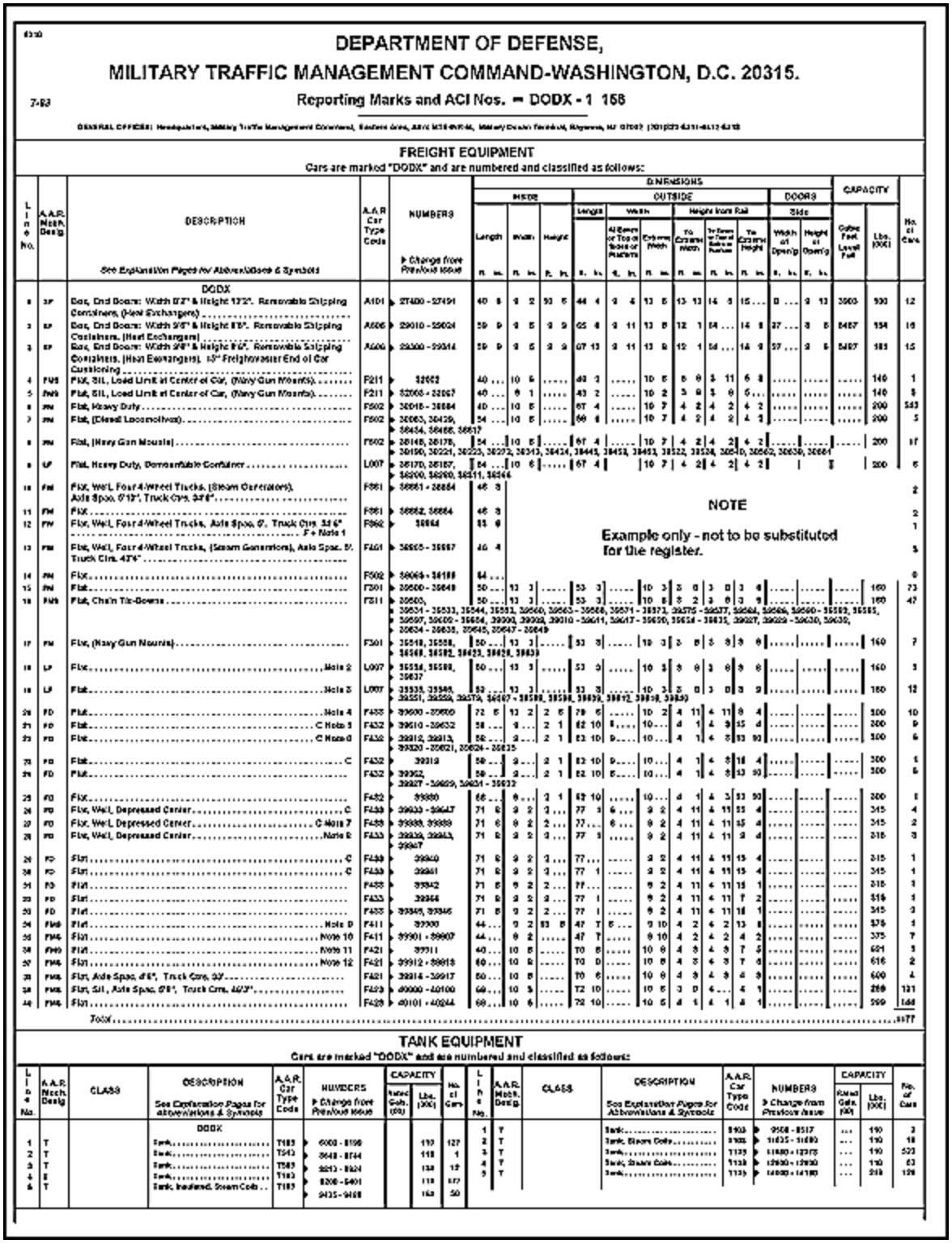
SSLMAS-53	4	26.3	61.6	NA	60' 8 5/16"	8' 11 13/16"	NA	NA	NA	4' 6 1/8"
SSKM-49	4	17.1	55.1	NA	40' 8 3/4"	8' 5 15/16"	NA	NA	NA	4' 3 9/16"
Flatcar (USA-owned)										
Tank car	2	14.0	NA	(2)	21' 2"	NA	Not avail	NA	NA	5'
Tank car	4	26.4	NA	(3)	33' 1/2"	NA	Not avail	NA	NA	5'
		(MTs)	(MTs)	(cu m)	(m)	(m)	(m)	(m)	(m)	(m)
RS 683,684,685	4	24.0	56.0	51.3	18.5	2.77	NA	NA	NA	1.33
RS689	4	23.6	56.0	51.0	18.5	2.77	NA	NA	NA	1.33
REMMS665	4	21.4	58.5	35.1	12.6	2.78	NA	NA	NA	1.33
RES686	4	25.0	55.0	49.0	18.5	2.75	NA	NA	NA	1.23
SA705	6	22.3	67.5	35.3	11.2	2.73	NA	NA	NA	1.43
SA (h) S710	6	31.0	65.0	45.7	15.0	2.56	NA	NA	NA	1.37
Sahs 711	6	31.5	64.0	Turning side jacks flooding molds	NA	2.90	NA	NA	NA	NA
		(MTs)	(MTs)	(cu m)	(m)	(m)	(m)	(m)	(m)	(m)
SGjs 716 (w) 718	4	24.0	18.8	55.0	2.7	NA	NA	NA	NA	1.24
shis	4	22.7	NA	NA	NA	NA	NA	NA	NA	NA
SAS709	6	30.6	65.0	46.0	15.0	3.09	1.37	NA	NA	NA
TS851	2	11.7	28.0	24.0	8.76	2.76	1.68	NA	NA	1.25
TCS850	2	11.6	28.0	24.0	8.66	2.76	1.68	NA	NA	1.25
TIS858	2	13.0	26.5	23.8	8.75	2.72	2.16	NA	NA	1.23
Tbis871	2	15.1	24.5	34.0	12.7	2.67	2.26	NA	NA	1.17
Tbis 869,870,875	2	14.4	25.5	34.0	12.7	2.67	2.26	NA	NA	1.17

[1] Height of flatcar is determined by height of stanchion.
[2] 4,356 US gallons.
[3] 14,266 US gallons.

Table 8-11. Characteristics of Korean Freight Cars

Type	Number of Axles	Light Weight (STONs)	Capacity					Door		Height of Floor Above Top of Rail
			Weight (lb)	Cube (cu m)	Inside Dimensions (m)			Door Dimensions (m)		
					Length	Width	Height	Width	Height	
Boxcar:										
40-T	4	21	88,160	87	12.95	2.7	2.5	1.7	2.1	1.1

50-T	4	22	110,200	95	13.04	2.8	2.6	1.8	2.1	1.6
Gondola:										
40-T	4	19	88,160	40	11.00	2.6	1.4	NA	NA	1.1
50-T	4	20	110,200	49	13.04	2.7	1.4	NA	NA	1.6
Flatcar:										
40-T	4	16	88,160	NA	12.20	2.5	NA	NA	NA	1.1
50-T	6	20	110,200	NA	15.00	2.9	NA	NA	NA	1.2
Tank car (USA-owned)	4	22	88,160	(10,000 gal)	11.09	2.9	2.7	NA	NA	1.1



DEPARTMENT OF DEFENSE,

MILITARY TRAFFIC MANAGEMENT COMMAND-WASHINGTON, D.C. 20315.

7-83

Reporting Marks and ACI Nos. = DODX - 1 158

FREIGHT EQUIPMENT

Cars are marked "DODX" and are numbered and classified as follows:

Line No.	A.A.R. Mech. Desig.	DESCRIPTION	A.A.R. Car Type Code	NUMBERS	DIMENSIONS Inside Length	DIMENSIONS Inside Width	DIMENSIONS Inside Height	DIMENSIONS Outside Length	DIMENSIONS Outside Width	DIMENSIONS Outside Height from Rail	DIMENSIONS Doors Side	CAPACITY	No. of Cars
		DODX											
1	XF	Box, End Doors: Width 9'2" & Height 13'2". Removable Shipping Containers, (Heat Exchangers)	A101	27400 - 27491	40 8	9 2	10 5	44 4	9 6	13 5	13 13	3500	12
2	XF	Box, End Doors: Width 9'6" & Height 8'6". Removable Shipping Containers. (Heat Exchangers)	A606	29010 - 29024	59 9	9 5	9 9	65 8	9 11	13 5	12 1	5487	15
3	XF	Box, End Doors: Width 9'6" & Height 8'6". Removable Shipping Containers. (Heat Exchangers). 15" Freightmaster End of Car Cushioning	A606	29300 - 29314	59 9	9 5	9 9	67 13	9 11	13 5	12 1	5487	15
4	FMS	Flat, Sill, Load Limit at Center of Car, (Navy Gun Mounts)	F211	32002	40 10	8		43 3		10 5	5 6	140	1
5	FMS	Flat, Sill, Load Limit at Center of Car, (Navy Gun Mounts)	F211	32005 - 32007	40 6	1		43 2		10 2	5 6	140	5
6	FM	Flat, Heavy Duty	F502	30015 - 30084	40 10	8		67 4		10 7	4 2	200	583
7	FM	Flat, (Diesel Locomotive)	F502	30063, 30439, 58434, 58466, 58617	54 10	8		66 8		10 7	4 2	200	3
8	FM	Flat, (Navy Gun Mounts)	F502	30148, 30178, 30190, 30221, 30223, 30272, 30313, 30434, 30445, 30453, 30493, 30522, 30526, 30540, 30562, 30630, 30661	54 10	8		67 4		10 7	4 2	200	17
9	LF	Flat, Heavy Duty, Demountable Container	L007	30170, 30187, 58200, 58260, 58311, 58564	54 10	8		67 4		10 7	4 2	200	6
10	FM	Flat, Well, Four 4-Wheel Trucks, (Steam Generators), Axle Spac. 6'10", Truck Ctrs. 37'6"	F561	30661 - 30664	46 3								2
11	FM	Flat	F561	30662, 30664	46 3								2
12	FM	Flat, Well, Four 4-Wheel Trucks, Axle Spac. 6', Truck Ctrs. 38'6" F + Note 1	F562	30664	46 6								1
13	FM	Flat, Well, Four 4-Wheel Trucks, (Steam Generators), Axle Spac. 6', Truck Ctrs. 43'6"	F401	30665 - 30667	46 4								3
14	FM	Flat	F502	30669 - 30688	54								0
15	FM	Flat	F301	30600 - 30648	50 13	3		53 3		10 3	3 6	160	73
16	FMS	Flat, Chain Tie-Downs	F311	30600, 30634 - 30633, 30644, 30653, 30660, 30663 - 30668, 30671 - 30673, 30675 - 30677, 30682, 30686, 30690 - 30693, 30695, 30697, 30699 - 30704, 30900, 30903, 30910 - 30911, 30617 - 30620, 30624 - 30625, 30627, 30629 - 30630, 30635, 30634 - 30635, 30645, 30647 - 30649	50 13	3		53 3		10 3	3 6	160	47
17	FM	Flat, (Navy Gun Mounts)	F301	30618, 30658, 58568, 58582, 58623, 58626, 58639	50 13	3		53 3		10 3	3 6	160	7
18	LF	Flat Note 2	L007	30634, 30699, 30637	50 13	3		53 3		10 3	3 6	160	3
19	LF	Flat Note 3	L007	30635, 30646, 30651, 30655, 30679, 30687 - 30688, 30698, 30699, 30812, 30818, 30839	53 13	3		53 3		10 3	3 6	160	12
20	FD	Flat Note 4	F455	30600 - 30609	72 6	13 2	2 6	78 6		10 2	4 11	300	10
21	FD	Flat C Note 5	F432	30610 - 30632	58 9	2 1		62 10	9	10	4 1	300	9
22	FD	Flat C Note 6	F432	30810, 30813, 30820 - 30821, 30824 - 30835	58 9	2 1		62 10	9	10	4 1	300	6
23	FD	Flat C	F432	30810	58 9	2 1		62 10	9	10	4 1	300	1
24	FD	Flat	F432	30802, 30827 - 30829, 30831 - 30832	58 9	2 1		62 10	9	10	4 1	300	5
25	FD	Flat	F432	30800	58 9	2 1		62 10		10	4 1	300	1
26	FD	Flat, Well, Depressed Center C	F433	30833 - 30847	71 8	2 2	2	77 3	8	2 2	4 11	315	4
27	FD	Flat, Well, Depressed Center C Note 7	F455	30888, 30889	71 8	2 2	2	77	8	2 2	4 11	315	2
28	FD	Flat, Well, Depressed Center Note 8	F433	30839, 30843, 30847	71 8	2 2	2	77 3		2 2	4 11	315	3
29	FD	Flat C	F433	30840	71 8	2 2	2	77		2 2	4 11	315	1
30	FD	Flat C	F433	30841	71 8	2 2	2	77 1		2 2	4 11	315	1
31	FD	Flat	F433	30842	71 8	2 2	2	77		2 2	4 11	315	1
32	FD	Flat	F433	30844	71 8	2 2	2	77 1		2 2	4 11	315	1
33	FD	Flat	F455	30845, 30846	71 8	2 2	2	77 1		2 2	4 11	315	2
34	FMS	Flat Note 9	F411	30900	44	2	2	48 7	8	10	4 2	375	1
35	FMS	Flat Note 10	F411	30901 - 30907	44	2	2	48 7		10	4 2	375	7
36	FMS	Flat Note 11	F421	30911	40 10	8		70 8		10 8	4 3	691	1
37	FMS	Flat Note 12	F421	30912 - 30918	60 10	8		70 0		10 8	4 3	616	2
38	FMS	Flat, Axle Spac. 6'6", Truck Ctrs. 53'	F421	30914 - 30917	60 10	8		70 6		10 8	4 3	600	4
39	FMS	Flat, Sill, Axle Spac. 6'6", Truck Ctrs. 46'3"	F429	40000 - 40100	60 10	8		72 10		10 8	3 0	260	121
40	FMS	Flat	F429	40101 - 40244	60 10	8		72 10		10 8	4 1	260	144
		Total											1177

TANK EQUIPMENT

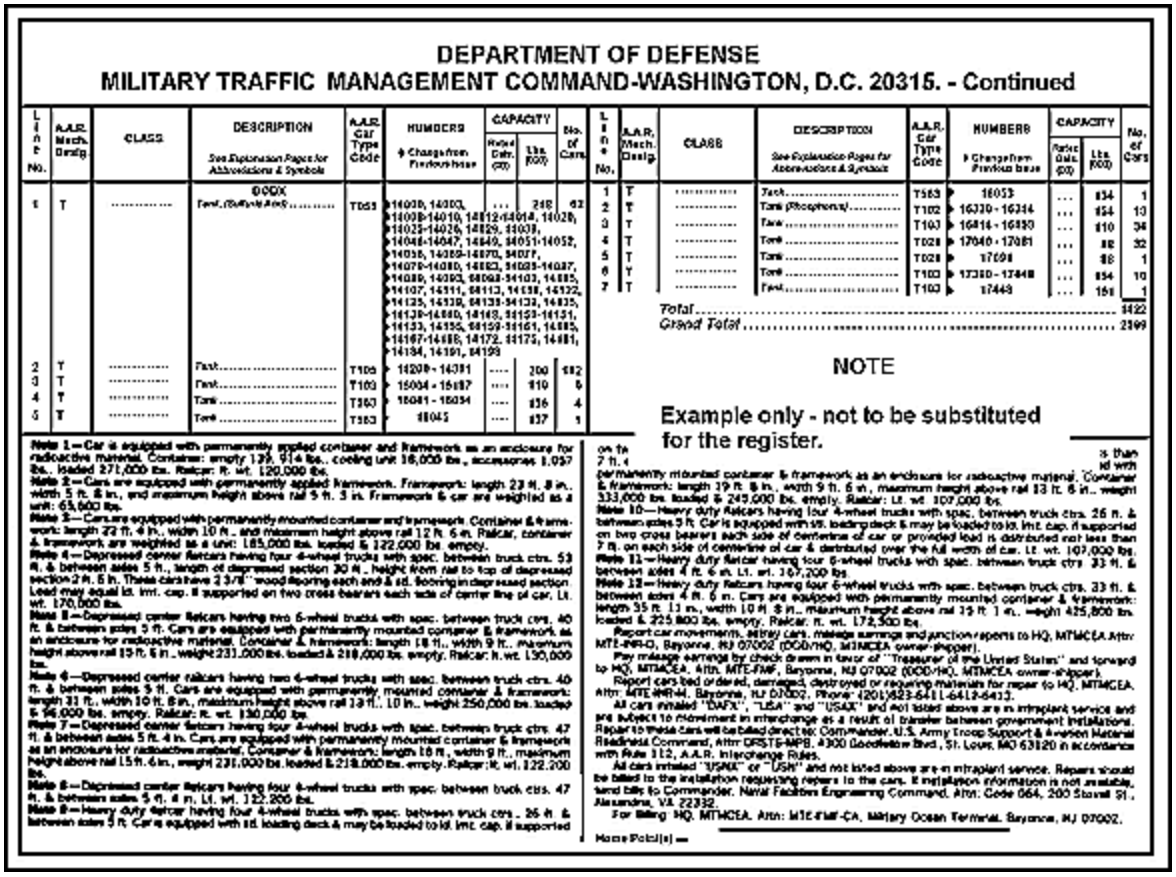
Cars are marked "DODX" and are numbered and classified as follows:

Line No.	A.A.R. Mech. Desig.	CLASS	DESCRIPTION	A.A.R. Car Type Code	NUMBERS	CAPACITY Rated Gals. (M)	CAPACITY Lbs. (000)	No. of Cars
			DODX					
1	T		Tank	T103	8000 - 8199	110	127	
2	T		Tank	T343	8648 - 8744	110	1	
3	T		Tank	T283	8213 - 8324	130	12	
4	T		Tank	T103	8200 - 8401	110	172	
5	T		Tank, Insulated, Steam Coils	T103	9435 - 9468	103	50	
1	T		Tank	T103	9508 - 9517		110	3
2	T		Tank, Steam Coils	T103	11635 - 11693		110	18
3	T		Tank	T139	11680 - 12015		110	522
4	T		Tank, Steam Coils	T139	12000 - 12030		110	63
5	T		Tank	T139	14000 - 14180		263	126

NOTE

Example only - not to be substituted for the register.

Figure 8-1. Characteristics of DOD Military Rail Fleet Cars (Extract From The Official Railway Equipment Register)



DEPARTMENT OF DEFENSE
MILITARY TRAFFIC MANAGEMENT COMMAND-WASHINGTON, D.C. 20315. - Continued

Line No.	A.A.R. Mech. Desig	CLASS	DESCRIPTION See Explanation Pages for Abbreviations & Symbols	A.A.R. Car Type Code	NUMBERS ▶ Changes from Previous Issue	CAPACITY Inside Cubic (000)	CAPACITY Lbs. (000)	No. of Cars
1	T	.....	DOOX Tank (Sulfuric Acid)	T053	▶14030, 14033, ▶14038-14010, 14012-14014, 14020, ▶14023-14026, 14029, 14038, ▶14040-14047, 14049, 14051-14052, ▶14056, 14059-14070, 14077, ▶14079-14080, 14082, 14084-14087, ▶14089, 14093, 14098-14103, 14105, ▶14107, 14111, 14113, 14130, 14132, ▶14135, 14139, 14139-14132, 14135, ▶14139-14140, 14148, 14150-14151, ▶14153, 14155, 14159-14161, 14165, ▶14167-14168, 14172, 14175, 14181, ▶14184, 14191, 14199	...	248	62
2	T	.....	Tank	T105	▶ 14209 - 14291	....	200	182
3	T	.....	Tank	T103	▶ 15004 - 15187	....	810	6
4	T	.....	Tank	T203	▶ 16041 - 16054	....	836	4
5	T	.....	Tank	T303	▶ 18045	....	837	1
1	T	.....	Tank	T503	▶ 16053	...	834	1
2	T	.....	Tank (Phosphoric)	T102	▶ 16330 - 16344	...	854	10
3	T	.....	Tank	T103	▶ 16416 - 16430	...	810	34
4	T	.....	Tank	T028	▶ 17040 - 17081	...	88	32
5	T	.....	Tank	T028	▶ 17098	...	88	1
6	T	.....	Tank	T103	▶ 17330 - 17448	...	854	10
7	T	.....	Tank	T103	▶ 17449	...	161	1
			Total					1422
			Grand Total					2399

NOTE

Example only - not to be substituted for the register.

Note 1—Car is equipped with permanently applied container and framework as an enclosure for radioactive material. Contains: empty 129, 914 lbs., cooling unit 16,000 lbs., accessories 3,057 lbs., loaded 271,000 lbs. Railcar: lt. wt. 120,000 lbs.

Note 2—Cars are equipped with permanently applied framework. Framework: length 23 ft. 8 in., width 5 ft. 8 in., and maximum height above rail 5 ft. 3 in. Framework & car are weighted as a unit: 63,500 lbs.

Note 3—Cars are equipped with permanently mounted container and framework. Container & framework: length 22 ft. 4 in., width 10 ft., and maximum height above rail 12 ft. 6 in. Railcar, container & framework are weighted as a unit: 185,000 lbs. loaded & 122,000 lbs. empty.

Note 4—Depressed center flatcars having four 4-wheel trucks with spec. between truck ctrs. 53 ft. & between axles 5 ft., length of depressed section 30 ft., height from rail to top of depressed section 2 ft. 6 in. These cars have 2 3/8" wood flooring each end & sd. flooring in depressed section. Load may equal ld. lmt. cap. if supported on two cross bearers each side of center line of car. Lt. wt. 170,000 lbs.

Note 5—Depressed center flatcars having two 6-wheel trucks with spec. between truck ctrs. 40 ft. & between axles 5 ft. Cars are equipped with permanently mounted container & framework as an enclosure for radioactive material. Container & framework: length 18 ft., width 9 ft., maximum height above rail 15 ft. 6 in., weight 231,000 lbs. loaded & 218,000 lbs. empty. Railcar: lt. wt. 130,000 lbs.

Note 6—Depressed center railcars having two 6-wheel trucks with spec. between truck ctrs. 40 ft. & between axles 5 ft. Cars are equipped with permanently mounted container & framework: length 31 ft., width 10 ft. 8 in., maximum height above rail 13 ft., 10 in., weight 250,000 lbs. loaded & 96,000 lbs. empty. Railcar: lt. wt. 130,000 lbs.

Note 7—Depressed center flatcars having four 4-wheel trucks with spec. between truck ctrs. 47 ft. & between axles 5 ft. 4 in. Cars are equipped with permanently mounted container & framework as an enclosure for radioactive material. Container & framework: length 18 ft., width 9 ft., maximum height above rail 15 ft. 6 in., weight 231,000 lbs. loaded & 218,000 lbs. empty. Railcar: lt. wt. 122,200 lbs.

Note 8—Depressed center flatcars having four 4-wheel trucks with spec. between truck ctrs. 47 ft. & between axles 5 ft. 4 in. Lt. wt. 122,200 lbs.

Note 9—Heavy duty flatcar having four 4-wheel trucks with spec. between truck ctrs., 26 ft. & between axles 5 ft. Cars equipped with sd. loading deck & may be loaded to ld. lmt. cap. if supported on fr 7 ft. e permanently mounted container & framework as an enclosure for radioactive material. Container & framework: length 19 ft. 8 in., width 9 ft. 6 in., maximum height above rail 13 ft. 6 in., weight 333,000 lbs. loaded & 245,000 lbs. empty. Railcar: Lt. wt. 107,000 lbs. is than id with

Note 10—Heavy duty flatcars having four 4-wheel trucks with spec. between truck ctrs. 26 ft. & between axles 5 ft. Car is equipped with sd. loading deck & may be loaded to ld. lmt. cap. if supported on two cross bearers each side of centerline of car or provided load is distributed not less than 7 ft. on each side of centerline of car & distributed over the full width of car. Lt. wt. 107,000 lbs.

Note 11—Heavy duty flatcar having four 6-wheel trucks with spec. between truck ctrs. 33 ft. & between axles 4 ft. 6 in. Lt. wt. 167,200 lbs.

Note 12—Heavy duty flatcars having four 6-wheel trucks with spec. between truck ctrs. 33 ft. & between axles 4 ft. 6 in. Cars are equipped with permanently mounted container & framework: length 35 ft. 11 in., width 10 ft. 8 in., maximum height above rail 15 ft. 1 in., weight 425,800 lbs. loaded & 225,800 lbs. empty. Railcar: lt. wt. 172,500 lbs.

Report car movements, delay cars, mileage earnings and junction reports to HQ, MTMCEA Attn: MTE-INR-O, Bayonne, NJ 07002 (DOD/HQ, MTMCEA owner-shipper).

Pay mileage earnings by check drawn in favor of "Treasurer of the United States" and forward to HQ, MTMCEA, Attn: MTE-FMF, Bayonne, NJ 07002 (DOD/HQ, MTMCEA owner-shipper).

Report cars tied ordered, damaged, destroyed or requiring materials for repair to HQ, MTMCEA, Attn: MTE-INR-H, Bayonne, NJ 07002, Phone: (201)823-6411-6412-6413.

All cars initialed "DAFX", "USA" and "USAX" and not listed above are in intraplant service and are subject to movement in interchange as a result of transfer between government installations. Repair to these cars will be billed direct to: Commander, U.S. Army Troop Support & Aviation Material Readiness Command, Attn: DRSTE-MPS, 4300 Goodfellow Blvd., St. Louis, MO 63120 in accordance with Rule 312, A.A.R. Interchange Rules.

All cars initialed "USAX" or "USN" and not listed above are in intraplant service. Repairs should be billed to the installation requesting repairs to the cars. If installation information is not available, send bills to Commander, Naval Facilities Engineering Command, Attn: Code 064, 200 Stovall St., Alexandria, VA 22332.

For Billing: HQ, MTMCEA, Attn: MTE-FMF-CA, Military Ocean Terminal, Bayonne, NJ 07002.

Home Port(s) —

Figure 8-1. Characteristics of DOD Military Rail Fleet Cars (Extract From The Official Railway Equipment Register) (continued)

LOCOMOTIVE CLASSIFICATION

8-6. Locomotives are classified according to wheel arrangement. The two systems used are the Wythe and the Continental.

Wythe System

8-7. This system is generally accepted in Great Britain and the British Commonwealth and in North and South America. The Army uses the Wythe system to classify steam and diesel-electric locomotives. Locomotive wheels are grouped as leading, driving, and trailing wheels. Numerals separated by hyphens represent the number of wheels in each group, starting at the front end of the locomotive. The first figure represents the number of leading wheels, the second represents the number of driving wheels, and the third the number of trailing wheels. Use the figure "0" if there are no leading or trailing wheels. Tender wheels are not included. The weight distribution of a diesel-electric locomotive is different from that of a steam locomotive. This is because the diesel has no tender, leading trucks, or trailing trucks. All wheels on Army diesel-electric locomotives are driving wheels. The locomotive's weight is evenly distributed on the driving wheels.

8-8. The wheel arrangements of two locomotives using the Wythe system are shown in Figure 8-2. Since the wheel arrangement represents a side view of the locomotive, only one wheel of each pair is shown. The 2-8-0 steam locomotive shown has two leading wheels, eight coupled driving wheels, and no trailing wheels. The 0-6-6-0 diesel-electric locomotive shown has six driving wheels on the front truck assembly, six on the rear truck assembly, and no leading or trailing wheels. The pulling capacity of a locomotive is directly related to the number of driving wheels (drivers) and the amount of weight that rests on them.

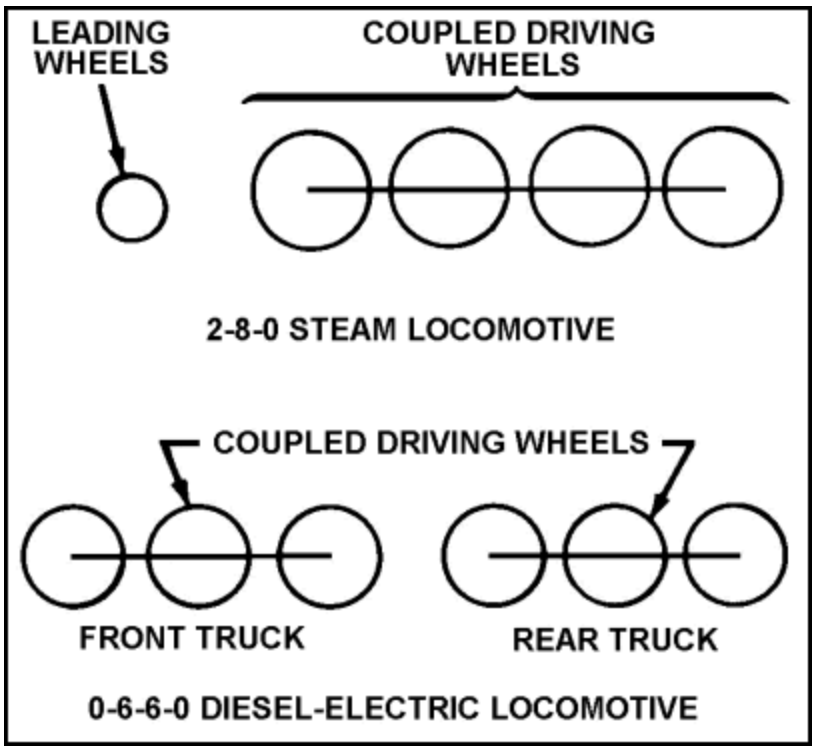


Figure 8-2. Wythe System of Wheel Arrangement (Two Locomotives)

8-9. The amount of a locomotive's weight that rests on its drivers is expressed in pounds or short tons of 2,000 pounds each. All tons mentioned in this text are short tons. Therefore, the terms "ton" and "short ton" are used interchangeably. The distribution of weight on drivers differs between steam and diesel-electric locomotives. This is important when computing tractive effort. The weight distribution of a 2-8-0 steam locomotive and tender is shown in Figure 8-3. The locomotive and tender weigh 296,350 pounds, but only that portion of the total weight that rests on the driving wheels (141,500 pounds) affects the work capacity or pulling power of the locomotive. On a diesel-locomotive, the weight of the locomotive is evenly distributed over all the wheels since all wheels are driving wheels.

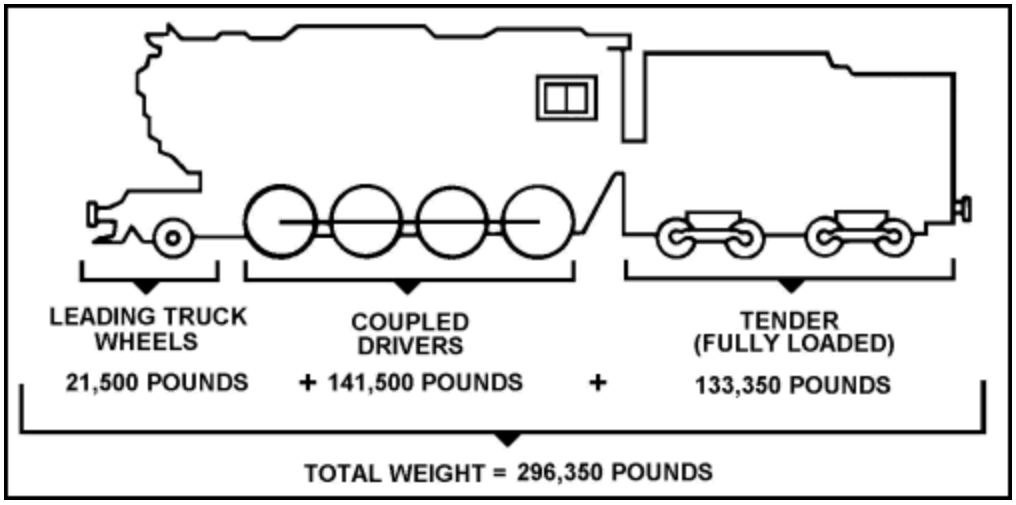


Figure 8-3. Weight Distribution of a 2-8-0 Steam Locomotive

Continental System

8-10. This system, commonly used in Europe and other parts of the world, uses letters and figures to identify a diesel or electric locomotive by its axles. Letters are used for driving axles and numbers are used for nondriving axles. In this system, "A" stands for one driving axle, "B" for two, "C" for three, and" D" for four. A small "o" placed after the initial letters shows that each axle is individually powered. Therefore, a single unit locomotive with two individually powered two-axle trucks would be classified as Bo-Bo. One with three axle trucks in which the center axle is an idler would be designated as A1A-A1A.

TYPES OF RAILWAY EQUIPMENT

8-11. The three basic types of railway equipment are passenger, freight, and special. Each type of equipment is discussed below.

PASSENGER EQUIPMENT

8-12. Passenger equipment is used to transport personnel. There are several different types of passenger cars, each designed for a special purpose. Examples are coach cars, sleeper cars, baggage cars, and dining cars. Passenger cars can be modified to handle medical patients and are moved in designated ambulance trains.

FREIGHT EQUIPMENT

8-13. Use freight equipment primarily for the movement of general cargo. The commodity to be moved dictates the type of freight car that will be used. Table 8-12, lists examples of the most common freight equipment. Freight equipment, both domestic and foreign, is shown in Figure 8-4 and Figure 8-5. Table 8-13, lists freight equipment (by category) used in Europe by US forces.

Table 8-12. Examples of Railway Equipment

TYPE	COMMODITY	EXAMPLES
Boxcar	Bulk items that need protection from the weather and/or theft.	Paper, electronic gear, medical equipment.
Flatcar	Bulk items where protection from the environment is not a factor. Also items that will not fit in other freight cars.	Vehicles, CONEXs, containers, oversize loads.
Gondola car	Bulk items where protection from the environment is not a factor. The sides of the car help keep the load from shifting.	CONEXs, field barrier materials, steel, scrap metal.
Hopper car (covered hopper)	Free-flowing solids that need protection from the environment.	Gravel, coal, sand, grain, chemicals.
Tank car	Bulk liquids.	POL, chemicals, water, beer.
Refrigerator car	Items that need a constant temperature--either cool in a warm environment or warm in a cold environment.	Perishables, whole blood, electronic equipment.

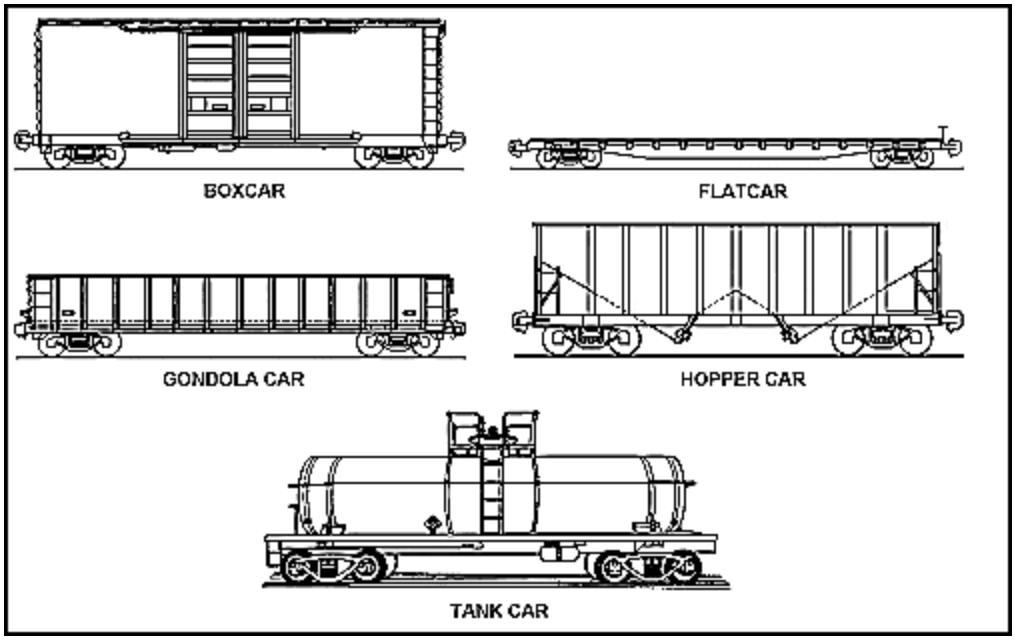


Figure 8-4. Freight Equipment (Domestic)

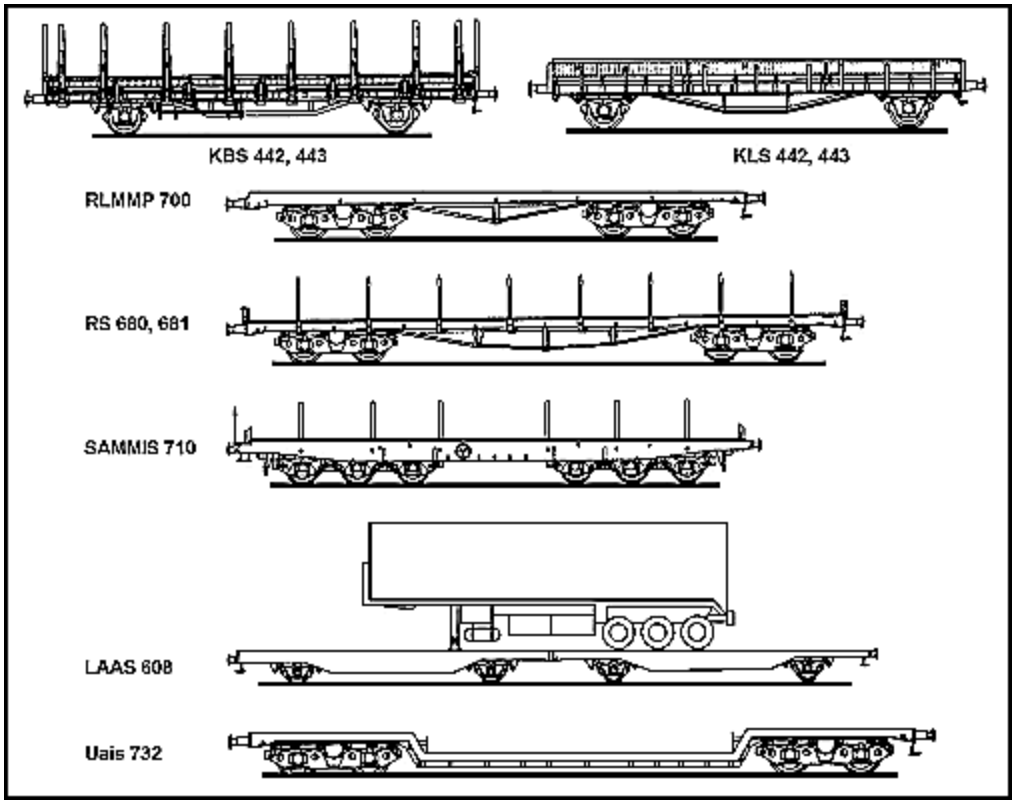


Figure 8-5. Freight Equipment (Foreign Service)

Table 8-13. Examples of Foreign Flatcars

Type	Number of Axles	Maximum Loading Specifications			Remarks
		Length (m)	Width (m)	Weight (m)	
Light-duty flatcars:					
KBS 442, 443	2	12.50	2.77	27	With stakes, removable side and end walls.
KLS 442, 443	2	12.50	2.77	27	With removable side and end walls.
Heavy-duty flatcars:					
RLMMP700	4	9.50	3.15	52	
RS 680	4	18.50	2.74	56	

RS 681	4	18.50	2.78	56	
SAMMS 710	6	15.00	3.11	65	End jacks provide stability during loading and off-loading.
Special flatcars:					
LAAS 608	4	9.00 per section	2.50	54	A short-coupled unit comprised of two 2-axle flatcar sections.
Uais 732	4	10.00	2.50	50	Deep-well cars are available in various sizes but are few in number and are in high demand.

SPECIAL EQUIPMENT

8-14. Special equipment consists of locomotives, wreck cranes, and snowplows. Figure 8-6, shows the special equipment used in domestic and foreign service.

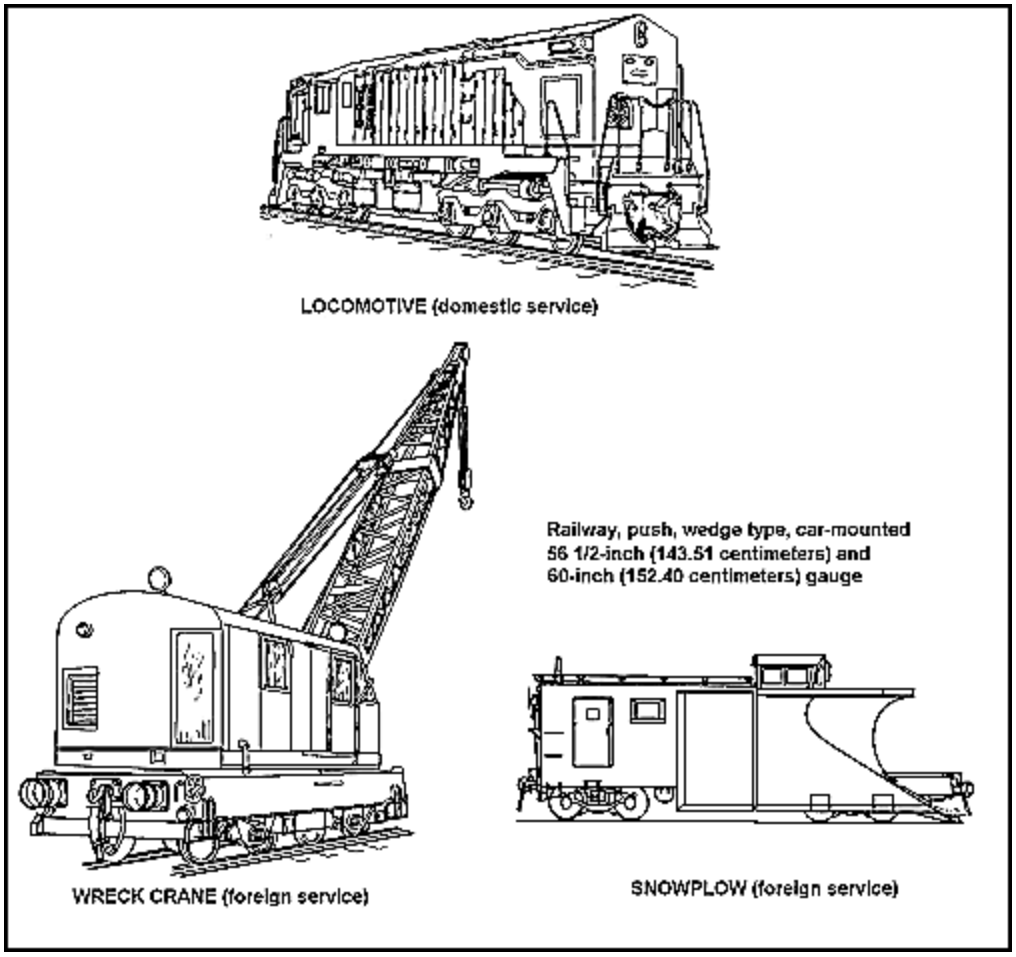


Figure 8-6. Special Equipment (Domestic and Foreign Service)

Car Components

8-15. Transporters must have a basic knowledge of car components. Those in rail operations must have a thorough knowledge of car components. The four main components of a freight car are the deck, underframe, truck, and coupler.

Deck

8-16. The deck is the surface on which the load rests. The deck or floor is usually steel or wood.

Underframe

8-17. The underframe is the structure under the deck that supports the weight of the load. Figure 8-7, shows the topside and underside views of the underframe.

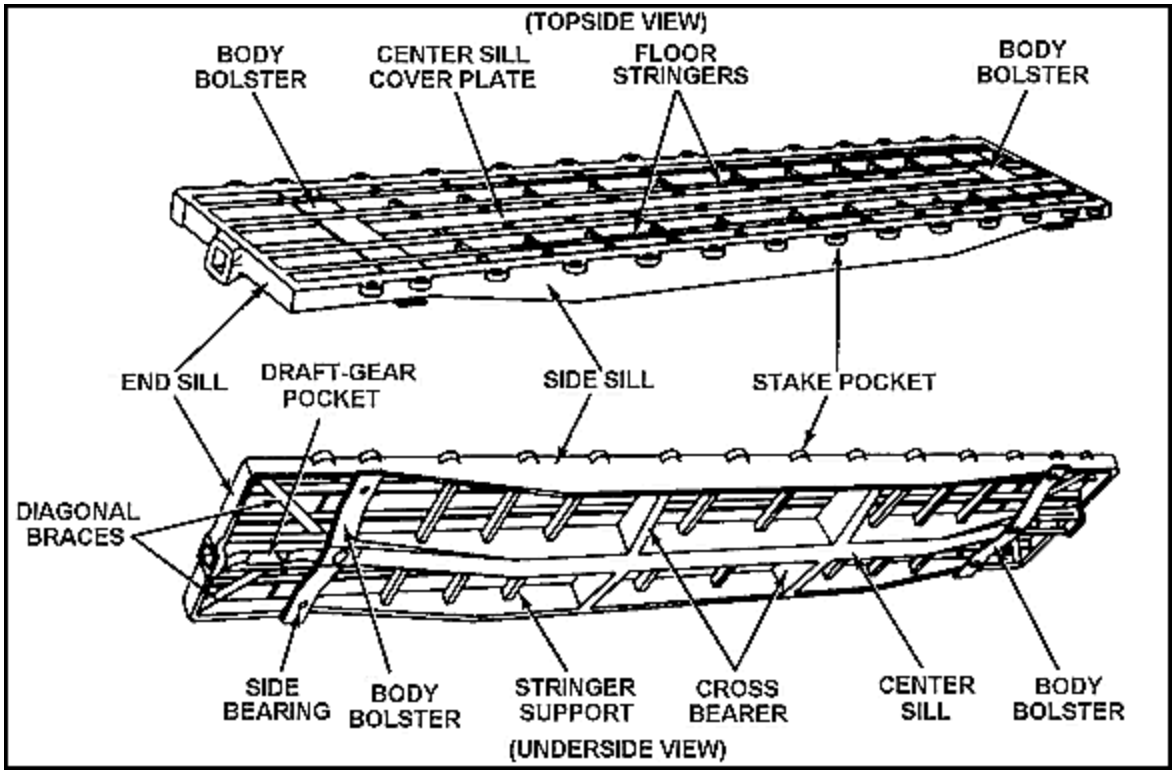


Figure 8-7. Underframe

Truck

8-18. The truck is that assembly which contains a car's wheels, axles, journals, suspension system, and brake system. Figure 8-8, shows all the components of the truck.

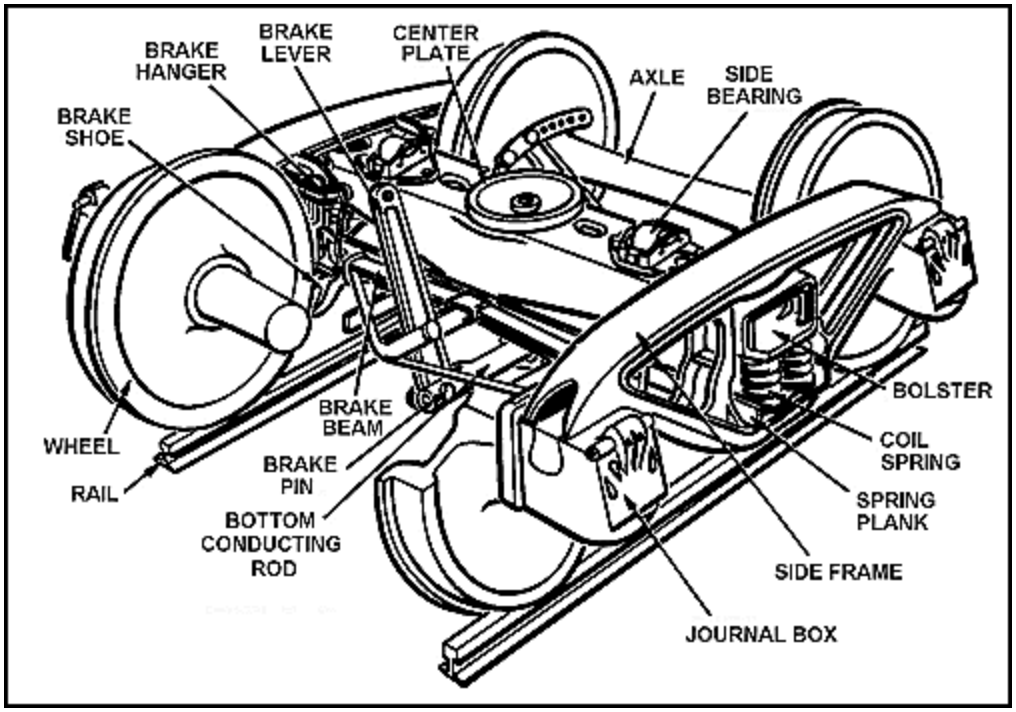


Figure 8-8. TruckCoupler

8-19. The coupler is a device which connects or couples a car with another car (Figure 8-9). An automatic or knuckle coupler is used in CONUS and in military railroading. The hook-and-link system is used in Europe. The automatic coupler has two advantages over the hook-and-link system. The automatic coupler is stronger (allowing for heavier trains) and it is also safer. The automatic coupler does not require a trainman to step between the cars to couple them, but a hook-and-link coupler does.

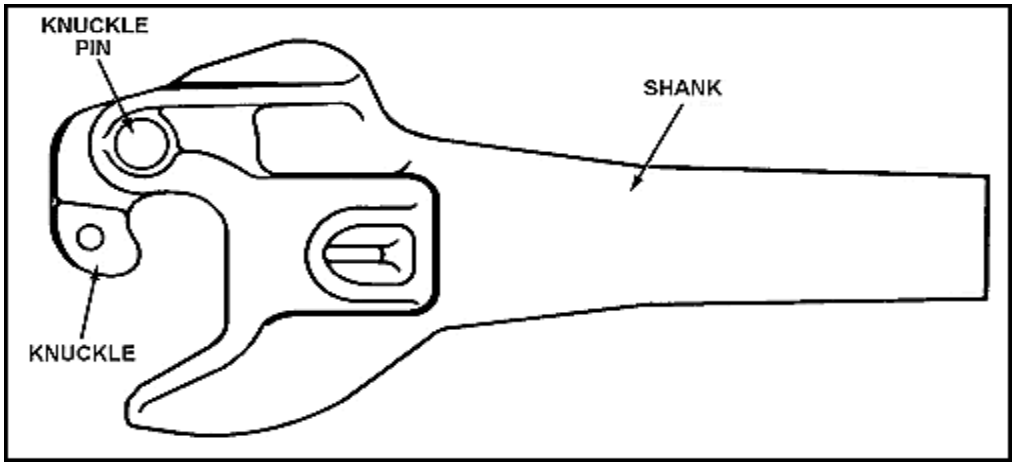


Figure 8-9. Automatic Coupler

EFFECTS OF COLD WEATHER ON MOTIVE POWER AND ROLLING STOCK

8-20. In the past, steam locomotives were used successfully by all railroads operating in cold climates. Most of the world's railroads have adopted the diesel because it offers certain advantages over the steamers. However, there are certain modifications that must be made to both types of locomotives before they are entirely suitable for extremely cold weather operations.

Steam Locomotives

8-21. Efficient steam locomotive operation depends on a local supply of fuel, water, and sanding facilities at suitable points along the line. Coal platforms are constructed with their beds level with the top of tenders. Such platforms have been used without any great difficulty resulting from cold temperatures. Water tanks must be kept heated all winter. This is done with steam pipes, which encircle the interior of the tank. In any climate having winter temperatures as low as 40 degrees Fahrenheit, sand for wheels must be thoroughly dried.

Insulation

8-22. Personnel will insulate exposed water pipes to keep them from freezing and exposed steam pipes to prevent heat loss. Locomotive cabs are especially insulated. On steam heated passenger cars, cover windows at night with blankets to keep out the extreme cold.

Standby Service

8-23. When steam locomotives are used, engine watchers must be provided. The watchers must fire up the engines to keep up pressure and must put water in the boilers. When first moving a steam locomotive, the cylinder cocks must always be opened to relieve the cylinders of extremely heavy condensation. In average winter climates, one watcher may tend as many as ten locomotives. In cold climates, the number of locomotives for each man must be reduced because of the greater variety of duties. These duties consist of continual operation and/or checking of the following:

- Stokers.
- Boiler blowoffs.
- Injectors.
- Cylinder cocks.
- Lubricators.

Reverse levers (particularly screw-reverse types) have to be operated frequently to protect against freezing. Any water leaking on parts that move must be corrected at once to prevent ice from forming. Placing locomotives inside heated roundhouses or enginehouses will substantially reduce standby service.

Diesel Locomotives

8-24. Diesel locomotives require considerably less standby service than steam locomotives. In extremely cold climates, the problem of water supply is virtually eliminated. However, before using diesels in subzero temperatures, make the following modifications.

- Insulate all outside piping to protect against freezing.
- Preheat fuel because of the extreme difference between the unheated fuel and the flashpoint. Install heaters in engine compartments.
- Keep engine coolant warm to aid in starting the locomotive under extreme conditions.
- Under extreme conditions, locomotives must not be shut down unless engine block heaters are used.
- Keep storage batteries reasonably warm to secure maximum output. Place coils of pipe around the battery boxes through which the saline water flows.
- Small steam generators must be provided to heat the cab and passenger coaches. Install extra insulation in engine cabs.
- Windows of cabs and passenger coaches should have sealed, airtight, double-thickness glass to keep out the cold.

Rolling Stock

8-25. One of the greatest problems encountered with cars is the freezing of journal boxes. When cars stand for any length of time, the journal boxes freeze so tightly that the wheels slide instead of turning when an attempt is made to move them. Sometimes a train of 20 cars that has been stationary for even a few hours will have to be broken into three or four sections and each section started individually. After moving the cars a short distance, the heat generated by the axle action on the bearing will warm and thaw the journal box. This condition will naturally delay operations and can only be overcome by moving cars and trains as much as possible. Cars equipped with roller bearings are less of a problem. Extreme cold can cause steel car parts to become so brittle that they break easily. As a result, knuckles may be broken when cars strike each other and drawbars pulled when "frozen" trains are started. When possible, cars should be switched as soon as they come into a yard and while the journal boxes are relatively warm. Trains on main tracks or in sidings should not be permitted to remain stationary longer than absolutely necessary.

Chapter 9

Wreck Crews and Equipment

Wreck crews operate equipment assigned to the wreck train. They assist in clearing wrecks and other line obstructions.

INTERRUPTIONS TO RAIL TRAFFIC

9-1. Interruptions to rail traffic must be cleared immediately. Major interruptions are reported to the commander, transportation railway group or brigade, so that adjustments may be made in the traffic flow. Interruptions may be listed according to their major causes. Interruptions may result from the following:

- Major derailment.
- Minor derailments.
- Washouts.
- Floods.
- Slides.
- Tunnel cave-ins.
- Guerrilla action.

Since the chief dispatcher's office, transportation railway battalion headquarters, controls the movement of trains, it is the first office notified in the event of traffic interruptions. The chief dispatcher immediately advises the battalion commander (division superintendent) or the battalion executive officer (assistant superintendent) of any interruptions. In their absence, the chief dispatcher takes any direct action required (such as ordering out wrecker crews). Major interruptions are reported promptly through command channels. Assistance may be obtained from the engineer command, communications personnel, and local civilians. In case of an accident involving a train, the conductor is in charge until a senior battalion officer arrives. The battalion representative is responsible for restoring service. He takes charge and coordinates the work of the wreckmaster, track foreman, and other wreck crew personnel in clearing the line. He keeps the chief dispatcher informed of any work progress. Rail units are responsible for restoring rail traffic as quickly as possible. Assistance may be obtained from engineer and/or signal service command units when required. If interruptions occur on a double-track line, traffic is restored immediately to one track. The other line is cleared later.
The following are some major causes of rail traffic interruptions:

- Enemy action (including aerial bombing and artillery fire using either conventional or nuclear weapons) and guerrilla activity.
- Human failure (including improper train operation, violation of rules, and improper inspection and maintenance of equipment).
- Equipment or facility failure due to equipment faults or defects.
- Natural causes (including floods, slides, washouts, lightning fires, and so forth).

Major Interruptions

9-2. The causes of major interruptions in rail traffic in a theater of operations are mechanical or human failure, natural causes, and enemy action. Corrective action must be as decisive and as prompt as conditions permit. When traffic is disrupted, the paramount objective is to reopen the line as quickly as possible.

Major Derailments and Wrecks

9-3. Clearing operations should be established from both sides of the derailment if wrecker equipment is available. To save time, pending arrival of the wreck crane(s), undamaged cars should be pulled away from the site and parked on the first available siding or spur. Damaged cars should be rolled off the right-of-way and picked up later. Traffic should be rerouted if the length of the interruption justifies it and if an alternate line is available. A rail truck transfer point may be established if required.

Washouts

9-4. Flood waters may carry away bridges, trestles, and culverts. They may also undermine sections of right-of-way and roadbed. Restoration may require temporary structures or field expedients. Action to be taken where washouts are likely to occur should be pre-planned and repair materials should be stockpiled at suitable locations. As in other major interruptions, urgent traffic should be diverted or rerouted if alternate lines exist. Personnel may be transferred from one train to another by walking around the washout. Transfer points may be established if motor transportation and suitable roads are available.

Floods

9-5. Flood waters may cause the most damage to rail plants and equipment. They can also cause the following to happen.

- Bridges, trestles, and culverts to be weakened or destroyed.
- Grade ballast and sub-ballast to be washed out.
- Equipment to be floated away.
- Contents of loaded cars to be damaged.

Damaged track, roadbed, and structures may take several days or weeks to repair (which may cause operations to come to a standstill). Mud and silt left behind by receding waters interfere with the operation of switches and electrical-signal mechanisms. Rail lines, which follow the course of a river to avoid steep grades, frequently incur serious damage from flooded rivers. Little can be done to protect against floods, except to take certain protective measures. Barring flash floods from cloudbursts, rail personnel will often have advance warning of rising waters, which may be expected to develop into flood conditions. The train dispatcher records the weather conditions on his train sheet every 6 hours for most stations on his division. These reports may offer the first indications of impending high water. Local weather bureaus and local labor forces offer valuable opinions on how high a crest may be expected.

Protective Measures

9-6. Critical freight and equipment branch lines beyond the threatened area, loaded cars, and other equipment should be moved to higher ground. Any storage or industry tracks that are higher than the yard or main tracks, and even those running up to and down from the hump, should be filled with the loaded cars that are most vulnerable to water damage. Moving ammunition, explosives, clothing, and foodstuffs to higher ground should logically precede that of field pieces, vehicles, and other freight not particularly vulnerable to high-water damage.

9-7. Detailed SOPs cite the precedence of the freight to be moved to safety. If there are any branch lines that run at right angles to a threatening river, they may provide excellent storage places for vulnerable freight and equipment. If possible, all locomotives should be moved to higher ground. Diesel-electric and electric locomotives should be moved before steam locomotives. Rail bridges over flooded rivers may be weakened or washed away. Bridges with many piers or timber-pile trestles are often most vulnerable because of pressure from collected debris. The weight of heavily loaded cars left on such structures usually tends to stabilize and assist in "anchoring" the bridge or trestle. Such cars should contain only low-grade aggregates such as coal, ore, sand, gravel, and so on. However, this method should not be used without approval from engineer bridge specialists or other qualified engineering personnel.

Cave-ins and Slides

9-8. The following, particularly in very mountainous areas, are often major causes of rail traffic interruptions:

- Tunnels and cut cave-ins.
- Dirt slides.
- Rock slides.
- Snowslides.

These may result from natural causes (such as earthquakes, melting snow, and soaking rains) or from enemy action (such as bombing, artillery fire, or sabotage). Cuts and slides are cleared in the most expeditious manner possible without regard to permanent construction. Heavy equipment should be requested from the engineer service, TASCOM, when clearing the obstruction is beyond rail transport operations capabilities. Where possible, a collapsed tunnel should be excavated or "day lighted" to create a cut in its place. If this is not feasible, a bypass ("shoo-fly") track may be constructed.

Terminal or Yard Congestion

9-9. Terminal congestion is often a by-product of a major traffic interruption or of poor control of movements. To maintain fluidity, yards and terminals should not be filled beyond 60 per cent of static capacity. When a yardmaster can foresee that a yard is about to be blocked, he should report the situation to the chief dispatcher. The yardmaster may request that cars be set off at sidings or diverted to other lines or yards until normal train movement is resumed. The battalion commander (division superintendent) may request the TRANSCOM transportation officer to apply an embargo on rail movement if the situation becomes serious.

Minor interruptions

9-10. Although many factors cause minor interruptions, they are generally classified in one of the three common categories. Each of these categories are discussed as follows.

Derailments

9-11. Minor derailments are most often caused by equipment failures (such as dragging brake rigging, sharp wheel flanges, splitting switches, wheels overriding derails, and so forth). Derailments usually are repaired quickly by train crews using rerailing devices or jacks carried on locomotives. A more serious derailment may require that a wreck train be brought to rerail the car(s) and repair track damage.

Minor Floods, Slides, and Washouts

9-12. Local track gangs can normally repair minor flooding, slides, and washouts of track and drainage culverts. Rock, mud, or snowslides may be removed by local labor and maintenance of way equipment without the need of a work train. The necessary repair materials should be stockpiled at suitable locations along the division right-of-way where these interruptions are frequent.

Signal Communication Interruptions

9-13. Local signal section personnel can usually quickly repair minor breaks in dispatcher circuits. As instructed by the chief dispatcher, local block operations may continue the movement of trains by "fleet" operations during such breaks. Signal service assistance may be requested in making signal and communication line repairs, which may be beyond the scope of rail personnel.

WRECK TRAINS

9-14. The transportation railway company (TOE 55917) provides wreck train support to the division. A wreck train consists of a locomotive, a wreck crane, tool cars, and enough bunk and cook cars for personnel required for a particular wreck. Wreck cranes and tool cars are stationed at strategic points along the railway line. Division terminals are considered strategic points because locomotives and engine, train, and wreck car crews are available on call. Wreck train equipment must be prepared for immediate movement. Ties, rails, spikes, and other repair materials are stockpiled at various points. An emergency supply of such items are also loaded in suitable cars and held with each wrecker as part of the wreck train. The transportation train operating company furnishes locomotive and train crews for wreck trains. Wreck trains may be obtained from HN resources.

Traffic Interruptions

9-15. When a derailment or wreck blocks main line traffic, the dispatcher secures as complete a record as possible about the extent of the damage. He also estimates the time required in restoring train movement. The dispatcher orders and arranges for a wreck train and its crew to go immediately to the scene. In serious wrecks, the wreck train may be ordered out from division points on both sides of the wreck to hasten clearing operations. The dispatcher also notifies the following to take appropriate action in his area of responsibility:

- Superintendent.

- Trainmaster (train crews).
- Unit commander (master mechanic).
- Wreck car crews.
- Maintenance-of-way superintendent (track repairs).

These officers go to the scene of the accident by the fastest available means. They survey the situation and make plans for the wreck crane to go to work immediately upon its arrival. The prime objective is to get the line open as quickly as possible. Cleanup and salvage operations can be performed later if necessary.

Wreck Car Crews

9-16. Wreck crews operate under the general supervision of the platoon leader of railway equipment maintenance platoon. A wreck crew consists of the following:

- Wreck foreman.
- NCOIC.
- Crane operator.
- Car repairman.
- Welders (as required).

This crew operates the equipment assigned to the wreck train. An officer or senior NCO, designated as wreckmaster by the company commander, is in charge of the wreck crew(s).

9-17. The mission of wreck crews is to remove wrecks and other line obstructions. They also salvage or repair wrecked rolling stock so that it can be safely moved to the nearest ship or repair track. The wreckmaster coordinates closely with maintenance of way platoon personnel sent to the scene. The mission of this platoon is to repair and restore right-of-way and tracks damaged or destroyed by derailments, acts of God, sabotage, and so forth.

Wreck Crane Operators

9-18. A crane operator must know the parts, principles of operation, and the safety precautions required of the crane to which he is assigned. He must be familiar with the types and capabilities of the cable rope, wire rope, blocks, hooks, and shackles with which his crane is equipped. An operator must be able to supervise the rigging of his crane for a particular lift. He must understand the mechanical advantage of various pulley combinations, the use of dead-man rigs, and other expedients required in rerailing locomotives and cars.

SAFETY

9-19. Two general rules found in FM 55-21 and which relate to safety are: "Safety is of the first importance in the discharge of duty," and "Obedience to the rules is essential to safety."

OPERATING RULES

9-20. Personnel engaged in the operation of wreck trains and wreck cranes must be familiar with the railway safety and operating rules given in FM 55-21. All personnel whose duties are affected by the rules of this publication must be provided a copy. Wreck crane personnel must ensure that cables and tackle of adequate strength are used when making heavy lifts. All personnel are also warned to stay away from any area where there is a possibility of being injured if a cable should break or a load slip.

Preoperational Safety Checks

9-21. Experience has proved that there are a number of potential hazards inherent to wreck crane operations. Safety checks to be performed before crane operations and safety practices incidental to operating the crane and making heavy lifts are discussed in the following paragraphs.

Equipment Servicing

9-22. Engine fuel, lubricants, and water should be checked and brought to the proper levels. Open gears and fittings should be greased. Power stoppages and mechanical failures caused by inadequate servicing can cause damage and injury. Wreck cranes should have air brakes, hand brakes, and generators for electricity and lights. Cranes should be capable of self-propulsion in either direction.

Decks and Platforms

9-23. Wreck crane decks and platforms must be kept free of grease, cables, chains, buckets, barrels, loose tools, and similar items. Machinery guards over open gears should be in place. Handholds and steps must be kept clean, secure, and marked as appropriate.

Brakes, Clutches, and Switches

9-24. The action and effect of all braking devices, clutches, and the engine cutoff switch is checked and required adjustments are made. On assuming his post, the crane operator will test the working condition of these controls and his ability to operate them quickly and automatically in an emergency. Crane operators must ensure that all dogs, pawls, and braking equipment are capable of effectively braking a weight of at least one and one quarter times the weight of the full rated load. Outriggers are used when testing a crane's rated capacity, but the rated capacity for the crane should be that given without outriggers.

Cables

9-25. The crane should have an adequate quantity of the following to meet capacity lift requirements:

- Cables.
- Devices.
- Falls.
- Sheaves.
- Pulleys.

- Other miscellaneous hoisting equipment.

Blocks and cables should be clean, free of dirt and sand, and properly lubricated at all times. Cables and rope are kept free of kinks and are stored coiled. A crane operator, before beginning any lift operation, will inspect cables and wire ropes for broken wires, fractures, and flat or pinched spots. Sheaves and drums are checked for proper line placement.

Special Safety Considerations

9-26. Statistically, a free moving crane is a potentially dangerous instrument. One-third of the injuries sustained in crane accidents result in fractures or severed limbs. Many of those injured are crane operators. Most crane accidents are preventable because they are, to a large measure, the result of actions, conditions, or situations directly under the control of the operating crews. Crane work must be the coordinated activity of a team of skilled workers. The operator, wreckmaster, riggers, and others assume control of lifts, movements, and similar actions. It is important that individual control responsibilities are clearly defined and the procedure for transferring them is thoroughly understood.

Signals

9-27. The wreckmaster, or someone designated by him, is responsible for giving signals. The responsibility for giving an emergency stop signal belongs to anyone on site who considers such a signal necessary. Copies of authorized signals should be posted in obvious places so wreck train personnel may become familiar with them. Crane and derrick operators must wait for a clear signal from the designated signalman before operating the equipment. If there is any doubt or confusion regarding the signal given, the operator must stop operations and clarify the signal before making another move. Figure 9-1 shows the standard hand signals used when operating cranes and derricks. These signals are used when visibility permits. Use lights or lanterns to give signals during periods of darkness.

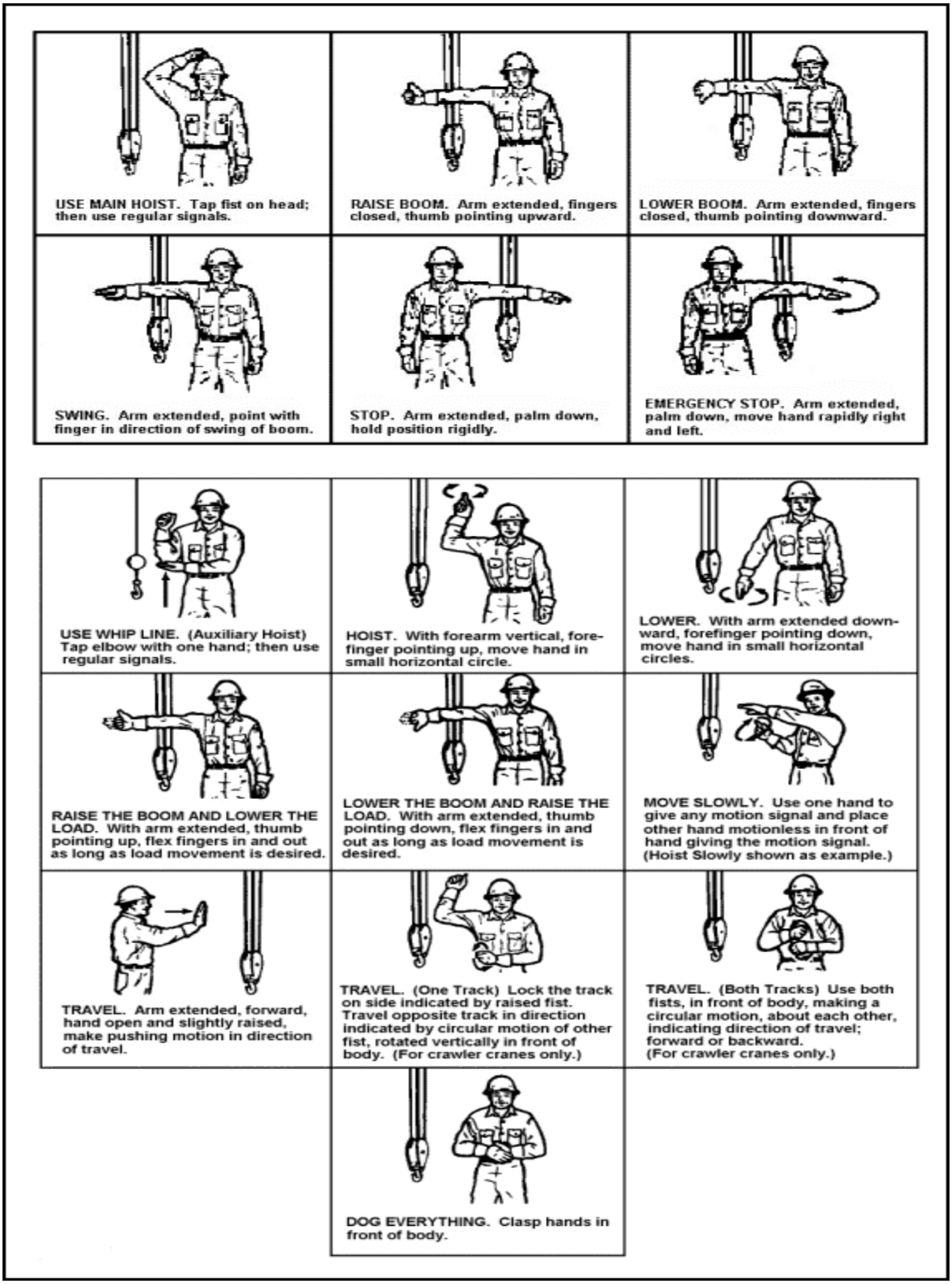


Figure 9-1. Standard Crane and Derrick Hand Signals

Overhead Powerlines

9-28. Wreck crane operations under or near electric powerlines are extremely hazardous. A closed electric circuit and a difference in voltage are required for the passage of electric current. When a crane boom or cables come in contact with a live powerline, the crane, cables, boom, and load become electrically charged. A person on the ground steadying a swaying load or touching any part of the crane becomes part of this closed electric circuit and can be instantly electrocuted or be critically burned. The crane operator is responsible for keeping his crane boom and/or cables away from powerlines. He is relatively safe while in the cab. Should he step off the crane and have one foot on the crane step and one on the ground, he also could be electrocuted or burned.

Movement in Tow

9-29. Wreck cranes are powered for independent movement by gear-driven wheels. When cranes are moved in tow, in work or wreck trains, operators must take the following precautions to avoid damage to the crane, the train, or wayside objects.

- Secure the rotating deck parallel to the centerline of the track. Fasten the deck at front and rear ends with tie bars provided.
- Lower the boom to the traveling position, preferably pointing to the rear. Place transmission lever in NEUTRAL position.
- Disengage driving gears so wheels will turn freely. Use handcrank to draw the gear assemblies out of mesh.

Safe Load Precautions

9-30. Cables and tackle must not be overloaded. When making heavy lifts, crane or derrick operators must be sure of the following:

- Boom is properly positioned.
- Boom is as high as possible.
- Hoist cables have greater capacity than the load to be lifted.
- Hoist cables have no kinks or broken wires.
- Crane is level and outriggers are in place.
- Brakes are in good working order.
- Load to be lifted is properly slung (rigged).
- Load is kept near the ground when traveling and not lifted higher than necessary.
- The swing is started slowly when swinging loads.
- Loads are not left hanging on the hook.

Safety Factors

9-31. The safety factor is the ratio of the strength of the rope to the working load. For example, a wire rope with the strength of 10,000 pounds and a total working load of 2,000 pounds would be operating with a safety factor of 5. It is not possible to set exact safety factors for cranes with various

types of wire rope as this factor can safely vary with conditions. The proper safety factor depends not only on the loads applied, but also on the following:

- Speed of operation.
- Type of fittings used for securing the rope ends.
- Length of the cable.
- Acceleration and deceleration.
- Number, size, and location of sheaves and drums.

The safety factors given in Table 9-1 have been established, by experience, as the minimum required for an average operation. Larger safety factors are desirable for greater safety and more efficient operation. Safe working loads of slings are shown in Figure 9-2.

Table 9-1. Safety Factors

Use	Minimum Safety Factor
Guys	**3.5**
Miscellaneous hoisting equipment	**5.0**
Derricks	**6.0**
Slings	**8.0**

CHAIN SLINGS (Loads in pounds)

Size of Chain	SINGLE	DOUBLE						
		5°	10°	15°	20°	30°	45°	60°
3/8"	2700	470	940	1450	1850	2700	3800	4700
7/16"	3450	600	1200	1750	2350	3450	4900	5900
1/2"	4500	780	1570	2300	3100	4500	6350	7800
5/8"	6900	1200	2400	3550	4700	6900	9750	12000
3/4"	10100	1750	3500	5200	6900	10100	14000	17500
7/8"	14000	2400	4900	7250	9600	14000	19500	24000
1"	18600	3200	6500	9650	12700	18600	26000	32000
1 1/8"	23400	4000	8000	12000	16000	23400	33000	40000
1 1/4"	28800	5000	10000	15000	19700	28800	40500	50000
1 3/8"	34500	6000	12000	17800	23500	34500	49000	60000
1 1/2"	40800	7000	14000	21000	28000	40800	57500	70000

WIRE ROPE SLINGS (Loads in pounds)

Size of Rope	SLIP NOOSE	TWO-END BRIDLE SLING			THREE-END BRIDLE SLING		
		When Angle is			When Angle is		
		45°	60°	75°	45°	60°	75°
3/8"	3200	2200	2800	3000	3400	4200	4600
1/2"	5400	4000	4800	5200	6000	7200	7800
5/8"	8400	6000	7200	8000	9000	10800	12000
3/4"	12000	8400	10200	11400	12600	15400	17000
7/8"	16000	11400	14000	16000	17200	21000	24000
1"	22000	15000	18000	20000	22000	26000	30000
1 1/8"	26000	19000	23000	26000	28000	36000	40000
1 1/4"	32000	23000	28000	32000	36000	42000	48000
1 3/8"	40000	28000	34000	38000	42000	52000	58000
1 1/2"	46000	32000	40000	44000	48000	60000	66000

NOTES:

- Loads are based on slings in good condition.
- Take up slack and start the load slowly.
- Keep slings free from twists, knots, and kinks.
- Lift from the center of hooks, never from the point.
- Distribute the load evenly on all legs of the sling.
- Inspect slings regularly.
- DO NOT OVERLOAD.

Figure 9-2. Safe Working Loads of Slings

LOAD FORMULAS

9-32. Safe working loads are selected from mathematically determined tables. However, the following formulas are rule of thumb methods for determining safe working loads (in tons) for hooks, chains, ropes, and cable (diameter in inches).

- **Hooks.** Where the hook starts to arc, the square of the diameter.
- **Chains.** Eight times the square of the diameter of one side of the link.
- **Rope.** Square of the diameter.
- **Cable (wire rope).** Eight times the square of the diameter.

SAFETY RULES

9-33. Crane operators MUST be sure of the following:

- Only authorized persons enter the crane cab.
- No one is in or about the crane before it is started.
- No hoist is made while anyone is riding on the load.
- A warning signal is sounded before traveling (moving the crane) or when the load approaches near or over other persons.

HOISTING AND LIFTING MATERIALS

9-34. Standard wire rope (cable) is used on wreck cranes for hoisting. Manila or sisal rope, because it is easy to handle, is carried for hand or tag lines, minor lashing, and rigging. All spare rope (both fiber and wire) should be kept coiled when not in use. The sizes of rope used by the US Army are designated as inches in diameter.

Fiber Rope

9-35. Fiber rope is made by twisting vegetable fibers together. The rope consists of three elements: fibers, yarns, and strands. The direction of twist of each element is reversed to prevent the elements from unraveling under load strain. Fiber rope is named for the kind of vegetable fibers of which it is composed. Manila rope (made from the fibers of plantain leaves) and sisal rope (made from the fibers of aloe leaves) are two types commonly used in military service. Manila rope is superior to other fiber ropes in elasticity, strength, and wear qualities. It is smooth and runs well over blocks and sheaves.

9-36. The minimum breaking strength of manila and sisal rope is much greater than their safe working capacity. The difference between the two is the safety factor. The safe working capability (in tons) for a given size of manila rope is approximately equal to the square of the diameter in inches, using a safety factor of four. Under no circumstances should fiber rope be loaded to more than twice its rated safe working capacity. As rope deteriorates, the safe load is one-half of the value shown in Table 9-2.

Table 9-2. Properties of Manila and Sisal Rope

		No. 1 Manila		Sisal	
Nominal diameter (inches)	Circumference (inches)	Breaking strength (tons)*	Safe load (tons)* FS = 4	Breaking strength (tons)	Safe load (tons) FS = 4
1/4	3/4	0.27	0.07	0.22	0.06
1/2	1 1/2	1.32	0.33	1.06	0.26
3/4	2 1/4	2.70	0.67	2.16	0.54
1	3	4.50	1.12	3.60	0.90
1 1/4	3 3/4	6.72	1.69	5.40	1.35
1 1/2	4 1/2	9.25	2.31	7.40	1.85
2	6	15.50	3.87	12.40	3.10
3	9	32.00	8.00	25.60	6.40
*Breaking strength and safe loads are for new rope used under favorable conditions.					

WIRE ROPE

9-37. Wire rope is made of steel or iron wires twisted to form strands. The strands may be wound around each other or twisted over a central core of fiber or steel rope. The direction of twist of each element of the rope is known as the "lay" of that element. Regular lay, the accepted standard for wire ropes, denotes ropes in which the wires are twisted in one direction to form the strands. Strands are twisted in the opposite direction to form the rope. In regular lay ropes, the wires are almost parallel to the longitudinal axis of the rope. Due to the difference in direction of the strand and rope lays, regular lay ropes are less likely to kink and untwist than ropes constructed with other lays. They are also easier to handle. Overloaded wire cable breaks a strand at a time. To prevent corrosion and internal abrasion, boom wire rope should be lubricated with lubricants thin enough to penetrate to the inner strands.

9-38. Fiber cores are standard for most constructions of wire rope, but are not as strong as ropes with wire cores. A fiber core supports the strands, supplies internal lubrication, and contributes to the flexibility and resiliency of the rope. Wire core ropes are less suitable than fiber core ropes for operations where shock loads are frequent. Wire rope constructions are designated by the number of strands in the rope and the number of wires in each strand. Therefore, a rope composed of six strands of 19 wires each is a 6 x 19 rope. This is the standard hoisting cable and is more universally used than any other rope construction.

Chains

9-39. Chains are composed of a number of metal links connected together. The links are made of a round or oval piece of rod or wire welded into a solid ring after being joined to the connecting link. Chain size is determined by the diameter of the rod composing the links. While chains may stretch under excessive loads, individual links will bend only slightly. Chains with bent links may suddenly

fail under load and break. Since chains are resistant to abrasion, they are often used to lift heavy objects with sharp edges that might cut wire rope.

Blocks

9-40. A block is a shell or frame, which holds one or more grooved pulleys, called sheaves. The sheaves revolve on a center pin or axle. A swivel-type hook is attached to one end of the block and often an eye is attached to the other.

Types of Blocks

9-41. Block sizes are determined by the length of the shell (frame) in inches and by the number of sheaves it contains. Single, double, triple, and quadruple blocks contain one, two, three, or four sheaves respectively. Blocks can be identified by their construction and the manner in which they are used. These two types of blocks are conventional and snatch.

- **Conventional block.** A conventional block is constructed of fiber or wire rope, which must be reeved or threaded through the sheaves. This is the type block found on crane booms.
- **Snatch block.** This type block, also called a gate block, is constructed so that one side opens to permit a cable or rope to be placed over the sheave without reeving through the block. It is easily identified by the hinge and lock on one side. It is normally used in making rigs to obtain mechanical advantage where the cables or ropes are continuous lines and cannot be threaded through the sheave.

Classification

9-42. Blocks are classified according to the manner in which they are used. These two types of blocks are fixed and running.

- **Fixed block**. This block is fastened to a stationary object. It does not affect mechanical advantage. Sometimes called a leading block, it does permit a change in direction of the cable.
- **Running block.** This block (also called a traveling block) is fastened to the object to be moved or lifted. This block does not produce a mechanical advantage.

Cable

9-43. The largest size cable or rope that can be used on a block is determined by the diameter of the sheave, depth of the groove, and the size of the opening through which the line passes over the sheave. The proper size is the largest one possible that fits the sheave groove and still has clearance between the frame and the sheave. This diameter is usually from one-eighth to one-ninth the shell length. The use of multiple sheave blocks increases the weight that can be lifted (mechanical advantage). This increase depends on the number of sheaves in the sheave blocks and the number of parts of cable between the blocks.

Hooks

9-44. Railway wreck cranes are equipped with two standard slip hooks (one large and one small). The large hook is rigged to the triple block on the main boom hoist. On steam cranes, the small, single hook is rigged to the single-hoist line over the sheave at the end of the boom. Army-owned, diesel-mechanical cranes may be equipped with a double hook on the single-hoist line. Slip hooks are made so the inside curve of the hook is an arc designed to be used with wire or fiber rope and chains. Hooks usually fail by straightening, thereby releasing the load. Any deviation from a perfect inner arc indicates overloading. Safe working loads of drop-forged steel hooks of various sizes are shown in Table 9-3.

Table 9-3. Safe Loads on Hooks

Diameter at Beginning of Arc (Inches)	Inside Diameter of Eye (Inches)	Length of Hook (Inches)	Safe Load on Hook (Pounds)
1	1 1/4	6-7 1/8	3,400
1 1/2	1 3/4	10 11/32	8,000
2 1/4	2 3/4	14 13/16	13,600
3	3 1/2	19 3/4	24,000

Crane Rigging

9-45. Wreck crane rigging includes all the combinations of cable, rope, and tackle used to raise or move heavy loads. Rigging may be used to change the direction of pull or to take advantage of favorable terrain features. Various combinations of cables, blocks, and pulleys may be rigged to create mechanical advantage. To employ crane rigging effectively, wreck crew personnel must understand the various parts and how effort and resistance are distributed among them. When effort is exerted on one end of a cable or a rope, there is equal resistance applied at the other end. Tackle must be used if the resistance (object to be moved) exceeds the effort available. This difference is supplied by the mechanical advantage of rigging.

9-46. The heavy load (main) hoist raises and lowers the big block on the crane boom. The main hoist consists of a number of wire rope cables running from the load block up to the peak of the boom, through sheaves, and down to the main hoist drum in the crane cab. The number and size of cables vary with the lifting capacity of the crane. The auxiliary hoist line raises and lowers the hook at the end of the boom. Cables for this line run through the sheaves of the light load hook to the sheaves at the tip of the boom, then to the auxiliary hoist drum. These cables vary with the lifting capacity of the light load hook.

EQUIPMENT RECOVERY AND LINE CLEARING OPERATIONS

9-47. The number of cars and locomotives off the track, whether they are upright or overturned, on the right-of-way or down an embankment, or in a ravine or a riverbed, are all factors in the equipment recovery and line clearing operations. Damaged equipment, that is unable to move on its

own wheels, is set aside for later recovery. The contents of cars must also be considered. Flammable and explosive ladings present certain safety hazards. Maintenance of way and signal maintenance personnel restores tracks and communication facilities that have been damaged. After traffic backlogs have been moved, the wrecked equipment can be picked up and evacuated to shops or salvaged by wreck trains operating in the traffic pattern. The division superintendent and other senior officers must consider the following factors when performing equipment recovery and line clearing operations:

- The military situation.
- Size and scope of the wreck.
- Density of traffic.
- Availability of personnel.
- Wreck cranes available.

Rerailers

9-48. Rerailers are cast iron devices used in simple derailments to retract cars and locomotives. Rerailers are carried on locomotives and wreck trains. Rerailers are made to fit over a rail with grooves and runways designed to guide car wheel flanges back onto the rail to the proper running position. Some rerailers are designed for use under either wheel; others are designed for use in pairs. Those designed for use under either wheel must be spiked to a crosstie to prevent slipping. The rerailer shown in Figure 9-3 is used in pairs. One of the paired rerailers guides the wheel on the outside of the rail (right side), over the rail to position. The other one (left side) guides the wheel on the inside of the rail into a flange position. All derailed cars are pulled onto the track when possible. If the coupling is too low or too far away for a secure connection, chains should be used. The rerailing devices shown have a tapered opening that fits against the outside web of the rail. A wedge is driven between the outside web and the rerail device. The wedge tightens against the rail and prevents the rerailer from slipping as a result of the thrust of the car wheel.

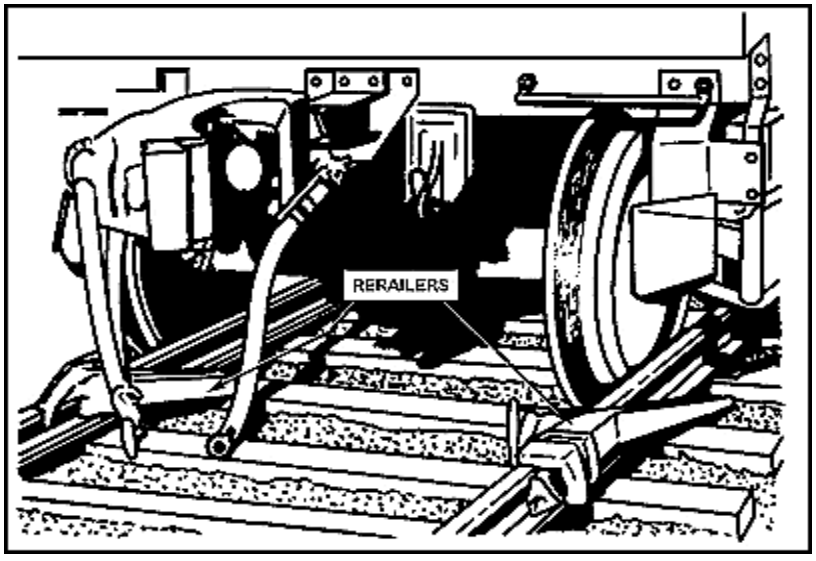


Figure 9-3. Using Rerailers to Retrack a Derailed Car

Note: Never attempt to rerail a diesel locomotive under its own power. Serious damage may result to traction motors from spinning wheels. Unloaded traction motors attain dangerously high speeds.

Other Equipment

9-49. Mobile cranes and bulldozers may often be used effectively in clearing operations when derailments or wrecks occur in areas accessible from the road. In complicated derailments involving a large number of cars, mobile cranes and bulldozers may be used to move car bodies and car trucks within reach of the wreck crane. Mobile cranes may also be used to lift and load small items during clearing and salvage operations. Specially designed hydraulic jacks may be available to lift and rerail rolling stock. These are especially useful when minor obstructions must be cleared quickly.

Preliminary Procedures

9-50. It is not practical to list all specific instructions covering the different kinds of lifts that must be made under wreck conditions. Each wreck is different and depends on the following before any recommendations can be applied to a particular wreck:

- Situation.
- Weather.
- Timing.
- Lifting hazards.
- Damage to equipment.
- Number and capacity of wreck cranes available.

The wreckmaster and other officials on the site must consider all factors and decide which action to take.

Preparation for Lifting

9-51. The total weight of the anticipated lift should be calculated as accurately as possible. This includes the weight of the material or object to be handled and the block, sling, or other devices between the hook and the load. The light weight of the railway car is stenciled on the side of the car. Net weights of the contents of loaded cars are available from train documents. The calculated total weight is checked against the officially tested capacity of the wreck crane. Crane operators must never operate any weight-handling equipment in excess of its rated capacity without specific authorization from the officer in charge of the operation.

Load Security

9-52. Loads should not be lifted or moved unless they have been hitched in such a way that no shifting of weight, slippage, or loss of load will occur. Incorrect rigging can damage lifting gear by breaking the fiber or wire of the cable. This can result in making subsequent lifts an increasingly hazardous operation.

Brake Tests

9-53. Heavy loads should be lifted a few inches off the ground and the load brakes tested to be sure they will hold before the load is raised any higher. Test-rated lifting capacities should always be checked to determine permissive loads. If the crane has been idle for a long time, hoist the load block to the boom several times with the brakes lightly applied before hoisting a heavy load. This will dry out any moisture in the brake lining. Excessive moisture in the brake lining will cause rough brake performance and could cause the load to drop.

Footing

9-54. Making a safe lift depends largely on having a firm foundation and a level base for the crane. The steel rails of the track usually provide a firm foundation, but a level base may require maximum use of the outriggers and blocking. Outriggers are used when making heavy lifts or when making lifts near the crane's maximum capacity at any radius. If blocking rests on a firm base, a small clearance must be allowed at points "A," (Figure 9-4). A level base is required to avoid swinging the load and to reduce the possibility of tipping. Level swinging requires a minimum of power and is fast and stable. Outriggers are securely extended and blocked before attempting near capacity lifts; footing must be level and solid. Outriggers are not extended beyond the crane manufacturer's recommended limits.

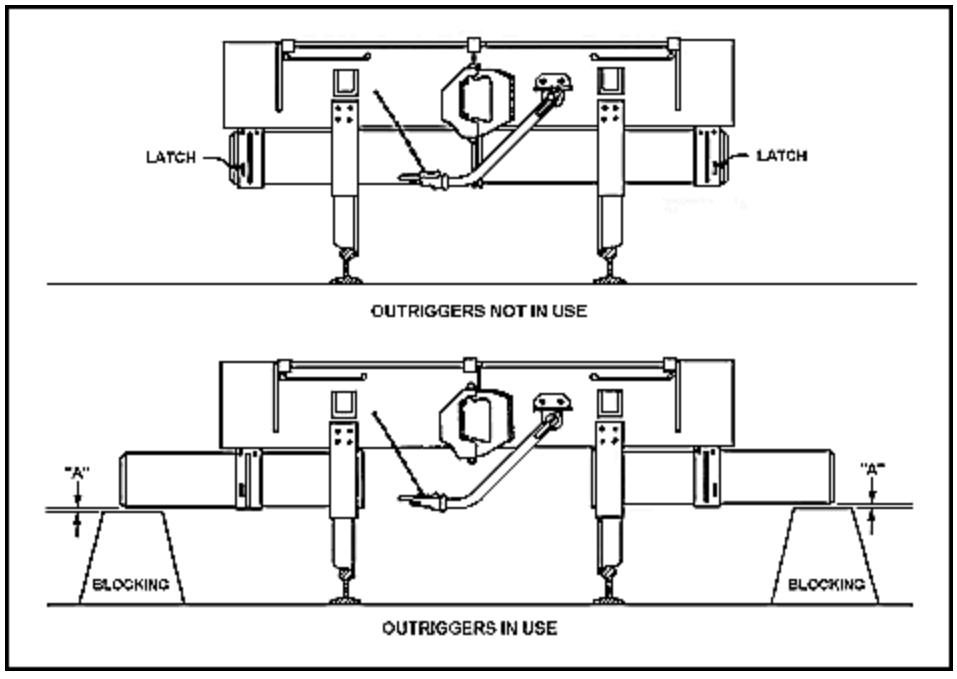


Figure 9-4. Outriggers

Lifting the Load (Mechanical Advantage)

9-55. In order to lift a load beyond the strength and capacity of the person lifting it, the mechanical advantage must be determined. Mechanical advantage is determined by multiplying the force exerted

by the force applied to lift or move a load. Mechanical advantage may be computed for simple and compound tackle systems.

Simple Tackle System

9-56. A simple tackle system (shown in Figure 9-5) has one cable (rope) and one or more blocks. In this system (Figure 9-5, number 1), there are two lines leaving the load, the fixed end and the fall line (pulling line). The fall line is bearing the pulley. The force in the line from the block to the load is P; the tension in the rope as it leaves the block is also P, so two forces, each equal to P, are lifting on the block. The total force being applied is 2P; therefore, the mechanical advantage is 2. In a simple tackle system with three lines leaving the block (Figure 9-5, number 2) the mechanical advantage is 3. In a simple tackle with two double blocks (Figure 9-5, number 3) and five lines leaving the load, the mechanical advantage is 5.

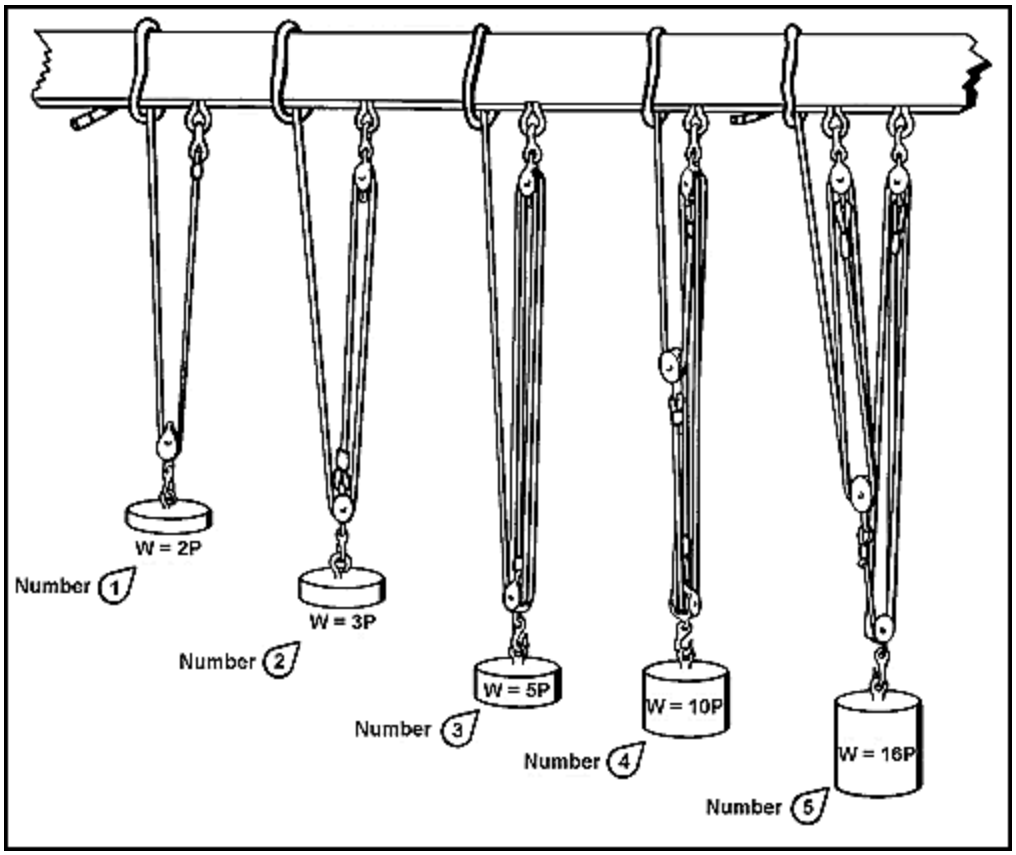


Figure 9-5. Mechanical Advantage of Various Tackle Rigs

Compound Tackle System

9-57. A compound tackle system has more than one rope and two or more blocks. Compound systems are made up of two or more simple systems. The fall line from one simple system is fastened to a hook on the traveling block of another simple system that may include one or more blocks. In such a compound system, the force exerted on the fall line of one simple system is multiplied by the

mechanical advantage of that system and applied to the fall line of the second simple system. This force is then multiplied by the mechanical advantage of the second simple system. In a compound system with five lines leaving the load (Figure 9-5, number 4) and the fall line of this tackle attached to a traveling block with two lines supporting it, the mechanical advantage is 2 times 5, or 10. A more complicated system is shown in Figure 9-5, number 5. This system is made up of two simple systems, each of which has four lines supporting the load. The traveling block of the first simple system is fastened to the fall line of the second simple system; the mechanical advantage of this compound system is 4 times 4, or 16.

Deadman

9-58. A deadman provides anchorage for additional pulling power when secured to an inanimate object. The deadman may consist of a log, rail, steel beam, or other similar object buried as deeply in the ground as the force to be exerted requires (Table 9-4). The deadman has a guy line connected to it at the center. Where digging is not practicable, holdfasts made of pickets, cable, rope, girders, ground anchors, and so forth, may serve as anchorage for tackle hookups. Examples of these field expedients are shown in Figure 9-6 through Figure 9-11.

Table 9-4. Holding Power of Deadman in Ordinary Earth

Depth of anchorage (feet)	Inclination of pull (vertical to horizontal) and safe resistance in deadman area (pounds per square foot)				
	Vertical	1-1	1-2	1-3	1-4
3	600	950	1,300	1,450	1,500
4	1,050	1,750	2,200	2,600	2,700
5	1,700	2,800	3,600	4,000	4,100
6	2,400	3,800	5,000	5,800	6,000
7	3,200	5,100	7,000	8,000	8,400

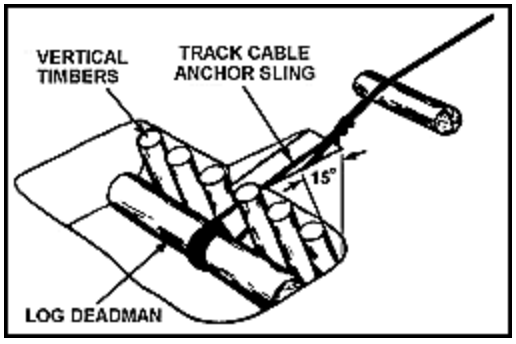


Figure 9-6. Log Deadman

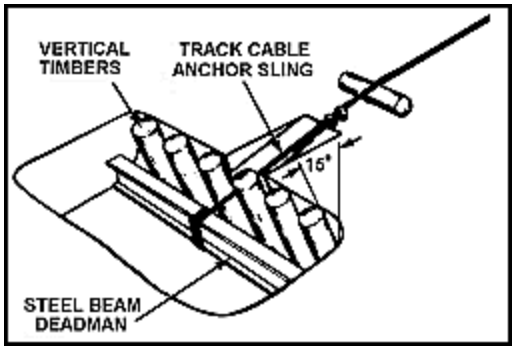


Figure 9-7. Steel Beam Deadman

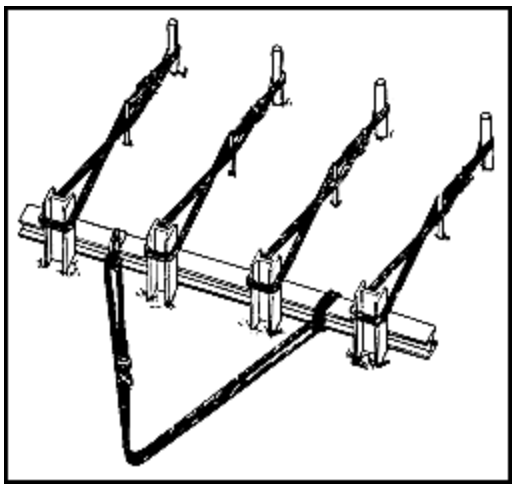


Figure 9-8. Combination Steel Picket Holdfast

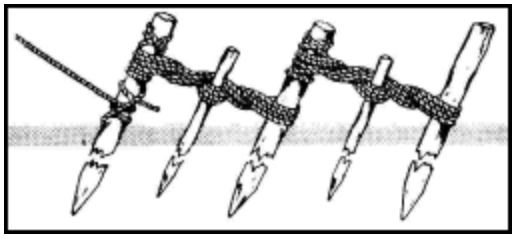


Figure 9-9. Picket Holdfast, 1-1-1 Combination

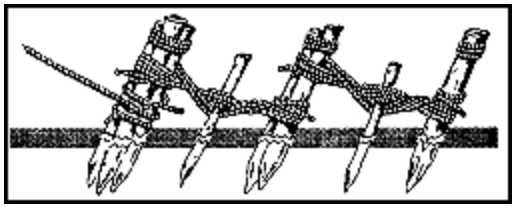


Figure 9-10. Picket Holdfast, 3-2-1 Combination

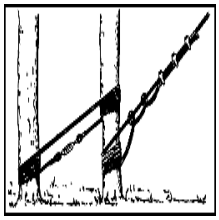


Figure 9-11. Use of Two Trees as Natural Anchorage

Deadman Installation

9-59. The hole in which the deadman is to be buried should be deep enough to provide a good bearing in solid earth. The bank in the direction of the guy line should be undercut at an angle of 15 degrees from vertical timbers (Figure 9-6). Stakes may be driven in the ground against the bank at the same angle to provide a solid bearing surface. A narrow, inclined trench (cableway) should be cut through the bank to the center of the deadman. A short beam or log should be placed under the guy line at the outlet of the inclined trench (Figure 9-7). The guy line must be fastened securely to the center of the deadman so that the standing part of the line (the part of the line on which the pull occurs) leads from the bottom of the deadman. This method of fastening the guy line, plus the angle of the bank, reduces the tendency of the deadman to move upward out of the hole. The strength of the deadman depends partly on the strength of the log or beam used, but mainly on the holding power of the earth (Table 9-4).

Picket Holdfast Installation

9-60. The strength of a picket holdfast depends on the following:

- How it is driven into the ground.
- The diameter and kind of stake used.
- The holding power of the ground.
- The depth to which the stake is driven.
- The angle of the stake.
- The angle of the guy line to the ground.

A combination steel picket holdfast provides more strength than wood and rope combinations (Figure 9-8). A multiple picket holdfast forms a stronger holdfast than does a single picket holdfast. To make a multiple holdfast, two or more pickets are driven into the ground in any desired combination and are lashed together (Figure 9-9 and Figure 9-10). The principal part of strength for a multiple picket holdfast is in the strength of the first (front) picket. To increase the surface area of

the first picket against the ground, three pickets are driven into the ground close to each other and lashed together. They are then lashed to a second picket group that is lashed to a third picket (Figure 9-10). Intervening pickets provide additional strength. Two trees used as natural anchorage are shown in Figure 9-11.

Lifts

9-61. When repetitive lifting is required, position the crane so it has the shortest possible swing cycle in order to reduce cycle time. When multiple lifts are projected over an assigned area, position the crane so that it begins to work at the point farthest from the next direction of travel to a different area. Lifts are completed in one area before moving the crane to the next area.

Positions

9-62. Exact formulas and specific rules for positioning wreck cranes cannot be prescribed. Many factors determine crane working positions. The most undesirable position for lifting is with the boom at right angles to the crane body. This position is often required when clearing derailed or wrecked cars and locomotives to one side of the track. Outriggers are usually required when lifting capacity loads in this position. For heavy lifts, the crane should be positioned where it has the maximum lift capacity. When there are a number of loads to lift, it is best to position the crane so that the loads can be lifted to the most remote points first. When in this position, the crane has greater boom clearance and subsequent crane operations are not blocked.

9-63. Each new job location or condition is checked for adequate boom clearance. During repetitive lifts, when work conditions remain unchanged, one thorough clearance check and careful continued observation will eliminate the need for raising and lowering the boom on each cycle. Wreck cranes are positioned, for safety reasons, so loads are not lifted over personnel or equipment. They are also positioned so that they do not touch overhead obstructions (especially electric wires). Crane hooks are kept high enough so that they will clear personnel and vehicles. Radius clearances are established by positioning the crane to provide adequate space between the load being handled and the point of final placement. Loads are hoisted high enough to ensure proper clearance, but no higher than necessary.

Resistance

9-64. When an overturned car or locomotive is to be rerailed, resistance must be overcome by force. This force is supplied by the crane and its rigging. In serious wrecks, cars and locomotives are often thrown some distance from the track. They must be dragged back to a lifting position, which may involve several forms of resistance. These forms of resistance are described below.

- **Friction.** Created by the contact with an object being pulled across the ground. For example, the amount of friction the resistance offers by soft sand is less than gravel.
- **Grade resistance.** Determined by the weight of the object pulling downhill and the angle of the slope. By rule of thumb, grade resistance can be determined by multiplying one-sixteenth of the weight of the car or locomotive by the number of degrees of slope. An example of this is the resistance encountered when pulling an overturned car up an embankment to track level.

- **Overturning resistance.** That part of the weight of an object, such as that of a diesel locomotive, which acts against the force being exerted to get it upright and back on the track. Half the weight of this object is the maximum that will ever be beyond the center of gravity from the point of lift, so only half of the weight is resisting recovery. When any overturned car or locomotive is to be set upright, the resistance is computed as one-half the weight of the object to be set up.
- **Tackle resistance.** A loss of energy or force that is created by the flexing of the cable of rope, the cable scuffing in the groove of the pulley or sheave, the sheave turning on the pin, and so forth. This loss (tackle resistance) must be overcome before the load can be moved. Each pulley or sheave in the tackle creates a resistance approximately equal to 10 percent of all the other resistance created by gravity, terrain, and so forth. If a standard 40-foot flatcar to be rerailed or picked up creates a resistance of 60,000 pounds and three sheaves are used in the tackle assembly (or crane boom), tackle resistance is 18,000 pounds (30 percent of 60,000 pounds).
- **Total resistance.** The total resistance that must be overcome before an object can be moved. Total resistance varies as conditions vary. For example, a car body weighing 20,000 pounds and dragged up a 6-degree, ice-covered slope would generate a total resistance of 2,800 pounds. The same object pulled over sand would create a total resistance of 5,000 pounds. An object dragged through mud or mire could create resistance equal to its own weight.

Operating Techniques

9-65. Precise rules and techniques cannot be given because of the diversity and wide range of jobs on which wreck cranes may be used. The experience and judgment of the wreckmaster and crane operator will dictate the procedures to be followed.

Cables

9-66. Cable breakage can cause serious injuries, loss of life, and property damage. Wire rope manufacturers recommend a safety factor of six for lifting operations. At full engine power, the safety factor on the crane hoist line of most free-moving cranes usually drops to about two. Do not load hoisting lines to the point where the engine begins to stall or use engine power as a gauge for safe line lifting capacity. If the engine is stalled by line pull only, flywheel inertia adds to rated power. A momentary increase in line pull to two and one-half times the full engine powerline pull will cause the cable to snap. Fast lowering with sudden stops will also overload hoist lines. Boom hoist lines usually encounter their heaviest loads when the load is just leaving the ground. At that point, the angle of lift is flat and there is considerable inertia in starting or stopping.

Working Radius

9-67. The general rule for working radius is that the load should be handled at the shortest possible radius in keeping with job conditions, boom length, height of lift, and boom clearance at all points in the swing cycle. With a given boom length, the steeper the working angle, the shorter the working radius. The nearer the boom moves to the vertical position, the greater the loss in radius for each degree of increase in boom angle. Loads should not be hoisted higher than necessary and should be lowered as quickly as possible to the proper height for swinging, traveling, or spotting.

Boom and Hoist Control

9-68. Lifting the load up and down with a boom lengthens the lift cycle and increases wear and tear on the equipment. Hoisting is generally the best method. The following are the principal factors in controlled handling of loads:

- Speed.
- Smoothness of operation.
- Stability.
- Shock.
- Tipping.
- Feel of the load.
- Safety.

Using the boom, a careful operator will slightly lift the load and check to ensure that it is secure before lifting it completely off the ground. If not satisfied, he should lower the load and investigate and correct the condition. Speed is an element almost fully within the control of the operator. Due to centrifugal force, crane swing should be slow enough to avoid any outward throw of the load. The action of the crane hook at the end of a line is similar to that of a pendulum. Therefore, the hook can be controlled only at the slowest speeds. Tag lines are required for controlling the outward swing of free-moving cranes. When conditions permit, handlines are used to ease the load down and guide it into place. The hoist line is then eased off until the crane settles back gently to a stable position. In case the boom and the crane have rocked from the release of the load, the operator should inspect the cables on the boom and on the drums to ensure that they are in place. The cables may have become wedged, damaged, or cut.

Block Positions

9-69. Before hoisting a load, the upper block is placed directly over the load to permit a vertical lift and to prevent the load from swinging or kicking out. Tag lines are used to increase load stability. Blocks are not pulled too close to the sheaves at any time. If the blocks come together and the hoisting continues, the hoist line may break. There must be adequate clearance between the block and point sheaves when lowering the boom. If not, the hoist line will tighten up and break or wedge down through other cables on the drum. As a safety factor, at least two full wraps of cable should be on the drums whenever they are in operation.

Car Lifts

9-70. When lifting a car, the coupler is the quickest and most practical place to make a hitch. However, couplers must be properly blocked to prevent damage to the car body. Some cars have jack pads or lifting eyes built integrally into the frames. Cars not equipped with these features can be easily hoisted by passing cable slings under the car frame.

Car Trucks

9-71. Most car frames are braced so that trucks may be chained to the car frame and lifted with the car body. When the car body must be lifted off the trucks for quick clearance, brake rods must be disconnected manually or cut in two with an acetylene torch. Car trucks may be lifted intact,

separately, or in any one of several ways. Quick, emergency lifts can be made by inserting chains or cable slings through the side frame openings.

Cars

9-72. When lifting a car for rerailing, cables may be placed around the body of a solid top car and underneath the trucks. Using this sling arrangement or a sling with an adjustable spreader bar gives more stability to the lift. This arrangement is also preferable to the coupler hitch. To prevent crushing the body of the car, gondolas or hoppers must be braced at the top. Bracing may also be required for solid top cars. A crosstie cut to the proper length may also be used as a brace. Most modern passenger cars have holes through the heavily braced collision posts at each end. These holes permit the use of hooks or slings for lifting. The use of slings for coupler lifts and method of blocking the coupler are shown in Figure 9-12. Because of the weight and construction of ambulance unit cars, coupler lifts are not used. Jacking pads and lift lugs are used in lifting the car.

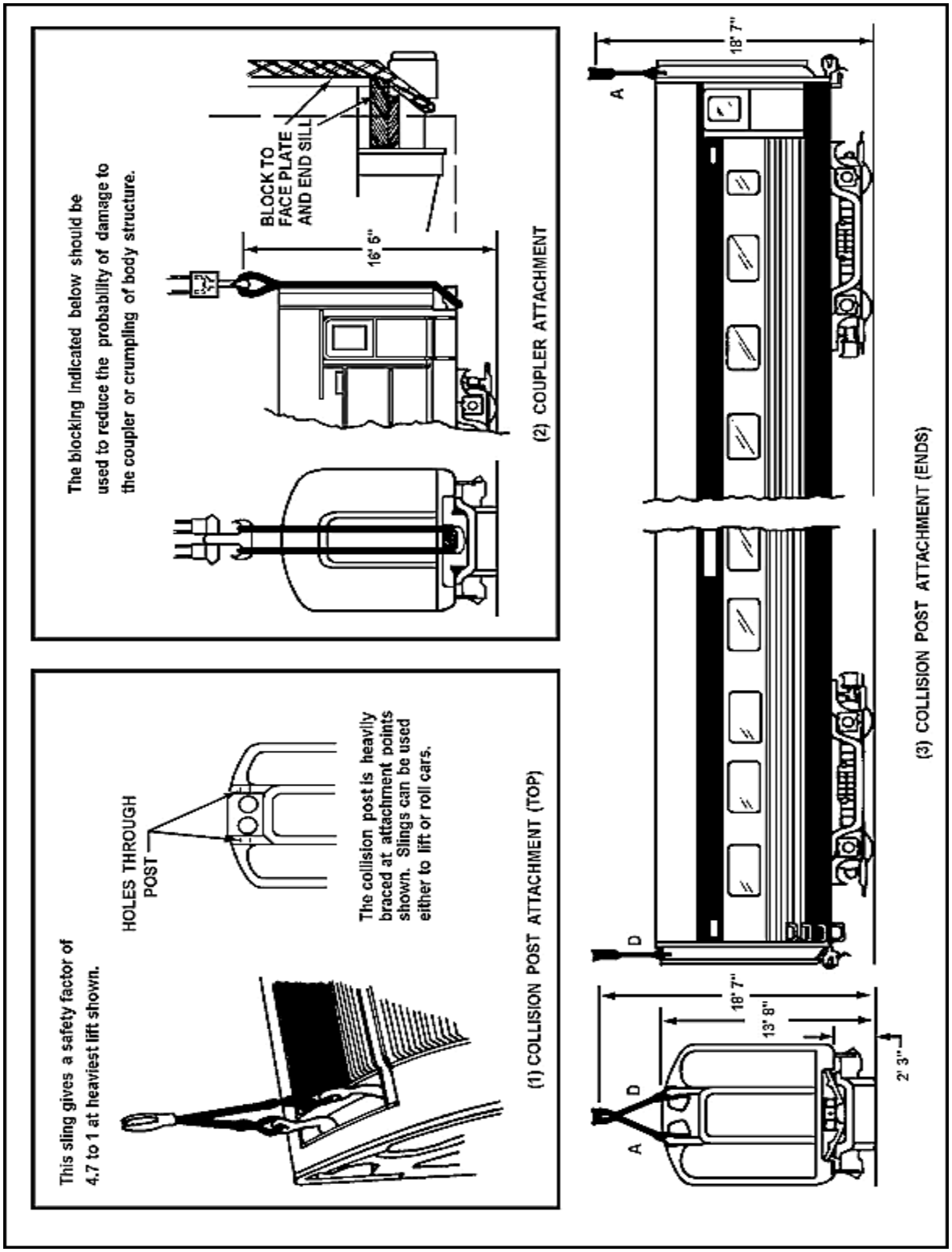


Figure 9-12. Method of Lifting Passenger Cars

LOCOMOTIVE LIFTS

9-73. Due to their weight, rerailing a diesel-electric or steam locomotive requires heavier and more careful rigging than that used for cars. Small locomotives may be lifted by a one-wreck crane using a spreader bar rig. Larger and heavier locomotives may require the use of two or three cranes. Depending on the type of truck and locomotive involved, removing the trucks of diesel-electric locomotives may decrease the lift required by 40 to 50 tons. When it is necessary to roll or lift a locomotive that is some distance from the track and beyond the reach of the crane rope, extensions should be fastened with suitable connectors. These should be of the same size and quality as the crane cable.

9-74. There are two principal types of diesel-electric locomotives in the Army-owned fleet. For wreck recovery planning, the weights of typical diesel-electric and steam locomotives in the Army fleet are shown in Chapter 8.

Lifting and Rolling

9-75. Two cranes, one at each end, should be used to roll a locomotive. Although a single crane large enough to handle the actual load and slings could be provided, an attempt to lift both ends at the same time could result in buckling the frame and crumpling the body structure.

Blocking

9-76. The body structure of a locomotive is heaviest directly over the bolsters. The load of the rolling operation can be carried best at these points. Adequate blocking is necessary to distribute the load. The amount of blocking necessary depends on the amount of roll required. If the locomotive is on its side and the cranes are pulling at a considerable angle, the entire top of the locomotive must be blocked to reduce damage (Figure 9-13, view 2). The major pull will be on this part of the structure during the initial rolling operation. As the locomotive approaches an upright position and the crane lift becomes more vertical, side blocking (shown in Figure 9-13, view 1) becomes more important.

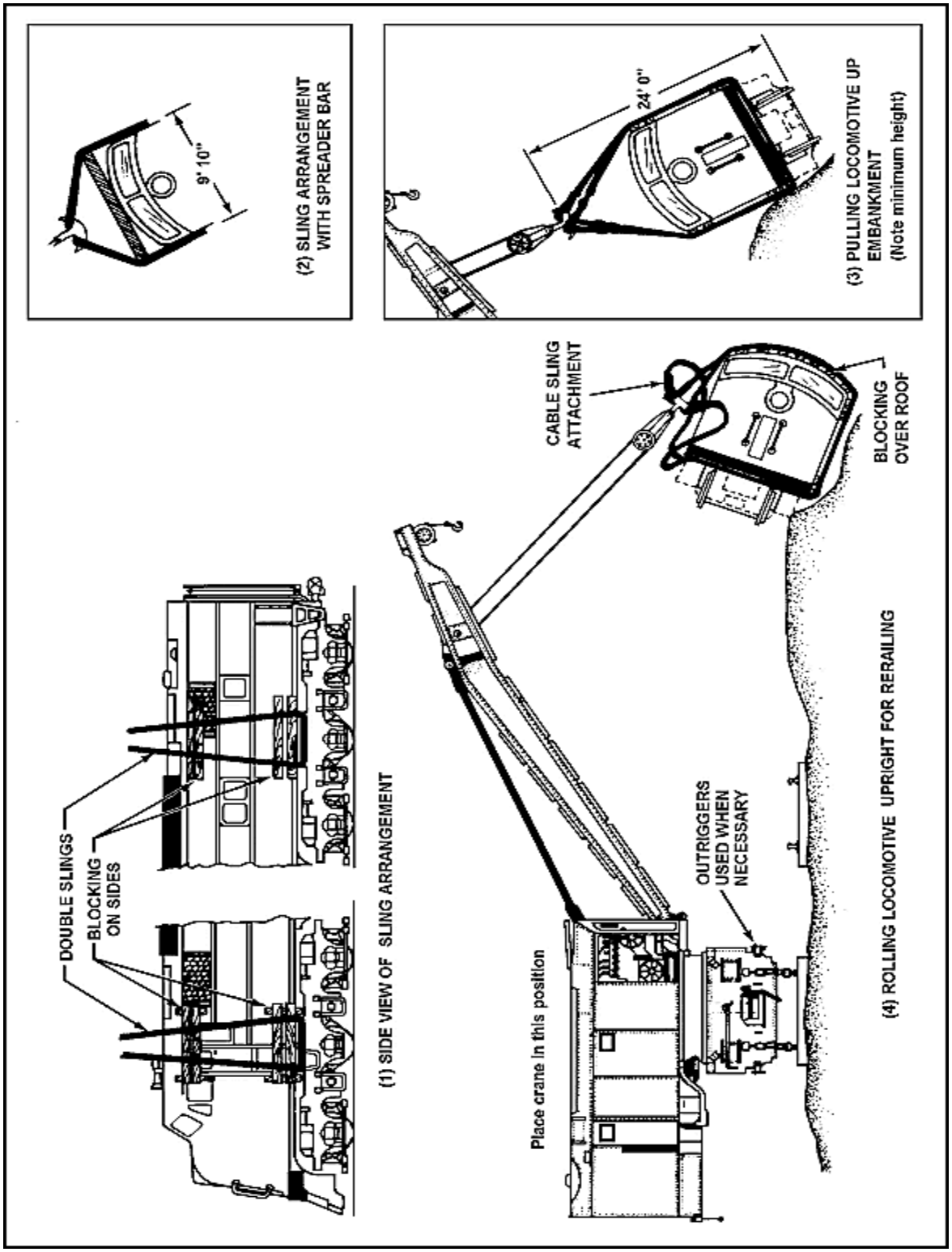


Figure 9-13. Method of Rolling Diesel-Electric Locomotive Upright--Single Crane

Rolling

9-77. Two slings are used for each end of the locomotive in a rolling operation. Each sling is passed from the hook down the side, around the centerplates, back to and up the side, and then back to the crane hook. The stress caused by rolling the locomotive falls on the "underside" sling at each end (Figure 9-13, view 3). When the roll is complete, the load is held by the four slings attached to the two cranes. Two slings are at each end of the crane. The load is now secure for either lifting or dragging. The method used when attaching two cranes to a locomotive, the sling positions when upright, and the minimum hook-to-rail height (24 feet) necessary to rerail the locomotive are shown in Figure 9-14. When possible, 24 feet of sling should be used to prevent the crane hook from bearing on the top of the locomotive when the locomotive is lying on its side. Using the sling also reduces the crushing action on the top sides of the locomotive after rolling is completed and actual lifting is begun. Where the lifting range of the wreck crane boom (or other conditions) does not permit a 24-foot clearance, a shorter cable rigs must be used.

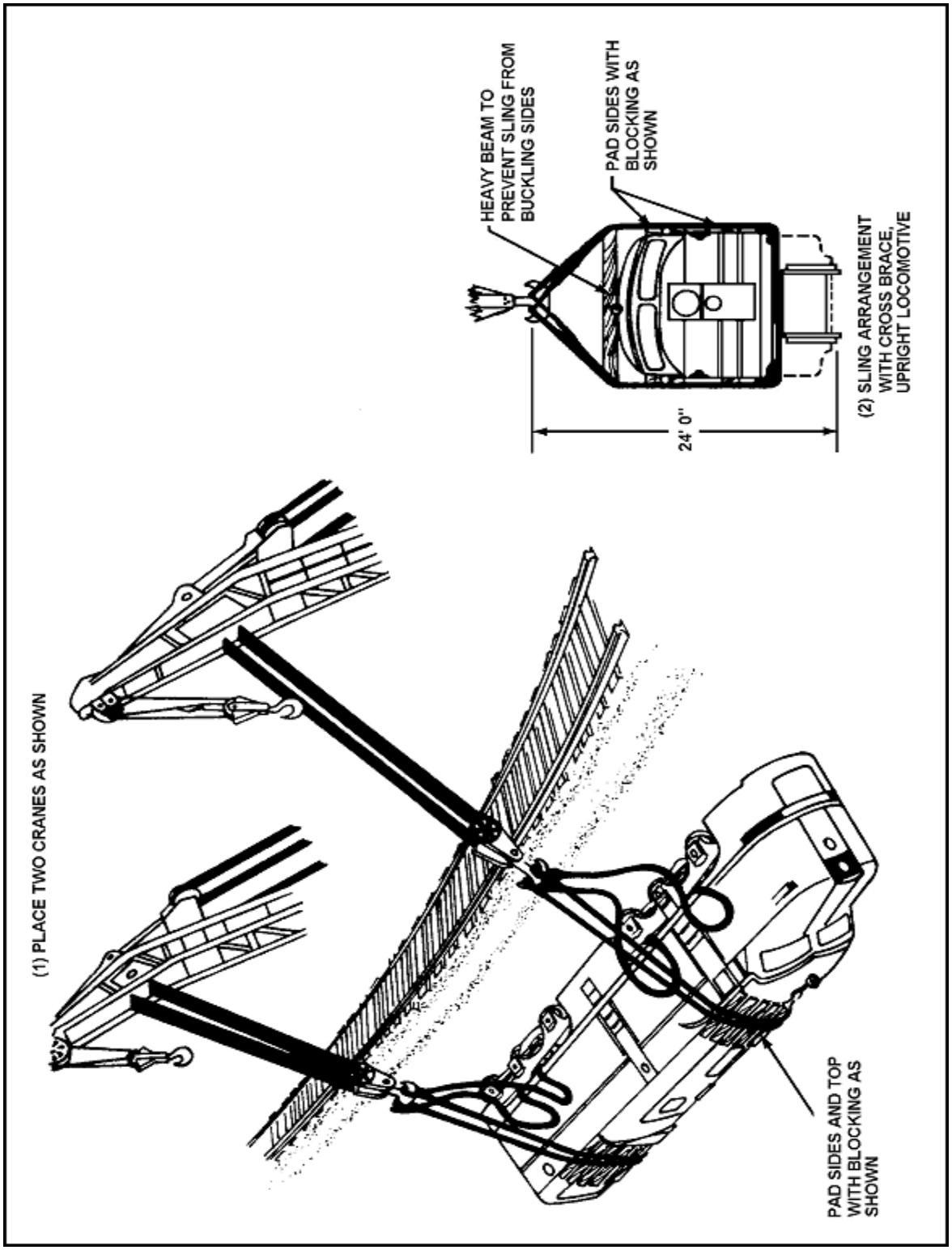


Figure 9-14. Method of Rolling Diesel-Electric Locomotive Upright--Double Crane

Other Precautions

9-78. Attach an extension cable to each "underside" sling to prevent the crane hook from bearing on the top of a rolling locomotive. This extension is removed when rolling is complete and before lifting starts. Use a load spreader when lifting a locomotive in the position shown in Figure 9-14, view 2. The crushing load at the top sides of the locomotive is approximately equal to the load to be lifted. The side blocking is not sufficient to protect the locomotive structure. Therefore, a suitable load spreader is placed over the top of the locomotive at each end to support the load. A load spreader can be any suitable wooden beam, such as a crosstie of proper length, notched at the ends to hold the slings against slippage.

Electro-Motive Division, Diesel-Electric Locomotive

9-79. All diesel-electric locomotive frames are designed to be supported at the bolsters. These frames can be strained or bent if the span between lifting points is too great. This is true whether the lifting slings are attached to the lifting lugs, couplers, or jacking pads. Any commercial-type EMD locomotive can be lifted at the extreme end (coupler hitch) if the other end is supported at the bolster. Military railway switcher type locomotives should be lifted only by the lugs. The special lifting bars and lugs are designed only for vertical lifting and should not be used to slide the locomotive.

Truck Centerplates

9-80. When only one end of a diesel-electric locomotive is to be lifted, place blocking between the truck and frame on opposite ends to prevent cracking the centerplates between the truck and bolster. The trucks are designed so that one end of the locomotive can be dropped below the rail height without damaging the liners on the truck remaining on the rail (as in simple derailments). If the derailed end is lifted excessively high, the liners are susceptible to damage. The clearance provided is enough to take care of normal deflections; but during rerailing, it is mostly absorbed by the deflection of the truck springs. Wreckmasters and crane operators must not lift one end of a locomotive more than 6 inches above the rail, unless the other end is lifted enough to separate the centerplates on its truck and bolster.

Lifting Lugs

9-81. All EMD road switches equipped with lifting lugs on each side of frame bolsters. These lugs are designed to permit wire rope slings to be directly attached to the bolsters. When rerailing this type of locomotive, slings should have a minimum hook-to-rail clearance of 17 feet (Figure 9-15). Under normal conditions, two slings and a lifting bar are used on each end of the locomotive. In an emergency (and if properly blocked) one end of a switcher (up to 125-tons) may be lifted at the coupler.

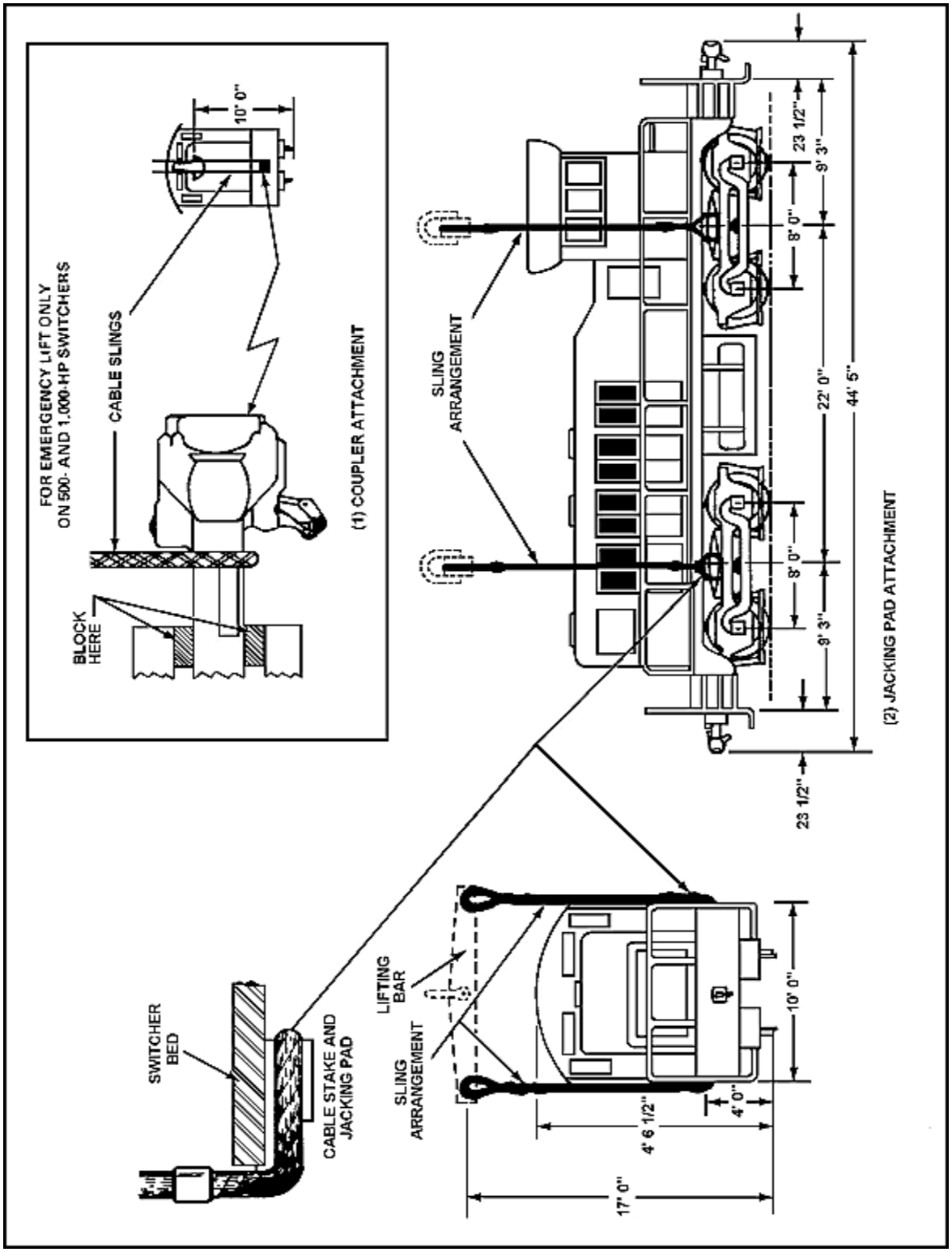


Figure 9-15. Methods of Lifting EMD Road Switcher Locomotive

Simple Derailment

9-82. Use the following procedure in simple derailments involving only one truck and when the locomotive is upright.

- Rerail locomotive by using rerailers if available and when practicable.
- Use spreader bar and two wire rope slings of adequate strength if available.
- Use two slings if the locomotive is equipped with lifting lugs. No lifting beam is necessary.
- Use sling and coupler hitch on locomotives equipped with a standard coupler locomotive if locomotive is not equipped with lifting lugs, or if the lift cannot be made from one side, or if the wreck crane cannot reach the bolsters. The coupler must be blocked as shown in Figure 9-15. If it can be avoided, never use a coupler hitch on any locomotive equipped with a retractable coupler.

Truck Removal

9-83. EMD locomotive frames are strong enough to permit lifting operations with the trucks attached as long as one end is supported at the bolster. However, truck removal may be required under certain wreck conditions. EMD freight and switcher locomotives in the Army fleet use two 4-wheel or two 6-wheel pedestal-type trucks. As preliminary steps, these trucks may be removed from the locomotive by disconnecting brakes, sander hoses, airlines, and traction motor leads. Depending on the locomotive type, the 4-wheel trucks are disconnected by removing three to five holding bolts. Removing these bolts frees the truck locks from the body bolster and side bearings. Free 3-wheel trucks, such as those on the EMD-military railway switcher (MRS-1), by removing the two nuts and bolts that secure each side-bearing clip and then removing the clips. Locomotive frames must be raised a minimum of 6 inches for sideways removal and 27 inches for endways removal.

American Locomotive-General Electric Diesel-Electric Locomotives

9-84. The frames of ALCO-GE locomotives, even though specially braced, are designed to be lifted at the bolsters. Lifts closer to the ends of passenger locomotives may cause excessive stresses if the trucks are attached at the time of lift. Road switcher locomotives with trucks attached can normally be lifted at designated lifting points (Figure 9-16). Lifting eyes are designed only for vertical lifts. When necessary to drag or roll the locomotive, the sling should be attached at the center of the truck.

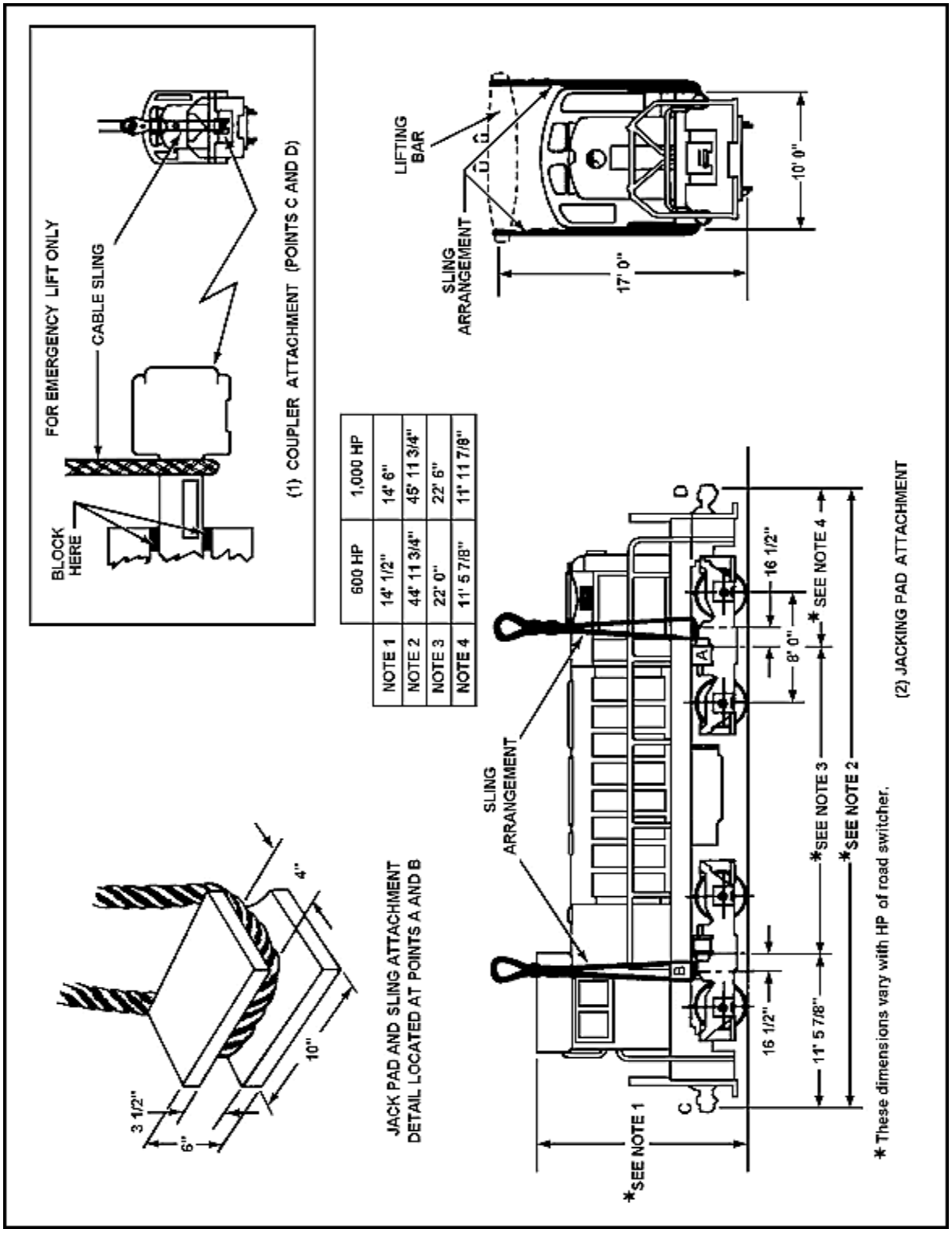


Figure 9-16. Jacking Pad and Lifting Lugs, ALCO-GE Locomotive

Truck Centerplates

9-85. When lifting only one end of an ALCO-GE locomotive, the same precautions must be taken as when lifting the EMD locomotive. Refer back to paragraph 9-80 on how to lift the EMD locomotive.

Lifting Lugs

9-86. ALCO-GE road switchers are equipped with combination jacking pads and lifting lugs attached to the frame on the body bolster (Figure 9-16). Methods of attaching cable slings for lifting are also shown. If no other hitch is available, the coupler hitch could be used as an emergency lift for all classes of ALCO-GE locomotives.

Simple Derailment

9-87. The recommended lifts, when one or both trucks are derailed and the locomotive is upright and close to the rail, are shown in Figure 9-16. Slings, rather than rerailing devices (irons), are used to lift ALCO-GE locomotives. The gear case or the gear of the driving axles could crack when using rerailing devices. Do not use the coupler for lifting because of the danger of springing the coupler and, more importantly, seriously springing the frame and buckling the cab. Another disadvantage of the coupler lift is the extreme care required in preventing damage to the centerplates on the end of the truck that is not being lifted. When a coupler lift must be used, the truck on the lifted end should be disconnected. The coupler should be blocked and the sling placed as close to the body as possible.

CAUTION: UNDER NO CIRCUMSTANCES SHOULD COUPLER LIFT BE ATTEMPTED ON BOTH ENDS AT THE SAME TIME. NOT ONLY WILL THE FRAME BE SPRUNG, BUT IT IS ALSO VERY LIKELY THAT THE LOCOMOTIVE WILL ROLL OVER.

Truck Removal

9-88. With the exception of certain extreme lifts, the frames of ALCO-GE road switchers are strong enough to permit rerailing without removing the trucks. Truck removal may be necessary under certain conditions because of limited crane capacity or to lighten the weight of the lift. ALCO-GE locomotives in the Army fleet include both 4-wheel and 6-wheel trucks. In either case, traction motor leads, air lines, sander pipes, brake rods, and any truck safety chains must be disconnected. The 4-wheel trucks are disconnected from the locomotive frame by removing the four bolts used to hold the truck locks in place. Removing these bolts allows the lock to disengage from the side bearings. ALCO-GE passenger locomotives (none in the Army fleet) are equipped with 6-wheel trucks. Truck locks on 6-wheel trucks are held in place by a bolt, which passes through the lock and engages three locking lugs on the body bolster. Removing the two bolts allows the locks to swing free. The ALCO-GE-MRS-type, 1,600-HP, multi-gauge, road switcher, 6-wheel truck does not have these locks. Disconnecting the service appliances and safety hooks frees the truck from the frame.

INSPECTION AFTER RERAILING

9-89. Inspect the diesel-electric locomotive or car trucks after they are rerailed before lowering the locomotive or car body onto the truck. Perform the following when inspecting the locomotive or car truck.

- Raise journal box lids.
- Ensure that wedge and brass are in place.
- Ensure that truck springs are aligned.
- Examine journal lubricator or packing. Add any needed oil, then close box.
- Inspect brake rigging and bolster for loose or dragging parts.

Track Restoration

9-90. The preliminary report of a wreck or derailment given to the dispatcher includes an estimate of how much track is torn up (in rail lengths) and the extent of the damage. The dispatcher relays this information to the maintenance of way superintendent for his planning. The maintenance of way superintendent alerts the section foremen (in the required numbers) to assemble their crews, tools, and equipment at the wreck site or at a prescribed rendezvous point where they can be transported by the wreck train. Ballast, rails, ties, and so forth, are usually available at emergency roadside stockpiles to supplement the limited quantity of track repair materials carried on the wreck train.

9-91. The transportation railway engineering company, maintenance of way section crews can begin to remove debris, any spilled car lading, and damaged crossties and rails as soon as the wreck cranes clear away damaged equipment. Ballast is raked, leveled, and replaced as necessary for a firm roadbed. New ties and new rails are laid, connected, gauged, and spiked. To expedite the start of traffic, spiking may be temporarily limited to every other tie plate, and only two bolts, hastily tightened, placed in angle bars. Moving trains over such hastily repaired sections is controlled by "slow orders" issued by the dispatcher. Surfacing and lining is also limited initially to the minimum standards required for safely moving trains at slow speeds. Complete ballasting, bolting, lining, spiking, and surfacing can be done after the congestion has been cleared, the wrecked equipment removed, and the line opened.

Restoring Communications

9-92. Derailed cars can break off or knock down telephone and telegraph poles. This can cut division wire communications. It may be necessary during recovery operations to cut these lines or remove poles to permit wreck crane booms necessary clearance. In such cases, personnel of the communication and railway signal maintenance platoon, transportation railway engineering company, repair the circuits as soon as possible to enable the division dispatcher to communicate with way stations. When derailments occur in interlocking plant territory, railway signal maintenance section personnel make the necessary repairs to the interlocking system.

Chapter 10

Rail Planning

Rail planning consists of determining what type of rail system is needed. It also includes what type of services will be used and who will use and maintain the rail system.

RAILWAY INTELLIGENCE

10-1. Rail line and equipment planners and operators, either before or after entry into the theater of operation, should gain as much information as possible on the rail system that they will be using for operations. The following is a sample listing of information that they should maintain for operation.

- Types of locomotive. Their manufacturer, model, horsepower number, gauge, mechanical condition, and if spare parts are available in area of operation.
- **Types of rolling stock.** Numbers, loading limits, repair condition, part availability, and distribution within the system.
- **Signal system.** Type, automation (if any), state of repair, and effectiveness.
- **Track structure.** Size and type of rails, condition of crossties, rail and ballast, washout and rockslide potential, number of single and double main lines, and the availability of sidings or passing tracks.
- **Layout of system.** Branch lines, grades, curves, bridges, tunnel and clearance limitation (both height and side clearance).
- **Methods of operation.** Fleet, block, or automation method. A very good system of electronic communication must exist and be put to use by the rail system.

Other matters concerning railway intelligence may be found in Chapter 3.

RAIL OPERATIONS PLANNING

10-2. Staff and planning functions for theater rail operations are the responsibility of the commander of the highest echelon of the unit in the theater. The railway plan that is developed is integrated into the overall movements plan for the theater. Selected personnel of the transportation railway battalion obtain the most detailed intelligence data through reconnaissance of captured or liberated rail lines, with augmentation by personnel from higher echelon rail units. Railway battalion commanders, who have been assigned a division of rail line, conduct a reconnaissance of their respective rail divisions and gather intelligence data. They then make estimates of the time required to get the line operational and the capacity or net tonnage that can be moved over the line. All intelligence information collected and plans and estimates formulated are forwarded to the next command level. Here all the information and estimates from the battalions are consolidated to form the transportation rail plan. The planner must make assumptions based on the information he has and on past rail operations experience if the required information is not available or cannot be easily obtained. The following are some important items a planner should consider:

- The strategic importance and selection of certain rail lines. Planned strategy attack, probable objective of the operation, lines of advancement, and enemy strengths and dispositions all influence the selection of primary and alternate rail lines.
- Details shown on maps and photographs (such as the rail routes, the number and location of railway facilities, and the number and kind of structures).
- A general description of the rail system (its facilities and its equipment). These descriptions help the planner to determine the potential capacity of the system and the importance of the system in the economic structure of the country in which it is located. Descriptions should also give information about the ownership of the railroad, its general operating procedures, and its organization.
- Detailed basic characteristics of routes, facilities, equipment, structures, and operations. These details help the planner to estimate a more accurate rail capacity. Intelligence data should include details on such items as right-of-way, roadbed, and track; types and amount of equipment; supply and maintenance factors such as spare parts, enginehouse facilities, and fuel and water stations; and availability of personnel.
- Types of gauges and classification of railways in the area. General gauge classifications are standard, broad, narrow, and meter. For defensive reasons, neighboring countries often do not construct railways having the same type of gauge. Such a precaution ensures that one gauge does not operate on another.

10-3. The planner must also consider physical features of the area when selecting railways. Considerations include the following:

- **Adequate yards, terminals, and shop facilities.** Without adequate yards and terminals, main lines become congested. Terminal yards should have sufficient track for receiving trains, classifying cars, and making up trains for departure. Tracks should be long enough to receive the longest train (without dividing it into segment(s)) intended to operate on that rail division. Facilities are needed to spot cars, unload them, and promptly return the empties to service. A terminal should include an enginehouse; car repair tracks; fuel, lube, sanding, and water stations; and buildings to house crews of the railway battalion. The heavy repair and maintenance of rail equipment require adequate shops located at or near yards and terminals.
- **Single, double, or multiple tracks.** Train density and overall rail capability are greatly affected by the type and number of tracks. If there is a usable double track, trains may operate in both directions without delays in schedules. However, the unit often takes the usable parts of a damaged double track to make one single main line with good passing tracks.
- **Seasoned roadbed, good ballast, and heavy rail.** The roadbed, ballast, and weight of the rails affect the speed and weight of trains. If the railway with the most seasoned roadbed, the best ballast, and the heaviest rail is selected, the number of interruptions in train operations caused by washouts and buckled rails are generally reduced.
- **Slight grade and curve.** Trains operated in mountains with steep grades require more motive power. Steep grades usually require pusher engines at the rear of a train, two or more locomotives pulling or doubleheader at the front of a train, or shorter trains. Train operations in mountainous terrain also reduce the train's speed. Strong pulling and sudden braking are hard on railcars and sometimes cause derailments. These cars require more maintenance than those used on fairly level grade.

- **Running time.** Running time is greatly increased if the line has sharp or long curves. A speed that can be reached on a straight run of track cannot be maintained on a curved track. The ideal railway, with no grades and no curves, is never realized. However, the rail lines with the slightest grade and the fewest, gentlest curves should be selected.
- **Adequate sidings and spurs.** Passing tracks should be long enough to permit the longest train on the division to be able to completely clear the main-line track. Sidings and spurs are desirable, but they are not a major basis in selecting rail lines.
- **Strong bridges and tunnels of sufficient clearance.** The strength of railway bridges directly affects the kind of locomotives operated over them. If bridges must be rehabilitated or constructed, they must be strong enough to support the locomotive and the desired train weight. Any tunnels on the railway should have enough clearance for wide and high loads (such as bulldozers and cranes) to pass.

10-4. When selecting rail lines, care must be taken to select those that are the least vulnerable to traffic interruption. The following are some potential bottlenecks, which are vulnerable to enemy action or natural forces.

- Tunnels.
- Long, high bridges or bridges over deep streams or valleys.
- Deep cuts and high fills.
- Limited access terminals or yards.
- Tracks located adjacent to banks of streams. These tracks are subject to the erosive action of flood waters.
- Restrictive clearance points. Tracks running through cuts where land and rock slides are common.

LINE CAPACITY PLANNING

10-5. While most military supply movements are primarily forward, military rail-line capacity estimates are usually based on net tonnage moving in one direction. However, total capacity is based on train density and must take into consideration movements of the train in both directions. When the railway net under consideration is made up of several divisions and/or branch lines, separate estimates should be made for each rail division and branch line. Use the following factors, formulas, and computations for planning considerations. Since locomotives are prime power units, their hauling capabilities must be established. Therefore, to establish a locomotive's pulling power, certain factors must be computed. The factors used are for initial planning and worse case situations. Once implemented, or if intelligence data permits, plans may be modified.

Tractive Effort

10-6. Tractive effort is a measure of the potential power of a locomotive expressed in pounds. It is the horizontal force that a locomotive's wheels exert on a straight, level track just before the wheels will slip on the rails. A locomotive's tractive effort is included in the data supplied by the manufacturer. Where such data are not available, tractive effort may be determined as described in paragraphs 10-7 and 10-8.

Starting Tractive Effort

10-7. The power exerted by a locomotive to move itself and the load that it is hauling from a dead stop is STE. It is correlated closely to the adhesion that the driving wheels maintain at the rails. If the tractive effort expended exceeds this adhesive factor, the driving wheels will slip. Normally, the adhesion factor when the rails are dry is 30 percent of the weight on drivers. When the rails are wet, this factor is reduced to 20 percent. However, for planning purposes, 25 percent is used. For a diesel-electric locomotive weighing 80 STONs or 160,000 pounds on the driving wheels, the STE is computed as follows:

$$\text{STE} = \frac{\text{Weight on drivers (pounds)}}{\text{25 percent adhesion factor}} = \frac{160{,}000 \text{ pounds}}{4}$$

$$\text{STE} = 40{,}000 \text{ pounds}$$

Continuous Tractive Effort

10-8. CTE is the effort required to keep a train rolling after it has started. As the momentum of a train increases, the tractive effort necessary to keep the train moving diminishes rapidly. The CTE of a diesel-electric locomotive is approximately 50 percent of its STE. The locomotive cannot continue to exert the same force while pulling a load as was attained in starting that load. The CTE of a diesel-electric locomotive weighing 80 STONs or 160,000 pounds on the driving wheels is computed as follows:

$$\text{CTE} = \frac{\text{STE}}{2} = \frac{40{,}000 \text{ pounds}}{2}$$

$$\text{CTE} = 20{,}000 \text{ pounds}$$

Drawbar Pull

10-9. Drawbar pull is the actual pulling ability of a locomotive after deducting from tractive effort, the energy required to move the locomotive itself. In planning, 20 pounds per ton of total locomotive weight is taken from the tractive effort as follows:

Total locomotive weight = 80 STONs

80 X 20 = 1,600 pounds

CTE – 1,600 pounds = DBP or $\text{STE} = \frac{160{,}000}{4} = 40{,}000$

$\text{CTE} = \frac{40{,}000}{2} = 20{,}000$ $\text{DBP} = 20{,}000 - 1{,}600 = 18{,}400$ pounds

10-10. Maximum DBP can be exerted only at lower speeds (up to about 10 miles [16 kilometers] per hour) and for a limited length of time. At higher speeds, diesel-electric locomotive DBP diminishes rapidly because the electric generator and traction motor cannot hold up under the heavy starting voltage and amperage. The generator and motor would also burn out if the load continued for a longer time after the locomotive reached a speed of 10 MPH.

Rolling Resistance

10-11. The force components acting on a train in a direction parallel with the track which tend to hold or retard the train's movement constitute rolling resistance. The following are the components of RR:

- Friction between the railheads and the treads and flanges on the wheels.
- Resistance due to undulation of track under a moving train.
- Internal friction of rolling stock.
- Resistance in still air.

Although there is no absolute figure to be used as RR, Table 10-1 shows the safe average values to use in a theater of operations.

Grade Resistance

10-12. Grade resistance is the resistance offered by a grade to the progress of a train. It is caused by the action of gravity, which tends to pull the train downhill. In military railway planning, use the factor of 20 pounds multiplied by the percentage of GR.

Curve Resistance

10-13. Curve resistance is the resistance offered by a curve to the progress of a train. No complete satisfactory theoretical discussion of CR has been published. However, engineers in the US usually allow from 0.8 to 1 pound per ton of train per degree of curve. In military railway planning, use the factor of 0.8 pounds multiplied by the degree of curvature.

Table 10-1. Safe Average Values

Track Condition	Average Value
Exceptionally good	5
Good to fair	6
Fair to poor	7
Poor	8
Very poor	9 and 10

Weather Factor

10-14. The weather factor reflects, by percentage, the adverse effect of cold and wet weather on the hauling power of a locomotive. Experience and tests has proven that whenever the outside temperature drops below 32 degrees Fahrenheit, the hauling power of a locomotive is decreased. Table 10-2, page 10-8, shows the weather factor (percent) for varying degrees of temperature.

10-15. Wet weather is usually regarded as local and temporary and is considered absorbed by average figures. However, in countries having extended wet seasons (monsoons, fog, and so forth), the loss of tractive effort due to slippery rails may prove serious if sanding facilities are lacking or inadequate. The applicable reduction is a matter of judgment. However, in general, tractive effort will not be reduced to less than 20 percent of the weight on drivers.

Table 10-2. Effect of Weather Upon Hauling Power of Locomotives

Most adverse temperature (°F)	Loss in hauling power (percent)	Weather factor (percent)
Above +32	0	100
+16 to +32	5	95
0 to +15	10	90
-1 to -10	15	85
-11 to -20	20	80
-21 to -25	25	75
-26 to -30	30	70
-31 to -35	35	65
-36 to -40	40	60
-41 to -45	45	55
-46 to -50	50	50

Gross Trailing Load

10-16. Gross trailing load is the maximum tonnage that a locomotive can move under given conditions (for example, curvature, grade, and weather). When diesel-electric locomotives are operated in a multiple unit operation, the GTL is equal to the sum of the GTL for all locomotives used. However, when the locomotives are not electrically connected for multiple unit operation, deduct 10 percent of the total GTL for the human element involved. Determine GTL by combining the factors discussed in the preceding paragraphs and using the following formula:

$$GTL = \frac{DBP \times WF}{RR + GS + CR}$$

Where–
GTL = gross trailing load
DBP = drawbar pull
WF = weather factor
RR = rolling resistance
GR = grade resistance
CR = curve resistance

10-17. Obtain the GTL by actual test for foreign or captured locomotives (for which little or no information is available) as quickly as track and cars become available.

Net Trainload

10-18. Net trainload is the payload carried by the train. The total weight of the cars under load is gross weight. The lightweight, or weight of empty cars, is tare. The difference between gross weight and tare is the NTL (payload) of the train. For military railway planning purposes, the NTL is 50 percent of the GTL. The formula is computed as follows: NTL = GTL X .50.

Train Density

10-19. The number of trains that may be operated safely over a division in each direction during a 24-hour period is known as train density. Work trains are not included in computing TD. However, their presence on divisions and the amount of time they block the main track can reduce the density of a rail division. TD may vary greatly over various divisions depending on the following:

- Condition and length of the main line.
- Number and locations of passing tracks.
- Yard and terminal facilities.
- Train movement control facilities and procedures.
- Availability of train crews, motive power, and rolling stock.

10-20. On single-track lines, passing tracks generally are 6 to 8 miles (10 to 13 kilometers) apart. Multiple tracks (three or more) generally are considered as double track, since it is often necessary to remove a portion or all of the third and fourth tracks to maintain a double-track line.

10-21. The capacity or operating turnover of cars and trains into and out of terminal yards must be considered, either from definite experience and intelligence factors or by inference from related information.

10-22. The rule-of-thumb and the formula for determining single track are designed primarily to determine freight train density. Both are reasonably accurate on lines over which passenger trains do not exceed 20 percent of the traffic.

Rule-of-Thumb for Determining Train Density

10-23. If enough information is not available to evaluate the potential train density of a rail line, a train density of 10 for single track and 15 for double track in each direction is used for planning.

Formula for Determining Single Track

10-24. If enough information is available, the following formula is used to determine train density for a specified railway division. In determining the number of passing tracks, do not include those less than 5 miles (8 kilometers) apart. Passing tracks should be uniformly spaced throughout the division.

$$TD = \frac{NPT + 1}{2} \times \frac{24 \times S\,2}{LD}$$

Where– TD = train density.
NPT = number of passing tracks.

1 = constant (number of trains that could be run if there were no passing tracks).
2 = constant to convert to each direction.
24 = constant (number of hours per day).
S= average speed (Table 10-3).
LD = length of division.

When the computation for train density results in a fraction, the result is raised to the next higher whole number.

Net Division Tonnage

10-25. Net division tonnage is the tonnage in STONs, or payload, which can be moved over a railway division each day. NDT includes railway operating supplies that must be programmed for movement. The formula for NDT is: NDT = NTL X TD. Compute NDT separately for each division.

End Delivery Tonnage

10-26. In military operations, the end delivery tonnage is the through tonnage, in STONs, of payload that may be delivered at the end of the railway line (railhead) each day. In an all-rail movement, the EDT equals the NDT of the most restrictive division.

Table 10-3. Determining Average Speed Value

		Average speed			
Condition of track	Percent of grade	Single track (mph)	(kph)	Double track (mph)	(kph)
Exceptionally good	1.0% or less	12	19.3	14	22.5
Good to fair	1.5% or less	10	16.1	12	19.3
Fair to poor	2.5% or less	8	12.9	10	16.1
Poor	3.0% or less	6	9.6	8	12.9

Notes:

1. The most restrictive factor governs the speed selected.

2. Consider the following, when using the table for average speed factor.

a. If the condition of track and/or the percent of grade are not known, use an average speed value of 8 MPH for single track and 10 MPH for double track.

b. Where the most restrictive factor occurs for a comparatively short distance--that is, less than10 percent of the division--use the next higher speed.

c. Where average speed falls below 6 MPH because of the grade lines, reduce the tonnage to increase speed (2 percent reduction in gross tonnage will increase speed 1 MPH).

YARD CAPACITY DETERMINATION

10-27. The capacity of the yard needs to be determined based on planning factors and planning formulas. The following describes the planning factors and planning formulas for classification yards.

Also described below are the planning factors for terminals with and without receiving and forwarding yards.

Planning Factors for Classification Yards

10-28. The following factors are based on day and night operations and may be used for planning purposes. Where two or more main line railways intersect at a major terminal, the facilities will have to be duplicated accordingly.

10-29. Flat switching capacity is 30 cars per locomotive per hour. This includes time for switch engines to push cars into the yard (based on foreign equipment). Hump switching capacity is 45 cars per locomotive per hour.

10-30. The numbers of cars, at any given time, in a classification yard should not exceed 60 percent of the yard's capacity. When cars exceed yard capacity, switching room decreases and operating efficiency is sacrificed.

10-31. Length of track in a classification yard generally is one train length, plus 20 percent, plus 300 feet (91 meters). Track and/or train length varies with local terrain characteristics and railway equipment and requirements.

10-32. Depending on the yard layout, the number of switch engines per shift that may be employed in the operation of the loaded freight classification yard may vary from one to three. Therefore, one switch engine may handle 30 to 60 cars per hour and three switch engines may handle 90 to 180 cars per hour. Functions for switch engines include the following:

- One switch engine at the head of the receiving yard, preparing cut of cars for switching.
- One switch engine switching cut of cars into the classification yard.
- One switch engine at the opposite end of the classification yard, coupling cars and making switching room.

During slack traffic periods, one switch engine may be used for all functions above. The switch engine functions above are also used in the classification yard proper and do not include those engaged in supporting other terminal operations.

10-33. The average time a car remains in the classification yard is 8 hours. Classification yard traffic changes an average of three times per day. (Some cars may be held 48 hours; others may clear in less than 8 hours.)

Planning Formulas for Classification Yards

10-34. You may use the following formulas to determine classification yard requirements and capabilities.

- Determine the required length of yard tracks using the following:

LT = ACT X LC X 1.2 + 300 feet (91 meters)

Where– LT = length of track.
ACT = average cars per train.
LC = average length of car.
1.2 = operational factor (to allow for overall length of car coupler rather than car length).
300 feet = clearance distance at each end of track from point of switch to clearance.

- Determine the minimum number of tracks using the following:

$$NTR = \frac{TDs}{3} \times 1.6$$

Where– NTR = number of tracks required.
TDs = sum of train densities of using divisions
3 = turnover per day.
1.6 = 60-percent factor of static capacity.

When computing requirements for a terminal yard, the result obtained in this formula must be doubled. The formula does not necessarily apply to railheads since classification of cars is not always necessary at railheads.

- Determine static yard capacity using the following:

$$SYC = ACT \times NT$$

Where– SYC = static yard capacity (in cars).
ACT = average cars per train.
NT = number of tracks of the length determined in paragraph 10-34, first bullet.

Daily yard capacity is equal to 1.6 times SYC. This figure takes into account that the number of cars in a yard at any given time will not exceed 60 percent of the static capacity.

Planning Factors for Terminals With and Without Receiving and Forwarding Yards

10-35. The following factors are based on how trains are moved in the terminal. These factors may be used for planning purposes.

With Receiving and Forwarding Yards

10-36. Where trains are operated into and out of terminals at 48-minute intervals, there should be a minimum of six tracks plus one runaround track in both the receiving and forwarding train yards to handle empty and loaded trains. In general, the number of tracks required equals the train density divided by 5, plus 1.

$$NT = \frac{TD}{5} + 1$$

Without Receiving and Forwarding Yards

10-37. Normally, receiving and forwarding train yards will be in balance with classification and main line capacity. However, some railways dispense with receiving and forwarding yards and operate all trains directly into and out of classification yards. In such cases, the classification yard's daily capacity is reduced by approximately 25 percent.

Two-Wall Tonnage Traffic in Terminals

10-38. Where there is two-way tonnage traffic in large terminals, the various yards are normally designed with yards for each direction. For example, northbound receiving, classification; forwarding yards and southbound receiving, classification; and forwarding yards.

RAILWAY EQUIPMENT REQUIREMENTS

10-39. Availability of equipment in liberated or occupied territory depends upon inventories, extent of destruction, condition of equipment, types of fuel and local availability of repair parts, types of coupling devices, and many other such factors. Base allowances, for use of captured or locally available equipment, on judgment after evaluation of the many factors involved. Technical data concerning railway equipment may be found in strategic surveys, special transportation studies based on intelligence reports, reports of governments or railways in peacetime, and sometimes in publications such as Railway Gazette (British) and Railway Age (American). The categories of equipment requirements considered when planning are as follows:

- Rolling stock, consisting of boxcars, gondolas, flatcars, tank cars, refrigerator cars, and hopper cars.
- Road engines, the motive power used to pull trains between terminals or division points.
- Switch engines, the motive power used to switch cars within yards or at division terminals.

Step-by-step procedures for determining railway equipment requirements are given in Appendix B.

Rolling Stock

10-40. There are three classes of railway rolling stock. These classes consist of freight, passenger, and special.

Freight

10-41. Compute requirements separately for operations between major supply installations or areas on each rail system. Use the following formula to compute requirements.

$$\text{Total cars Required} = \frac{\text{EDT (by type car)}}{\text{Average payload for type car}} \times \text{TAT} \times 1.1$$

Where– EDT = end delivery tonnage.
TAT = turnaround time.

10-42. Obtain the first factor of this formula from that part of the computation for 1 day's dispatch which determines the number of cars required by type to transport all or a given portion of the EDT of a rail system (see Appendix B, third computation).

$$\text{l DD} = \frac{\text{EDT (by type car)}}{\text{Average payload for type car}}$$

10-43. The number of cars dispatched in a day from the base of operations is 1 day's dispatch. For planning purposes, the number of cars dispatched from a division terminal, railhead, or other dispatch point is considered the same as the number dispatched from the base of operations. Use the formula shown in paragraph 10-42 to determine the rolling stock for 1 day's dispatch. Computations are made for each type of car to be used (boxcars, gondolas, and/or flatcars) and the sum of the results for all types of cars that are computed are 1 day's dispatch for the system (see Appendix B, third computation).

10-44. Turnaround time is the estimated number of days required for a car to make a complete circuit of the rail system. It is the days elapsed from the time the car is placed at the point of origin for loading until it is moved to its destination, unloaded, and returned to its point of origin. Time may be computed as follows: 2 days at origin, 1 day at destination, and 2 days in transit (1 day forward movement, 1 day return movement) for each division or major portion of each division which the cars must traverse. This method, rather than an actual hour basis, is used to incorporate delays due to terminal and way station switching as well as in-transit rehandling of trains.

10-45. The 1.1 factor is used to express a 10-percent reserve factor. The reserve factor provides for extra cars to meet operational peaks, commitments for certain classes of cars, and bad-order cars (cars needing repair).

10-46. Compute planning factors for net load per freight cars by using 50 percent of the rated capacity for all freight cars except tank cars. Tank cars are rated as carrying 100 percent of their capacity.

10-47. Compute tank car requirements separately based on bulk POL requirements, tank car capacities, and computed turnaround time. The disposition of rolling stock for the operation of a railway system is shown in Table 10-4, page 10-16.

Table 10-4. Disposition of Rolling Stock

Disposition	Rolling Stock Required
At base of operation	2 day's dispatch
Forward traffic	1 day's dispatch per division
Return traffic	1 day's dispatch per division
At the railhead	1 day's dispatch

Passenger

10-48. Passenger car requirements vary depending on troop movement policies, evacuation policies, and rest and recuperation policies. Theater passenger car requirements normally are fulfilled by acquisition of local equipment with the exception of equipment required for hospital cars or trains.

Special

10-49. Special equipment is that equipment used exclusively by the railroad for its own use. This type of equipment includes maintenance of way equipment, work cranes, snow removal equipment, locomotives, and so forth.

Road Engines

10-50. You may determine the number of road engines required for operation over a given railway division by the following formula:

$$\text{Road engines Required} = TD \times \frac{(RT + TT)}{24} = X\ 2\ X\ 1.2$$

Where–

- TD = train density.
- RT = running time (length of division divided by average speed).
- TT = terminal time (time for servicing and turning locomotive is 3 hours for diesel-electric locomotives and 8 hours for steam locomotives).
- 24 = number of hours per day.
- 2 = constant for two-way traffic.
- 1.2 = constant allowing 20-percent reserve.
- $\frac{(RT + TT)}{24}$ = engine factor (time during a 24-hour period in which a road engine is in service). The engine factor provides for motive power, which may make more than one trip per day over a short division.

Switch Engines

10-51. No two ports, divisions, or terminal railheads are alike in design or operation. However, the functions of the main yards in each are essentially the same. Receiving cars, classifying, and reassembling them for delivery or forward movement constitutes the main functions of any yard. The switch engine is the type of motive power used for these operations.

10-52. The number of switch engines required at a terminal is based on the number of cars dispatched and received at, or passing through, the terminal per day. When the number of cars has been computed, apply that figure to the factors shown in Table 10-5 to determine the number of switch engines required at each terminal.

10-53. When the total number of switch engines required for the railway line has been computed, 20 percent is added as a reserve to allow for maintenance, operational peaks, and so forth (see Appendix B, fourth computation).

Table 10-5. Switch Engines Required

Location	Switch Engines Required
Port or loading terminal	1 per 67 cars dispatched and received per day
Division terminals	1 per 100 cars passing per day
Railhead or unloading terminals	per 67 cars dispatched and received per day

PERSONNEL AND UNIT REQUIREMENTS

10-54. Requirements for rail units and personnel are based on the following:

- Number of divisions in the system. This provides a guide in determining the number of battalions required for operation.
- Number of train operating crews required to operate road and switch engines. This provides a guide to determine the number of train operating companies required in the system.
- Maintenance requirements for right-of-way, locomotives, and rolling stock. This provides a guide to determine the number and type of maintenance units and personnel required.

On the basis of these factors, you can use unit and organizational capabilities and normal employment procedures to organize a command structure and to determine support requirements.

Road Crews

10-55. In computing the number of road crews required for each division, preparation time is included. Preparation includes the following:

- A 2-hour period at the originating terminal for the crew to receive orders and instructions, test the air, and check the train.
- Running time involved, which is computed by dividing the length of the division by the average speed of the train. If information is not available to compute the speed, the speed may be assumed to be 10 miles per hour. Normally, running time over a division will be about 12 hours.
- A 1-hour period at the final terminal to submit necessary reports.

10-56. To allow enough time for the crews to rest, the running time normally does not exceed 12 hours. Although experience shows that safety and efficiency decrease when crews work continuous daily shifts of more than 12 hours, this time can be exceeded in emergencies. However, it is possible to work shifts of 16 to 18 hours, if the crews have enough rest periods before reporting for another run. Sometimes it will be necessary to designate longer hours because of the length of the division involved. In such cases, enough time off between runs should be permitted to limit the average daily shift to 12 hours.

10-57. When determining the number of road crews needed per division use the following formula (see fifth computation, Appendix B).

$$\text{Number of road crews} = TD \times 2 \times \frac{(RT + 3)}{12} \times 1.25$$

Where–
- TD = train density.
- 2 = factor to convert to two-way traffic.
- RT = running time (length of division divided by average speed).
- 3 = 2 hours allowed for preparation at originating terminal, plus 1 hour at final terminal.
- 12 = 12-hour shift per road crew per day.
- 1.25 = constant factor to allow for ineffectives.

Switch Crews

10-58. To determine the number of switch crews required, the number of switch engines in use at each terminal must be known. Two crews are required per switch engine per day. Use the following formula to determine the number of switch crews required for each terminal (do not compute crews for reserve switch engines) (see fifth computation. Appendix B):

Number of switch crews = SE X 2 X 1.25.

Where–
- SE = number of switch engines.
- 2 = crews per engine.
- 1.25 = constant factor to allow for ineffectives.

SUPPLY REQUIREMENTS

10-59. Railway supply tonnages are normally quite large. Planners, when computing EDT, should ensure that all concerned persons understand that supply tonnage must be deducted from EDT to arrive at the actual figure that will be delivered to the units at the railhead. The following paragraphs discuss the method of arriving at specific supply requirements for fuel, lubricants, and repair parts.

Fuel Consumption of Diesel-Electric Locomotives

10-60. Table 10-6, page 10-16, contains an estimated average rate of diesel fuel oil consumption in gallons per train-mile for diesel-electric road locomotives and in gallons per hour of operation for switch engines. For planning purposes, the operation of switch engines is assumed to be 20 hours per day. The method of determining fuel oil requirements in gallons for road locomotives and switch engines is as follows:

10-61. The following is the method of determining fuel oil requirements, in gallons, for road locomotives:

- Multiply the train density of the first division by 2 (for two-way travel), then multiply the result by the length of the division. This result is the train-miles per day for the division.
- Repeat this procedure for each division of the system.
- Total the daily train-miles for all divisions.

- Multiply the total daily train-miles by the fuel consumption factor to obtain the daily fuel requirement.
- Multiply the daily fuel requirement by 30 to obtain the monthly fuel requirement.
- Add 5 percent to this computed total to provide a reserve for contingencies.

Table 10-6. Fuel Requirements for Diesel-Electric Locomotives

		Estimated Average Rate of Fuel Oil Consumption	
Type of Locomotive	Type of Operation	Gallons Per Train-Mile	Gallons Per Hour
*Standard gauge:			
0-6-6-0, 120-ton	Road switcher	2.5	11.5
0-4-4-0, 50-ton	Road switcher	.9	8.0
*Narrow gauge:			
0-6-6-0, 80-ton	Road switcher	1.5	10.0
0-4-4-0, 48-ton	Road switcher	.9	8.0
*When computing fuel requirements and the table does not provide for an engine wheel match and/or tonnage match, the next largest wheel/tonnage figure should be used.			

10-62. The following is the method of determining fuel oil requirements, in gallons, for switch engines:

- Multiply the total number of switch engines required (do not include reserve engines) by 20 to determine the total hours per train-day of operation.
- Multiply the total hours per train-day of operation by the fuel consumption factor of the engine concerned (Table 10-3). This result is the daily fuel requirement in gallons.
- Multiply the daily fuel requirement by 30 to obtain the monthly fuel requirement.
- Add 5 percent to this computed total to provide a reserve for contingencies. When coal is the fuel, use a reserve factor of 10 percent.

Lubricants

10-63. Use lubricants on all moving parts of railway tools, appliances, machinery; and on all motive power and rolling stock. For planning purposes however, only the lubricants necessary for the operation of motive power and rolling stock are based on an estimate of 1,000 pounds per month for each train moving in either direction over each division in one day. Use the following method to determine the amount of lubricants required:

- Multiply the train density of the first division by 2 (for two-way travel); then multiply the result by 1,000. This gives the amount in pounds of lubricants required per month for the division.

- Repeat this procedure for each division of the system.
- Total the amount of lubricants for all divisions to determine the grand total of STONs required per month for the railroad.

Repair Parts

10-64. In a theater, the number and kinds of supplies and repair parts are seldom found necessary to maintain the motive power and the rolling stock used by the unit. For planning purposes, only the repair parts necessary for the maintenance of motive power and rolling stock are considered. An estimate of repair parts required is based on a factor of 1.5 STONs per month for each train moving in either direction over each division in one day. Use the following method to determine repair parts required:

- Multiply the train density of the first division by 2 (for two-way travel). Multiply the result by 1.5 to get the total amount in STONs of repair parts required per month for the division.
- Repeat this procedure for each successive division of the system.
- Total the amounts to determine the grand total of STONs required per month for the entire railroad.

10-65. Good judgment and certain assumptions are required when making allowances for railway operating supplies. It is assumed that all trains operated over each division are tonnage trains and that each division requires the same amount of operating supplies. The above formulas are an accepted method for computing operating supplies from a broad spectrum; however, a more refined method would employ the following methodology in making allowances:

- **First division.** No allowance is made, since the operating supplies are available at the port terminal or base of operations.
- **Second division.** An allowance of 5 percent of the first division net tonnage, which means only 95 percent of the first division net tonnage, will be hauled over the second division.
- **Third division.** An additional allowance of 5 percent of the first division net tonnage, or a total deduction of 10 percent of the first division net tonnage, which leaves only 90 percent of the original tonnage to be hauled over the third division.
- **Additional division.** An additional allowance of 5 percent of the first division net tonnage will be made for each successive division, with a corresponding reduction in tonnage hauled.

Chapter 11

Foreign Service
Host Nation Equipment

11-1. During wartime or contingencies U.S. forces face the prospect of having to utilize any available equipment upon entry into the theater, particularly when host nation support is not available. Either the tactical situation or security concerns may preclude the use of HNS, in particular, in the rear areas of the Division, Corps and higher.

11-2. In many developing nations, U.S. forces may encounter cars, locomotives, and other equipment that has been declared obsolete by American railroads years ago and exported outside the U.S., either new, or used. They may also encounter foreign built equipment, primarily British or Soviet-era that may differ significantly from what they are familiar with.

11-3. Commanders of Rail Units and Transportation Groups should thoroughly familiarize themselves with the constraints and challenges of providing rail services in this type of environment, and train accordingly.

TYPES OF EQUIPMENT

11-4. Diesel-electric locomotives should be thoroughly inspected to insure that they are mechanically safe to operate, and should be brought up to the best level of maintenance that existing facilities and supplies allow for. It is not mandatory that they are equipped exactly as required for CONUS operations, but they must not present any type of hazard while being operated.

11-5. Electric locomotives most likely will not be able to be put into service in an austere environment due to damage to infrastructure providing power. However, extreme care should be taken when working on or around this equipment due to the threat of electrical shock. Soldiers should have specific training relative to electric train operations and safety around overhead catenary(power lines) before attempting any work on electric equipment.

11-6. Steam powered locomotives are still found in use in many parts of the world, if for no other reason than their fuel is readily available and there is no money for replacement of these engines. Steam locomotives have a proven ability to operate in extremely cold environments, which can be advantageous. The maintenance and support requirements for steam operations far outweigh any advantages, however unless there are adequate shop forces and repair parts readily available. Like electric train operations, soldiers should have specific training in the operations and maintenance of steam locomotives before attempting to operate them. It is strongly recommended that any steam locomotive considered for use by U.S. forces is fully inspected according to the guidelines found in 49 CFR, Part 230, in order to prevent death or serious bodily injury to train crews.

Locomotives of all types, that appear to be serviceable, but with which soldiers have no familiarity, or insufficient resources to place back into service, should be set-out on a siding and secured until they can be repaired or re-utilized by HN or allied personnel.

11-7. Freight cars should be inspected as they would in CONUS to determine load capacity and mechanical safety. Many cars may not have the tie-down characteristics or the capacities of CONUS based cars. Soldiers should insure that cars are not loaded over-capacity or out of balance.

RULES

11-8. Absent any interaction with HN personnel, where the U.S. has exclusive use of trackage and equipment, operations and maintenance should be conducted IAW current U.S. Doctrine and operating rules.

11-9. Where allied forces, HNS, or contractor support may share operating responsibilities, representatives from all organizations involved in train operations must meet and determine what set of rules will be followed. All train crews should be made familiar with the operating rules before being placed into service. It should also be determined which language will be used for dispatching and train crew communication. All communications must be clearly transmitted and clearly understood by all personnel involved in train operations.

SUSTAINMENT OF RAIL OPERATIONS

11-10. Prior to commitment to conduct rail movements within the operational area, railway-operating units must insure that there is an adequate maintenance and supply system in place to support train movements. Planners should consider among other factors, track and structure repair and maintenance; motive power and rolling stock fueling and maintenance; and an adequate supply of repair parts for all track, structure, signal systems, rolling- stock and motive power.

11-11. Also of significance is the availability of material handling equipment (MHE) at both the originating and destination points of the rail movement. Example: It would be useless to move containers via rail if there was no container handling equipment available at the destination.

Chapter 12

Rail Accidents and Incidents

Any and all Army Rail Accidents and incidents are to be reported to the Transportation Branch Rail Safety Office within 24 hours of occurrence, per Transportation Branch Rail Safety Office Accident/Incident Reporting Policy. Information obtained from these notifications/reports are used to identify problem trend areas in order to "develop accident prevention measures" for the entire fleet (AR 385-40, Safety, Accident Reporting and Records).

RAIL HAZARD ISSUES

12-1. Following the Chief of Staff of the Army's direction, it is this office's mission to be the user representative for both acquisition and training issues. It is incumbent on the users in the field to inform this office or any issues or hazards before they cause injury or damage to Army or contract personnel and equipment. The intent of the Hazard Issues web site is to identify trends throughout the fleet and recommend, "fixes" to the appropriate Risk Level Authority.

12-2. All Army Rail Accidents and incidents that meet the classification of an Army Class A through D Accident will be recorded with the US Army Safety Center and Carbon Copied to this office.

Accidents and Incidents Overview

12-3. Rail accidents and/or incidents (may also be known as Train accidents) involve any collision, derailment, or injury as a result of the operation of any Army Rail equipment. Rail accidents will be reported as Class A through Class D accidents and identified as engineering, mechanical, Transportation, or Other, as appropriate on **DA Form 285** (block 63). Rail incidents will be reported using your local SIR format.

12-4. Rail accidents and/or incidents include:

- Accidents/incidents occurring while loading, off-loading, or receiving services.
- Damage to Army property handled as a loaded commodity.
- Damage and all injuries to Army personnel occurring while operating or riding rail equipment.

12-5. Rail accidents do not include accidents that are reportable under other major categories prescribed in this regulation; for example, aircraft, missile, or chemical agent accidents.

12-6. The following information covers trains and rail equipment under the jurisdiction of DA that are:

- Operated and exclusively controlled or directed by the Army. This includes rail equipment furnished by a contractor or another Government Agency when operated by Army train personnel.

- Lent or leased to non-Army organizations for modification, Maintenance, repair, test, contractor training, research, or development projects for the Army.
- Under test by Army agencies responsible for research, development, and test of equipment.
- Under operational control of a contractor. Accidents involving Army equipment lent or leased by the Army to a non-Army organization for maintenance, repair, test, contract training, or experimental projects will not be charged to the Army if the non-Army organization that has operational control of the equipment has assumed the risk of loss.

This information does not negate the engineer or crew responsibility to report any applicable rail accident, injury, or death involving commercial or Government owned property to the FRA.

Notification Requirements

12-7. In addition to the notification required by Chapter 3, of AR 385-40 rail accidents and/or incidents will be reported as follows: *Rail Accident and incident*. Any accident/incident or injury that is caused by a hazard or creates a hazard to the crew, the equipment, or the environment, or any occurrence affecting the worthiness or fitness for service of any part of the locomotives, cars, equipment, or track (to include but not be limited to the switches, ties, rail, ballast, or Frogs) will be telephonically or electronically reported to the Transportation Branch Rail Safety Office, 705 Read Street, Fort Eustis, VA 23604-5113, DSN 826-3692, Commercial (757) 878-3692, RailSafety@eustis.army.mil, within 24 hours.

Record Keeping

12-8. The person in charge of any rail equipment involved in an accident and/or incident will retain all records relevant to the equipment IAW 49 CFR Part II. Records include, but are not limited to, event recorder download, DD 862, records of air tests, and any HAZMAT records, radio logs, crew and passenger lists and statements, alcohol and drug tests, and drawings or photographs made at the scene of the accident, articles of shipment, and other material which might be of assistance in investigating and determining the cause of the accident. The person(s) responsible for these records' custody shall make these records available upon request to the authorized safety investigator(s).

12-9. The information on the trains' data recorder will be saved before any rail equipment involved in an accident or incident is put back into service.

Rail Accident Investigation

12-10. In addition to the normal procedures required for investigating Army accidents, rail accidents require the following:

12-11. A copy of all data recorder information will be forwarded to the Defense Non-Tactical Generator and Rail Equipment Center (DGRC), 6233 Aspen avenue, Building 1701, Hill AFB, Utah 84056, DSN 777-5913, Commercial (801) 777-5913, robert.arrington@hill.af.mil, with in 48hrs of the accident.

12-12. All rail accidents and/or incidents may be investigated by the Transportation Branch Rail Safety Office, U.S. Army Transportation Center and School, Ft. Eustis, VA 23604. To determine if possible safety violations were the cause of the accident / incident.

Appendix A
Blank Locally Reproducible Forms

This appendix contains blank reproducible forms (reduced to fit on page) that are authorized for local reproduction. You may reproduce these forms on 8 1/2 x 11-inch paper. You may also request these forms through appropriate distribution channels. The forms are as follows:

DA Form 5620-R Daily Installation Situation Report

DA Form 4090-R Combined Register of Trains and Comparison of Watches

DA Form 5614-R Superintendent's Telegraphic Report of Accident

DA Form 4093-R Station Record of Train Movements and Operator's Transfer

DA Form 5619-R Daily Empty Car Situation Report

DA Form 4092-R Train Order

DA Form 4091-R Clearance Form "A"

DA Form 5706-R Track Bulletin

DA Form 5618-R Conductor's Wheel Report

DA Form 5615-R Set Out Report

DA Form 5616-R Car Inspector's Train Report

DA Form 5617-R Daily Statement of Cars On Hand

Appendix B

Railway Planning Example

This appendix contains an example of railway planning. Use this plan for the operation of any rail system.

SITUATION

B-1. Plan for the operation of a rail system to move supplies in a theater of operations. The target date for the initiation of service is on 1 December. Route all rail tonnages originating in the port to the railhead over the main line of the system as shown in Figure B-1.

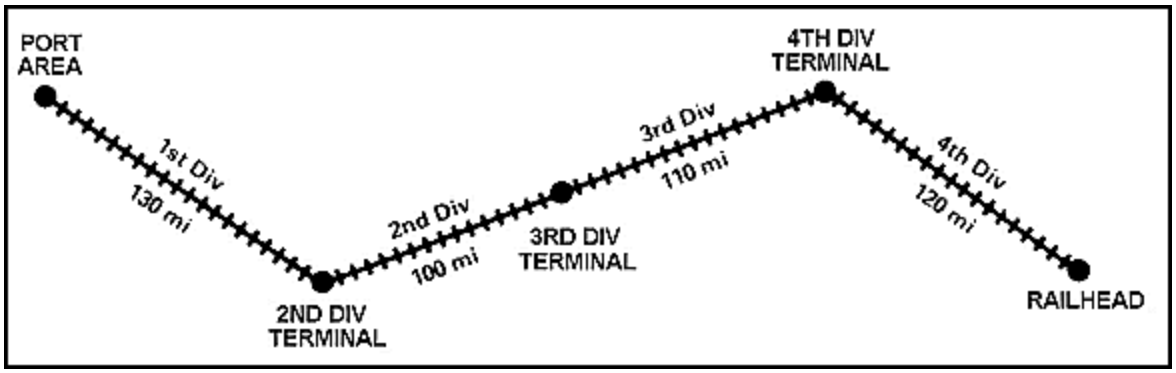


Figure B-1. Hypothetical Rail System for Planning

Note 1. All tonnages are expressed and computed in STONs.
Note 2. All computations resulting in a fraction are raised to the next higher whole number.

PLANNING DATA

B-2. Planning depends on the size and type of rails, condition of crossties, rail and ballast, washout and rockslide potential, number of single and double main lines, and the availability of sidings or passing tracks.

TRACK

B-3. If there is a usable double track, trains may operate in both directions without delays in schedules. However, the unit often takes the usable parts of a damaged double track to make one single main line with good passing tracks. Computations in this appendix are based on a single track.

Number	Single track (unless otherwise stated)
Gauge	Standard (56.5 inches)
Condition	All divisions: Good to fair
Percent of Grade	All divisions: 1.5 percent or less

Ruling Curve	All divisions: 5 degrees
Weather	All divisions: Summer: +60°F to +95°F Winter: +35°F to -20°F Wet weather: Local and temporary
Passing Tracks	First divisions - 15 Second division - 9 Third division - 11 Fourth division - 14

MOTIVE POWER

B-4. Motive power consists of all self-propelling equipment found on a railroad. The most common motive power refers to locomotives.

Road Engines

B-5. US Army 0-6-6-0, 120 tons, diesel-electric locomotive.

Switch Engines

B-6. US Army 0-4-4-0, 60 tons, diesel-electric locomotive.

ROLLING STOCK

B-7. Rolling stock refers to a collection of a large group of railway cars.

Boxcars	40-ton rated capacity
Gondolas	40-ton rated capacity
Flatcars	50-ton rated capacity

FIRST COMPUTATION

B-8. Determine the train density for each of the four railway divisions.

$$TD = \frac{(NPT + 1)}{2} \times \frac{24 \times S}{LD}$$

S = 10 mph (refer to Table 10-2)

STEP 1.

First Division: $TD = \frac{(15 + 1)}{2} \times \frac{24 \times 10}{130} = \frac{16}{2} \times \frac{240}{130}$

$= \frac{3,840}{260}$ = 14 + of 15 trains

STEP 2.

Second Division: $TD = \frac{(9 + 1)}{2} \text{ X } \frac{24 \text{ X } 10}{100} = \frac{10}{2} \text{ X } \frac{240}{100}$

$= \frac{2,400}{200} = 12 \text{ trains}$

STEP 3.

Third Division: $TD = \frac{(11 + 1)}{2} \text{ X } \frac{24 \text{ X } 10}{110} = \frac{12}{2} \text{ X } \frac{240}{110}$

$= \frac{2,880}{220} = 13 + 14 \text{ trains}$

STEP 4.

Forth Division: $TD = \frac{(14 + 1)}{2} \text{ X } \frac{24 \text{ X } 10}{120} = \frac{15}{2} \text{ X } \frac{240}{120}$

$= \frac{3,600}{240} = 15 \text{ trains}$

SECOND COMPUTATION

B-9. Determine the end delivery tonnage of this rail line during winter months using single-engine operation. You must use the following formulas:

- EDT = NDT of most restrictive division
- NDT = NTL X TD
- NTL = GTL X .50
- GTL = $\frac{\text{DBP X WF}}{\text{RR + GR + CR}}$
- DBP = CTE -- (Total weight of engine in STONs x 20 pound per STON)
- CTE = $\frac{\text{STE}}{2}$
- CTE = $\frac{\text{Weight on drives (lb)}}{\text{25\% adhesion factor}}$

STEP 1. Compute the starting tractive effort.

$\text{STE} = \frac{\text{Weight on drivers (lb)}}{4}$

$= \frac{240,000}{4} = 60,000 \text{ pounds}$

STEP 2. Compute the continuous tractive effort.

$$STE = \frac{STE}{2}$$

$$= \frac{60{,}000}{2} = 3{,}000 \text{ pounds}$$

STEP 3. Compute the drawbar pull of the road engine.

DBP = CTE-- (Total weight of engine in STONs x 20 pounds per STON)

= 30,000 -- (120 X 20)

= 30,000 -- 2,400 = 27,600 pounds

STEP 4. Compute the gross trailing load.

$$GTL = \frac{DBP \text{ X } WF}{RR + GR + CR}$$

Where:
DBP = 27,600 pounds (preceding calculations)
WF = 80 percent (see Table 10-1)
RR = 6 (see paragraph 10-4)
GR = 1.5 percent X 20 = 30
CR = 5 degrees X 0.8 = 4

$$GTL = \frac{27{,}600 \text{ pounds X .*80}}{6 + 30 + 4}$$

$$= \frac{22{,}080}{40} = 552 \text{ STONs}$$

STEP 5. Compute the net trainload.

NTL = GTL X .50

= 552 X .50 = 276 STONs

STEP 6. Compute the EDT of the system by determining the NDT of the most restrictive division.

NTL X TD = NDT

First Division 276 X 15 = 4,140 STONs
Second Division 276 X 12 = 3,312 STONs

Third Division 276 X 14 = 3,864 STONs
Fourth Division 276 X 15 = 4,140 STONs
EDT = NDT of second division (most restrictive)
EDT = 3,312 STONs

THIRD COMPUTATION

B-10. Determine the rolling stock requirements for this rail system when operating at maximum capacity during winter months using single-engine operation. Each type of freight car will move the following percentages of the end delivery tonnage:

Boxcars 50 percent of EDT
Gondolas 25 percent of EDT
Flatcars 25 percent of EDT

STEP 1. Compute the portion of the EDT to be moved in each type of railcar:

Boxcars: EDT X 50 percent = 3,312 X .50 = 1,656 STONs
Gondolas: EDT X 25 percent = 3,312 X .25 = 828 STONs
Flatcars: EDT X 25 percent = 3,312 X .25 = 828 STONs

STEP 2. Compute rolling stock requirements for one day's dispatch. You must apply the following formulas:

$$\text{Total cars required} = \frac{\text{EDT (by type car) X TAT X 1.1}}{\text{Average payload for type of car}}$$

$$1\text{ DD} = \frac{\text{EDT (by type car)}}{\text{Average payload for type car}}$$

$$\text{Note: Average payload in tons per type car} = \frac{\text{Rated capacity}}{2}$$

Therefore, 1 day's dispatch for all types of cars is computed as follows:

Boxcars: $1\text{ DD} = \frac{1,656}{20} = 82 + \text{or } 83 \text{ cars}$

Gondolas: $1\text{ DD} = \frac{828}{20} = 41 + \text{or } 42 \text{ cars}$

Flatcars: $1\text{ DD} = \frac{828}{25} = 33 + \text{or } 34 \text{ cars}$

Total cars in 1 DD = 159 cars

Rolling stock requirements are based on a TAT of 11 days (see paragraph 10-47). Therefore, total rolling stock requirements are computed as follows: 1 DD X TAT = cars required X 1.1 (reserve factor) = total cars required (also see Figure B-2).
1 DD X TAT = cars required X 1.1 (reserve factor) = total cars required

Boxcars:	83 X 11 = 913 X 1.1 =	1,004+ or	1,005 cars
Gondolas:	42 X 11 = 462 X 1.1 =	508+ or	509 cars
Flatcars:	34 X 11 = 374 X 1.1 =	411+ or	412 cars

Total rolling stock requirements: 1,926 cars

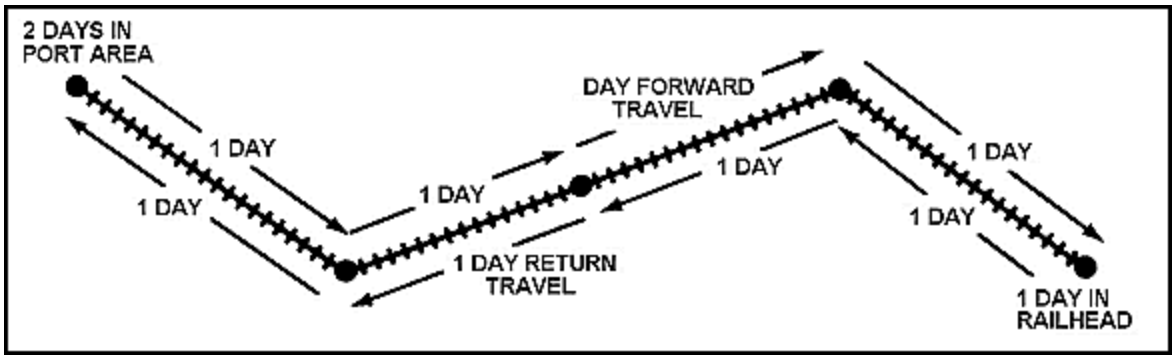


Figure B-2. Determination of Turnaround Time in Days

FOURTH COMPUTATION

B-11. Determine the road and switch engine requirements for the operation of the system at maximum capacity during winter months using single engine operation.

STEP 1. Compute for road engines required.

$$\text{Number of road engines} = TD \times \frac{(RT + TT)}{24} \times 2 \times 1.2$$

COMPUTE FOR FACTORS

B-12. Compute the running time for each division.

	TD	RT (Length of div ÷ avg speed)
First division:	15	130 ÷ 10 = 13
Second division:	12	100 ÷ 10 = 10
Third division:	14	110 ÷ 10 = 11
Forth division:	15	120 ÷ 10 = 12

Note: Average value for terminal time of diesel-electric motive power is 3. Average value for steam is 8.

COMPUTE REQUIREMENTS

B-13. The following computations shows the number of road engines (per division) required for operation over a given railway division.

First division: $15 \times \frac{(13 + 3)}{24} \times 2 \times 1.2 = 36 \times \frac{16}{24} = \frac{576}{24}$

Second division: $12 \times \frac{(10 + 3)}{24} \times 2 \times 1.2 = 28.8 \times \frac{13}{24} = \frac{274.4}{24}$

Third division: $15 \times \frac{(13 + 3)}{24} \times 2 \times 1.2 = 36 \times \frac{14}{24} = \frac{504}{24}$

Forth division: $15 \times \frac{(12 + 3)}{24} \times 2 \times 1.2 = 36 \times \frac{15}{24} = \frac{540}{24}$

Total road engines required = 24 + 16 + 21 + 23 = 84 road engines

STEP 2. Compute for switch engines.

		Cars dispached and recieved per day	*Cars passing per day*		*Computation factor (refer to par 10-4C(2))*		*Switch engines required*
Port							
	Terminal	159 X 2		÷	67	=	4+ or 5
2nd div:							
	Terminal		159 X 2	÷	100	=	3+ or 4
3rd div:							
	Terminal		159 X 2	÷	100	=	3+ or 4
4th div:							
	Terminal		159 X 2	÷	100	=	3+ or 4
Railhead		159 X 2		÷	67	=	4+ or 5
					Subtotal	=	22
					+ 20 percent reserve (4+ or 5)	=	5
					Total	=	27

FIFTH COMPUTATION

B-14. Determine the number of switch and road crews required to support this rail system.

STEP 1. Compute for road crews required.

$$\text{Road crews} = \text{TD} \times 2 \times \frac{(\text{RT} + 3)}{12} \times 1.25$$

COMPUTE FOR FACTORS

B-15. Compute the running time for each division.

	TD	RT (Length of div ÷ avg speed)
First division:	15	130 ÷ 10 = 13
Second division:	12	100 ÷ 10 = 10
Third division:	14	110 ÷ 10 = 11
Forth division:	15	120 ÷ 10 = 12

COMPUTE FOR ROAD CREW REQUIREMENTS

B-16. The following computations shows the number of road crews (per division) required for operation over a given railway division.

First division: Road crews = $15 \times 2 \times \frac{(13 + 3)}{12} \times 1.25 = 37.5 \times \frac{16}{12} = \frac{600}{12}$ = 50 crews

Second division: Road crews = $12 \times 2 \times \frac{(10 + 3)}{12} \times 1.25 = 30 \times \frac{13}{12} = \frac{390}{12}$ = 32+ of 33 crews

Third division: Road crews = $14 \times 2 \times \frac{(13 + 3)}{12} \times 1.25 = 35 \times \frac{14}{12} = \frac{490}{12}$ = 40+ or 41 crews

Forth division: Road crews = $15 \times 2 \times \frac{(12 + 3)}{12} \times 1.25 = 37.5 \times \frac{15}{12} = \frac{562.5}{12}$ = 46+ or 47 crews

Total road crews required = 50 + 33 + 41 + 47 = 171 road crews

STEP 2. Compute for switch engine crews required (do not include reserve switch engines).

Switch crews = SE X 2 X 1.25

Port area: Switch crews = 5 X 2 X 1.25 = 12+ or 13

Second division terminal: Switch crews = 4 X 2 X 1.25 = 10

Third division terminal: Switch crews = 4 X 2 X 1.25 = 10

Fourth division terminal: Switch crews = 4 X 2 X 1.25 = 10

Railhead:	Switch crews = 5 X 2 X 1.25 =	12+ or 13
	Total switch crews required =	56

STEP 3. Determine total number of switch and road crews required.

Road crews =	171
Switch crews =	56
Total switch and road crews =	227

SIXTH COMPUTATION

B-17. Determine the monthly engine fuel, lubricants, and repair parts requirements for the operation of this system.

STEP 1. Compute fuel requirements for road engines.

	TD	X	Two-way travel	X	LD	=	Train miles per day
First division:	15	X	2	X	130	=	3,900
Second division:	12	X	2	X	100	=	2,400
Third division	14	X	2	X	110	=	3,080
Fourth division	15	X	2	X	120	=	3,600
					Total train miles per day =		12,980

12,980 train miles per day X 2.5 gal per train mile = 32,450 per day

32,450 gallons per day X 30 days = 973,500 gallons per month

973,500	gallons per month
+ 48,675	5-percent reserve
1,022,175	total gallons per month

STEP 2. Compute fuel requirements for switch engines (do not include reserve switch engines).

Number of switch engines	X	Hours per day operation	X	Rate of fuel consumption (gallons per hour per locomotive)	=	Daily require-ment (gallons)
22	X	20	X	8	=	3,520

3,520 gallons per day X 30 days = 105,600 gallons per month

105,600	gallons per month
+ 5,280	5-percent reserve

110,880 total gallons per month

STEP 3. Compute total fuel requirements.

1,022,175	road engine requirements per month in gallons
+ 110,880	switch engine requirements per month in gallons
1,133,055	total requirements per month in gallons

STEP 4. Compute monthly lubricant requirements in STONs.

	TD	X	Two-way travel	X	Lubricants (STONs per month per train per day	=	Lubricants (STONs per month)
First division:	15	X	2	X	.5	=	15
Second division:	12	X	2	X	.5	=	12
Third division	14	X	2	X	.5	=	14
Fourth division	15	X	2	X	.5	=	15
Total lubricants per month = 56 STONs							

STEP 5. Compute monthly repair parts requirements in STONs.

	TD	X	Two-way travel	X	Repair parts (STONs per month per train per day	=	Repair parts (STONs per month)
First division:	15	X	2	X	1.5	=	45
Second division:	12	X	2	X	1.5	=	36
Third division	14	X	2	X	1.5	=	42
Fourth division	15	X	2	X	1.5	=	45
Total spare parts per month = 168 STONs							

Appendix C

Rail Transport Organizations

The Transportation Railway Battalion commands and controls all railway units assigned or attached to a major transportation organization (a Transportation Command Element or Transportation Group) under the Theater Support Command.

Transportation Railway Battalion (TOE 55916L000)

C-1. **Mission.** The Railway Battalion commands, controls, and supervises Rail operating Companies. MCTs. The battalion controls the movement of all personnel, units, and materiel in the theater. The battalion maximizes the use of available transportation assets.

C-2. **Capabilities.** Commands, controls, and provides staff planning and technical supervision of three to seven assigned or attached transportation rail operating companies (TOE 55917L).

C-3. **Assignment**. The Railway Battalion is assigned to a Transportation Command Element (TOE 55602F000) and normally attached to a Transportation Group (TOE 55622F000).

- **Methods of Operation**. The HHD is normally located at a main terminal area within the operating area. The HHD dispatches trains and supervises all railway operations. The HHD is responsible for maintaining and operating approximately 90 to 150 miles of track.

- **Functions.** The following provide a variety of functions to ensure the successful mission of the corps MCB.

Paragraph 01, Battalion Headquarters. The battalion headquarters commands and controls the rail units in theater. Advises the theater commander on rail operations.

- Commander.
- Executive Officer.
- S2/3
- S6
- Chaplain
- S1
- S4
- Command Sergeant Major.
- Vehicle Driver

Paragraph 02, Detachment Headquarters. The detachment headquarters commands, controls, and provides limited administrative and logistical support to the battalion and attached teams. Personnel requirements are as follows:

- Commander

- Detachment Sergeant
- Supply Sergeant
- Human Resource Specialist
- Wheeled Vehicle Mechanic
- Decontamination Specialist
- Cook (to provide support to the battalion)

Paragraph 03, Unit Ministry Team. The Unit Ministry Team plans and provides religious support to all personnel assigned or attached to the battalion including collective worship services, ministry for mass casualties and hospitalized soldiers. Advises commander and staff on religious, moral soldier welfare issues, and the impact of indigenous religions. Establishes liaison and maintains contact with unit ministry teams of higher and adjacent units. It is comprised of one Chaplain and one Chaplain' Assistant.

Paragraph 04, Battalion S1 Section. The S1 section performs internal administrative services, personnel actions, mail distribution, and awards support to the battalion. Personnel requirements are as follows:

- Human Resource Sergeant.
- Paralegal Specialist.
- Mail Delivery Clerk.

Paragraph 05, S2/3 Section. The S2/3 is responsible for deployment planning, security, and the manning of the operations center. This section provides supervision for the Plans, Programming, and Operations Section (paragraph 04) and Highway Traffic Section (paragraph 05). Personnel requirements are as follows:

- Plans Officer
- Operations Sergeant
- Force Protection Supervisor
- Railway Operations NCO
- NBC NCO
- Trans Management NCO
- Senior Railway Sergeant
- 2 Trans Management Coordinators
- 4 Railway Specialists
- Intelligence Analyst
- 3 Railway Clerks

Paragraph 06, Battalion S4 Section. The S4 section plans, coordinates, and supervises all unit logistical activities. The S4 communications systems operate on the command net and the admin/log nets. Maintains the consolidated property book. Personnel requirements are as follows:

- Property book officer
- Senior Maintenance Supervisor
- Railway Equipment Maintenance NCO

- Track Maintenance NCO
- Supply NCO
- Property Book NCO
- 2 Supply specialists

.

Paragraph 07, S6 Section. This section maintains the equipment and systems for the HHC and supervises and assists in the maintenance of communications and automation equipment and systems in subordinate units. The section coordinates the communications system organic to the headquarters company and subordinate elements of the BN. It provides technical advice and staff assistance to the BN commander, BN headquarters staff, and subordinate commanders. It coordinates with area communications elements to ensure efficient communications within the BN, and with attached and supported units. The section interacts with the Group S6 and integrates databases for new units. It coordinates signal support actions requirements with the S6 officer. It maintains data on CSS hardware and software use on all automated information systems (AIS) operated by subordinate units.

Paragraph 08, Railway Supply Section. The railway supply section is responsible for receiving, storing, and issuing rail repair parts to units assigned or attached to the battalion. Personnel requirements are as follows:

- Materiel Storage/Handling Specialist
- MHE Operator

TRANSPORTATION RAILWAY OPERATING COMPANY (TOE 55917L000)

C-4. **Mission.** This unit maintains and repairs railway track, performs running inspections on rolling stock and diesel-electric locomotives, and performs unit maintenance on rolling stock and diesel-electric locomotives. Operates railway locomotives and trains.

C-5. **Capabilities.** At level 1, this unit has the following capabilities:

- Operates a rail division of approximately 40 to 60 miles (65 to 96 kilometers) long.
- Dispatches all trains, supervises on-line operations, and operates railway stations and signal towers within its railway division.
- Operates trains and locomotives for yard, road, and incidental switching service.
- Provides eight train crews for road service, terminal operations or port clearance (to include switching, classifying, and making up trains for the road).
- Maintains and repairs track and roadbeds.
- Repairs major track damage.
- Performs maintenance on diesel-electric locomotives and railway cars. Completes, on an annual basis, running repairs on sixteen diesel-electric locomotives and 320 railway cars.
- Provides wrecked train support.
- Provides railway equipment maintenance contact teams.
- Provides direct support maintenance.

C-6. **Assignment**. The Railway Operating Company is assigned to a Transportation Command Element (TOE 55602F000) and normally attached to a Transportation Railway Battalion (TOE 55916L000).

- **Methods of Operation**. The Company is normally located at a main terminal area within the operating area. This company consists of a company HQ, a transportation operating platoon, a railway equipment maintenance platoon, and a maintenance-of-way platoon.

- **Functions.** The following provide a variety of functions to ensure the successful mission of the corps MCB.

Paragraph 01, Company Headquarters. The company HQ provides command, control, supervision, and administrative functions for the unit.

- Commander
- First Sergeant
- Railway Operations Supervisor
- Supply Sergeant
- Human Resource Specialist
- Decontamination Specialist
- Vehicle Driver
- Armorer

Paragraph 02, Food Service Section. When tasked, provides food service support for the Transportation Railway Operating Battalion (TOE 55916L).

- Food Operations Sergeant
- 3 Cooks

Paragraph 03, Maintenance Section. Provides organic vehicle maintenance and vehicle recovery. When tasked, this section provides vehicle maintenance and recovery support to the Transportation Railway Operating Battalion (TOE 55916L).

- Motor Sergeant
- Equip Rec/Parts Sergeant
- 3 Wheeled Vehicle Mechanic
- Const Equipment Repairer
- Equip Rec/Parts Specialist
- Recovery Vehicile Operator

Paragraph 04, Train Movements Section. Directs the movement of all trains, reroutes rail traffic in emergencies, determines rail line capacity, and directs railcar setouts and pickups within the rail division. It also establishes train movement priorities, develops train makeup and train departures, and distributes motive power and train crews over the railway division. It provides personnel for the operation of one yard area and the operation of one tower. This section also operates the net control station.

- Yardmaster

- Senior Train Movement Supervisor
- Train Movement Supervisor
- 5 Train Crewmember
- Railway Specialist
- Railway Clerk

Paragraph 05, Train Operating Platoon Headquarters. Provides personnel for mainline and yard operations. The platoon leader also serves as the trainmaster and is responsible for the safe and efficient operation of the trains. He prescribes a special timetable of instructions, rules, and regulations for yard and road service.

- Platoon Leader
- Platoon Sergeant
- Vehicle Driver

Paragraph 06, Eight-train Crews/Teams x 8. The train crews operate main freight and passenger trains, performs switching in yards and terminals, and provides personnel to operate four trains on a 24-hour basis.

- 8 Train Movement Supervisor
- 24 Train Crewmembers

Paragraph 07, Railway Equipment Maintenance Platoon. Coordinates, inspects, and supervises the work of subordinate sections. The platoon leader also serves as the maintenance superintendent-rail equipment and is responsible for maintaining records as to the condition and availability of locomotives and rail cars.

- Platoon Leader
- Platoon Sergeant
- Vehicle Driver

Paragraph 08, Railway Equipment Maintenance Squads x 2. The squad is responsible for the maintenance and running repairs to locomotives and rail cars. It performs running inspection for defects on rail cars as they pass through the rail division. The squad provides wreck crews to operate equipment assigned to the wreck train and assists in clearing of wrecks and other obstructions. The squad also provides contact maintenance teams within the rail division.

- 2 Railway Equipment Foreman
- 4 Railway Equipment Inspector
- 14 Railway Equipment Repairer

Paragraph 09, Railway Equipment Maintenance Support Section. This section provides organic support for the platoon. It also provides an air compressor operator, crane operators, a fork lift operator, and welders.

- Senior Crane Operator
- Crane Operator
- Senior forklift Operator
- 3 Welder

- General Construction Equip Operator

Paragraph 10, Maintenance-of-Way Platoon Headquarters. This platoon HQ supervises and coordinates the activities of the maintenance-of-way squads. This platoon HQ also distributes tools and materials and prepares and forwards supply requests and inspection reports.

- Platoon Leader
- Platoon Sergeant
- Vehicle Driver

Paragraph 11, Maintenance-of-Way Squads x 2. This squad is responsible for all maintenance-of-way within its assigned territory. Maintenance-of-way includes inspection of tracks, roadbeds, bridges, culverts, station grounds, tunnels, milepost signs, and highway grade crossings.

- 2 Railway Section Supervisor
- 4 Section Gang Foreman
- 16 Section Hand

Paragraph 12, Maintenance-of-Way Support Section. This section provides organic support of the platoon. It also provides an air compressor operator, a construction equipment operator, a fork lift operator, a vehicle driver and welders.

- Welder
- Heavy Vehicle Driver

Transportation Railway Operating Battalion and Company- TDA

The TDA Transportation Railway Operating Battalion and Company operate trains, repair track, provide running repairs to rolling stock and locomotives, provide yardmaster services and command and control for rail operations on a port or installation.

C-7. **Mission.** The Transportation Railway Operating Battalion and Company (TDA) is designed for specific missions supporting CONUS ammunition terminals, and are capable of providing rail service to any CONUS installation to support deployments. The primary focus of the TDA Rail Units is to provide qualified train crews during both surge and sustainment operations, as well as the ability to maintain and repair trackage. The units are also capable of providing routine maintenance to locomotives and rolling stock and yardmaster/car-clerk services as well as C2 of rail operations at multiple locations.

C-8. **Capabilities.** Provides up to 24 trained and qualified train crews and 3 maintenance of way (MOW) (track repair) teams, as well as 3 rail equipment repairers for augmentation of installation rail service. Battalion is structured to provide 3 separate operating companies, each with its' own MOW team and one equipment repairer. Each team is capable of operating independently of the BN, when required, allowing for support of multiple installations, or support of 3 shifts during 24 hr. operations.

C-9. **Assignment.** These units are assigned to Military Traffic Management Command (MTMC).

C-10. **Methods of Operation.** In these units the TDA changes frequently due to modernization and changing mission requirements. These units depend upon supporting installations or contracting for all sustainment and services.

Glossary

ACT	average cars per train
ADC	area damage control
ADP	automatic data processing
ALCO-GE	american locomotive-general electric
AMovP	Allied Movement Publication
AO	area of operations
AOR	area of responsibility
Approx	approximately
AR	Army regulation
ATTN	attention
AUG	August
AUTH	authorized
Aux	auxiliary
avail	available
avg	average
Bn	battalion
C-E	communications-electronic
CEOI	communications-electronics operation instructions
CM	centimeter(s)
CMD	command
COFC	container on flat car
COMMZ	communications zone
COMSEC	communications security
CONEX	container express
CONUS	continental United States
CR	curve resistance
CS	combat support
CSS	combat service support
CTC	centralized traffic control
CTE	continuous tractive effort
cu ft	cubic feet
CZ	combat zone
DA	Department of the Army
DBP	drawbar pull
D.C.	District of Columbia
DD	day's dispatch
DEC	December
DIV	division
DOD	Department of Defense
ea	each
EDT	end delivery tonnage
EMD	electro-motive division
ETA	estimated time of arrival
EW	electronic warfare
F	fahrenheit
FM	field manual
FS	safety factor
ft	feet; foot
gal	gallon(s)
GR	grade resistance
GTL	gross trailing load
HHD	Headquarters and Headquarters Detachment
HN	host nation

HNS	host nation support
HP	horsepower
HQ	headquarters
HR	hour(s)
in	inch(es)
JUN	June
KM	kilometer(s)
kph	kilo meters per hour
lb	pound(s)
LC	average length of car
LD	length of division
LOC	lines of communication
LT	length of track
m	meter(s)
MCT	movement control team
mi	mile(s)
MILSTAMP	Military Standard Transportation and Movement Procedures
MOPP	mission-oriented protection posture
MP	military police
MPH	miles per hour
MT	measurement ton
MTON	measurement ton
NA	not applicable
NATO	North Atlantic Treaty Organization
NBC	nuclear, biological, chemical
NCO	noncommissioned officer
NCOIC	noncommissioned officer in charge
No.	number
NPT	number of passing tracks
NT	number of tracks
NTL	net trainload
NTR	number of tracks required
POL	petroleum, oil, and lubricants
RAOC	rear area operations center
RAP	rear area protection
RAS	rear area security
RR	rolling resistance
RT	running time
S1	Adjutant (US Army)
S2	Intelligence Officer (US Army)
S3	Operations and Training Officer (US Army)
S4	Supply Officer (US Army)
S6	Communications/Automation Officer (US Army)
SCPE	simplified collective protection equipment
SE	switch engines
SEC	section
SEP	September
SFC	sergeant first class
SOP	standing operating procedures
STE	starting tractive effort
STON	short ton
svc	service
SYC	static yard capacity (in cars)
T	ton
TAT	turnaround time
TCMD	transportation control movement document

TD	train density
TM	technical manual
TOE	table(s) of organization and equipment
TOFC	trailer on flat car
TRADOC	United States Army Training and Doctrine Command
TRANSCOM	Transportation Command
TRB	Transportation Railway Battalion
TSC	Theater Support Command
TT	terminal time
TWC	track warrant control
UMT	unit ministry team
US	United States (of America)
USA	United States Army
USACASCOM	United States Army Combined Arms Support Command
USAREUR	United States Army Europe
VA	Virginia
VIP	very important person
W	width
w	with
WF	weather factor
w/o	without

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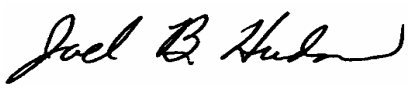
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General, United States Army
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Official:



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