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 equipment maintenance company (TOE 55919) 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 the car repair platoon, car shop foreman. A wreck crew consists of the following:

- Wreck foreman.
- NCOIC.
- Crane operator.
- Car repairman.
- Electricians.
- 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 transportation railway engineering company (TOE 55918L) personnel sent to the scene. The mission of this unit 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.

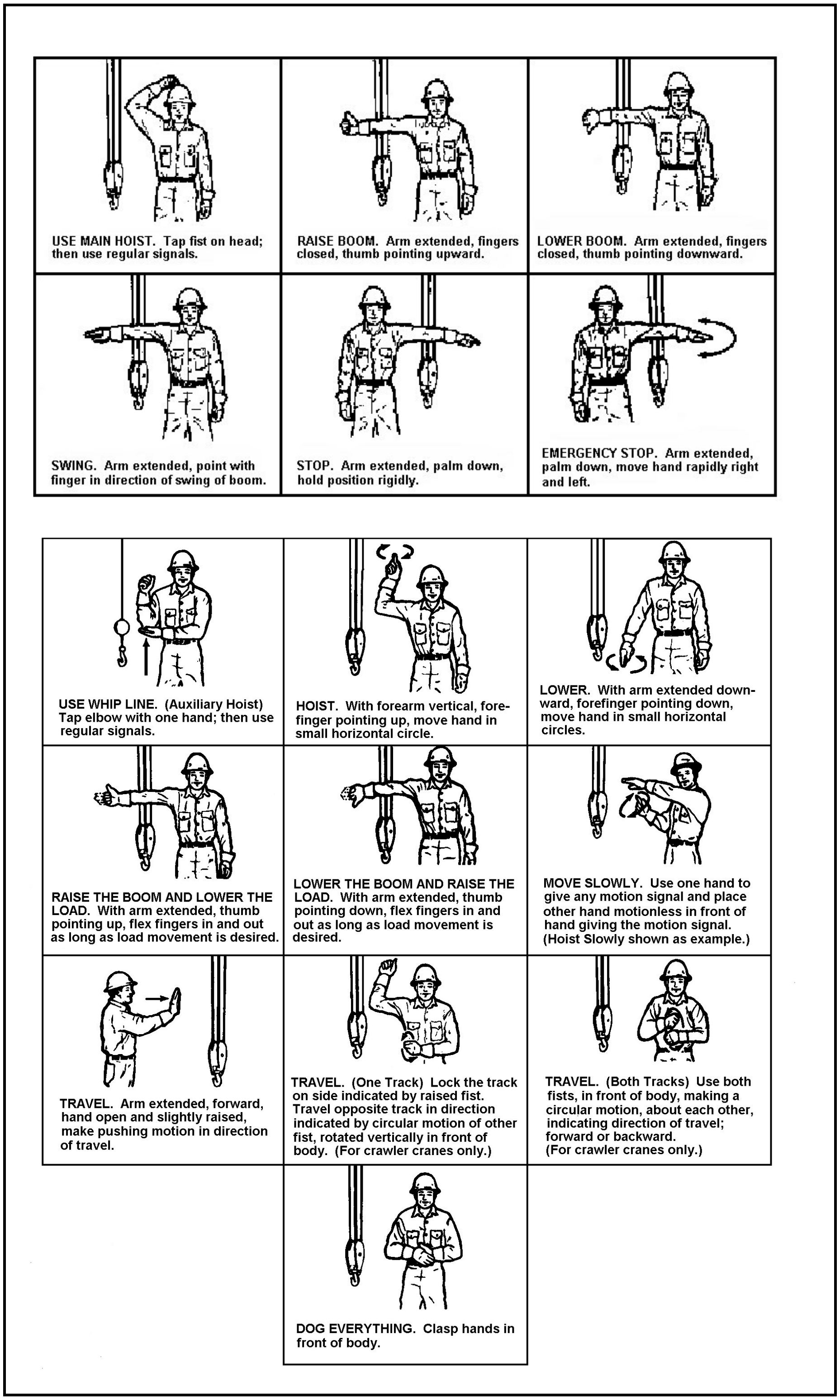


Figure 9-1. Standard Crane and Derrick Hand Signals

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, page 9-12.

Table 9-1. Safety Factors

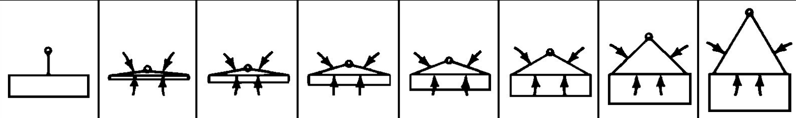
Use	Minimum Safety Factor
Guys	3.5
Miscellaneous hoisting equipment	5.0
Derricks	6.0
Slings	8.0

LOAD FORMULAS

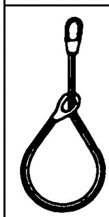
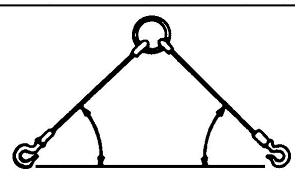
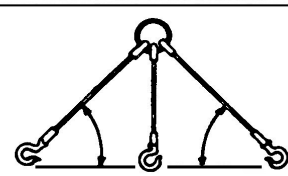
9-32. Safe working loads are selected from mathematically determined tables. However, the following formulas are rule of thumb methods for determining safe working loads (in tons) for hooks, chains, ropes, and cable (diameter in inches).

- **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.

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  When Angle is 45°	60°	75°	THREE-END BRIDLE SLING  When Angle is 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

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, page 9-14.

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.

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.

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

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.

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.

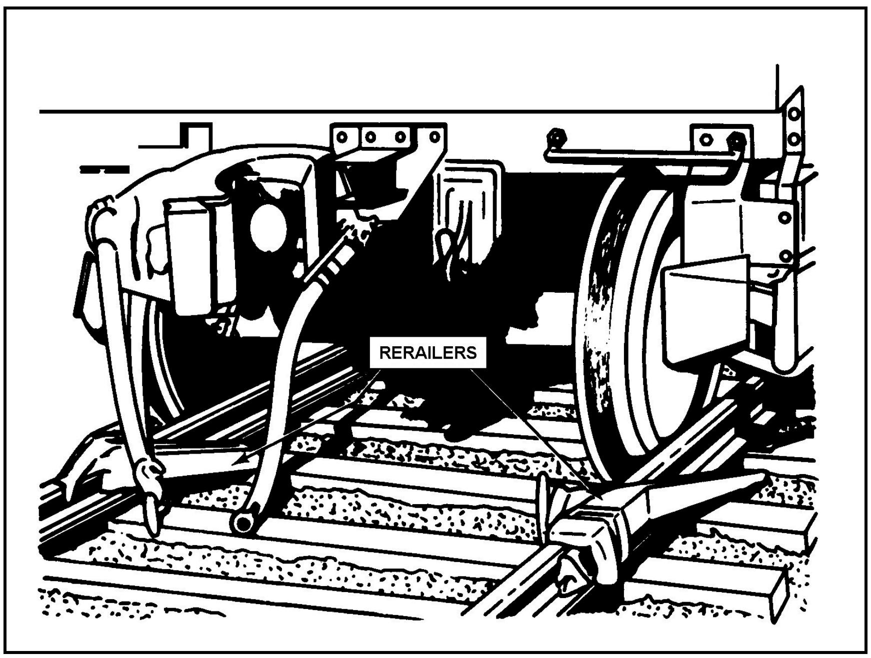


Figure 9-3. Using Rerailers to Retrack a Derailed Car

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.

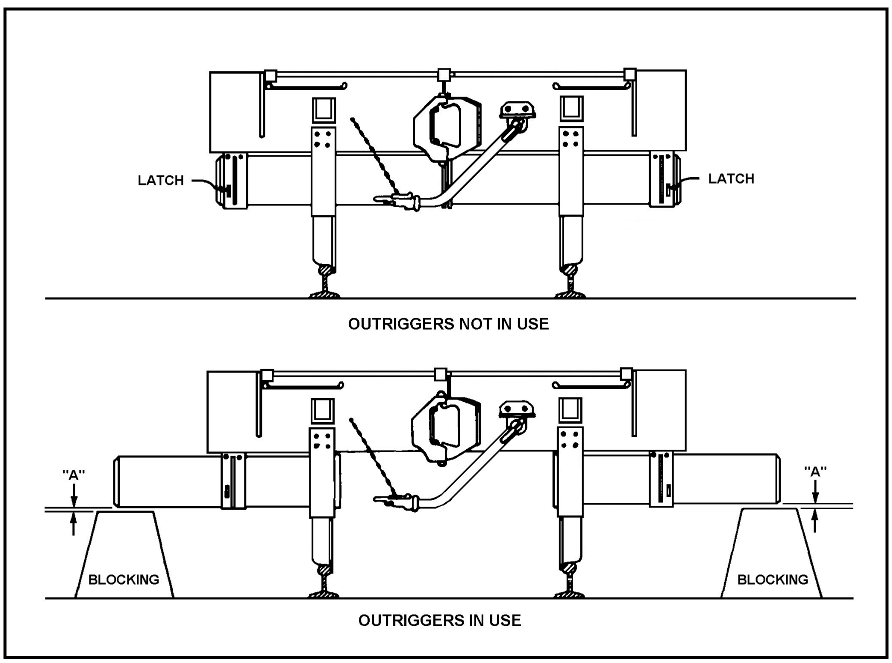


Figure 9-4. Outriggers

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, page 9-22) 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.

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.

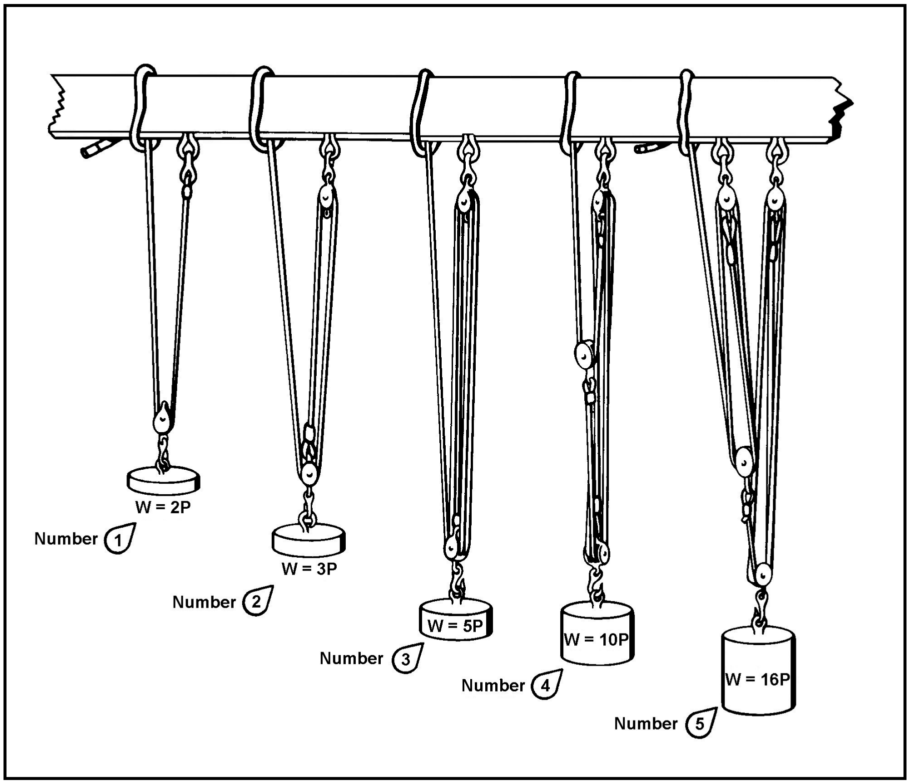


Figure 9-5. Mechanical Advantage of Various Tackle Rigs

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, page 9-24). 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 (pages 9-24 and 9-25).

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.

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

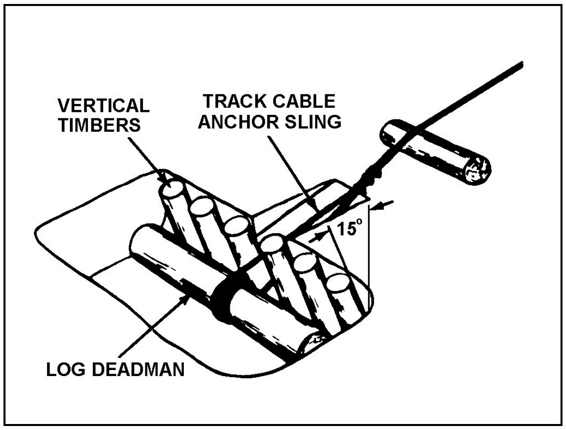


Figure 9-6. Log Deadman

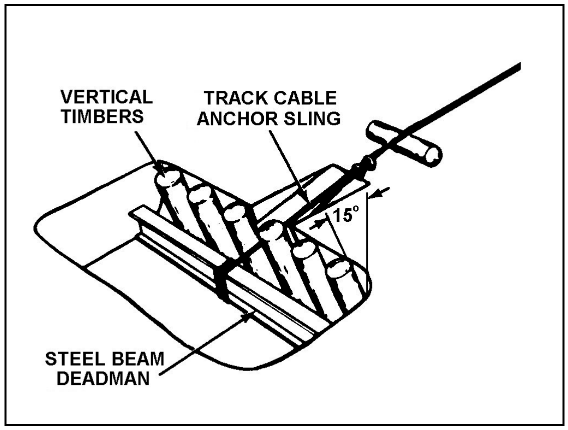


Figure 9-7. Steel Beam Deadman

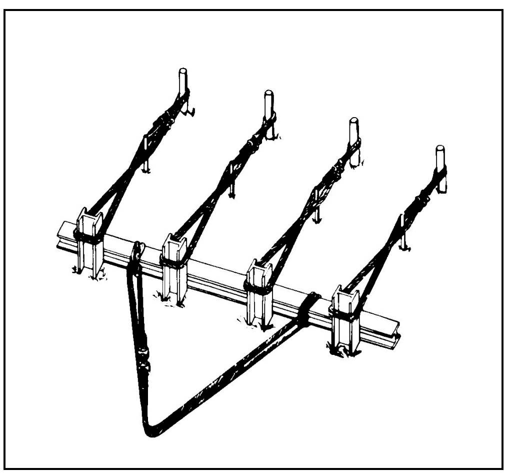


Figure 9-8. Combination Steel Picket Holdfast

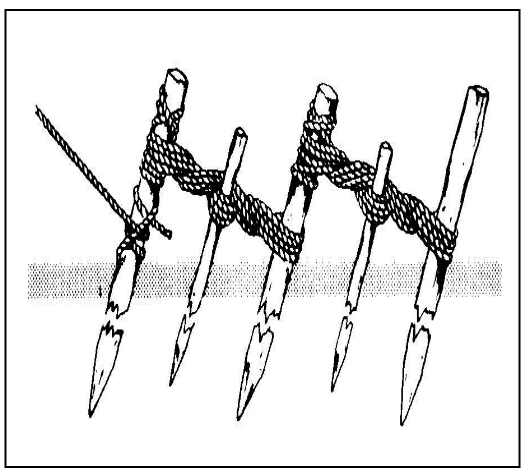


Figure 9-9. Picket Holdfast, 1-1-1 Combination

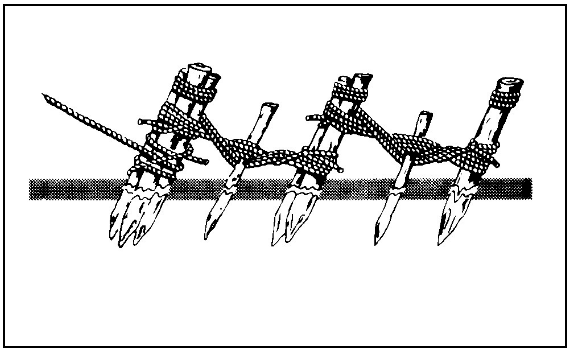


Figure 9-10. Picket Holdfast, 3-2-1 Combination

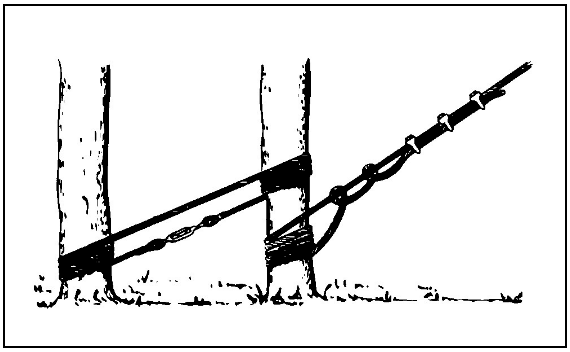


Figure 9-11. Use of Two Trees as Natural Anchorage

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, page 9-30. 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.

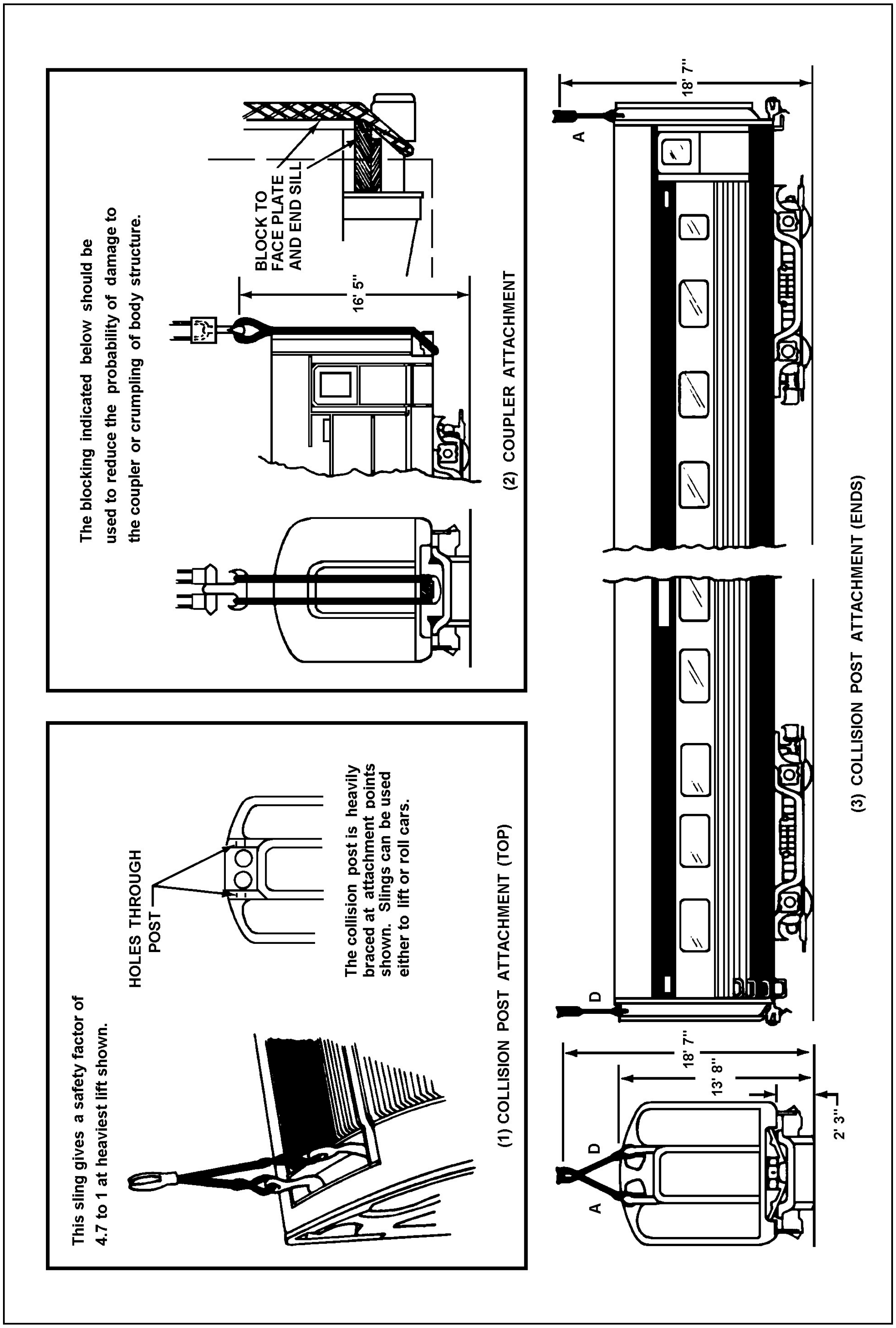


Figure 9-12. Method of Lifting Passenger Cars

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 [page 9-33]). 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 [page 9-33]) becomes more important.

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, page 9-35. 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.

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.

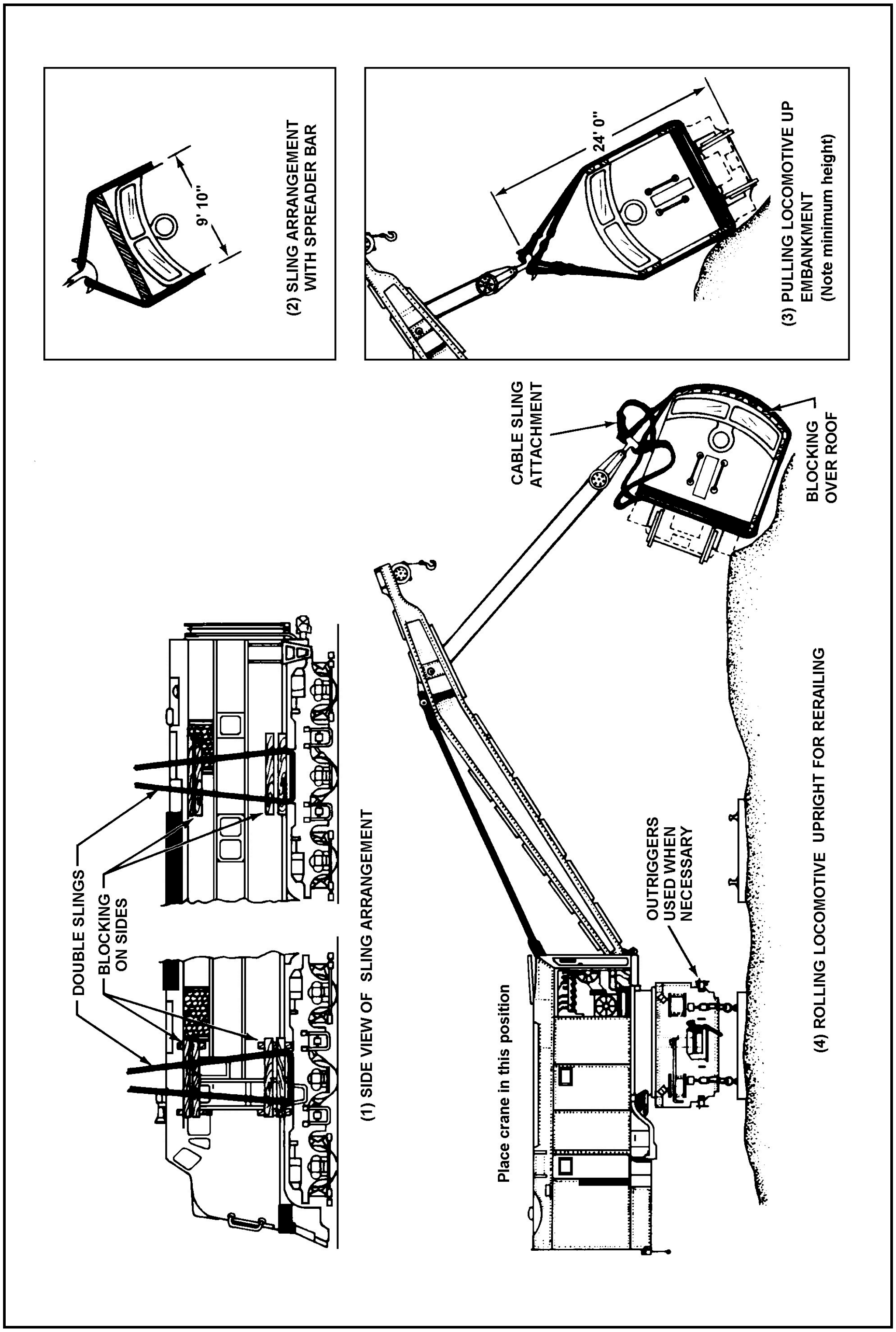


Figure 9-13. Method of Rolling Diesel-Electric Locomotive Upright--Single Crane

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, page 9-36). 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.

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.

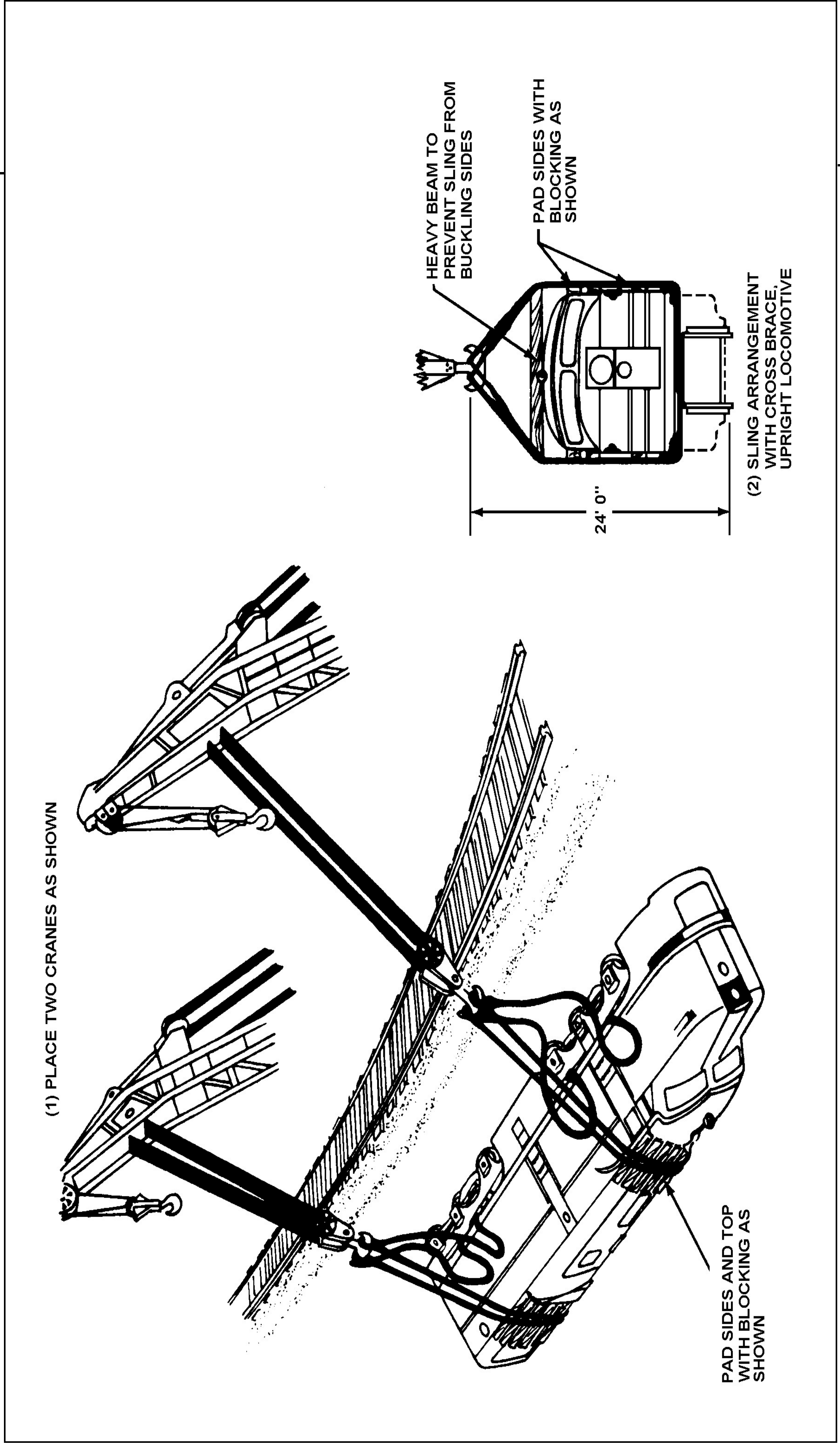


Figure 9-14. Method of Rolling Diesel-Electric Locomotive Upright--Double Crane

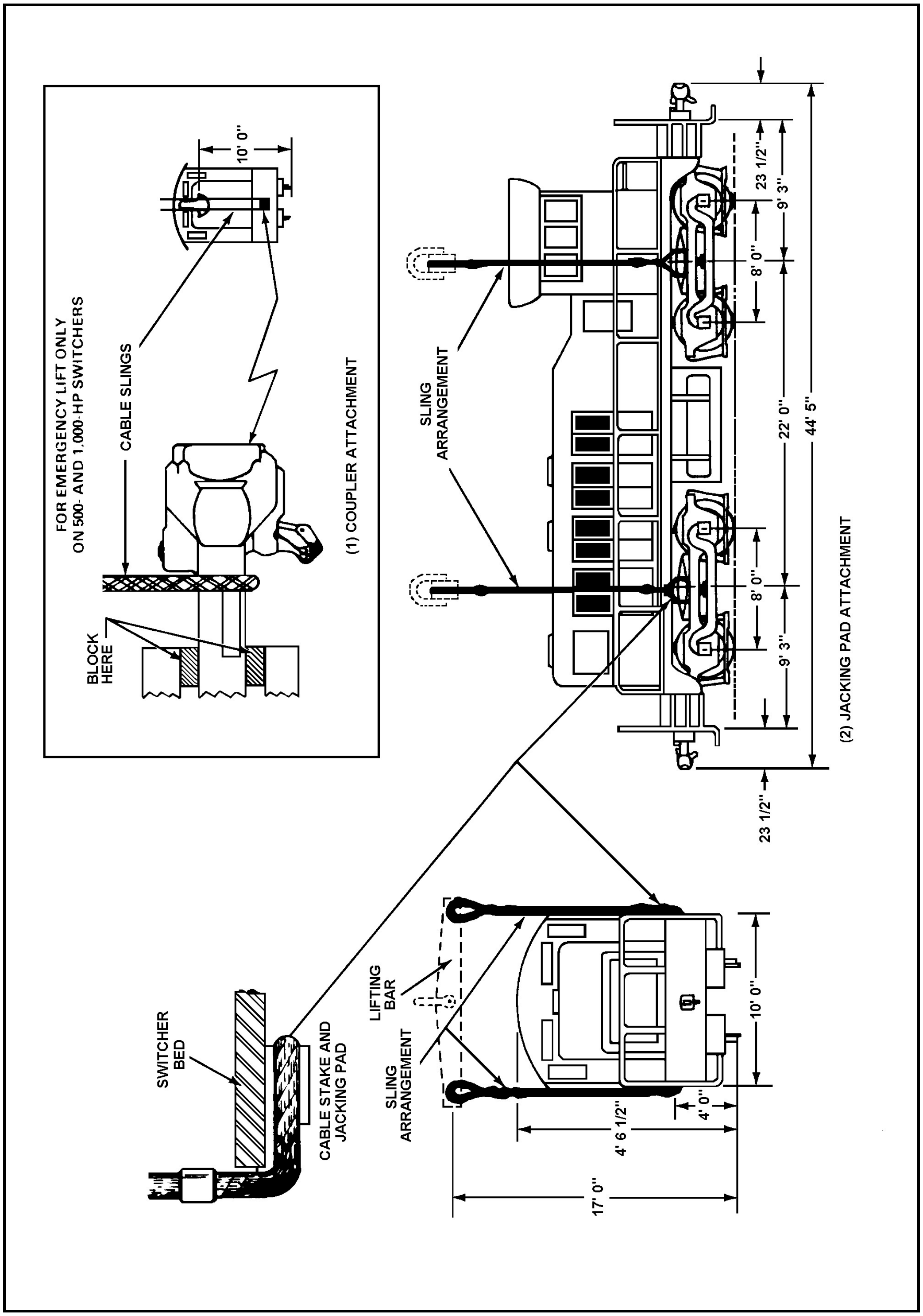


Figure 9-15. Methods of Lifting EMD Road Switcher Locomotive

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

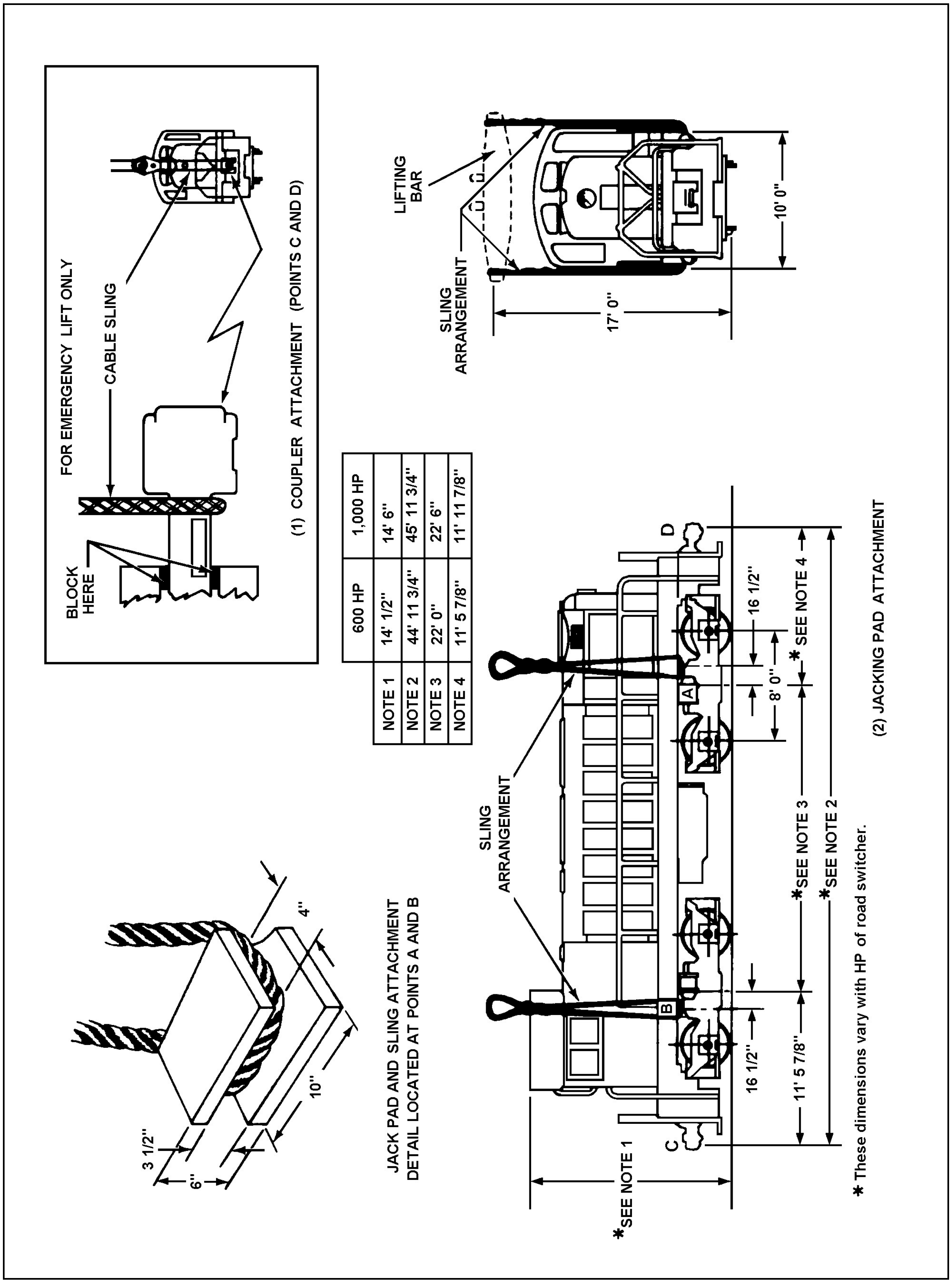
9-84. The frames of ALCO-GE locomotives, even though specially braced, are designed to be lifted at the bolsters. Lifts closer to the ends of passenger locomotives may cause excessive stresses if the trucks are attached at the time of lift. Road switcher locomotives with trucks attached can normally be lifted at designated lifting points (Figure 9-16, page 9-38). 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.

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.



	600 HP	1,000 HP
NOTE 1	14' 1/2"	14' 6"
NOTE 2	44' 11 3/4"	45' 11 3/4"
NOTE 3	22' 0"	22' 6"
NOTE 4	11' 5 7/8"	11' 11 7/8"

Figure 9-16. Jacking Pad and Lifting Lugs, ALCO-GE Locomotive

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.