CHAPTER 3
TRACK STRUCTURE ELEMENTS

Section 1. GENERAL

3–1. Purpose.

To present methods and procedures for maintenance of track elements in a manner that complies with the policies set forth in Chapter 1.

3–2. Scope.

The criteria for repair, maintenance, and rehabilitation presented in this part of the manual pertain directly to elements making up the track structure. Many track problems originate with faulty drainage (Chapter 4) or improper original construction. These problems must be solved prior to or during the repair or rehabilitation. Competent engineering assistance may be required to solve them when the determination of the cause of the deficiency is beyond the capaility of the maintenance force. Early attention to maintenance problems reduces costly repair and adds to the efficiency of overall operations.

Section 2. BALLAST

3–3. Purpose of Ballast.

Ballast is selected material placed on the roadbed for the purpose of holding the track in line and elevation. It provides uniform support for the track, anchors the track in place, drains water falling onto the roadbed, reduces heaving from frost, and retards the growth of vegetation. Economic factors as well as matching existing work will be considered in determining the type of ballast material for maintenance use.

3–4. Types, Sizes, and Application.

3–4.1. Crushed Stone, Slag, and Gravel. Ballast will have high strength, durability, and permeability. Crushed stone, slag, gravel, and similar materials may be used if they conform to AREA requirements for gradation, wear, and soundness. Coarse graduations, up to 2–1/2-inch maximum size, are preferred.

3–4.2. Pit-Run Gravel. Pit-run gravel is satisfactory for low-use tracks, whereas crushed stone or similar high quality material is required for running track. On weak subgrades, free-draining sand is used as subballast to reduce pumping and the formation of ballast pockets.

3–4.3. Sizes. Tables 3–1 presents maximum and minimum sizes recommended for ballast materials.

Table 3–1. Recommended Ballast Gradation

Type	Maximum Size in.	Minimum Size in.	Percent Fines Allowable by Weight
Crushed rock:			
Traprock	2–1/2	3/4	10
Limestone	2–1/2	3/4	10
Granite	2–1/2	3/4	10
Slag, broken and screened	2–1/2	1	15
Gravel:			
Screened and washed	1–1/2	1/2	10
Screened	1–1/2	1/2	20
Pit-run	Large rocks removed		

3–5. Reconditioning Ballasted Track.

Stone or hard slag ballast shall be cleaned when dirty enough to grow vegetation or when other foreign material restricts proper drainage. Pit-run gravel with fines exceeding 30 percent shall be replaced. Hand methods or mechanical means may be used for reconditioning ballast.

3–5.1 Stone, Slag, or Screened-Gravel Ballast. To recondition ballasted track, the following steps are necessary:

3–5.1.1. Clean ballast shoulder down to subgrade or top of the subballast (Figure 3–1).

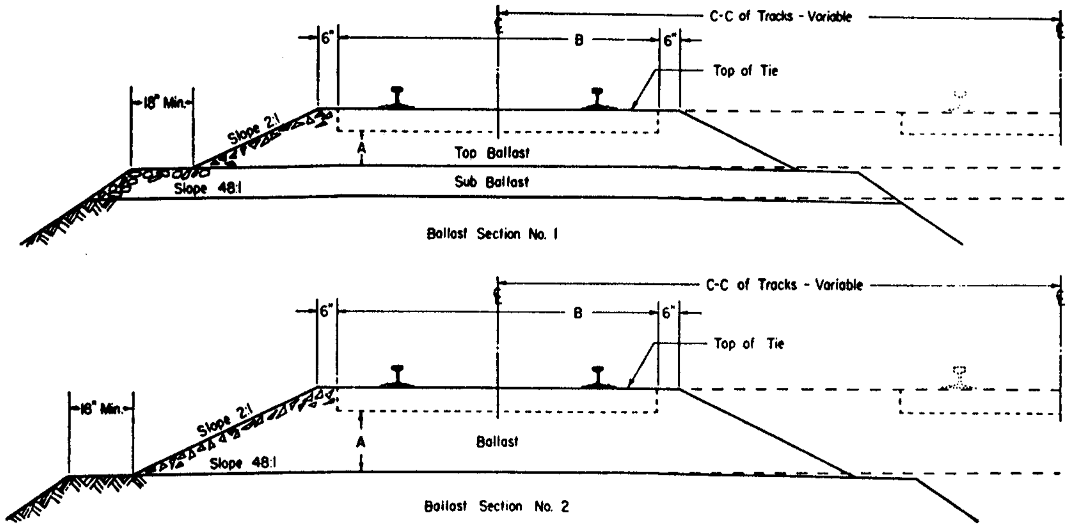


Figure 3-1. AREA ballast sections, single and multiple track, tangent.

3-5.1.2. Clean crib to bottom of ties.

3-5.1.3. Clean space between multiple tracks to bottom of ballast or, at least, to 6 inches below the bottom of the ties.

3.5.1.4. Clean the berm to the bottom of the ballast, preferably not less than 8 inches below the bottom of the ties.

3-5.1.5. Clean cross ditches or drains.

3-5.1.6. Dress subgrade and provide drainage in accordance with minimum slopes shown in Figure 3-2.

3-5.1.7. Clean the ballast removed.

3.5.1.8. Replace cleaned ballast under the track and add enough new ballast to make a standard section. Minimum ballast depth must be maintained at 6 inches below the bottom of crossties.

3-5.1.9. Collect refuse material, and distribute it along slopes of fill.

3-5.2. Pit-Run Ballast. To recondition pit-run ballast, the following steps are necessary:

3.5.2.1. Skeletonize the track by stripping or by raising the track on the old ballast (Figure 3-3).

3-5.2.2. Remove the ballast from outside the track to the original depth of the ties.

3-5.2.3. Dress subgrade and widen cuts or fills wherever necessary. Maintain a 2:1 maximum slope, preferably 3:1 to facilitate maintenance.

3-5.2.4. Clean existing cross drains, or construct new ones; be sure they are deep enough to provide adequate drainage. Never locate cross drains at rail joints.

3-5.2.5. Distribute enough clean ballast to provide for the lift and width desired.

3-5.2.6. Resurface track to uniform grade.

3-5.2.7. Collect refuse material, and place it along slopes of fills.

3-6. Distribution of New Ballast.

Except where the distribution of new ballast is needed for an intended raise out-of-face, the track is surfaced before distribution of new ballast.

3-6.1. Dumping. Ballast is usually unloaded by dumping from hopper cars (Figure 3-4). It is unloaded by having one or more cars opened at a time, allowing the required amount of ballast material to flow out as the train is moved along slowly.

3-6.2. Spreading. The unloaded material should be leveled by means of a ballast plow or spreader. Care must be taken to hold to the established grade set for the new material. Hand methods require special attention to placement of ballast under the full tie length (Figures 3-5 and 3-6).

3-6.3. Tamping. Ballast must be well packed with hand tools or machines, Figures 3-7, 3-8, and 3-9.

3-6.4. Frogs, Guardrails, and Switches. At turnouts, remove all excess ballast from frogs, guardrails, and the movable parts of switches.

3-6.5. Trimming the Ballast. Ballast should be trimmed to conform to the standard ballast section (Figures 3-1 and 3-2), using an appropriate template. Slopes shown are preferred; however, conditions may require different slopes. The portion of the subgrade outside the ballast line should be left with a full, even surface and the shoulder of an embankment clearly defined and properly dressed to the standard road-

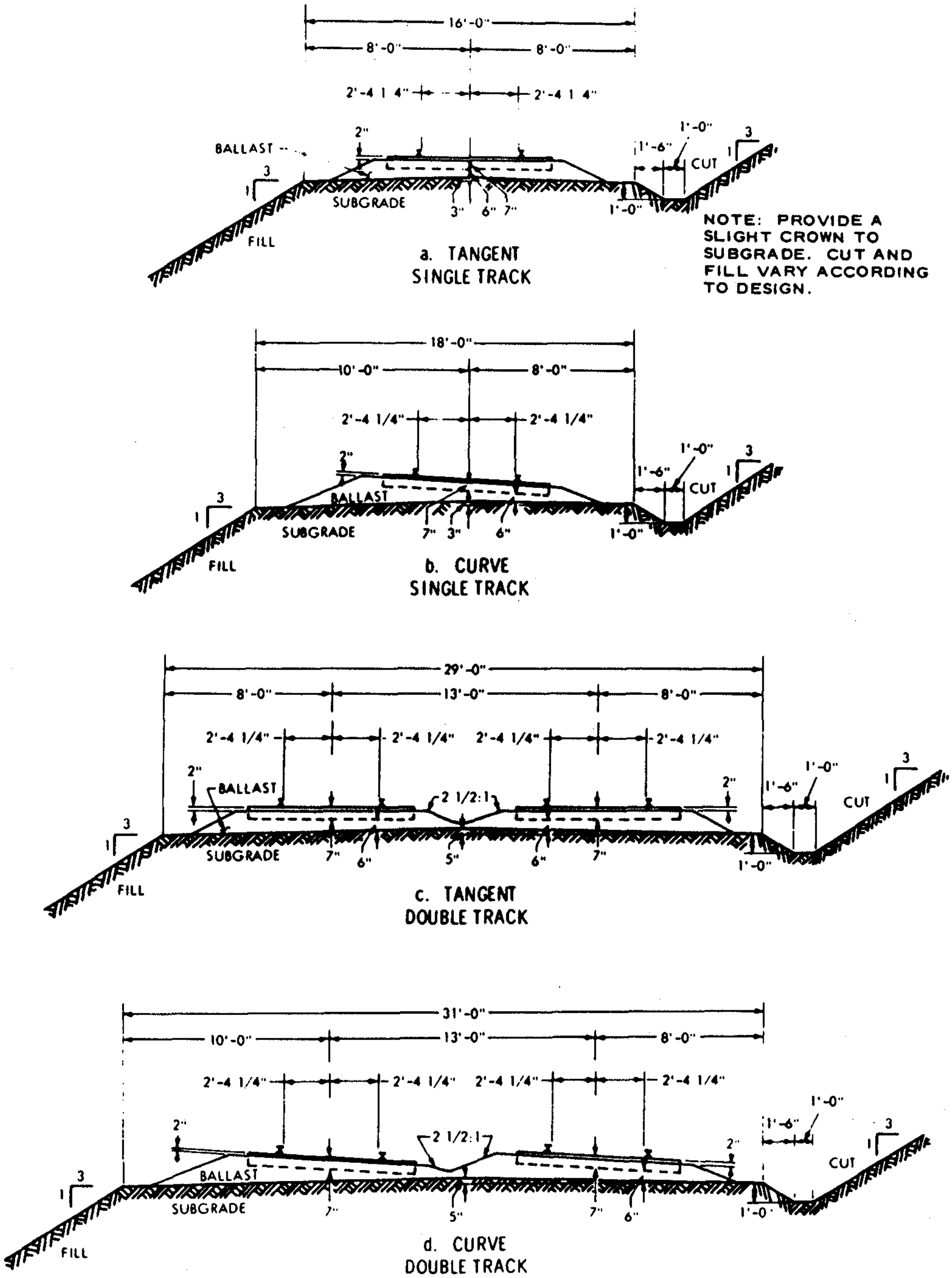


Figure 3-2. Details of standard ballast sections.

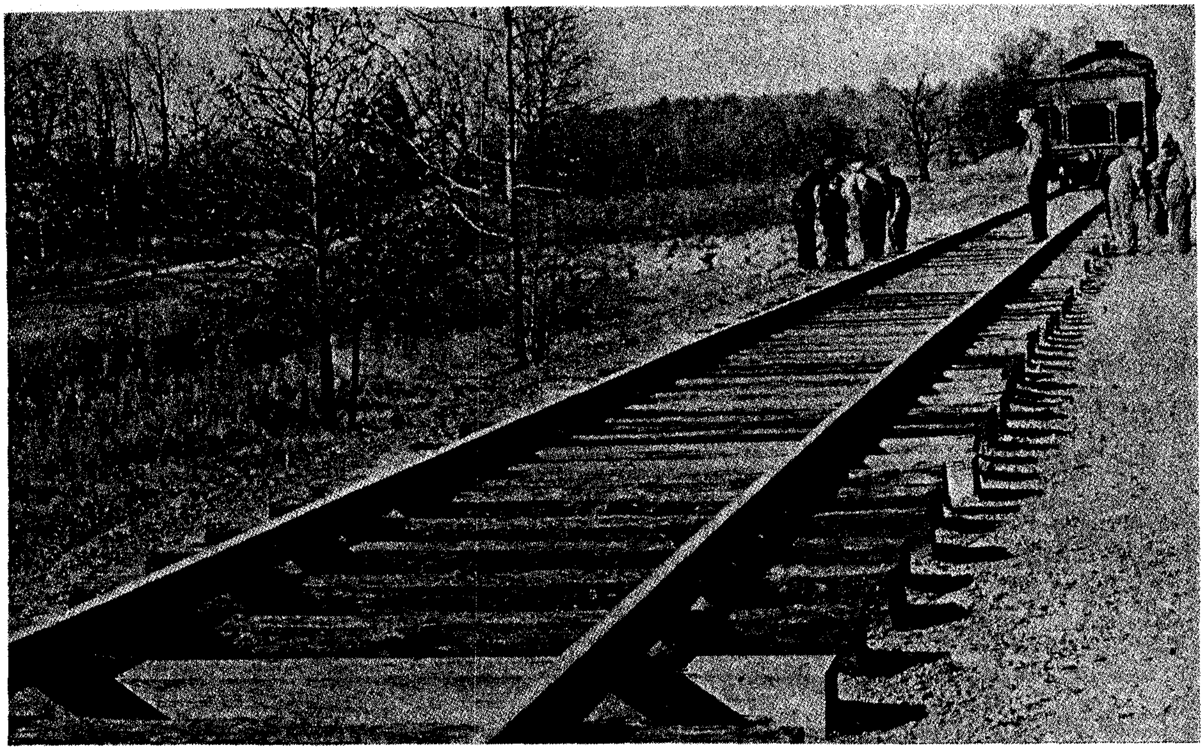


Figure 3-3. Track skeletonized to receive ballast.

way section. Clean or rake the berm. Surplus ballast left over from trimming should be disposed of in an appropriate area.

3-6.6. Cleanup. After the ballast is cleaned or renewed, remove all materials, tools, and equipment used to perform the work; install and secure promptly all stock guards, crossing planks, and similar facilities adjacent to or forming part of the track; and dispose of all rubbish and waste remaining from the operation. Do not litter the right-of-way.

Section 3. TIES

3-7. General.

Nearly all railroad trackage on military installations has been constructed on wood ties. The use of wood ties for most such trackage will be continued, but there are circumstances where the use of concrete ties may be warranted. Trackage constructed on concrete ties in recent years by several commercial railroads has indicated that some of the potential advantages of concrete over wood ties include longer in-use life, greater strength, and better ability to hold rails permanently in line and to gage.

3-8. Wood Ties.

The service life of wood ties depends on the kind of wood, the method of treatment, the mechanical protection afforded, the severity of use, and climatic conditions. The use of untreated wood ties can no longer be justified. Only treated wood ties are to be purchased or used. Design and specification of ties used in maintenance and repairs must conform to AREA Standards and/or Federal Specifications and should match the ties in existing adjoining work (see Appendix G).

3-8.1. Preservative Treatment. Pressure treatment with creosote has proved to be the most effective and practical preventive of decay (rot) and insects. Damage to wood fibers during spiking is less in treated than in untreated ties. Water repellance is better in treated than in untreated ties. Coal-tar creosote, solutions of wood-tar and coal-tar creosotes, and oil-borne solutions of pentachlorophenol are the most common preservatives used for wood ties. Pressure treatment is more effective than field treatment because preservatives applied under pressure penetrate the wood deeper and more uniformly than they do when applied in the field under no pressure. Consequently, field treatment is relied on only to

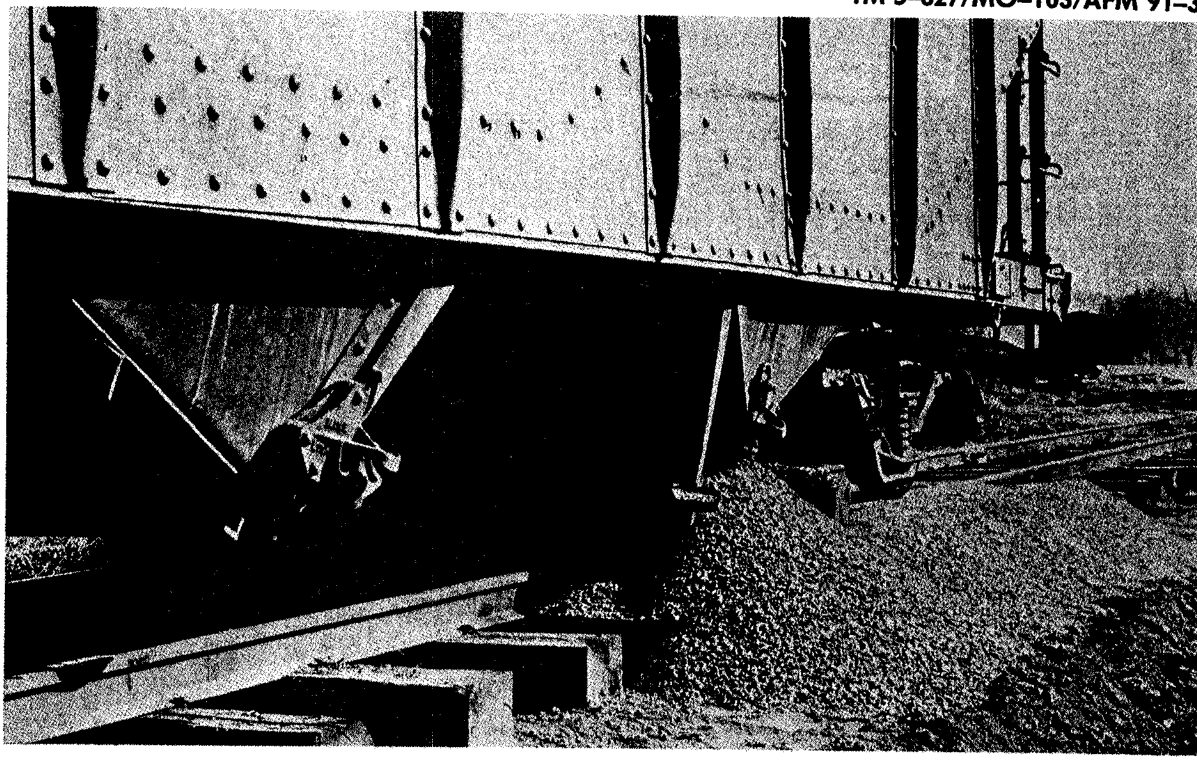


Figure 3-4. Distributing ballast from hopper car.

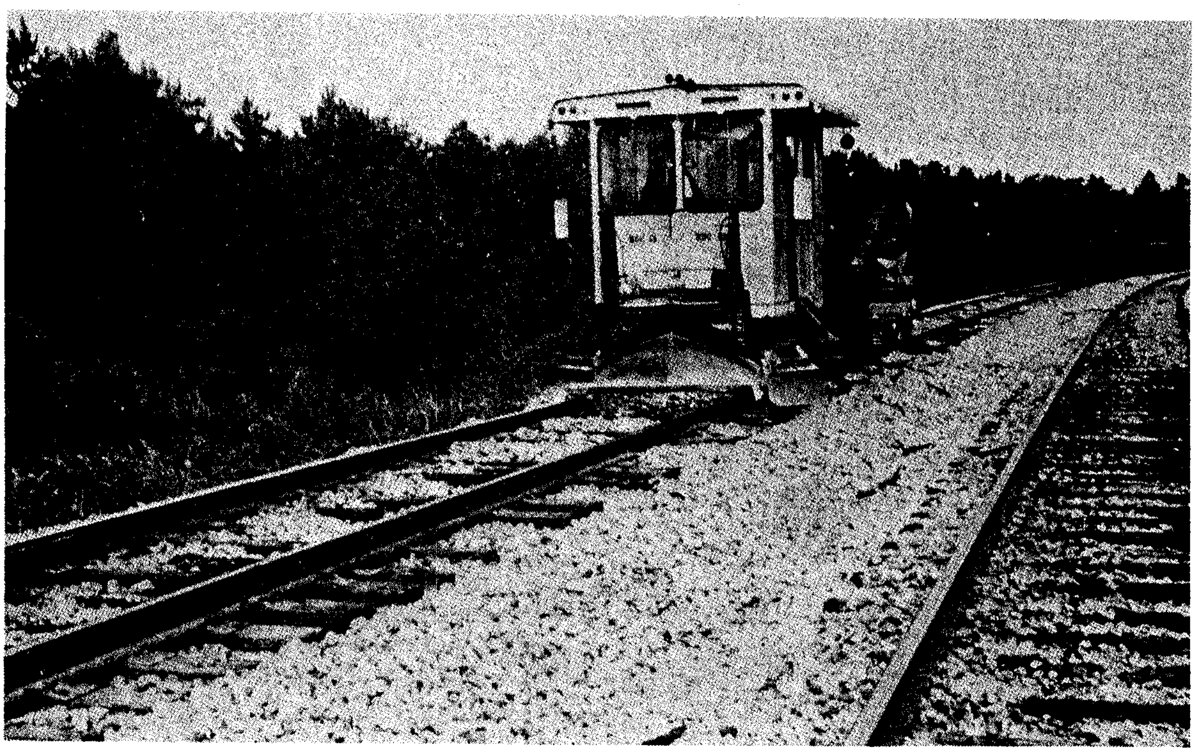


Figure 3-5. Ballast plow.

Figure 3-6. Hand-placing ballast after mechanical distribution.

Figure 3-7. Manually tamping ballast with compressed air tools.

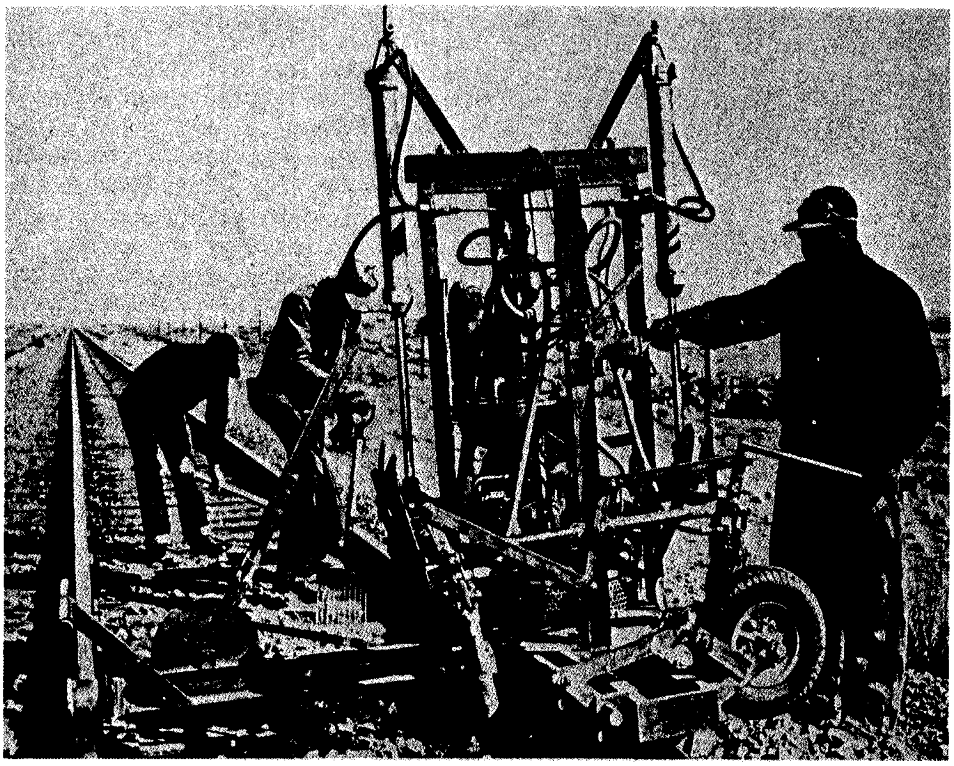


Figure 3-8. Machine tamping ballast.

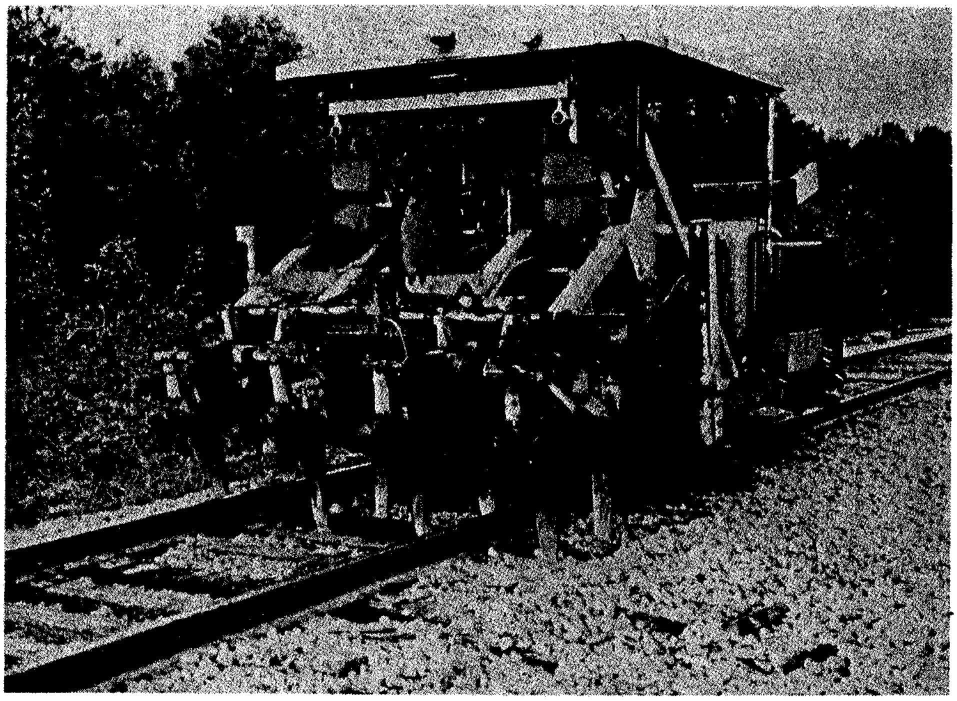


Figure 3-9. Large ballast tamping machine.

supplement pressure treatment; i.e., where it becomes necessary to penetrate the treated "shells" of pressure-treated ties by cutting, adzing or boring, etc.), the resultant exposed untreated wood is to be treated with field-applied creosote. Treating shall conform to the standards of the American Wood Preservers Bureau.

3-8.1.1. Any fabricating such as end trimming and, if required, adzing and boring or application of antisplitting devices (irons) (Figures 3-10 and 3-11 or dowels (Figure 3-12) should be performed before the ties are pressure treated. Seldom are the treated shells of such ties damaged while being properly handled and placed. Where the pressure-treated shells are unavoidably damaged, field-applied preservative is to be provided.

3-8.1.2. Because switch ties are not of uniform length (Figure 2-13) and because the locations of switch components cannot be predicted, switch ties are not adzed or bored before pressure treatment. The prefabrication of switch ties should consist of cutting and installation of antisplitting devices only. The field adzing and boring of switch ties is to be followed by carefully applied field preservative treatment.

3-8.1.3. The field treatment is to consist of two applications of hot creosote. On flat untreated surfaces (where ties have been adzed or cut), the material shall be brush applied. Unused bored holes or spike holes are to be filled with tight-fitting, soft wood, treated plugs firmly driven into the holes.

3-8.2. Handling Wood Ties. Broken, bruised, gouged, and otherwise damaged ties are the result of careless handling. Ties are not to be unloaded by dropping or throwing them onto rails, rocks, or hard or paved surfaces. Ties handled with tongs suffer less damage than ties handled with bars or sharp tools. Figures 3-13 through 3-16 illustrate the proper method of handling wood ties. The proper manner in which wood ties are to be stacked when they are not to be used immediately is shown in Figure 2-15 (para 2-4). Stacks of ties in areas exposed to sparks or other fire hazards can be protected by covering the stacks with earth or sand.

3-8.3. Safety. Creosote is a skin irritant, and splinters are a constant hazard in the handling of ties. All personnel who handle ties must wear appropriate gloves (Figure 3-16). Other common hazards are the dropping of ties and other heavy objects and tripping over tools and supplies. All personnel exposed to these hazards will wear safety shoes.

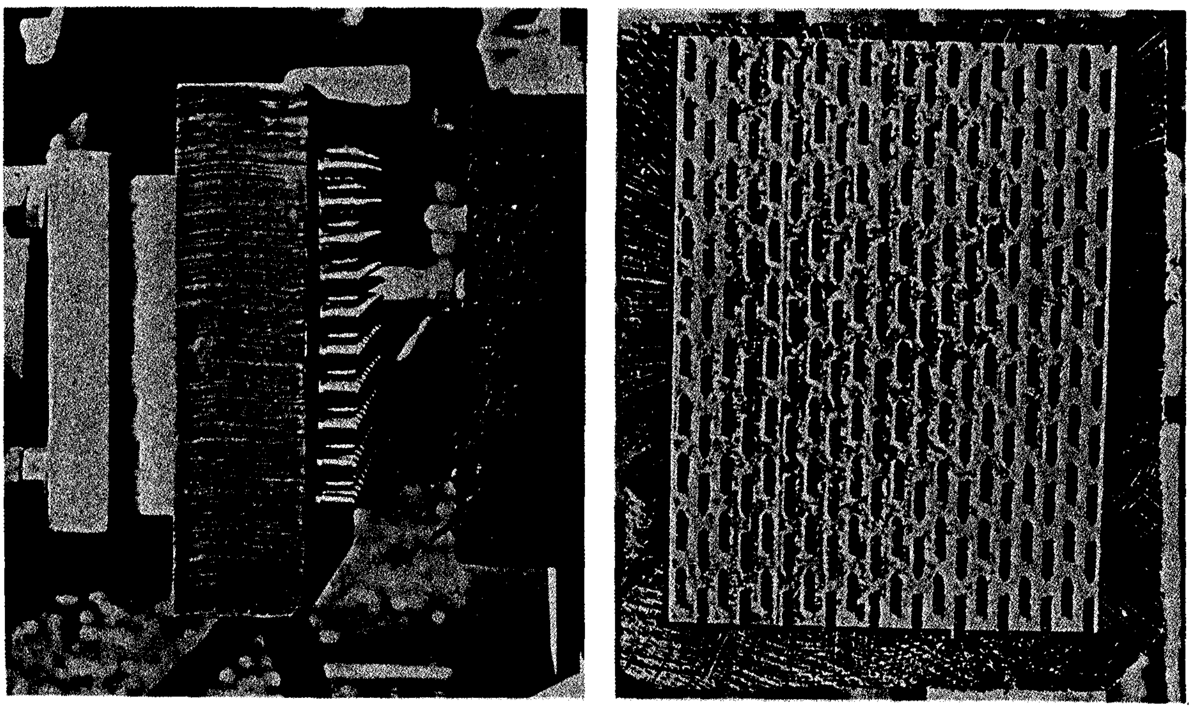


Figure 3-10. Antisplitting device.

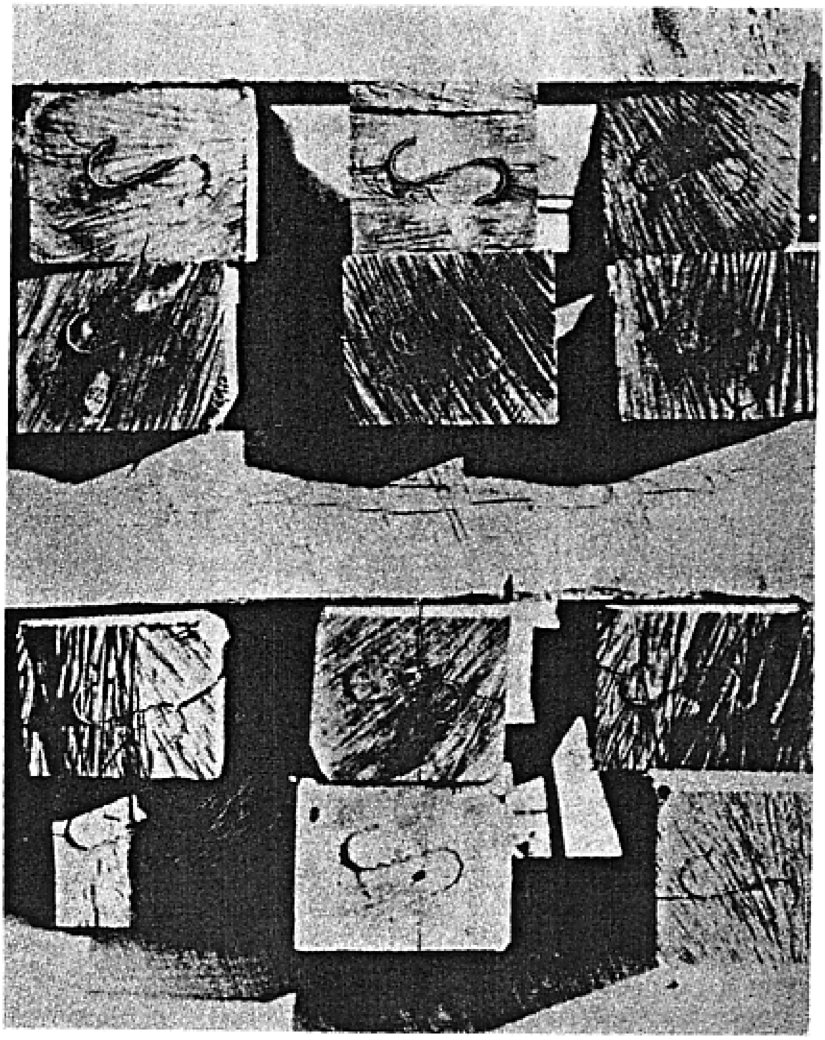


Figure 3–11. Antisplitting irons installed in ties.

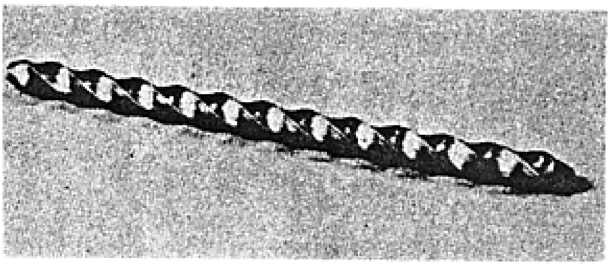


Figure 3–12. Tie dowel.

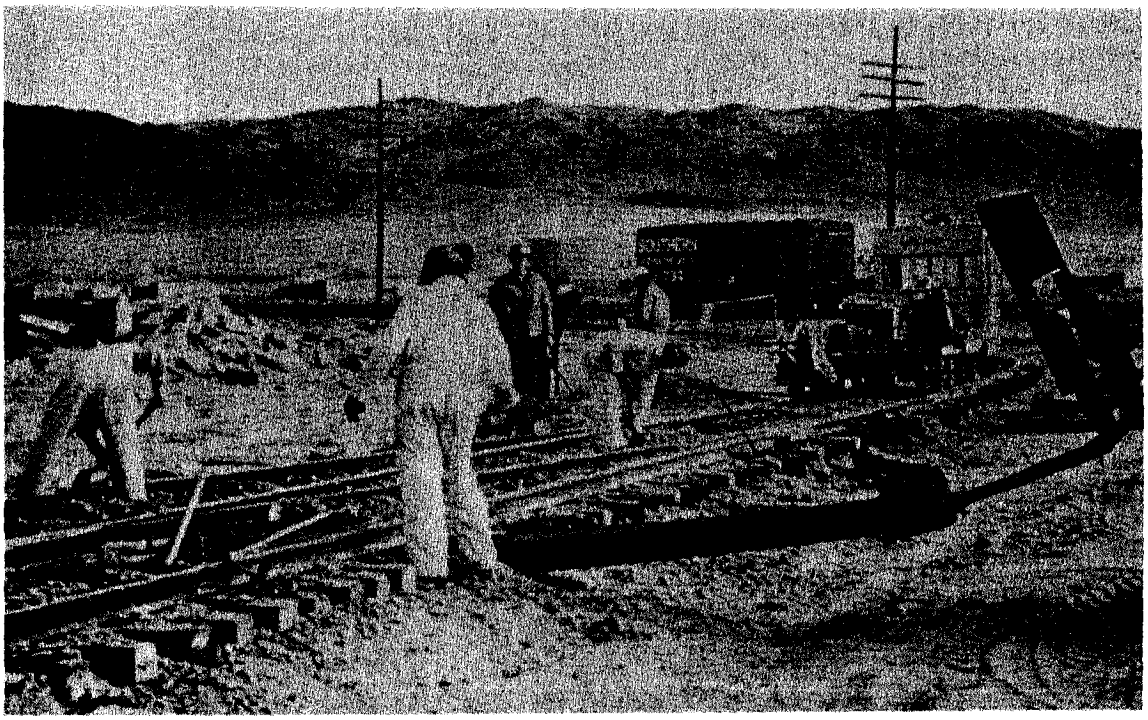


Figure 3-13. Typical switch tie installation.

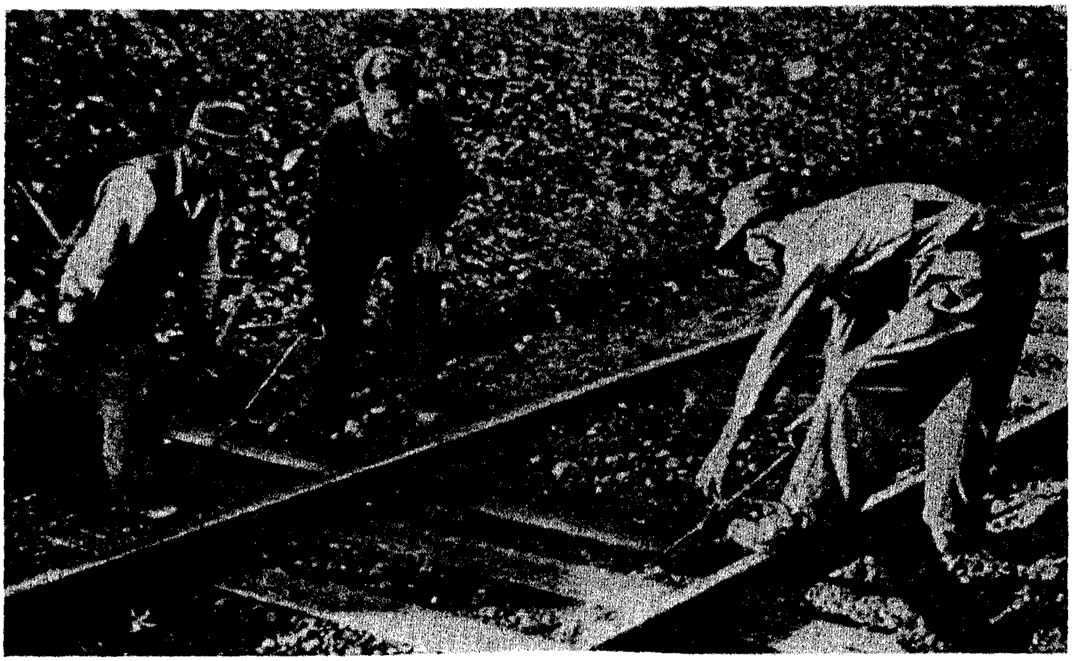


Figure 3-14. Installing ties with hand tools

Figure 3-15. Installing ties with a tie crane.

Figure 3-16. Handling treated wood ties.

3-9. Ties Other Than Wood.

Decisions on the use of ties other than wood are to be made by a qualified authority and shall be based on comparative cost estimates reflecting all factors. The longer in-use life of concrete ties may justify their use in areas where tie inspection and maintenance work entail pavement removal, or at critical locations where track maintenance work results in serious operational problems (i.e., crossings, paved streets, paved industrial areas).

3-9.1. Concrete and Composite Tie Data. The Federal Specification covering concrete and composite ties has not been completed. Meanwhile, specifications for the ties will be developed for individual installations by those responsible for engineering at the military installations or at the offices of higher echelons of the engineering elements of the Departments of the Army, the Navy, and the Air Force.

3-9.2. Other Material. Ties made of composite materials and other state-of-the art-materials leading to tie substitutes may be used as available and proven in service.

3-9.3. Handling Concrete Ties. Workmen must wear appropriate safety shoes when handling ties. All ties shall be unloaded and loaded mechanically. Figure 3-17 illustrates the proper method for unloading concrete ties. Where ties must be stacked, they shall be stacked mechanically. No ties shall be loaded, unloaded, or stacked by hand. Because each concrete tie weighs nearly 500 pounds, all ties are to be moved from the unloading area or from stacks to the work sites by rail or truck. After the ties have been distributed and placed mechanically as close as possible to their final position, then and only then are they to be manhandled into position in the track work.

3-10. Tie Sizes.

Current tie inventories at some military installations include wood ties of nonstandard dimensions. Such ties are to be used generally on side tracks and spurs, not on running tracks. Future purchases are to include only standard sizes of ties.

3-10.1. Wood Crossties. Wood crosstie dimensions for military trackage should be selected based on the

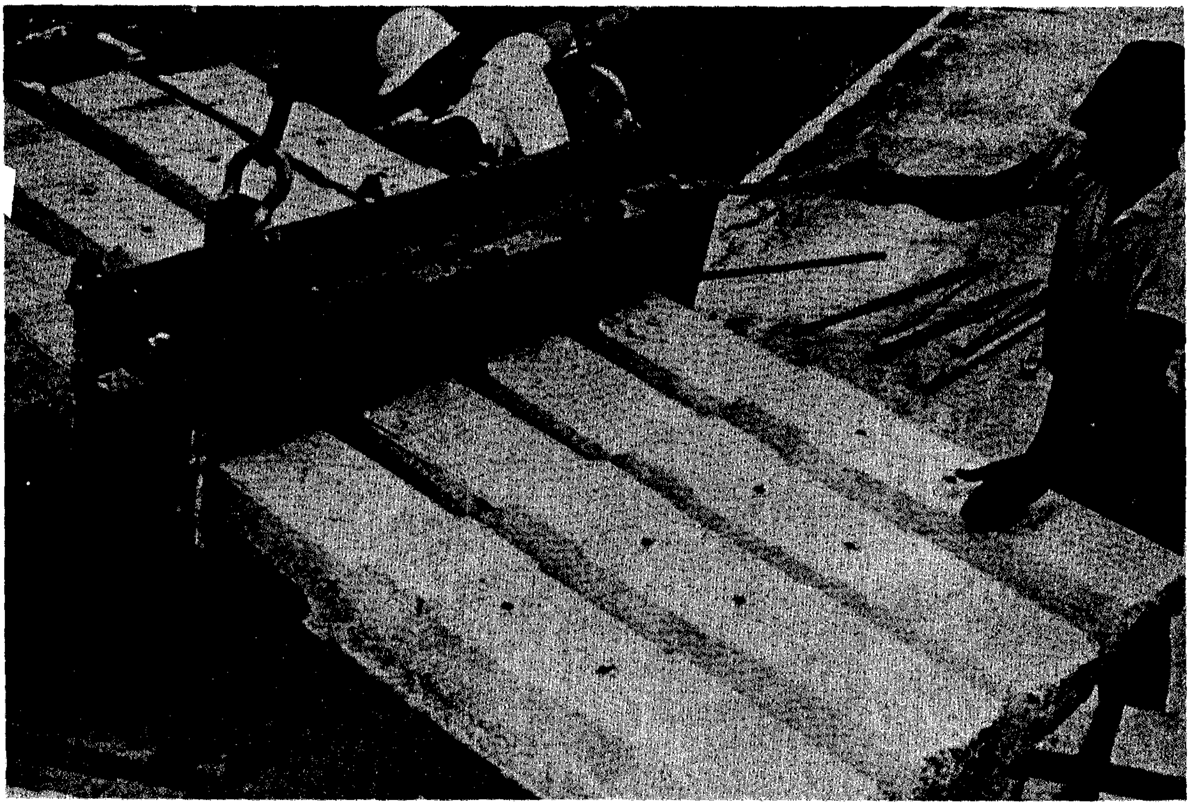


Figure 3-17. Handling concrete ties.

trackage category (para 1-10). Ties for running and access tracks should be at least 7 inches thick, 8 inches wide, and 8 feet 6 inches long. Ties 6 inches thick, 7 or 8 inches wide, and 8 feet long may be used for low-use trackage. In addition, ties 7 inches thick, 9 inches wide, and 9 feet long should be used where warrented, in accordance with AREA recommendations and this manual (para 4-11). Cross-sectional tie dimensions apply between 20 and 40 inches from the center of the tie.

3-10.2. Wood Switch Ties. Wood switch tie cross sections are 7 by 9 inches. The bill of materials in Figure 3-18 lists the lengths of 7- by 9-inch ties specified by AREA for No. 5 through No. 20 turnouts.

3-10.3. Wood Bridge Ties. The lengths of wood bridge ties are determined by the design of the bridge on which they are to be used. Normally, the minimum length is 10 feet, and the minimum cross section is 8 by 8 inches.

3-10.4. Concrete Crossties. The minimum length of concrete crossties is 8 feet 6 inches. Figure 3-19 shows a typical concrete tie. The dimensions of concrete ties may vary slightly between the products of different suppliers but will conform generally to the same configuration.

3-10.5. Concrete Switch Ties. Concrete switch ties are not currently available.

3-10.6. Concrete Bridge Ties. Standard concrete crossties may be used as bridge ties, *when approved by qualified engineering authority*.

3-11. Tie Replacement and Reuse.

In general, ties should not be replaced until decayed or mechanically worn beyond serviceability for the purpose intended. However, where general track reconditioning (ballast and rail removal) is under way, consideration should be given to replacing ties that are near the end of their serviceability so that the track need not be disturbed again in the near future. Installation of used ties is normally confined to light-traffic or temporary lines, sidings, and dead-storage tracks. Replacement usually is considered in the following order of priority: (1) running or access tracks, (2) classification yard, and (3) siding and storage tracks.

3-11.1. Spot Replacement. Spot replacement is the replacement of an occasional defective tie or a small group of ties (no more than 10 or 10 percent of the ties) from a length of track in which all the other ties are in satisfactory condition.

3-11.2. General Replacement. General replacement involves a larger number of ties (over 10 percent) from a length of track in which only occasional ties or small groups of ties are in satisfactory condition.

3-11.3. Identifying Defective Ties. Tie replacement will be made only after tie inspections have been completed and defective ties marked (Figure 3-20 and 3-21) for removal. Chapter 7 of this manual and the FRA Track Safety Standards (Appendix B) describe defective ties. Due to the movable parts at switches, the switch ties must be maintained in better condition than the crossties. Ties under the

Figure 3-19. Typical concrete tie.

Figure 3–20. Spot marking ties for removal.

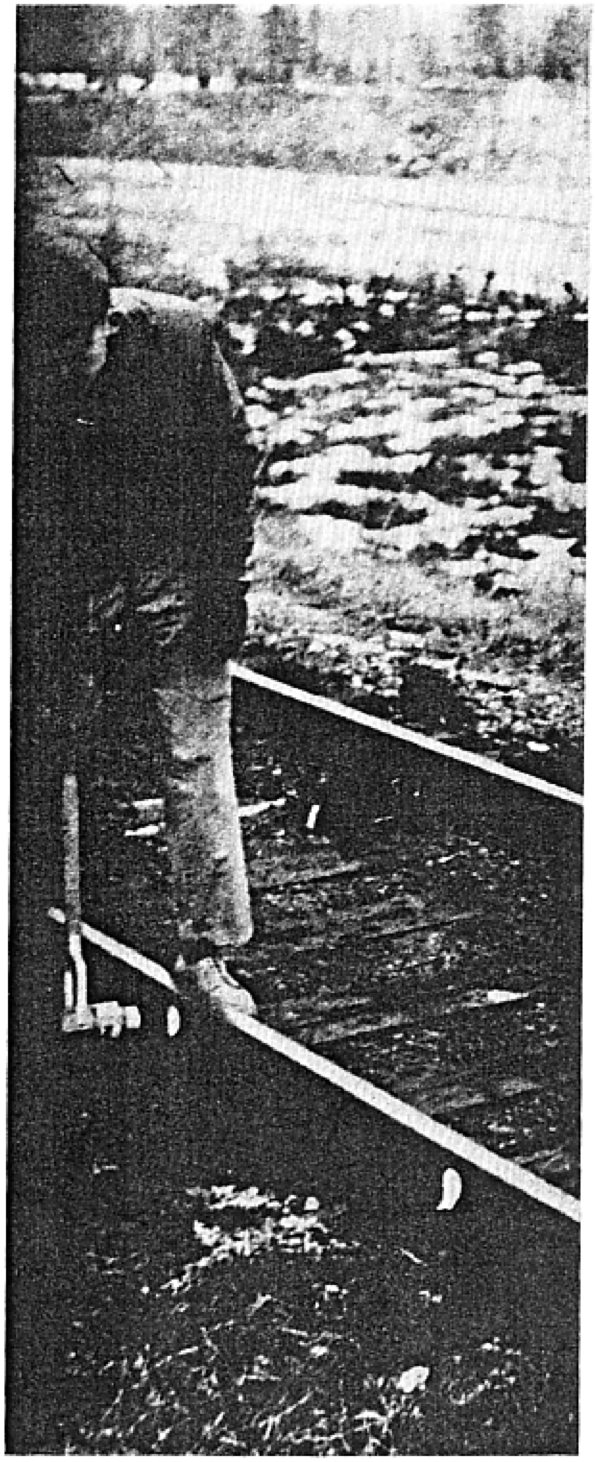


Figure 3–21. Spot marking rail with paint.

switch points and at the frog should never be allowed to reach the condition of crossties for Class 2 track. Only ties marked for removal will be replaced. Replacement ties shall be inspected prior to installation for compliance with applicable AREA Standards and/or Federal Specifications and for damage or deterioration while in storage or while being handled.

3-11.4. Tie Spacing. Tie quantity and spacing is based on roadbed conditions, trackage category, rail size, anticipated load, and experience or engineering judgement. Installation criteria for new construction and rework trackage should be specified for each section of trackage based on current instructions, design standards, need, and economics.

3-11.5. Spacing for Spot Replacement. For spot replacement of wood with wood ties, spacings will not be changed. However, the face-to-face separation between ties shall be at least 10 inches, but less than 16 inches. Skewed ties shall be straightened.

3-11.6. Spacings for General Replacement. When replacing wood with wood ties, standard spacings should be as designed: 22 to 24 ties per 39 feet of running track, and 20 to 22 ties per 39 feet for low-use trackage. In no case shall less than 18 ties per 39 feet be present in any section of trackage. Tie-spacing gages will be used except where variations in wood tie cross sections and placement make its use impractical. Figure 3-22 illustrates such a gage welded to a shovel. Proper spacings for concrete ties are to be determined by a qualified engineer.

3-11.7. Skewed Ties. A skewed tie is one having an axis other than perpendicular to the rails (except turn out rails). Skew distance, as shown in Figure 3-23, is measured along the base of a rail on the gage side. Measurements of skew distance may be made while checking gage; however, a visual check at any trackage system is adequate. Spotting ties that are over half the width of a tie out-of-line can be easily done while walking or riding over the trackage system. Single skewed ties are not serious. Sections of trackage with skewed ties indicate a problem area that should be investigated.

3-11.8. Alignment of Ties. When placing standard length wood ties in double tracks, align the outside ends of ties. For three or more tracks, align the outside ends of ties with the outer tracks; align the ties of inner tracks the same as for single track. For single track, align the east ends of ties of north-south tracks, and the north ends of east-west tracks. Under-length wood ties shall be centered under the track.

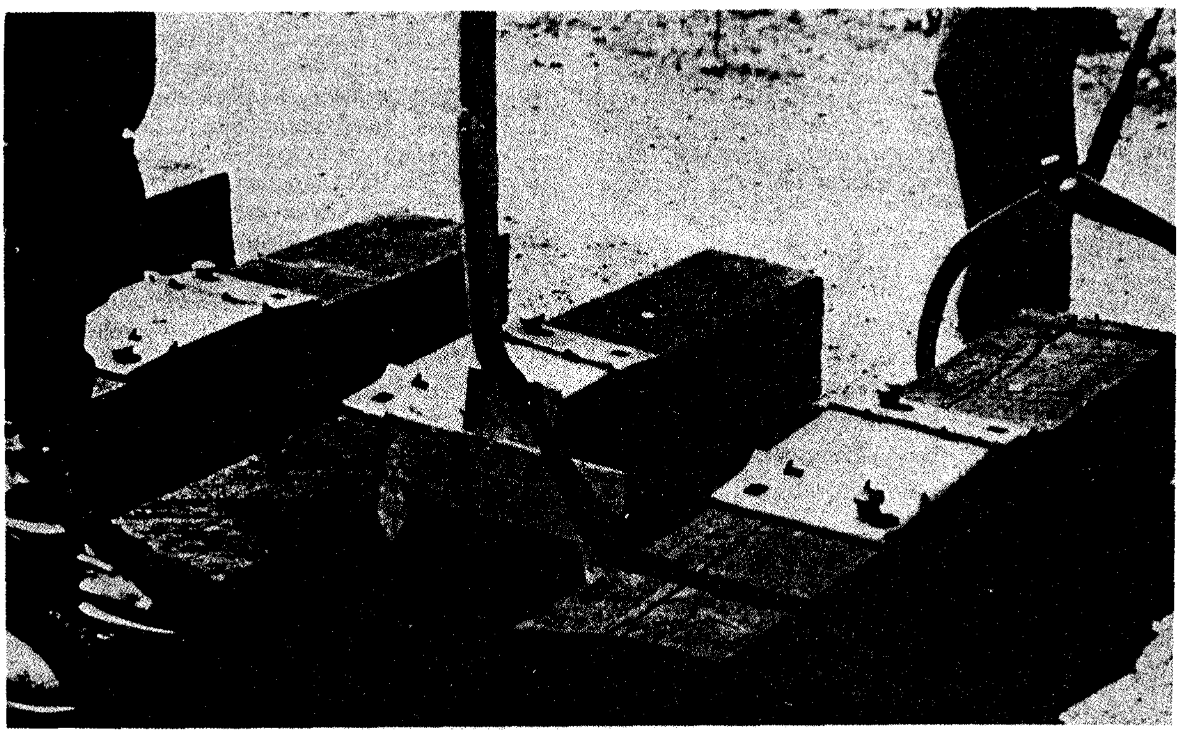


Figure 3-22. Tie spacing gage welded to shovel.

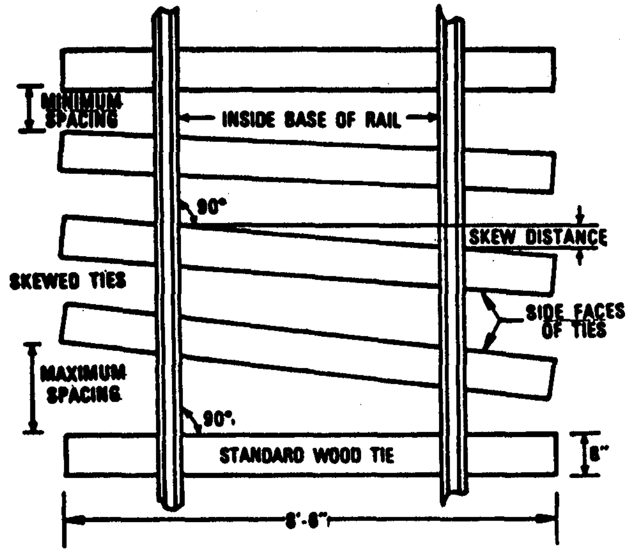


Figure 3-23. Railroad tie terminology and identification.

3-11.9. Procedures for General Tie Replacement. Traffic volume and the availability of alternate trackage may dictate replacement procedures. When a track can be removed from service without interrupting functions, a complete removal and replacement program is recommended. Verify and reference line and grade of existing trackage and remove the rail and ties. As in new construction, grade the ballast; salvage excess ballast; set the replacement ties and rail; and bring the track to proper alignment, grade, and surface. If the track cannot be removed from service, replace as many ties at one time as traffic permits.

3-11.10. Procedures for Spot Replacement. The following guidelines are applicable to the usual spot replacement programs:

3-11.10.1. After removing spikes, remove sufficient ballast from the crib to permit easy removal of the tie, pull the tie, and dress the roadbed.

3-11.10.2. Insert the replacement tie, accurately spaced and at right angles to the rail.

3-11.10.3. When replacement ties are wood, use the largest and best ties at rail joints. The distance from rail joint to the face of either adjacent wood tie shall not be more than 12 inches. Intermediate ties shall be evenly spaced.

3-11.10.4. Wood ties shall be laid heart-side down.

3-11.10.5. Spike wood ties to the rails at proper gage. Bolt concrete ties to the rails after placing the bearing pads.

3-11.10.6. Tamp ballast under the ties.

3-11.10.7. Avoid raising the track because ballast may run under adjacent ties. Instead of raising track, remove a little more ballast from under the tie being removed to facilitate the placement of the new tie.

3-11.10.8. Tamp under adjacent ties where one tie shows evidence of being cut by the rail base. The adjacent ties will then carry more of the load.

3-11.10.9. Tie plates will be used on running or access and heavy-use classification yard trackage. Tie plates are not required on temporary trackage except over bridges, trestles, or culverts and on curves sharper than 8 degrees (maximum radius 717 feet).

3-11.10.10. Avoid adzing ties. Adjust and tamp ballast to lower high ties. Where adzing is unavoid able, where different tie plates must be used, or where adzing is required to correct tie damage from a derailment, adze only the minimum depth. Then make a field application of preservative.

3-11.10.11. Fill unused spike holes with treated soft wood plugs, firmly driven into the holes.

3-11.10.12. Salvage all sound ties, spikes, and tie plates for appropriate reuse. Dispose of unsound ties and unusable materials.

Section 4. RAILS AND ACCESSORIES

3-12. General.

Design and specifications for rails and accessories should be in accordance with AREA Standards (Chapter 2, Section I). In repair and maintenance work it is important to match existing design of materials and construction wherever it is economically justifiable. In cases of individual rail replacement, where the existing rail does not meet the standard criteria listed herein and where the remaining track is performing satisfactorily, the same size rail should be installed. Rails must be connected at the joints so that the rails will act as a continuous girder with uniform surface and alignment. Rails and accessories obtained from suppliers or storage should be inspected before they are placed in track.

3-13. Rail Sections.

3-13.1. Standard Railroad Rail. Most of the existing substandard trackage at military installations consists of the 30- or 33-foot rails (Figure 2-1, para 2-3.1.). Rails required for replacement of worn or substandard trackage should normally be 39 feet long unless there is sufficient justification for using the shorter rail. The 90-lb/yd RA-A section, in 39-foot lengths, is satisfactory for most military installations except when wheel loading or spacing of supports require heavier rail. Heavier rail sections will be routinely used only to meet minimum requirements of the serving railroad when their locomotives are used on the installation. When it becomes necessary to relay the existing 90-pound or lighter rails on running or access tracks and it is desired to use 115-pound rail, approval must be secured from the appropriate military service headquarters.

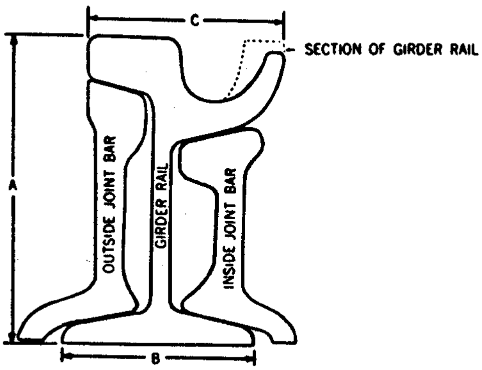
3-13.2. Ground-Level Crane Rail. Ground-level crane rail should be at least 135-pound CR for major replacement or new installations.

3-13.3. Elevated Crane. The rail section to be used shall be that which has been recommended by the crane manufacturer or equivalent to the existing rail. Rail sections shall accommodate all crane wheels.

3-13.4. Girder Rail. Rails of the street-railroad type, with deep webs, heads, and flangeways, are often used for trackage in pavement (Figure 3-24). (Figure 4-23 in Chapter 4 shows an installation of girder rail in a paved area.) Flangeways 2-1/2 inches wide shall be provided on tangent track and on curves of 8 degrees and under, and flangeways 2-3/4 inches wide on curves in excess of 8 degrees.

3-14. Rail Inspection.

All rails should be periodically checked. Some types of defects may be detected visually, and some by hitting the top of the rail with a hammer. Internal defects require the use of some type of electronic device to determine the type of defect. Figure 3-25 shows a sonic detector that can be used to detect defects within the joint bar area. A small ultrasonic tester is shown in Figure 3-26. Fissures are detected by a magnetic induction process.



R E SECTIONS

WEIGHT OF RAIL LB	A	B	C
128	7"	6"	6"
149*	7"	6"	6 1/8"
159	9"	5 3/4"	5 7/8"
174	9"	5 3/4"	5 7/8"

*GIRDER GUARDRAIL TO BE USED OPPOSITE GIRDER RAIL FROG

Figure 3-24. Details of girder rail.

Figure 3-25. Inspecting rail for flaws with a sonic detector.

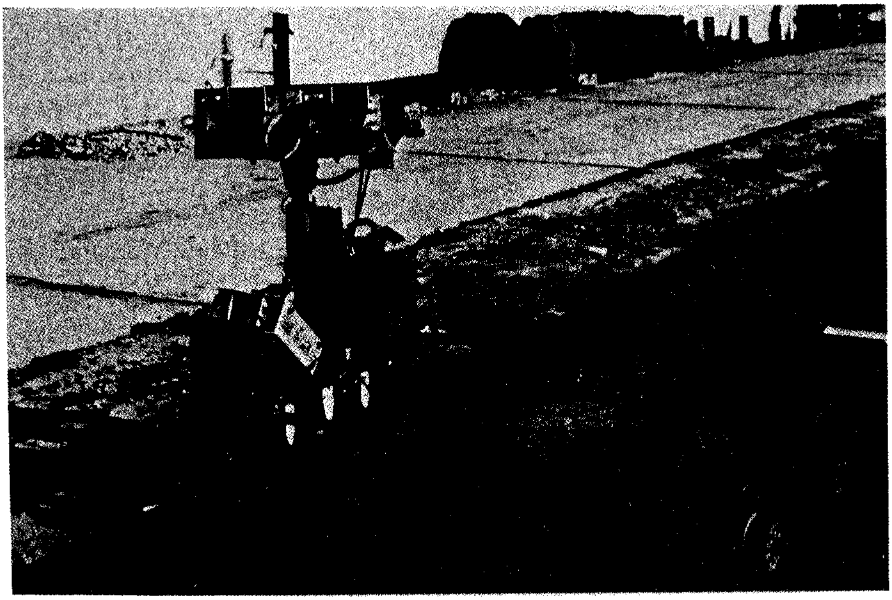


Figure 3-26. Ultrasonic rail detector.

3-15. Rail Failures.

Rails that are damaged to the extent of being hazardous to traffic should be replaced promptly. This applies particularly to locations such as switches, trestles, and the like where derailment might occur. Broken rails must be replaced immediately in any part of a track. Common causes of damage to rails are derailments, sliding wheels locked during braking, broken, flat, or unbalanced wheels, and stiff or unmoving trucks. Internal fissures can be detected only through the use of an ultrasonic testing device or some other type of rail flaw detector.

3-16. Common Rail Defects.

Figure 3-27 shows graphic examples of the following defects. Appendix B and Chapter 7 give additional descriptions, acceptable limits, and remedial actions to be taken.

3-16.1. Transverse Fissure. A transverse fissure is a crosswise break in the railhead, starting from a center or nucleus inside the head and spreading outward. The broken rail shows a smooth area around the nucleus, which may be either bright or dark, round or oval (Figure 3-27a).

3-16.2. Compound Fissure. A compound fissure is a horizontal split in the railhead that in spreading turns either up or down in the head (Figure 3-27b).

3-16.3. Horizontal Split Head. A horizontal split head is a horizontal break beginning inside the head of the rail and spreading outward; it is usually indicated on the side of the head by a lengthwise seam or crack or by a flow of metal (Figure 3-27c).

3-16.4. Vertical Split Head. A vertical split head occurs through or near the middle of the head. A crack or rust streak may show under the head close to the web, or pieces may split off the side of the head (Figures 3-27d and 3-28).

3-16.5. Crushed Head. A crushed head is a flattening or crushing down of the head (Figure 3-27e).

3-16.6. Split Web. Split webs are lengthwise cracks extending into or through the web (Figure 3-27f and g).

3-16.7. Piped Rail. A piped rail is a rail split vertically, usually in the web (Figure 3-27h).

3-16.8. Broken Base. A broken base is illustrated in Figure 3-27i.

3-16.9. Square or Angular Break. Square or angular breaks are illustrated in Figures 3-27j and 3-29).

3-16.10. Broken Base and Web (Bolt Hole Break). A broken base and web is a break in the web extending to the base (Figure 3-30).

3-16.11. Other Defects. In addition to the defects listed above, flaking, slivers, flowing, engine burn, mill defect, bolt hole crack, and top and side wear of the head are shown in Figure 3-27k-4. Most of these are considered minor.

3-17. Replacement of Rails.

Where rails are to be replaced or interchanged, the following rules apply:

3-17.1. Inspection. Before placing any rail in track, inspect it thoroughly for possible failures and defects.

3-17.2. Salvage. Do not place badly worn rails in running tracks; save them for use in storage tracks. Reject rail that cannot be straightened.

3-17.3. Curve-Worn Rails. Reset curve-worn rails with the worn side facing away from the gage side. On curves, use the worn rail as the low or inside rail. CAUTION: This type usage is not recommended as changes in stress can cause failure.

3-17.4. Weight and Section. Match weight, section, and amount of wear of adjacent rails as closely as practicable. Do not connect rails with full heads to rails with worn heads where the gage of track at the joints would be altered appreciably.

3-17.5. Compromise Joints. When, by necessity, rails of different weights or sections are connected, use compromise bars to match the weights and sections of the two rails (Figure 2-3). Compromise joints are either right-hand or left-hand. To determine which is needed, refer to Figure 3-31. If large rail is on your left, the joint is left-hand; if on your right, it is right-hand.

3-17.6. Length of Rail. Do not use rails less than 13 feet long in running or access tracks, in classification or receiving yards, or where there is considerable movement of cars. Reserve such rails for dead storage tracks or extreme ends of stub tracks.

3-17.7. Broken and Cracked Rails. Remove broken or cracked rails from track immediately. If it is not feasible to replace the broken rail at once, use a pair of fully bolted joint bars at the break as an emergency measure. Remove the broken or defective rail as soon as possible.

3-17.8. Drilling Bolt Holes. Drill or punch the full number and correct size of bolt holes to coincide with the holes in the joint bars used. Hold joint bars in place with rail or C-clamps while the bolt holes are drilled, to insure correct spacing (Figure 3-32).

3-17.9. Traffic Precautions. If a rail is broken or defective and safety at normal speeds is questionable, give "slow" orders (Figure 3-33) for that section of track and move trains under direction of a flagman. Never use these measures at hazardous locations; stop traffic until defective rails are replaced.

3-17.10. Cutting Rail. As soon as possible, remove rails that have been cut with an acetylene torch to make a temporary closure. Cut off at least 6 inches of the torch-cut end of the rail with a rail saw (Figure 3-34) or cutting tool before using the rail in track again.

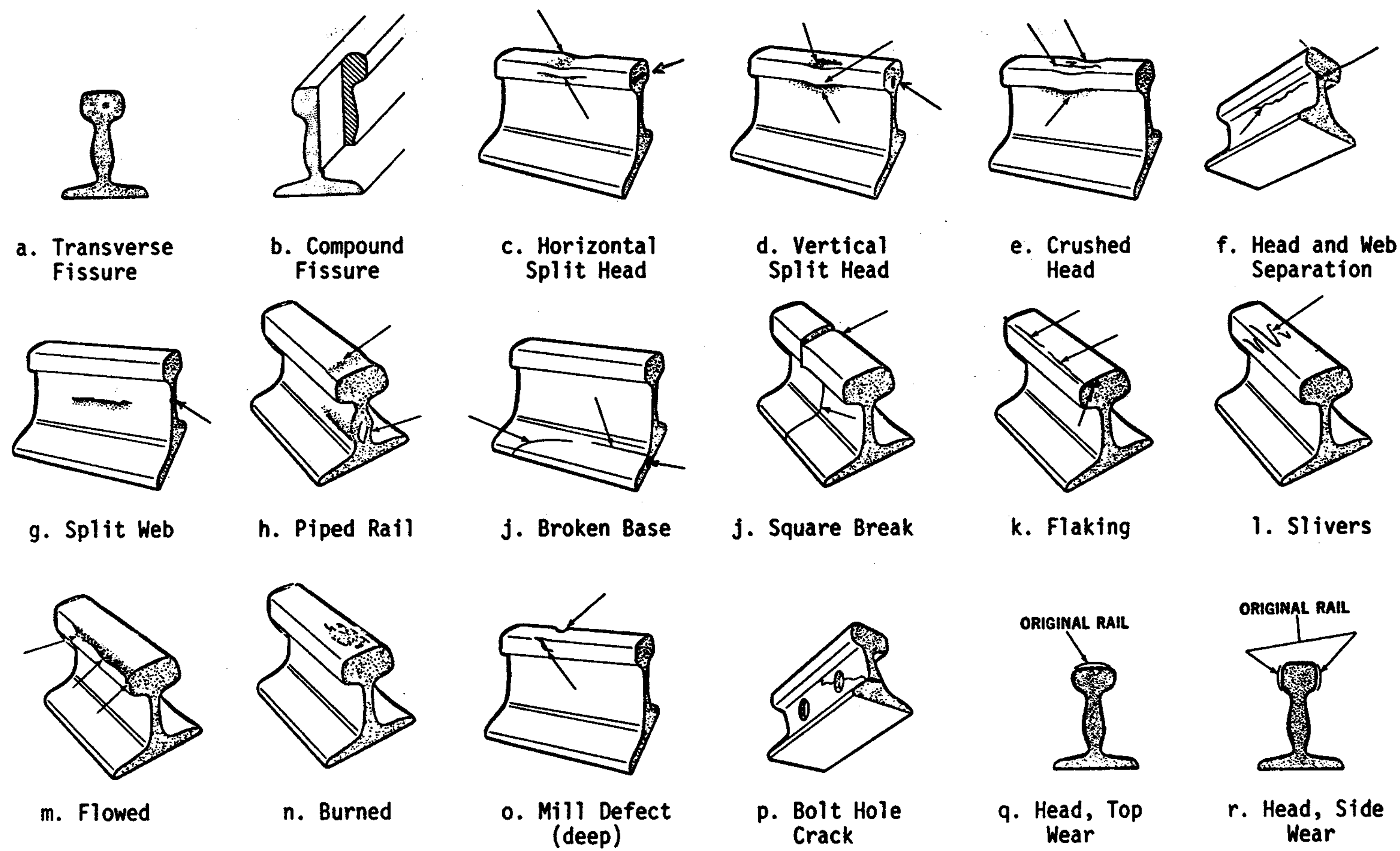


Figure 3-27. Types of rail failures.

Figure 3-28. Vertical split head.

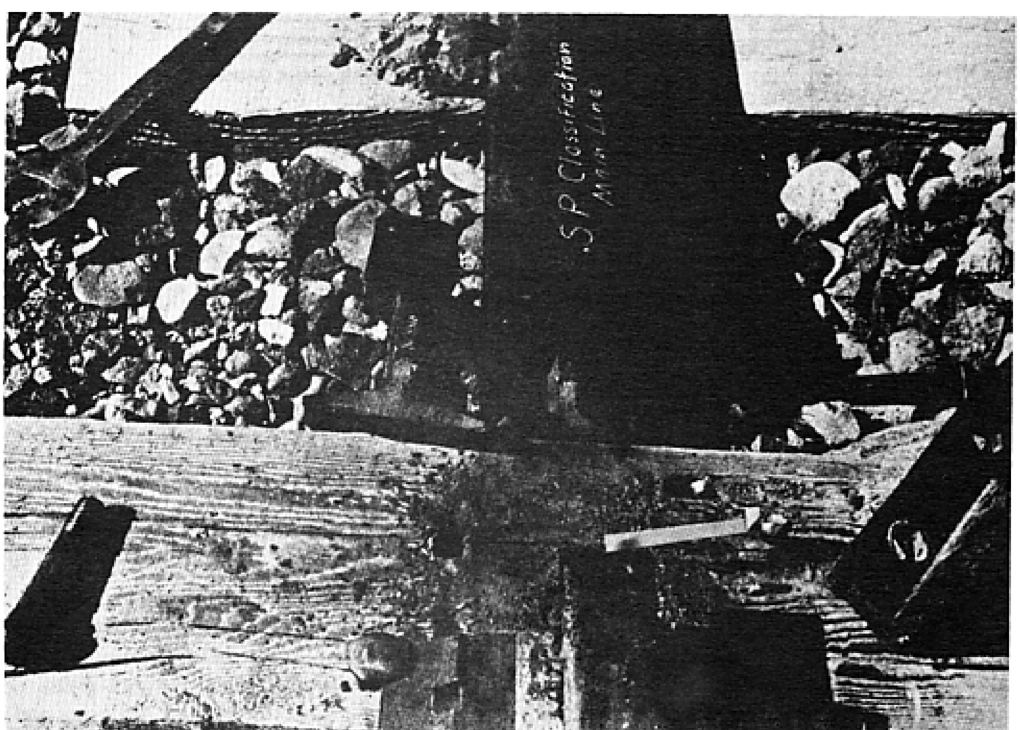


Figure 3-29. Square break in rail.

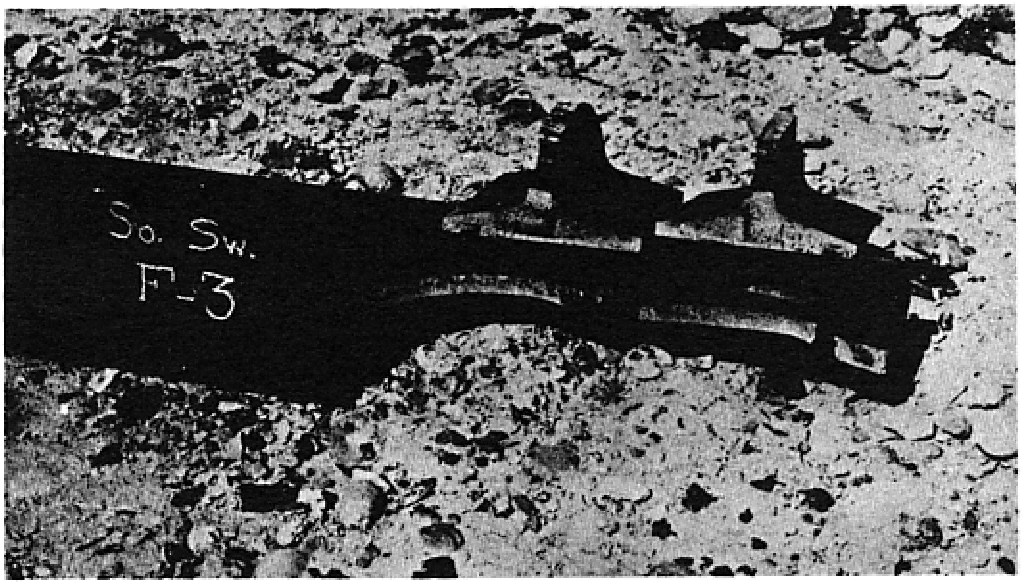


Figure 3–30. Broken base and web.

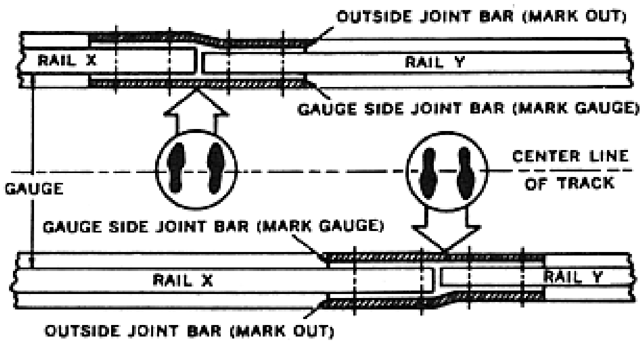


Figure 3–31. Compromise joint identification.

3–18. Welded Rail Replacement.

In continuous welded rail, a minimum of 13 feet shall be maintained between welds or joints. The method of welding shall be the preheated thermite process or another approved procedure. Joint bars are required on welded rail when there are existing bolt holes in the rail. Joint bars are mandatory if there are bolt holes in either piece of rail being used in new or replacement work. Existing rail holes (not at the ends), such as bolt holes and old gage rod holes may be maintained as is, provided there are no other potentially serious defects in the immediate area.

Figure 3-32. C-clamp.

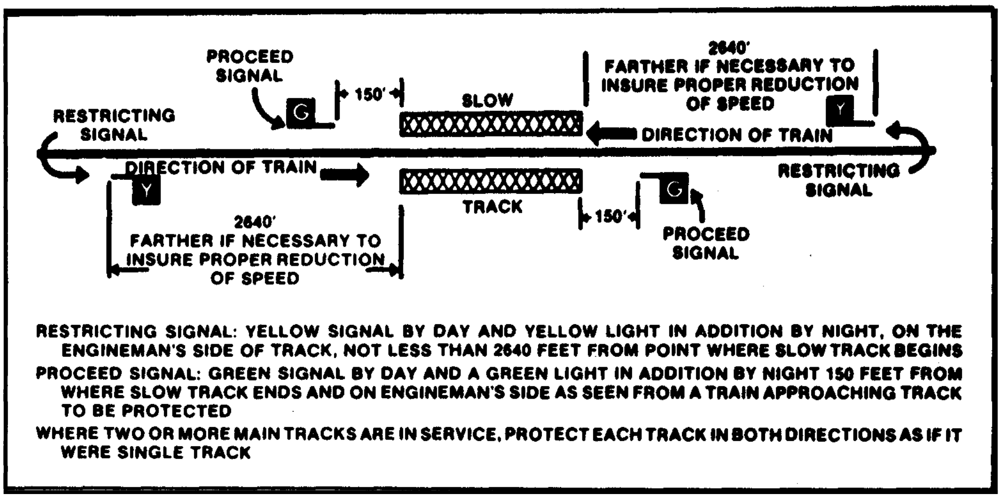


Figure 3-33. Details for establishing slow order.

3-19. Handling Rails.

Care must be taken in handling rails both in removing old rail for replacement and in delivering and placing new rail.

3-19.1. Precautions. Take care not to damage bolts, nuts, or rail anchors when removing rail from track. A crane should be used for loading rails when it is available. In most installation maintenance, it is necessary to load or carry rails by hand (Figure 3-35). Rail tongs must be used and the following precautions observed:

3-19.1.1. Divide the gang equally at ends of the rail. Utilize suitable lifting tools, distribute weight safely, do not overload crew (75 pounds per man is recommended maximum load), assure safe footing, and lift properly with back kept straight. Safety-toe shoes must be worn during such operations.

3-19.1.2. Designate one person to call directions.

3-19.1.3. Never attempt to throw rail.

3-19.1.4. Always load so that a person can jump clear if the rail should fall.

3-19.1.5. If there is a danger of operating personnel falling over rails distributed along the track,

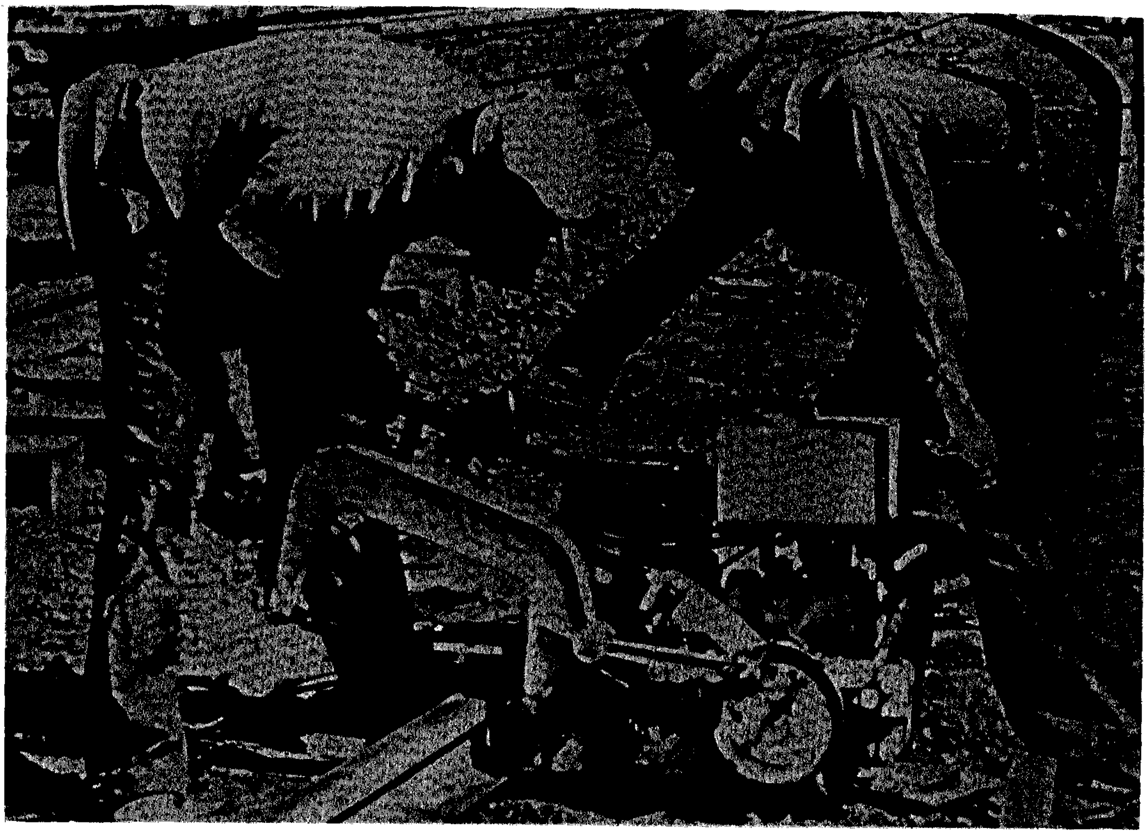


Figure 3–34. Cutting rail with a power saw.

report rail locations so they can be warned. Mark the obstructions with visible warning signs.

3–19.1.6. In yards and station grounds, stack rails well out of the way of operating personnel, and in a place convenient for distribution.

3–19.2. Distribution of Rails. Distribute rails so that they can be laid without unnecessary handling as follows:

3–19.2.1. Place rails base down (Figure 3–35), parallel with the track and with sufficient bearing to prevent bending or swinging, except where there is a hazard of movement due to vibration. Rail left between or adjacent to tracks must be left lying on side, unless on ground that is more than 1 foot below top of tie.

3–19.2.2. Rails should be unloaded opposite the locations in which they are to be placed in the track, allowing suitable gaps for short lengths.

3–19.2.3. Proper lengths of rail for road crossings, station platforms, bridges, and other special locations shall be unloaded in a safe and convenient location, where they will not constitute an obstruction.

3–19.2.4. To minimize the cutting of new full-length rails, shorter rails should be distributed in proper places to provide for proper spacing at insulated joints and for connections to switches.

3–19.2.5. No rail less than one-half rail length shall be used in main tracks, except that shorter rails not less than 13 feet long may be used for temporary closures and for connections within turnouts.

3–19.2.6. Joints, turnouts, and fastenings should be unloaded and distributed concurrently with the rail, except that small material must be left in the containers until the time of laying the rail.

3–20. Preparation For Laying Rails.

Bring grade to true line and elevation before laying new rail, particularly on curves that are out of line. No part of the track structure in use shall be removed until the replacement rail is ready to be installed. Full flag protection or slow-order protection must be provided in cases where rail is being laid under traffic. See Figure 3–33 above for details of establishing slow orders.

3–20.1. Tie Plates and Bearings. Tie plates shall bear fully and uniformly on the ties, and the bearings on each tie shall be in the same place.

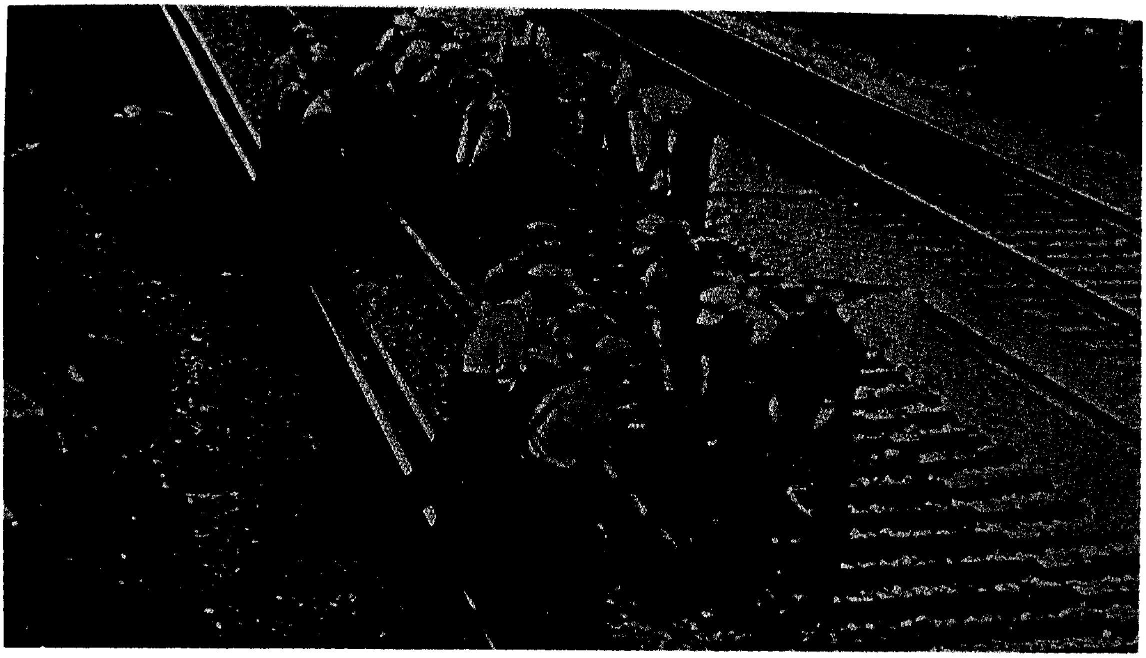


Figure 3-35. Handling rail manually.

3-20.2. Curved and Straightened Rails. When available, use a bender to precurve rails for sharp curves. Curvature must be uniform throughout the length of the rail. Straighten rails that have sharp crooks or bends (para 3-17.2).

3-20.3. Placement of Rail Accessories. Distribute bolts, spikes, tie plugs, tie plates, and rail anchors as close as possible to the site where they will be used, shortly before rail is laid. Do not put such articles on top of ties or in cribs when track is in use.

3-21. Steps In Laying Rails.

Never lay more rails than can be properly secured during the day in which they are laid to prevent damage to the rails or fastenings by normal traffic. Utilize mechanical devices to lay rails whenever possible. If this is not possible or practicable, extreme care must be exercised by personnel to preclude serious personal injury. Lifting and lowering of rails must be done with backs straight. A check list of the pertinent steps in rail laying follows:

3-21.1. Tamp loose ties to provide a good bearing under the new rail. Follow standards for spiking and bolting, and apply necessary rail anchors before permitting trains to pass over the rail.

3-21.2. See that insulating joints in the track circuit are spiked and supported as soon as possible, as insulating fibers are easily damaged.

3-21.3. Lay rails one at a time. To insure good adjustment, bring rail ends squarely together against suitable rail expansion gages, and bolt them before spiking. Under special conditions, certain departures from this plan are permissable. In areas of heavy traffic, when trains cannot conveniently be diverted to other tracks, stretches of rail not over 1,000 feet long may be bolted together, and then lined into place. Proper allowance for expansion must be maintained (Table D-8, Appendix D); requisite rail expansion gages should remain in place until rails are set in final position. Figure 3-36 shows section of rail being lined off ties in preparation for relay.

3-21.4. Never use switch points to make temporary connections. This is a dangerous practice.

3-21.5. Provide holes for complete bolting of cut rails according to standard drilling practices and the following rules: (1) New holes must be drilled (Figure 3-37) or punched and not slotted, or burned with a torch. They shall not be drilled between existing holes (para 3-17.8). (2) The distance from the end of a rail to the center of the first bolt hole should be at least twice the diameter of the hole. (3) The distance between centers of any two holes of the same size should be at least four times the diameter of the hole; in the case of holes of different sizes, the distance should be at least 3-3/4 times the mean diameter of the two holes.

2-21.6. Paint the contact surfaces of all rail ends and angle bars with a lubricant equal to black lubricating oil just before laying the rails.

3-21.7. Install standard metal, fiber, or wood shims between the ends of adjacent rails to insure proper space allowance for expansion, as indicated in Table D-10.

Figure 3-36. Rail being lined out.

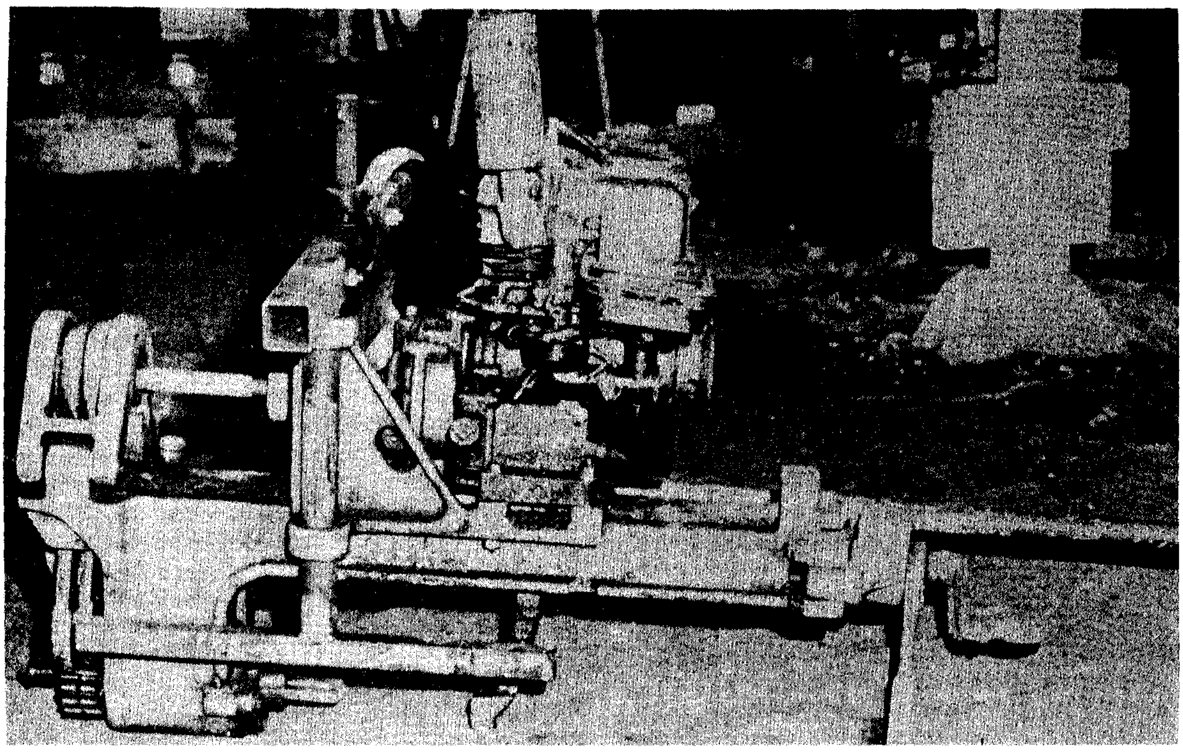


Figure 3-37. Rail drill.

3-21.8. Use a spike maul or a mechanical or pneumatic spike driver (Figures 3-38 through 3-40) to drive spikes. Spikes must be vertical and square with the rail. Straightening spikes as they are driven decreases the holding power. Hold rail against gage when spiking.

Figure 3-38. Driving spikes with a spike maul.

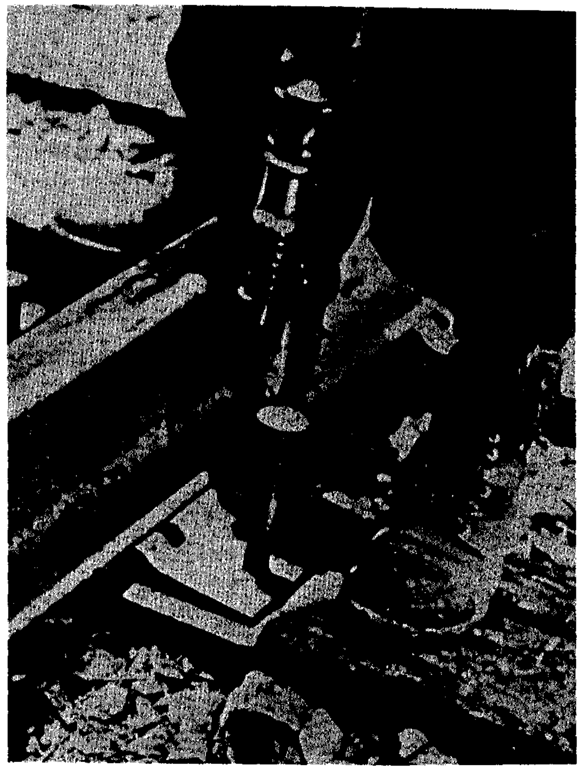


Figure 3-39. Driving spike through tie plate.

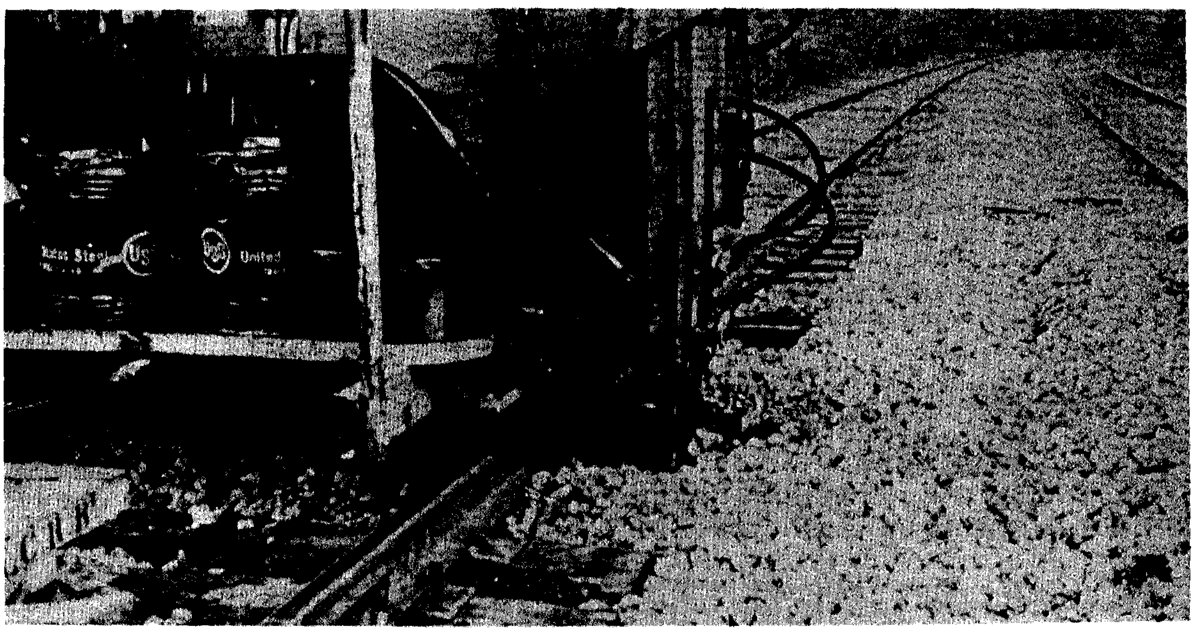


Figure 3-40. Power driven spike driver.

3-21.9. Use four spikes per tie on tangent trackage and on curves with less than 6 degrees of curvature (radius 955 feet or more). Spikes shall be staggered so that all the outside spikes and inside spikes on the opposite end of the tie are in relatively the same position in the tie, i.e., spikes should be in a "V" pattern with the "V" pointing in the direction of heaviest traffic. Spikes should be about 2 inches from the edge of the tie, except where tie plates are used, in which case they are driven through the spike holes (Figure 3-39).

3-21.10. On curves with more than 6 degrees of curvature (radius less than 955 feet) and at other critical points, use two spikes on the gage side of (inside) the rail and one on the field side (outside) (six spikes per tie), when using tie plates. If tie plates are not used, place one spike on the gage side and two spikes on the field side.

3-21.11. Drive spikes down snugly, but not tight against the rail. A space of approximately 1/8 inch should be left between the head of the spike and the base flange of the rail (Figure 3-41).

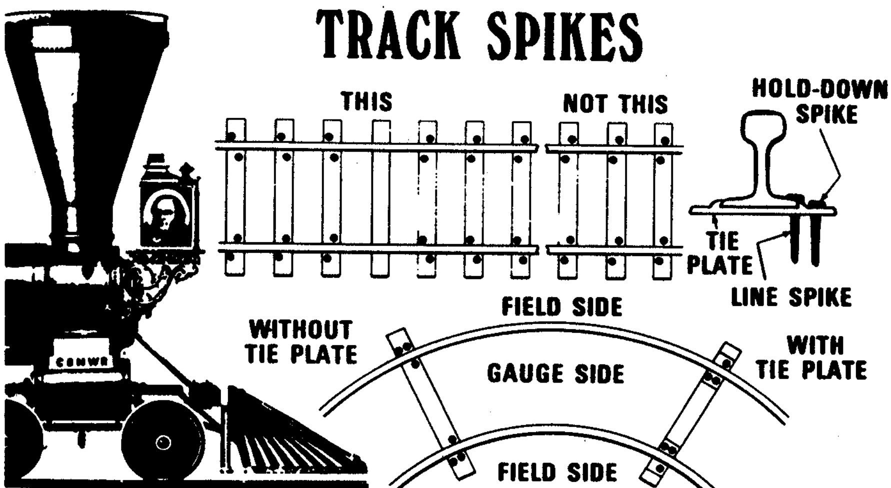


Figure 3-41. Proper spike placement.

3-21.12. Gaging shall be done at least at every third tie when laying the second line of rail.

3-21.13. Install rail anchors and gage rods, when required, before allowing traffic over new track.

3-21.14. When necessary to make a temporary connection for the passage of a train, the union shall be made with a rail of the section being renewed. The closure rail shall not be less than 13 feet long, and shall be connected to the new rail by a compromise joint if the rails are of different sections. The connecting rail shall have a full number of bolts and the required number of spikes.

3-22. Rail Joints.

3-22.1. General Requirements. Rail joints should fulfill the following requirements:

3-22.1.1. They should connect the rails so that they act as a continuous girder with uniform surface and alignment.

3-22.1.2. Their resistance to deflection should approach that of the rails to which they are applied.

3-22.1.3. Battered rail ends should be repaired by an approved method of welding and grinding.

3-22.2. Jointing. Lay rails so that the joints of one are opposite the middle of the other rail, with permissible variations as follows:

3-22.2.1. Except through turnouts and at paved road crossings, the staggering of joints should not vary more than 30 inches from the center of the opposite rail, preferably not more than 18 inches.

3-22.2.2. Do not locate joints within the limits of switch points, opposite guardrails, or within 6 feet of the ends of open-floor bridges or trestles.

3-23. Bonded Rails.

Where highway or train signals are actuated through the track circuit, or where petroleum fueling facilities or ammunition loading points require grounding of rails, rails must be constantly bonded by pin-connected (Figure 3-42) or welded bonds. The bonding may be applied to the outer side of the railhead, within the limits of the joint bars or outside of joint bars in the web of the rail.

3-23.1. Pin-Connected Bonds. For pin-connected bonding, the following steps are required:

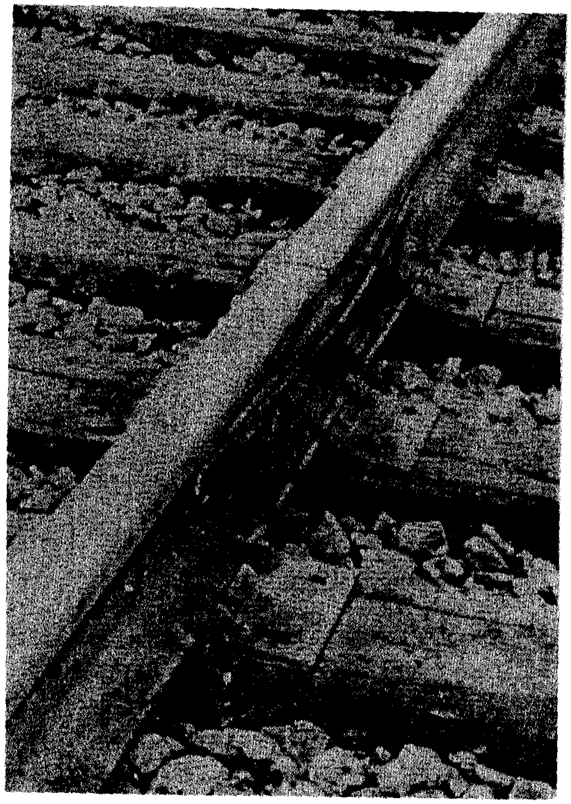


Figure 3-42. Properly pin-connected bonded rail.

3-23.1.1. Drill holes in head or web of rail the size of lugs on end of bond wires, and drive lugs into them to secure a firm fit.

3-23.1.2. Do not disconnect bonding wires or reverse bonded rails without an electrical maintenance crewman present. In emergencies when a broken rail, switch, or frog needs immediate repair, make as tight a connection as possible, but notify the electrical and communication maintenance officers at the first possible opportunity.

3.23.2. Welded Bonds. Use approved methods for welding bonds in lieu of pin-connected bonds where it is more practical.

3-24. Cutting Rails.

When available, use either a tooth or friction-type rail saw for cutting rails (Figure 3-34). When these automatic tools are not available, a rail chisel will suffice. In cases of extreme emergency, rails may be cut with gas cutting torches by qualified operators, but torch-cut rails should be replaced as soon as possible. When rails are cut with gas cutting torches, suitable face, eye, and other body protection must be afforded in the form of goggles, face shields, flameproof gauntlet gloves, and other protective devices to prevent injury.

3.24.1. Rail Saw. Manufacturers' instructions should be followed in the operation and maintenance of mechanical saws. General rules that apply are: keep the machine clean, inspect at regular intervals, use proper adjustment, and see that the railroad maintenance crew takes care in handling and operation.

3-24.2. Rail Chisel. When using a rail chisel, the striker and the man holding the chisel must not face each other. Both must wear prescribed goggles. The chisel must be sharp and the head properly rounded. Use a sledge, not a spike maul. Place the rail on a block with the base of the rail up and the block a slight distance behind the cut. Do all cutting on the base and the web of the rail. Do not drop rails to expedite cutting; use the chisel until the cut is completed.

3-25. Joint Bars.

3-25.1. Installation. Joint bars are installed with the full number of bolts, nuts, and spring washers. Rails weighing over 75 lb/yd are bolted so that nuts alternate between the inside and outside of the track (Figure 3-43).

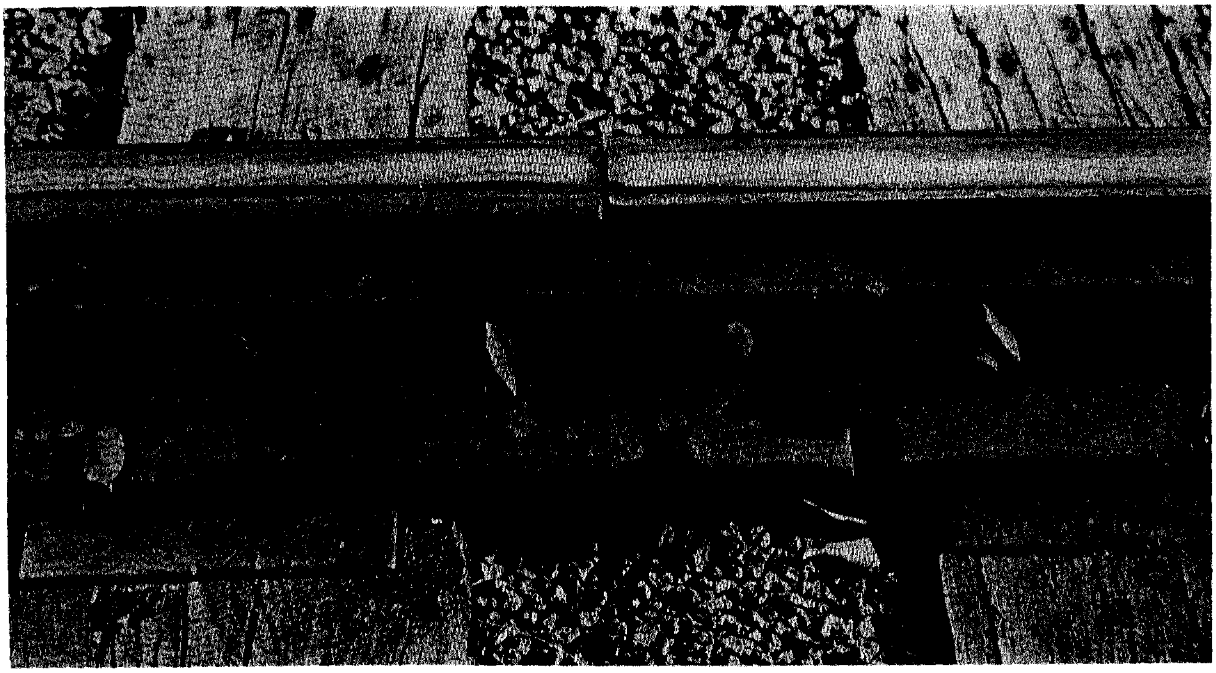


Figure 3–43. Joint-bar installation.

3–25.1.1. Keep joints tightly bolted to prevent injury to the rail ends. Use standard hand track wrenches (Figure 3–44) or a power wrench (Figure 3–45) as discussed below.

3–25.1.2. Take up wear in fishing spaces of rail and joint bars by replacing bars.

3–25.1.3. Oil all track bolts when installed and each time they are tightened. It is recommended that bolts be oiled and checked at least once every 3 months.

3–25.2. Track-Bolt Maintenance. The following practices are necessary to maintain track bolts:

3–25.2.1. In applying nuts on track bolts, the flat side of the nut should be placed next to the spring washer.

3–25.2.2. The applied bolt tension should be within a range of 20,000 to 30,000 pounds per bolt for the initial tightening and within a range of 15,000 to 25,000 pounds for subsequent tightenings. Use mechanical torque wrenches set in accordance with manufacturer's instructions.

3–25.2.3. Track bolts should be retightened as required, preferably one week and 1 to 3 months after the joint bars are applied and at intervals of 1 year thereafter. Annual retightening of bolts in paved areas may be waived based on engineering judgment and provided nondestructive tests and visual inspection are satisfactory. More frequent tightening is unnecessary and therefore uneconomical. Less frequent tightening requires too high an applied bolt tension to carry over the longer period.

3–25.2.4. Corrosion-resistant lubricant will be applied to bolt threads prior to the application of the nuts. This will reduce the variation in thread friction and promote the uniformity of tension obtained.

3–26. Compromise Joints.

Compromise joints (Figure 3–31) are used wherever rails of different weights or sections are connected. The bars must conform to the weight and section of each rail at the connection. The maintenance of compromise joints is the same as for joint bars (para 3–25).

3–27. Spikes.

3–27.1. Specifications. All spikes used for replacement, repair, and rehabilitation shall conform to AREA Standards. They must be smooth and straight with well-formed heads and sharp points and be free from nicks, cracks, or ragged edges. See Figures 2–10 and Table D-13.

3–27.2. Use. The standard 5/8- by 6-inch spike is used for all track spiking except when tracks are being shimmed. Shimming spikes are 6 inches plus the thickness of the shim taken at 1/2-inch intervals. NOTE: Smaller spikes may be required on lightweight substandard rail.

3–27.3. Location. Location of spikes shall be in accordance with Figure 3–41.

Figure 3–44. Using a hand wrench.

3–28. Bolts, Nuts, and Lock Washers.

All joints will be fully bolted with the proper size, type, and number of bolts, nuts, and lock washers for the type of joint bar used. These items must conform to AREA criteria (see Figures 2–7 and 2–9 and Table D–13).

3–29. Rail Anchors.

3–29.1. General. Rail anchors are used in track that is subject to serious movement from rail expansion or from traffic on steep grades. They must grip the base of the rail firmly and have full bearing against the face of the tie opposite the direction of creeping. (Note rail anchors in Figure 2–11.) The following general rules apply:

3–29.1.1. At locations where rail anchors are required, ties shall be firmly tamped and fully imbedded in ballast.

3–29.1.2. When the bearing of the rail anchor has been disturbed by removal of the tie, the anchor shall be removed and reset.

3–29.1.3. Ballast should be kept away from rail anchors.

3–29.2. One-Direction Traffic. See Figure 3–46 for placement of anchors for one-direction traffic. With very few exceptions, rail creepage is in the direction of traffic. The amount of creepage will vary with the kind of ballast used and with local conditions. Figure 3–47 shows tie skewing caused by rail creepage. A minimum of eight anchors per 39-foot rail length is recommended where the need exists. Additional anchors shall be used where needed. Rail anchors shall be spaced approximately uniformly along the rail length. To avoid skewed ties, the anchors shall be applied against the same tie on opposite rails. To provide for occasional reversal of traffic and to prevent excessive opening in case of a broken rail, at least two backup anchors should also be applied per rail length and boxed in around the tie with two of the forward anchors near the quarter points of the rail.

3–29.3. Two-Way Traffic. Effective anchorage is required where track conditions indicate a need to minimize the back and forth movement of rail resulting in the churning and bunching of ties. This condition is usually caused by train movements in both directions (Figure 3–46). The use of 16 rail anchors per 39-foot rail length is recommended, eight

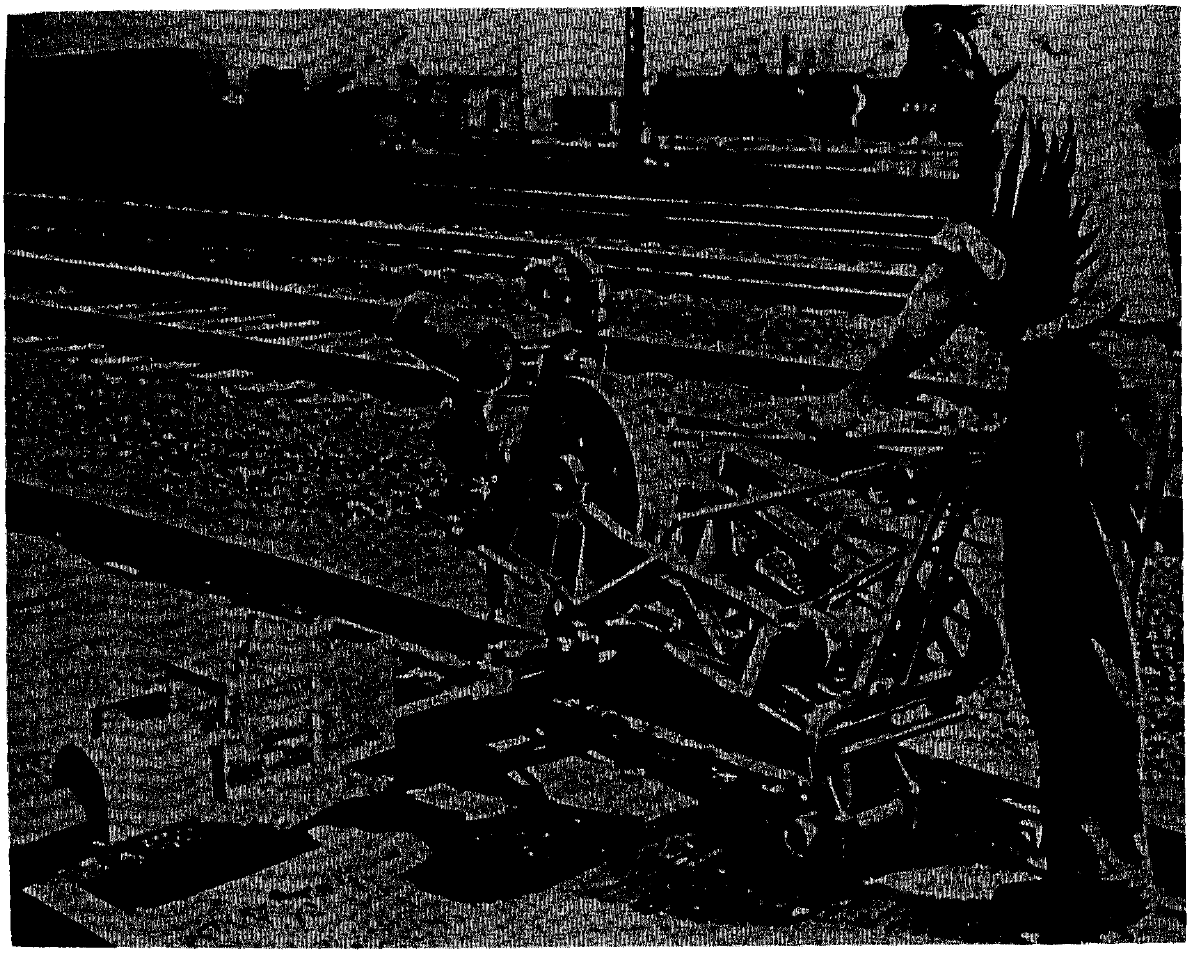


Figure 3-45. Using a power wrench.

anchors to resist movement in each direction for balanced traffic. If the traffic is much lighter in one direction, the number of anchors used to resist movement in that direction may be reduced. Additional anchors will be used where needed. The rail anchors should be spaced approximately uniformly along the rail length and against the same tie under opposite rails. The anchors to resist movement in the two directions shall be placed in pairs and boxed around the same tie. The arrangement of rail anchors for both one- and two-directional traffic is indicated in the diagram, Figure 3-46. It is important that the anchors be carefully applied and that they be in contact and remain in contact with the tie face.

3-30. Gage Rods.

Gage rods are recommended for use on sharp curves that are difficult to hold to gage, and where the track may shift because of unstable roadbed conditions. Two to four rods are used for each rail length, applied so that the rods are at right angles to the rail and the jaws have a firm grip on the base of the rail. Some types of gage rods prevent rails from canting or tipping. Where tipping has been encountered, this combination rod shall be used to maintain alignment and gage under unfavorable conditions. Gage rods are not required with concrete ties.

3-31. Turnouts and Crossovers.

3-31.1. General. The number of the frog in a turnout designates the nomenclature of the turnout (Figure D-1) and generally establishes: (1) length of switch points; (2) lead distance; (3) radius of lead curve; (4) length of the closure rails; and (5) number, length, and spacing of ties.

3-31.2. Replacement. For purposes of maintenance, the No. 8 turnout with a straight split switch, low switch stand, and solid manganese self-guarded

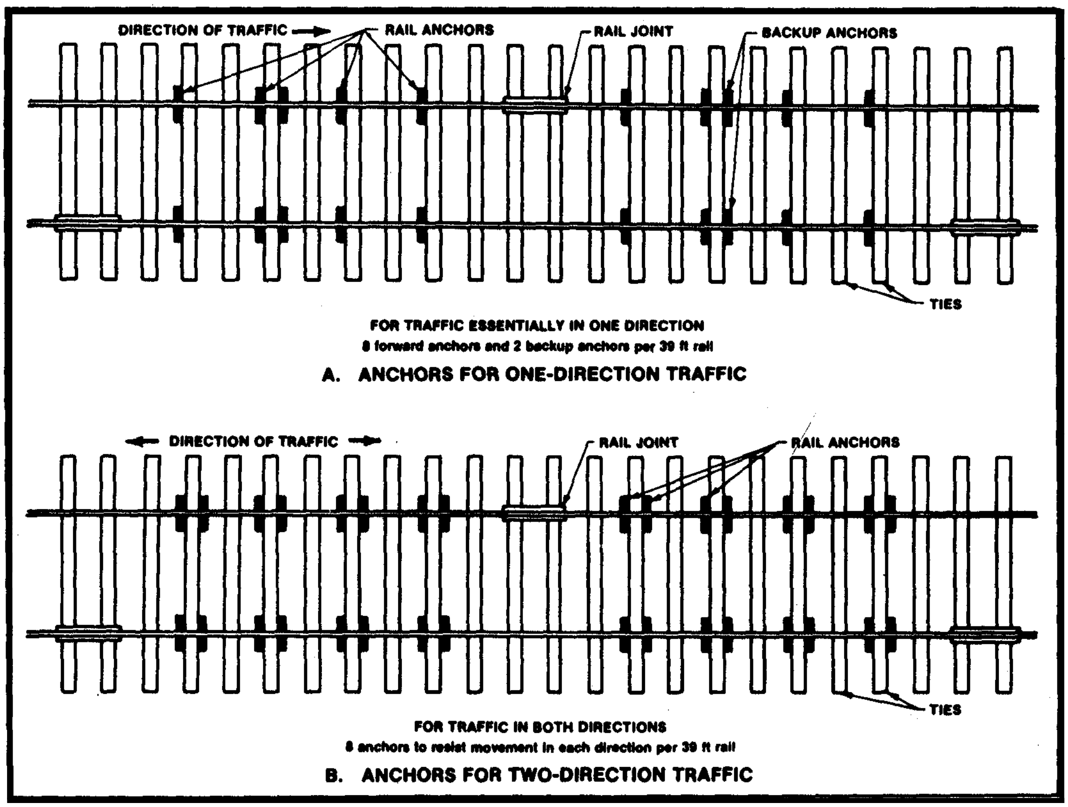


Figure 3-46. Anchor locations.

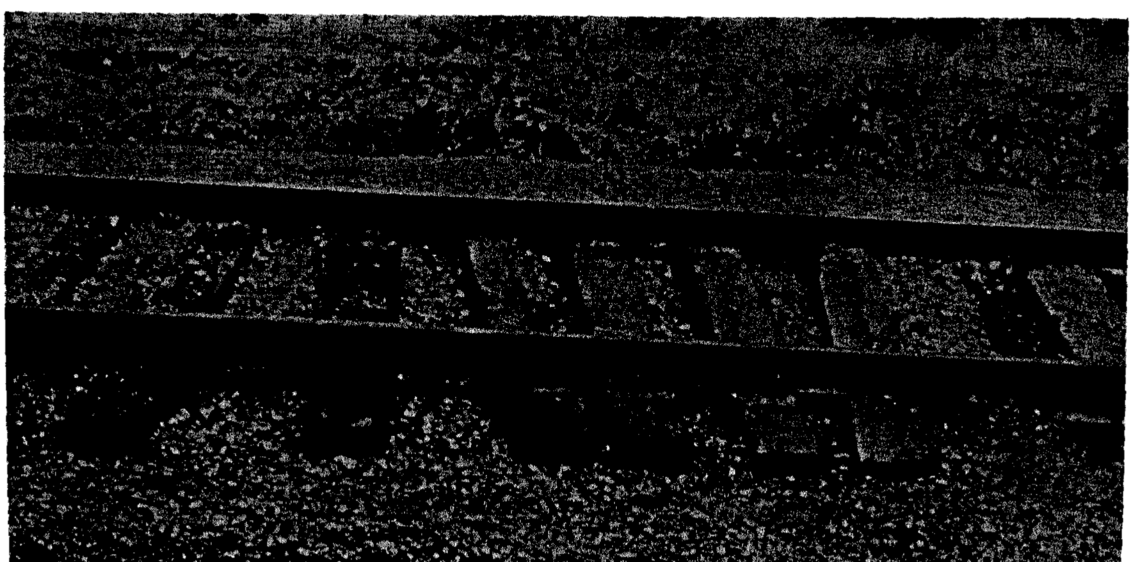


Figure 3-47. Result of rail creepage.

frog (Figure 3-48) is standard for replacement purposes wherever possible. Weight factors of switching equipment, installation layout, and site conditions must be considered in determining frog requirements. Under some circumstances, frog Nos. 7 through 10 will be needed to fit specific requirements of installation railroad trackage. Figure 3-49 illustrates a No. 8 turnout.

3-31.3. Crossovers. A crossover consists of two turnouts with track between, and it connects two adjacent and usually parallel tracks (Figure 3-50 and 3-51).

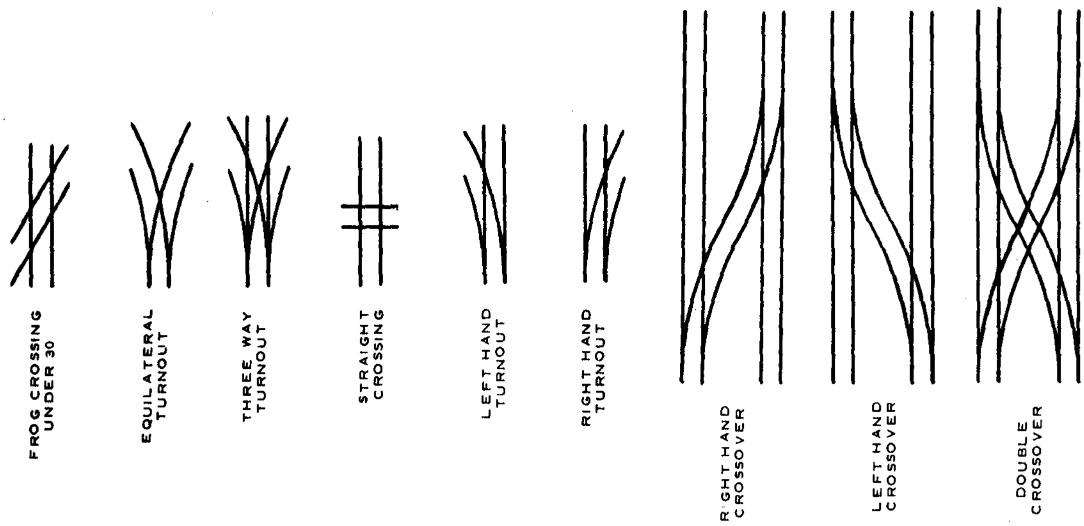


Figure 3-50. Track formations.

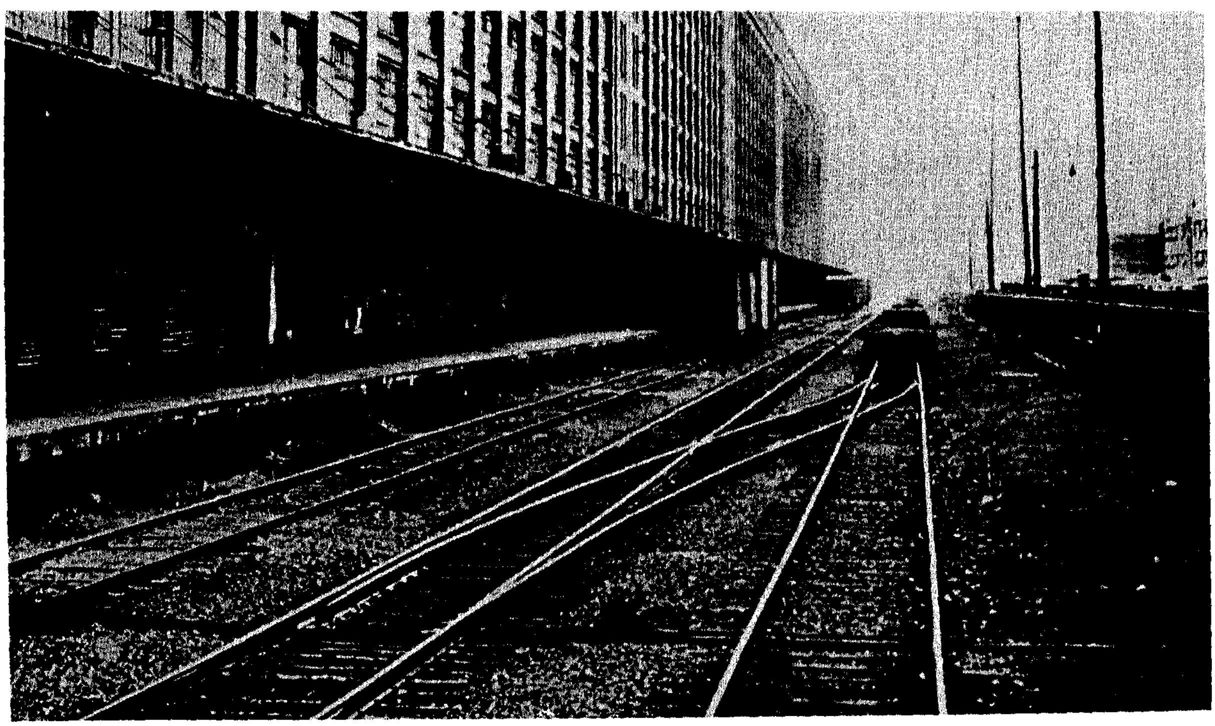


Figure 3-51. Crossover installation.

3-31.4. Location. Turnouts are located on tangent track wherever possible to minimize wear on switch points, frogs, and guardrails. When a turnout is from the inside of a curve, the degree of curvature of the turnout is approximately its normal degree plus the degree of curvature of the main line; if from the outside, the degree of curvature of the turnout is the difference between these two. Thus, if a No. 8 turnout was an angle of 12°24'23" is installed on the inside of a 4-degree curve, the curvature through the turnout is equal to 12°24'23" plus 4 degrees, or 16°24'23". Safety against derailment and economy in maintenance require that turnouts be located so that the total curvature does not exceed 16 degrees. Figure 3-52 shows a turnout on the inside of a curve, and Figure 3-53 shows a typical ladder turnout installation.

3-31.5. Position. To facilitate switching, it is desirable that all turnouts to spur tracks lead in the same direction (Figure 3-53).

3-31.6. Switch Ties. Switch ties are of the length and spacing specified in standard plans for the turnout. Policies governing installation and maintenance of crossties apply to switch ties (para 3-10.2.).

3-31.7. Switches. Lengths of switch points adopted as standard for various turnouts are as indicated in Table 3-2. Because a loose connection or a broken connection rod is a serious defect and is likely to cause a derailment, all connecting points and connection rods require close inspection. The following instructions are supplemented and illustrated by the standard plans (Figures 3-18, 3-48, 3-49, 3-54, 3-55, and 3-56).

Table 3-2. Standard Switch Point Lengths

Number of Turnout	Length of Switch Point ft
15	22-30
12	22-30
10	15-16.5
8	15-16.5
7	15-16.5
6	11
4	11

3-31.7.1. Match switch points to weight and section of stock rail. When points are renewed, renew stock rail also, if necessary, to secure a proper fit. Connect points to the operating rod to provide ample flangeway between the open point and the stock rail. Check both switch points for this adjustment. The correct throw of the switch is 4-3/4 inches, with an allowable minimum limit of 4 inches or according to switch design. Mechanisms for throwing switches in paved areas should be adjusted to provide the maximum throw permitted by the equipment. Provide all vertical bolts on switch connections with cotter pins, and place the bolts with nuts facing up. Center the slide and heel plates on the tie to provide a uniform bearing for the switch point.

3-31.7.2. If switch point protectors are used, the bolts should be checked regularly and retightened as necessary or the protector will not provide adequate protection for the switch point. When wear makes repairs necessary, manufacturer's instructions should be followed.

3-31.7.3. Check each switch to determine that it operates freely, that points fit accurately, and that rods do not foul on ties or ballast. Keep all operating mechanisms clean and thoroughly lubricated. Keep the switch free of ice, snow, and debris at all times. Frequency of switch maintenance is discussed in Chapter 7 and should be an item on the installation work plan.

3.31.7.4. Maintain surface, line, and gage throughout. Keep the gage side of the main track point in line with the gage side of the stock rail in advance of the point. Bend the stock rail with a rail bender at the proper place so that the point fits snugly against the rail when closed. Table 3-3 gives data on bends of stock rails for different lengths of switch points. Table D-1 and Figure D-1 give data regarding various turnouts. NOTE: In ground-level crane trackage switches, the rail in some switches will "bow-up." This is a "not serious" defect unless it causes binding or other difficulty in operation of the switch or the passing of a crane. Insure that ample flangeway is available between the open point of switch and the stock rail; this is controlled by flange width of crane wheels using the track system.

Table 3.3 Offsets for Bending Stock Rail

Length of Switch Point ft	Distance of Bend Ahead of Switch Point in.	Perpendicular Offset from Original Line at 10 Feet from Bend in.
30	7-3/8	1-7/8
22	5-1/2	3-1/8
16.5	3-1/4	3-5/8
15	4-1/16	3-7/8
11	5-1/2	5-5/8

3-31.8. Switch Stands. The switch-operating mechanism consists of a hand-operated switch stand with throw lever and a connecting rod. The switch stand is placed on the two 15-foot header ties at the point of switch. Where practicable, the switch stand is located on the right side of the track with respect to the normal direction of traffic. The switch stand is installed and maintained according to the following requirements:

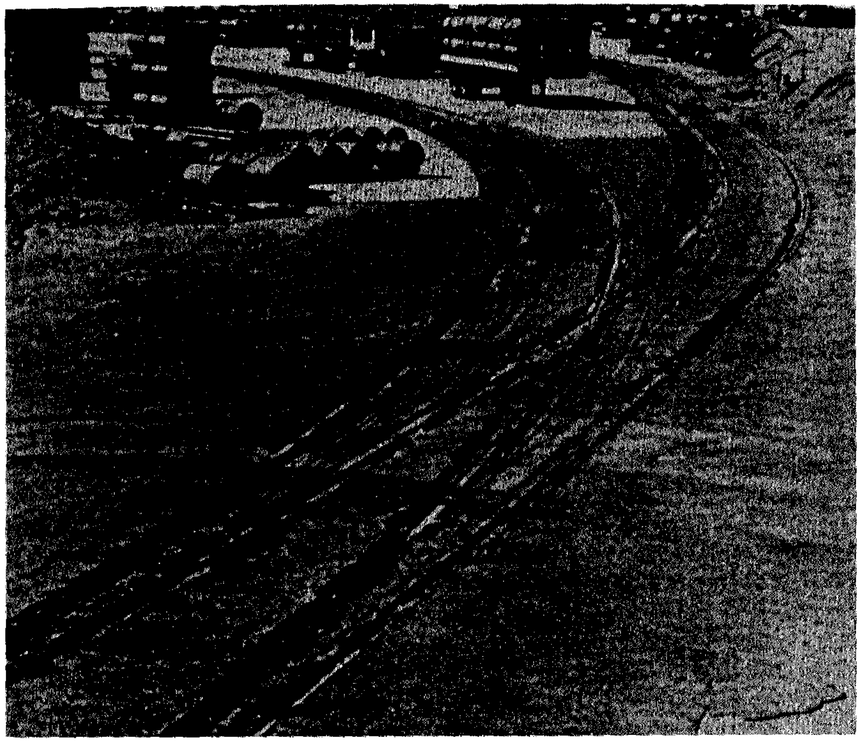


Figure 3-52. Turnout on a curve.

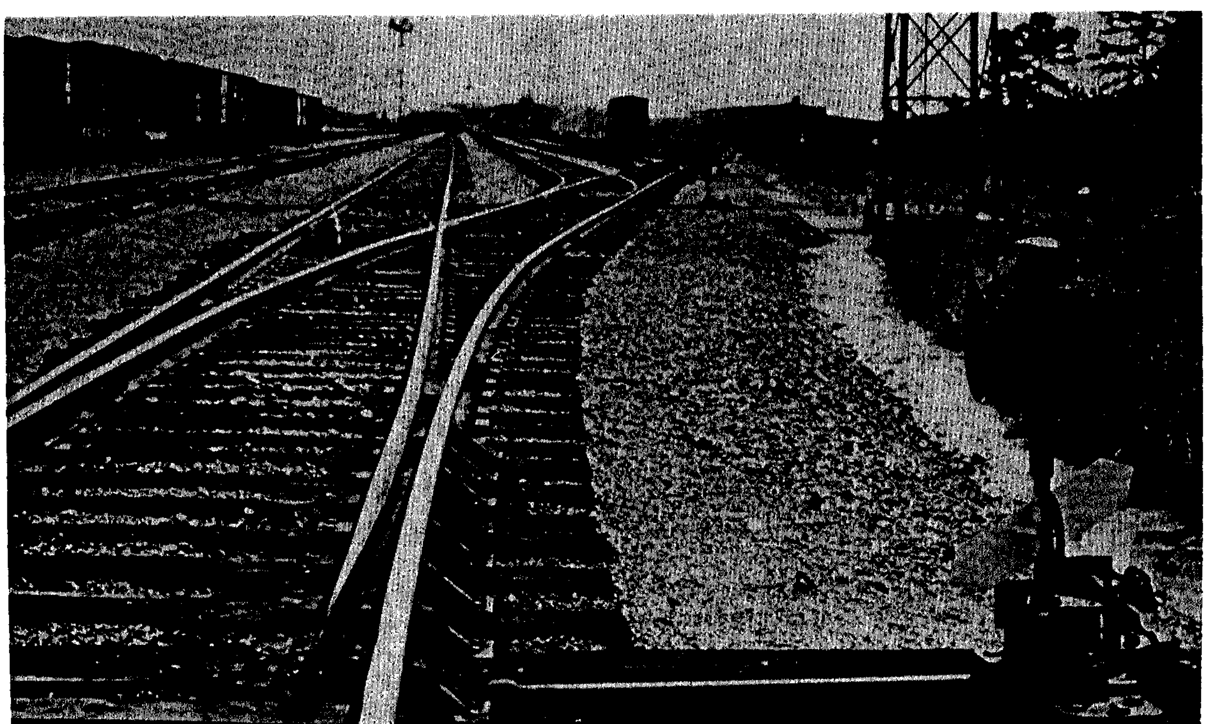


Figure 3-53. Ladder turnout installation.

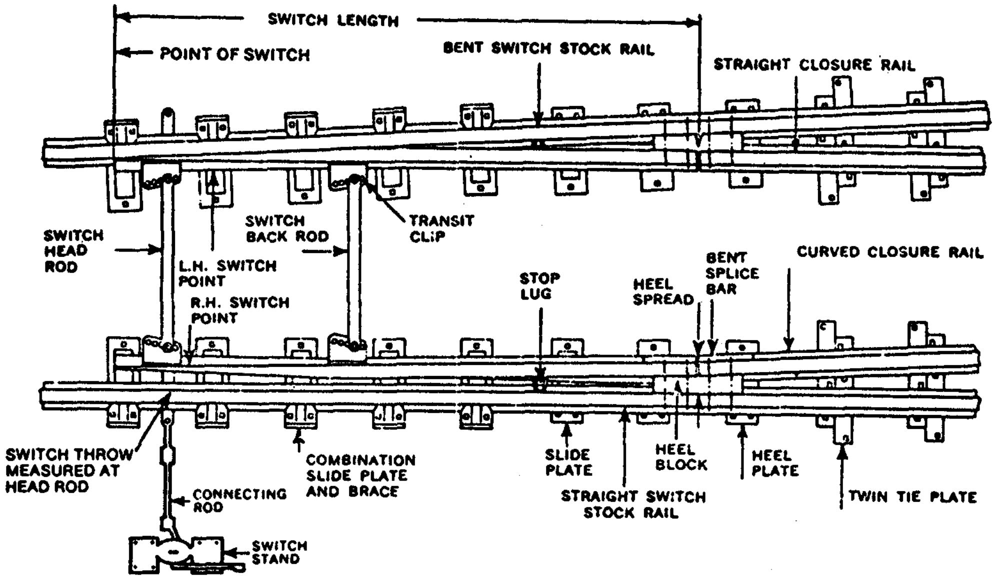


Figure 3-54. Nomenclature of switch parts.

3-31.8.1. Hand lever operates parallel to the track.

3.31.8.2. Throw of stand is adjustable from 4-1/2 to 5-1/2 inches; the adjustment is made so that each switch point has a throw of 4-3/4 inches. Throw of switch points should be a minimum of 4 inches.

3-31.8.3. Center of stand is approximately 6 feet 6 inches from centerline of track.

3-31.8.4. Colored targets and/or distinctly shaped targets are provided to indicate switch points clearly at locations where such indications are necessary. Figure 3-57 shows the type of switch stand most commonly used on military installations; it may be used in paved areas. Figure 3-58 shows the type of switch stand that clearly shows the setting of the switch by high target.

3-31.8.5. For night operations, switch targets are red and green reflectors or red and green lanterns mounted on the spindle. Green indicates switch normal and red indicates switch reversed.

3-31.9. Railroad Frogs. When necessary to purchase new frogs, the solid manganese self-guarded frogs (Figure 3-48) should be purchased; however, any supply of rigid bolted frogs on hand can be used. The above frogs should be used unless a variation is specifically authorized by a higher authority. The rigid frogs are preferred for all locations because of their maintenance free characteristics; however, the use of the turntable frog is mandatory for certain angles below 30 degrees, depending upon frog angle, curve radius, and flangeway width of crossing rail. Existing spring rail frogs should be replaced as soon as practicable with standard rigid frogs. When using standard bolted frogs, guard rails shall be installed to protect the frog point and assist in the prevention of derailments. Railroad frogs are installed in the following manner:

3-31.9.1. The frog number corresponds to the turnout number.

3-31.9.2. The frog is of the same weight and section as the rails through the lead.

3-31.9.3. All frogs are fastened to switch ties by hook plates (Figure 3-59), fully spiked. Spikes will be kept fully driven; all bolts must be tight, and any broken bolts shall be replaced immediately.

3-31.9.4. Correct line, surface, and gage shall be maintained.

3.31.10. Guardrails. Guardrails are not required with solid manganese self-guarded frogs, except under special circumstances. Guardrails may be either 8 feet 4-1/2 inches, one-piece manganese or 9 feet 5 inches tee rail with fillers (Figures 3-60 and 3-61).

3-31.11. Guardrail Placement. Requirements for guardrail placement are:

3-31.11.1. Guardrails are placed in accordance with Figure 3-59 or 3-60, and Figure 3-62.

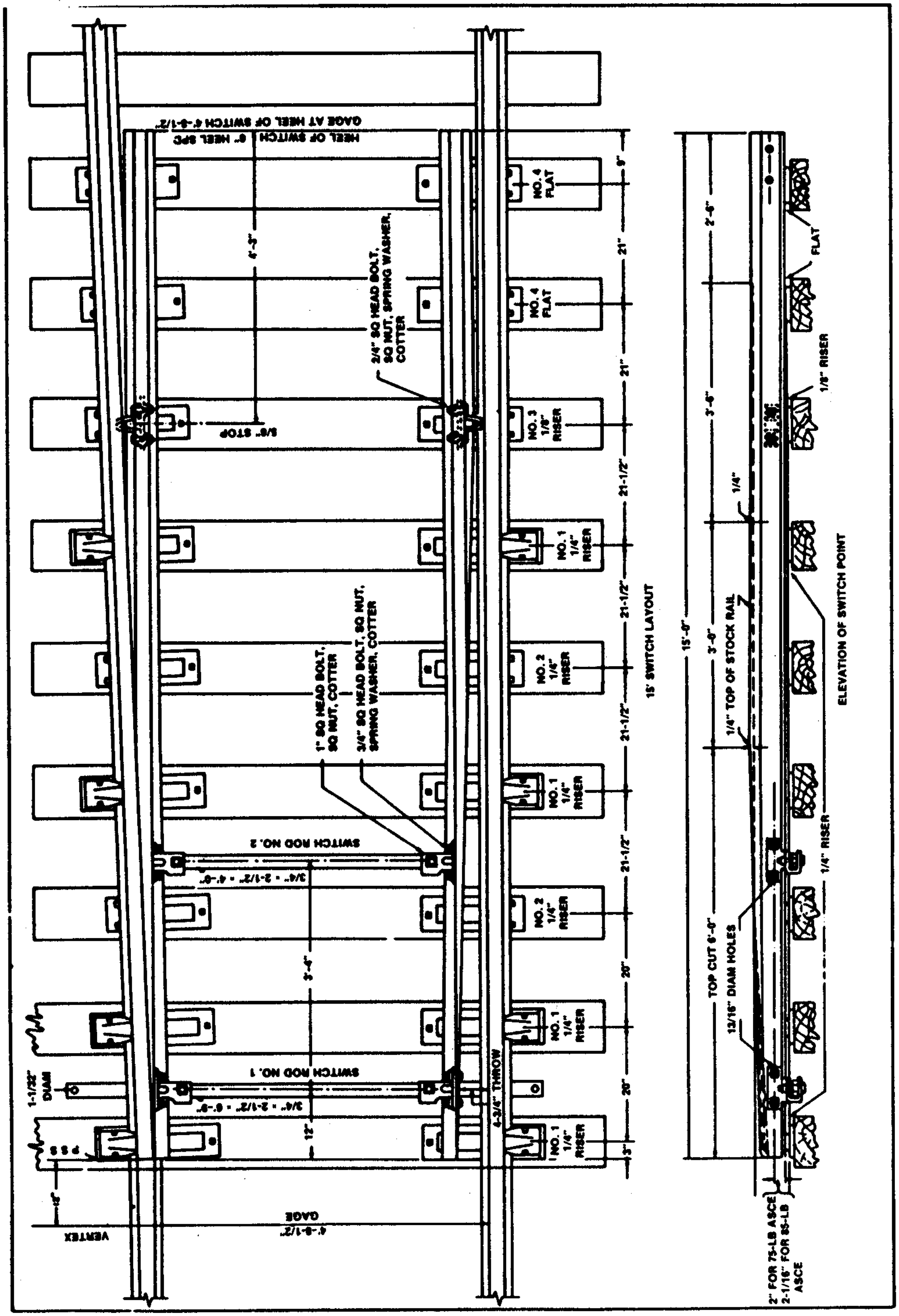


Figure 3-55. Layout and details of 15-foot switch.

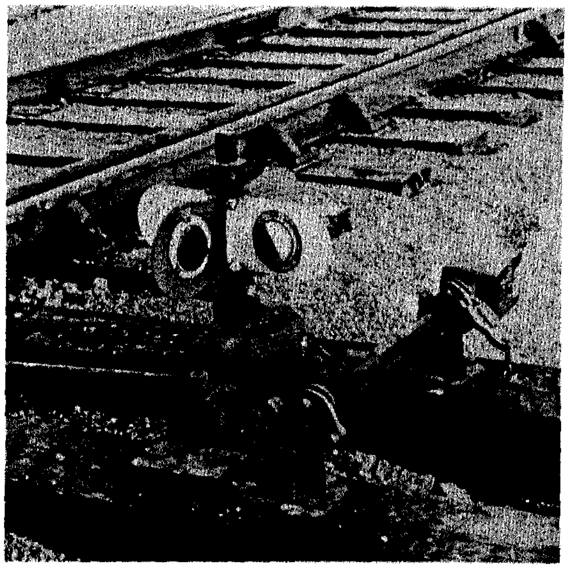


Figure 3-57. Switch stand with target.

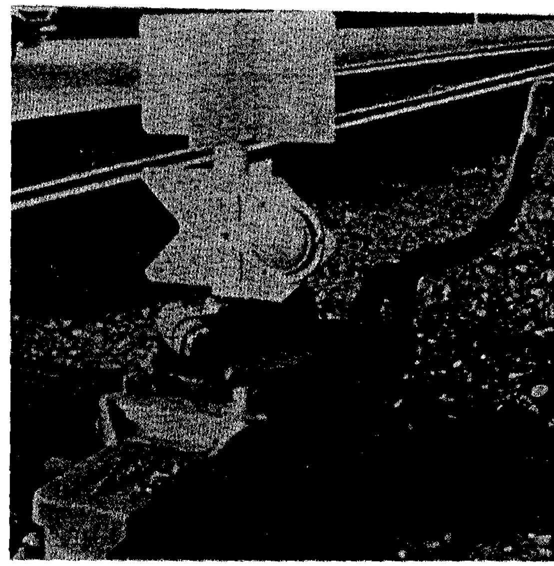


Figure 3-58. Switch stand with high target.

3-31.11.2. The gage of guardrails at frogs must be checked frequently. Normally, the distance from the gage line of the frog to the flangeway face of the guardrail is 4 feet 6-5/8 inches (guard check gage); however, if curvature through turnout exceeds 8 degrees, the distance must be 4 feet 6-3/4 inches regardless of track gage. The distance between the guard line of the guardrail and the guard line of the frog (guard face gage) should not exceed 4 feet 5 inches (Figure 3-62).

3-31.11.3. Ends of guardrails are placed on a tie or are otherwise protected to prevent loose or dragging objects from catching or fouling the rail.

3-31.12. Derails and Rerails. Derails and rerails (Figure 3-63) must be kept in good operating condition. Frequent observations should be made go see that the clearance point has not changed because of shifting or movement of running track. Derails are painted a bright chrome yellow to make them clearly visible. Rerail devices shown in Figure 3-63 are not permanent and should not be placed in track unless needed for rerailing cars.

3-31.13. Clearance Marker. Where derails are not used, a chrome yellow strip 10 inches wide should be painted across the web and base of each rail of the connecting track at the clearance point, or other distinctive marker should be used (Figure 3-64). The markings or markers must be located at sufficient distance from cross or converging tracks to provide adequate clearance between standing or moving trains, or at road crossings to prevent standing trains or cars from fouling the intersection.

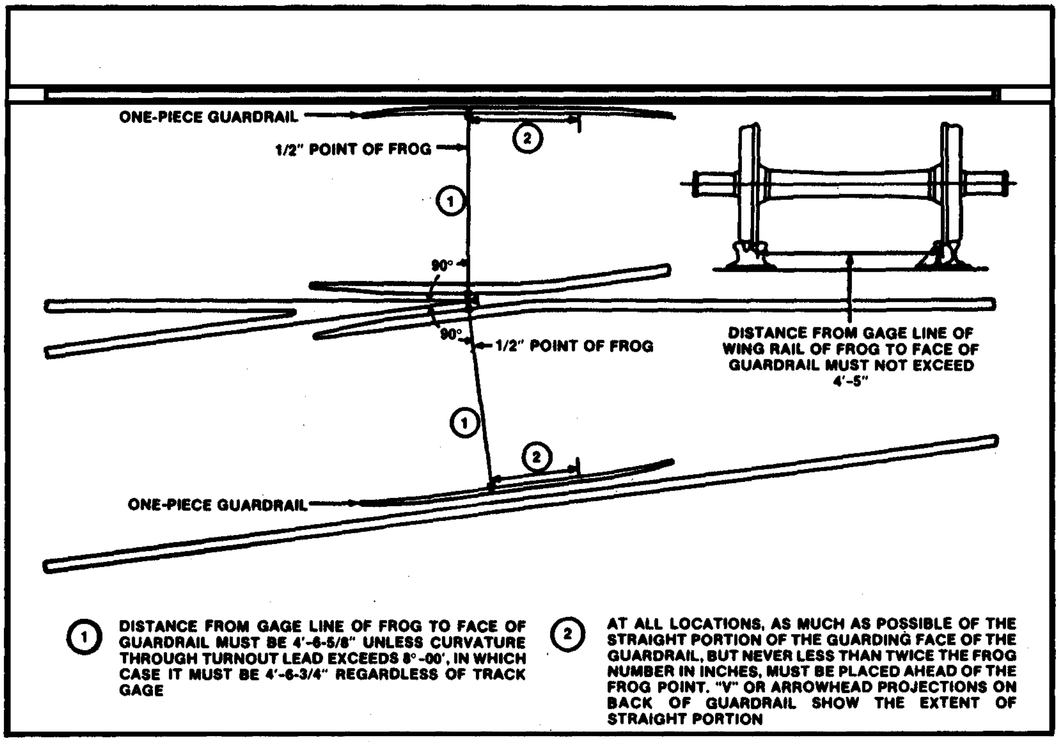


Figure 3-62. Gage at guardrails.

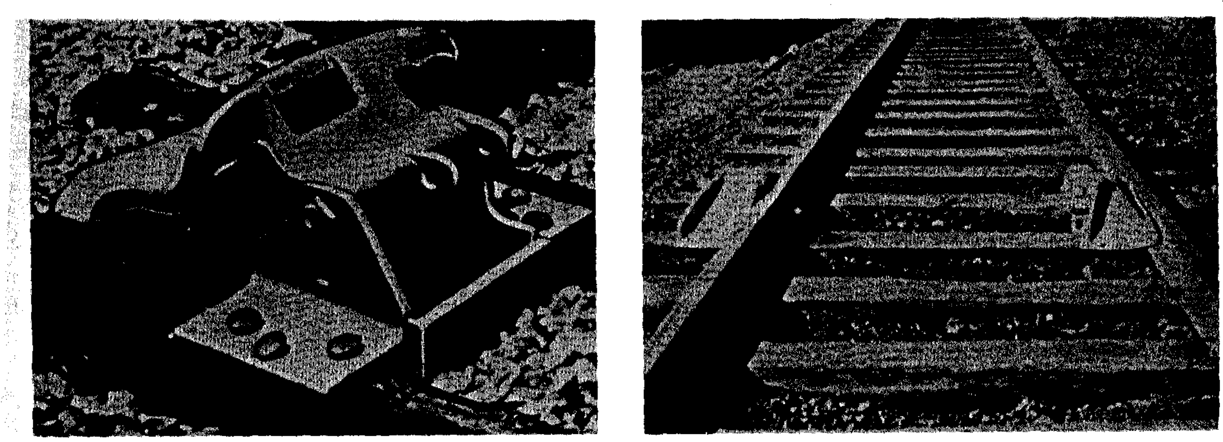


Figure 3-63. Derail (left) and rerail installations.

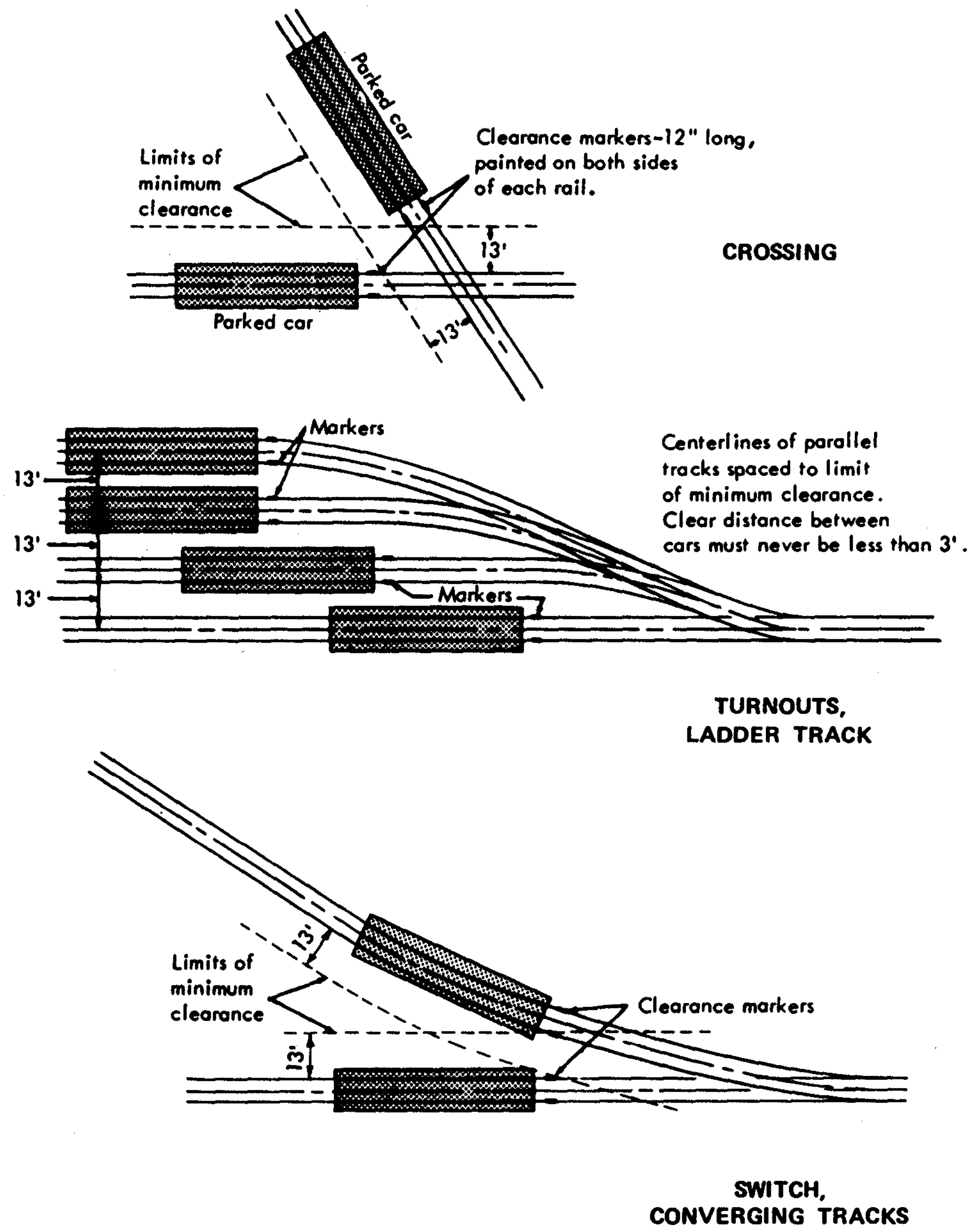


Figure 3-64. Locations of clearance markers.