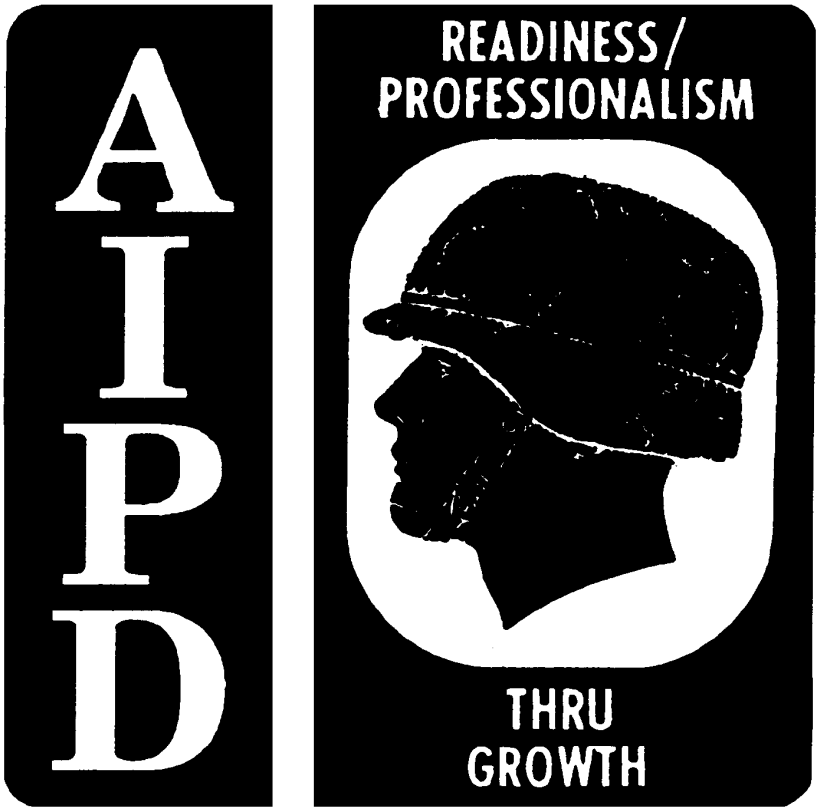
SUBCOURSE
TR0675

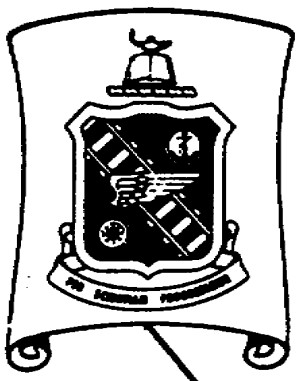
EDITION
6

# MAINTENANCE OF DIESEL-ELECTRIC LOCOMOTIVES AND ROLLING STOCK




THE ARMY INSTITUTE FOR PROFESSIONAL DEVELOPMENT

ARMY CORRESPONDENCE COURSE PROGRAM



# CORRESPONDENCE COURSE OF THE U. S. ARMY TRANSPORTATION SCHOOL

DIRECTORATE OF TRAINING AND DOCTRINE, COURSE DEVELOPMENT DIVISION, USATSCH

# MAINTENANCE OF DIESEL-ELECTRIC LOCOMOTIVES AND ROLLING STOCK

## LESSON BOOKLET TRANS SUBCOURSE 675

**Fort Eustis, Virginia** **June 1976**

Supersedes Trans 675, Maintenance of Diesel-Electric Locomotives and Rolling Stock, Version 1, February 1969.

TRANS SUBCOURSE 675

# MAINTENANCE OF DIESEL-ELECTRIC LOCOMOTIVES AND ROLLING STOCK

## INTRODUCTION

Maintenance of railway equipment is performed to keep equipment in a safe and serviceable condition. The effectiveness of that maintenance directly affects the efficiency of railway operations, particularly in a theater of operations. Military railway men and all transportation officers should know how, when, and why to inspect and maintain railway equipment.

This subcourse introduces you to the Army's diesel-electric locomotives and rolling stock, regulations that govern railway equipment and maintenance, forms used to guide inspectors and maintenance men in performing their duties, and preventive maintenance indicators for railway equipment.

This is a two-lesson subcourse, including two lesson exercises, lesson solutions, and an examination. Before beginning this subcourse, ensure that your social security number (SSN) or student number and the subcourse number are printed correctly on the response sheet. If either is incorrect, return the sheet to AIPD, calling attention to the error. AIPD will in turn send you a corrected sheet. You must also include your SSN or student number on all correspondence.

This subcourse consists of two lessons and an examination:

| | | Credit Hours |
|---|---|---|
| Lesson 1 - | Army Rail Equipment; The Diesel-Electric Locomotive | 1 |
| 2 - | Rolling Stock | 1 |
| Examination | | 1 |
| | Total | 3 |

You must complete the lesson exercises under the concept of self-paced instruction. You must grade the exercises yourself, using the lesson solutions. Because of this, we have only forwarded one examination response sheet with this subcourse. You must use this sheet to submit your answers to the examination questions. After successfully completing the examination, you are entitled to three credit hours for the entire subcourse.

To complete this subcourse, you must--

- Study the text material assigned for each lesson.

- o Answer each question in all the lesson exercises by marking or circling your answer in the lesson book.

- o Check your answers against the solutions provided in the subcourse. Look up the text reference given on the solution sheet if you answered any question incorrectly. Study the reference and evaluate all possible exercise solutions; make sure you understand why the correct answer is the best choice.

- o After completing the lesson exercises to your satisfaction, complete the examination as directed and mail your response sheet to AIPD for grading.

After you finish this subcourse, keep the reference text, lesson book, solution sheets, and the examination. Only return the examination response sheet to AIPD.

Text and materials furnished: Trans Subcourse TR0675, Maintenance of Diesel-Electric Locomotives and Rolling Stock, June 1976, and one response sheet for answering the examination questions.

LESSON 1.....Army Rail Equipment; The Diesel-Electric Locomotive.

CREDIT HOURS.....1.

TEXT ASSIGNMENT.....Reference Text 675, paras. 1.1-2.30.

MATERIALS REQUIRED.....None.

LESSON OBJECTIVE.....To enable you to describe Army railway equipment and maintenance requirements for diesel-electric locomotives.

SUGGESTIONS.....None.

EXERCISES

Weight Cluster True-False

(Each of the following groups of questions is related to the statement that precedes them. Write by each question T or F.)

FIRST GROUP

Which of the following components are found on each Army diesel-electric locomotive.

Weight

3 1. Main generator.

3 2. Auxiliary generator.

3 3. Steam generator.

3 4. Fuel-flow sight glasses.

3 5. Air compressor.

SECOND GROUP

It is characteristic of each diesel-electric locomotive the Army owns and operates that it:

4 6. Has an irregular torque that provides excellent high-speed pulling power.

4 7. Is classified according to its wheel arrangements.

4 8. Is equipped with three generators, the main, the auxiliary, and the electric.

4 9. Generates power through the use of an internal combustion engine.

4 10. Turns electrical energy into mechanical energy to operate its traction motors.

Matching

Preventive maintenance procedures to be carried out on various systems on a diesel-electric locomotive are listed in column I. In column II, the systems are listed. From column II, select the correct system that matches the preventive maintenance procedure listed in column I. Indicate your choice by writing the proper letter by each question. Each item in column II may be used once, more than once, or not at all.

| Weight | | Column I | Column II |
|---|---|---|---|
| 3 | 11. | Check to see if its temperature is at the proper level before engine operation. | A. Air pressure. |
| 3 | 12. | Check its one pressure gage to detect abnormal readings. | B. Fuel. |
| 3 | 13. | Test its gages with a deadweight tester. | C. Water. |
| 3 | 14. | Make sure its cutoff valve has been reset. | D. Lubrication. |

Preventive maintenance procedures to be carried out on various assemblies on a diesel-electric locomotive are listed in column I. In column II, the assemblies are listed. From column I, select the correct assembly that matches the preventive maintenance procedure listed in column I. Indicate your choice by writing the proper letter by each question. Each item in column II may be used once, more than once, or not at all.

| Weight | | Column I | Column II |
|---|---|---|---|
| 3 | 15. | Check the distance between it and its brush holders. | A. Overspeed trip mechanism. |
| 3 | 16. | Examine the straightness of its contact pins. | B. Ground relay. |
| 3 | 17. | Inspect this speed-retarding, fuel cutoff safety device before operating the engine. | C. Commutator. |
| 3 | 18. | Reset this mechanism if it has been tripped and power to traction motors has been cut off. | D. End receptacle. |

(Continued)

| Weight | Column I (cont) | Column II (cont) |
|---|---|---|
| 3 | 19. Check to see if its plates are free of burned spots. | |

Certain forms required when inspecting and maintaining locomotives are given in column II. In column I are listed uses for the forms. Match the form to use by writing the proper letter by each question. Each item in column II may be used once, more than once, or not at all.

| | Column I | Column II |
|---|---|---|
| 3 | 20. Requires that a test run and visual checks be made. | A. DA Form 2408-1. |
| | | B. DA Form 2408-5. |
| 3 | 21. Used for both daily and monthly logs. | C. DD Form 862. |
| | | D. DA Form 2407. |
| 3 | 22. Used to request DS and GS maintenance. | |

## LESSON ASSIGNMENT SHEET

TRANS SUBCOURSE 675.....Maintenance of Diesel-Electric Locomotives and Rolling Stock.

LESSON 2.....Rolling Stock.

CREDIT HOURS.....1.

TEXT ASSIGNMENT.....Reference Text 675, pars. 3.1-3.23.

MATERIALS REQUIRED.....None.

LESSON OBJECTIVE.....To enable you to describe the maintenance requirements for Army railway rolling stock.

SUGGESTIONS.....None.

EXERCISES

Weight — True-False

(Write T for true or F for false.)

3 1. In both warm and cold weather, water in a journal box can cause improper lubrication of the journal.

3 2. Railway cars with hook-and-link couplers must be coupled manually but can be uncoupled automatically.

Cluster True-False

(The following group of questions is related to the statement preceding the group. Write by each question T or F.)

GROUP

Of the railway cars owned by the Army, it is true that:

4 3. Superstructures are generally designed for specific uses.

4 4. Underframes contain pockets for holding the draft gear.

4 5. Major components of all cars are basically the same.

4 6. The wheel and axle assembly used on some passenger and high-speed freight cars is the three-axle, six-wheel combination.

4 7. The brake cylinders of a depressed-center car are mounted on the underframe.

## Matching

Serious wheel defects can cause undue wear on rails and equipment or cars to derail. In column II are listed the major defects found on wheels of rolling stock; in column I are given characteristics of the defects. Match a defect in column II with a characteristic in column I by writing the proper letter by each question. Each item in column II may be used once, more than once, or not at all.

| | Column I | Column II |
|---|---|---|
| 4 | 8. Can cause the flange to break off. | A. Out of round. |
| | | B. Slid flat. |
| 4 | 9. Revealed when bottom nipple of gage is clear of tread. | C. Cracked plate. |
| | | D. Worn-hollow tread. |
| 4 | 10. Revealed when its depth exceeds 3/64th of an inch. | E. Lengthwise crack in tread. |
| 4 | 11. Caused by skidding of locked wheels. | |
| 4 | 12. Becomes bowlike in shape as it grows. | |

In the following two groups of questions match a part or an assembly from column II to its function or description in column I by writing the proper letter by each question. Each item in column II may be used once, more than once, or not at all.

Weight

GROUP ONE

| | Column I | Column II |
|---|---|---|
| 3 | 13. Wheeled assembly supporting underframe and superstructure. | A. Body bolster.<br>B. Side sill. |
| 3 | 14. Tranverse member of car underframe located over center of truck. | C. Center sill.<br>D. Journal. |
| 3 | 15. Backbone of underframe. | E. Truck. |
| 3 | 16. End of axle. | |

GROUP TWO

| | Column I | Column II |
|---|---|---|
| 3 | 17. Brass part transferring heat to journal box top. | A. Wedge.<br>B. Brakeshoe. |
| 3 | 18. Cross member in center of truck carrying center plate. | C. Side frame.<br>D. Truck bolster. |
| 3 | 19. Its coil springs distribute the car's weight onto the axle journals. | E. Journal friction bearing. |
| 3 | 20. Device that provides braking action. | |

Five forms used in the inspection and maintenance of rolling stock are listed in column II. Uses of them are listed in column I. Match the forms in column II to the uses in column I by writing the proper letter by each question. Each item in column II may be used once, more than once, or not at all.

| | Column I | Column II |
|---|---|---|
| 3 | 21. Used to show a car that needs to be weighed. (Continued) | A. DA Form 55-164.<br>B. DD Form 1335. (Continued) |

| Weight | Column I (cont) | Column II (cont) |
|---|---|---|
| 3 | 22. Used by the chief car inspector. | C. DA Form 55-161.<br>D. DA Form 55-162. |
| 3 | 23. Fastened to a car in duplicate. | E. DA Form 55-163. |
| 3 | 24. Attached to a car with faulty brakes. | |
| 3 | 25. Used to report maintenance inspections. | |
| 3 | 26. Cannot be removed until repairs are finished. | |

Analytical

(Using the following key, state your reaction to each of the next four questions by writing the proper letter in the lesson book.)

A. The underscored statement is true, and the reason for it or result of it is true.

B. The underscored statement is true, but the reason or result is false.

C. The underscored statement is false.

3 27. A U.S. rail car's draft gear lessens the impact on the underframe caused by coupling shock but is not designed to absorb shock or stress from other sources.

3 28. When an inspector at a receiving yard finds a journal box on a car needs to be repacked, he sends the car to the car repair track because such a repair cannot be made at the receiving yard.

3 29. Journal roller bearings seldom cause hotbox problems because of their efficient lubrication system.

3 30. Handholds on a car are seldom inspected because their condition would rarely affect a workman's welfare.

# REFERENCE TEXT
# 675

# MAINTENANCE OF DIESEL-ELECTRIC LOCOMOTIVES AND ROLLING STOCK

The information contained herein is provided for instructional purposes only. It reflects the current thought of this school and conforms to printed Department of the Army doctrine as closely as possible. Development and progress render such doctrine continuously subject to change.

**U.S. ARMY TRANSPORTATION SCHOOL**
**Fort Eustis, Virginia**
**June 1976**

Supersedes Trans 675, Maintenance of Diesel-Electric Locomotives and Rolling Stock, February 1969.

CONTENTS


| | Paragraph | Page |
|---|---|---|
| INTRODUCTION | | 1 |
| CHAPTER 1. ARMY RAIL EQUIPMENT | 1.1 | 3 |
| 2. THE DIESEL-ELECTRIC LOCOMOTIVE | 2.1 | 11 |
| Section I. Major Components | 2.2 | 11 |
| II. Preventive Maintenance | 2.9 | 18 |
| III. Inspection and Maintenance Forms | 2.19 | 27 |
| CHAPTER 3. ROLLING STOCK | 3.1 | 38 |
| Section I. Common Components | 3.2 | 38 |
| II. Preventive Maintenance | 3.8 | 47 |
| III. Inspection and Maintenance Forms | 3.14 | 56 |
| APPENDIX I. REFERENCES | | 64 |
| II. GLOSSARY | | 65 |
| INDEX | | 71 |

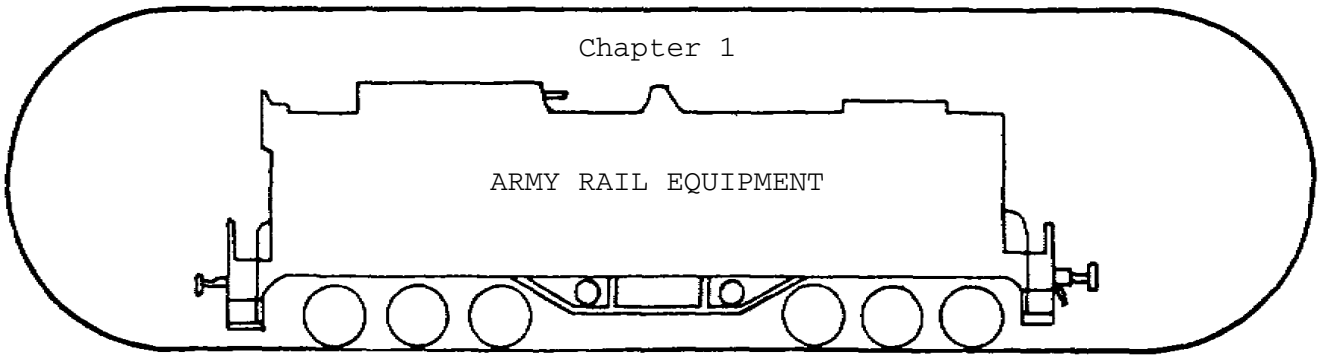


Have you ever stood quietly in darkness and listened to the distant call of a locomotive whistle and wondered where the train was going? Momentarily, you may have even speculated on why the train was going to that someplace where trains go. The where, the why, and a little imagination would make a grand railroad story. But that would be only a story. Another railroad story is based upon facts only, and it is that story--of how trains go and what keeps them going--that this text tells.

At the heart of the story is the one word around which all railroading revolves. That word is "maintenance." What is maintenance? When something broken or damaged is repaired, that is maintenance. But there is another and more important side to maintenance--preventive maintenance. This is the inspection, detection, and correction of minor defects before they can cause serious damage or breakage. For example, if you do not inspect your automobile engine for proper lubrication, its working parts wear out long before they should, and you have a major repair or maintenance problem. If, on the other hand, you check the lube oil level in your engine regularly, changing or adding oil as needed, the engine lasts much longer. That is preventive maintenance.

Why should you know about railway equipment maintenance? You may be assigned to the transportation railway service and be responsible for Army railway equipment. If so, you must know the proper inspection and maintenance procedures, for you will want to be confident that every piece of equipment entrusted to you is working perfectly and ready to do its job.

What are you expected to learn about the inspection and maintenance of rail equipment from the three chapters in this text? First, in chapter 1, you are given a general description of the three major parts of a train and the rules and regulations that govern the inspection and maintenance of Army rail equipment. Then, in chapter 2, you are introduced to the diesel-electric locomotive in terms of its major components, the forms used in its inspection and maintenance, and the preventive maintenance checks that should be performed before it is operated. Finally, chapter 3 contains similar discussions on railway rolling stock and discusses preventive maintenance checks for the truck assemblies, journal box assemblies, wheels, and safety appliances common to all rail equipment.




## 1.1. GENERAL

To understand how to maintain equipment, you must have a general knowledge of it and of the regulations governing its maintenance. Therefore, this chapter introduces some typical rail equipment the Army owns and the regulations that deal with its inspection and maintenance. Only the equipment which makes up the three basic parts of a train is covered in this chapter: the locomotive that moves the train, the rolling stock or cars containing the things it moves, and the caboose at the rear of the train.

## 1.2. TYPICAL U.S. ARMY RAILWAY EQUIPMENT

Vast tonnages of supplies must be moved to support military forces in a theater of operations. For that reason, the transportation railway service (TRS) has more to do with freight train operations than with passenger movements. Although large numbers of troops are moved by rail, normally this is not the first order of business. The TRS does, however, operate ambulance trains for casualties and work trains to clear and repair rail lines, but they are relatively few compared to the large number of freight trains that it operates in a theater.

The following subparagraphs discuss three kinds of rail equipment that may be found in Army trains. Let's begin at the front of the train and work rearward.

a. Locomotive. The Army uses two basic diesel-electric locomotives: an 0-6-6-0, 120-ton, 1,600-horsepower engine and an 0-4-4-0, 60-ton, 400-horsepower engine. These engines may be employed in either road or yard service and may be used singly or in multiple units. Note that the terms locomotive and engine are used interchangeably in this text. Figures 1.1 and 1.2 illustrate both locomotives.




Figure 1.1. The 0-6-6-0 Diesel-Electric Locomotive.

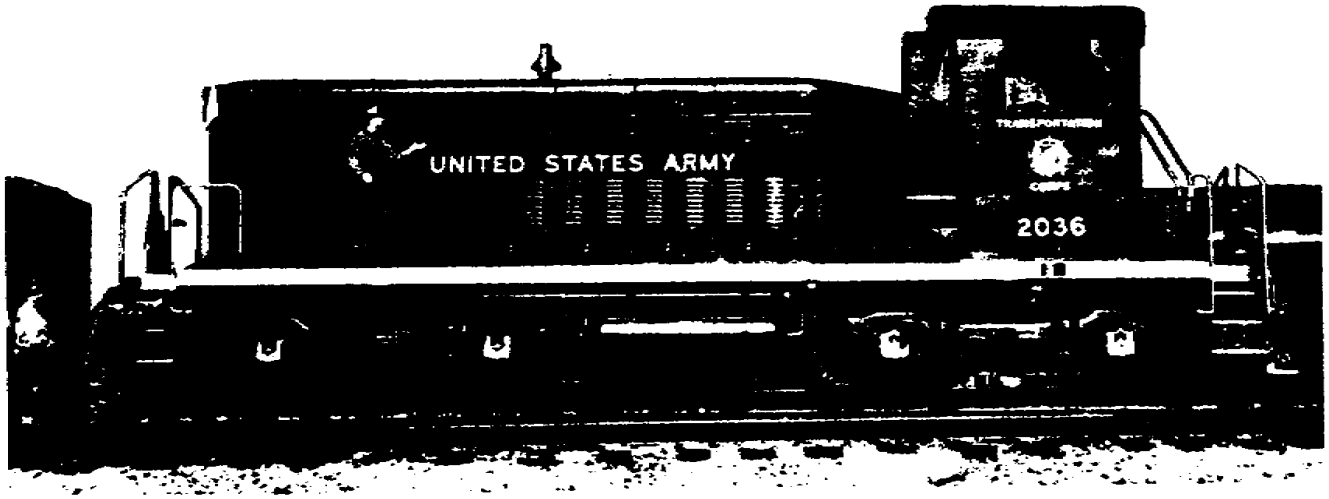
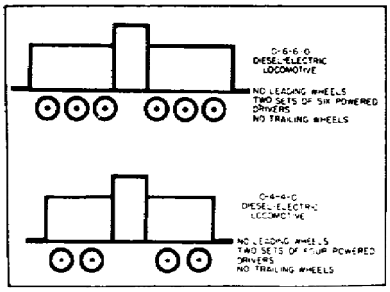



Figure 1.2. The 0-4-4-0 Diesel-Electric Locomotive.

Locomotives are classified under the Whyte Classification System according to their wheel arrangement. The Whyte System is based upon a group of three or more digits. The first digit indicates the number of leading wheels a locomotive may have; the second, the number of driving wheels; and the third, the number of trailing wheels. The absence of leading or trailing wheels is shown by a zero.

All the wheels on the Army diesel-electric locomotives are driving wheels. The 0-6-6-0 has two 6-wheel trucks (the "6's"), each of which has three axles with two wheels each, but no leading or trailing wheels (the "0's"). The 0-4-4-0 has two 4-wheel trucks (the "4's"), each containing two axles with two wheels each, but no leading or trailing wheels (the "0's"). See the inserted sketch.

b. Rolling stock. Following the locomotive in a train is the rolling stock--the railway cars. As discussed later, all have




the same basic design except for the superstructure which is designed for specific uses. Figure 1. 3 shows some of the more common railway cars, and the use for which each was designed is readily apparent. You could haul coal in a boxcar, but you probably would not if you had hopper and gondola cars. You would want to save the boxcars to haul freight subject to pilferage or weather damage. On the other hand, you could use boxcars for troop movements if you could not get passenger cars.

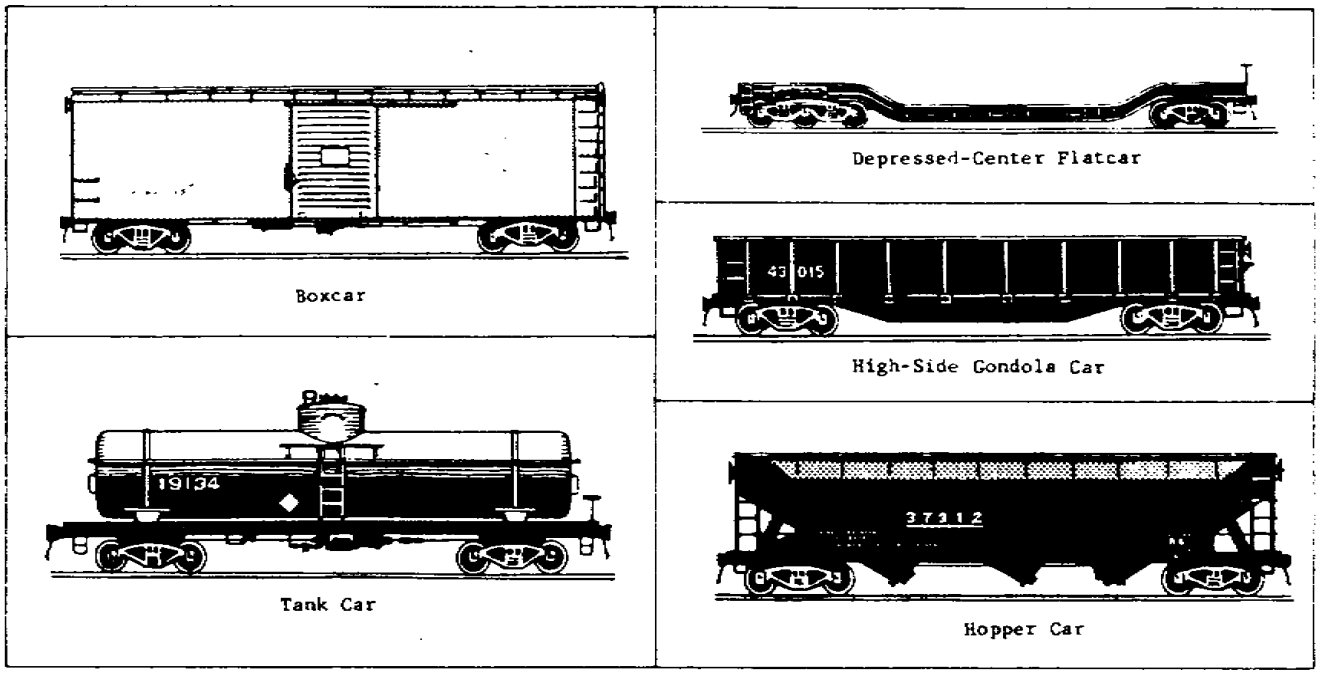



Figure 1.3. Common Railway Cars.

Although the cars shown in figures 1.4 and 1.5 are not presently in the Army's worldwide inventory of rail equipment, they are included to show the technological advances in the design and construction of commercial rail equipment. As new equipment is developed for commercial railroads, military transportation planners explore the possibilities of applying the new concepts and designs to military rail equipment.

The multilevel rack car, shown in figure 1.4, reflects the emphasis on larger loading capacity. Such equipment is being developed to keep pace with our Nation's increasing demands for

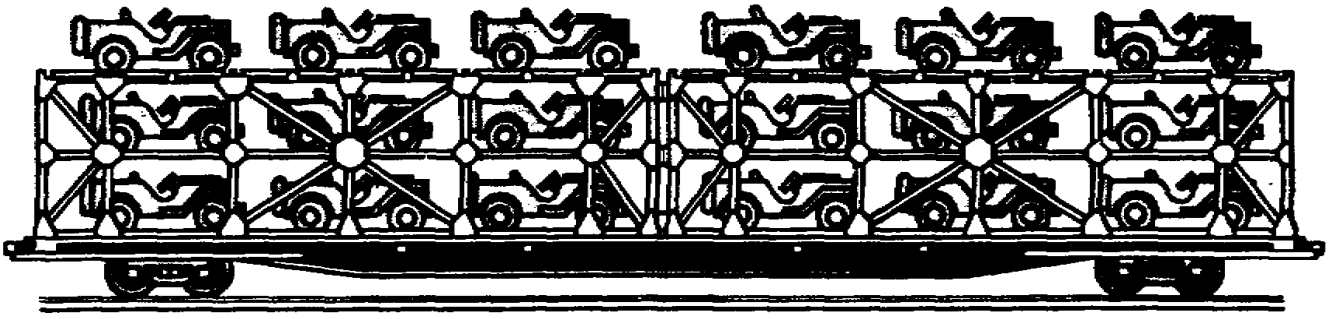


Figure 1.4. Multilevel Rack Car.

adequate and efficient rail transportation. Movements of new automobiles from factories to dealers in rack cars are steadily increasing; the number of automobiles carried runs into several million annually.

The piggyback car, shown in part A of figure 1.5, is noted for its shock-absorbing qualities. They are provided by the mechanism shown in part B of figure 1.5; the encircled numbers in it are referred to in the next few sentences. On either side of the center sill (A) is a cushioned rub rail (B) with a pocket (C) every 12 inches. A special tiedown device (D) is snapped securely into place in one of the pockets. Two chains (E) are fastened to both the tiedown device and the equipment being shipped. After that, the device is locked. When the car is subjected to a substantial impact, springs in the chains expand as much as 8 inches to absorb possible shock to the loaded equipment. The devices and chains eliminate the usual blocking required in rail shipments, thereby saving loading time and costs. Results of test loads of military vehicles and guided missile systems on rub-rail cars reveal that the damaging forces ordinarily present in rail shipments are substantially lessened by the shock-absorbing feature of the cushioned rub rails.

c. Caboose. Attached to the rear of the train is the caboose; a typical one is shown in figure 1.6. The train conductor and the rear brakeman ride the caboose, and emergency and safety equipment is stored in it. With the engineer, the fireman when on board, and the head brakeman riding in the locomotive cab, the train is easily protected at both ends when an emergency or unscheduled stop occurs on the main line. The caboose's cupola and lookout windows provide the occupants with a unique vantage point from which to view the train.

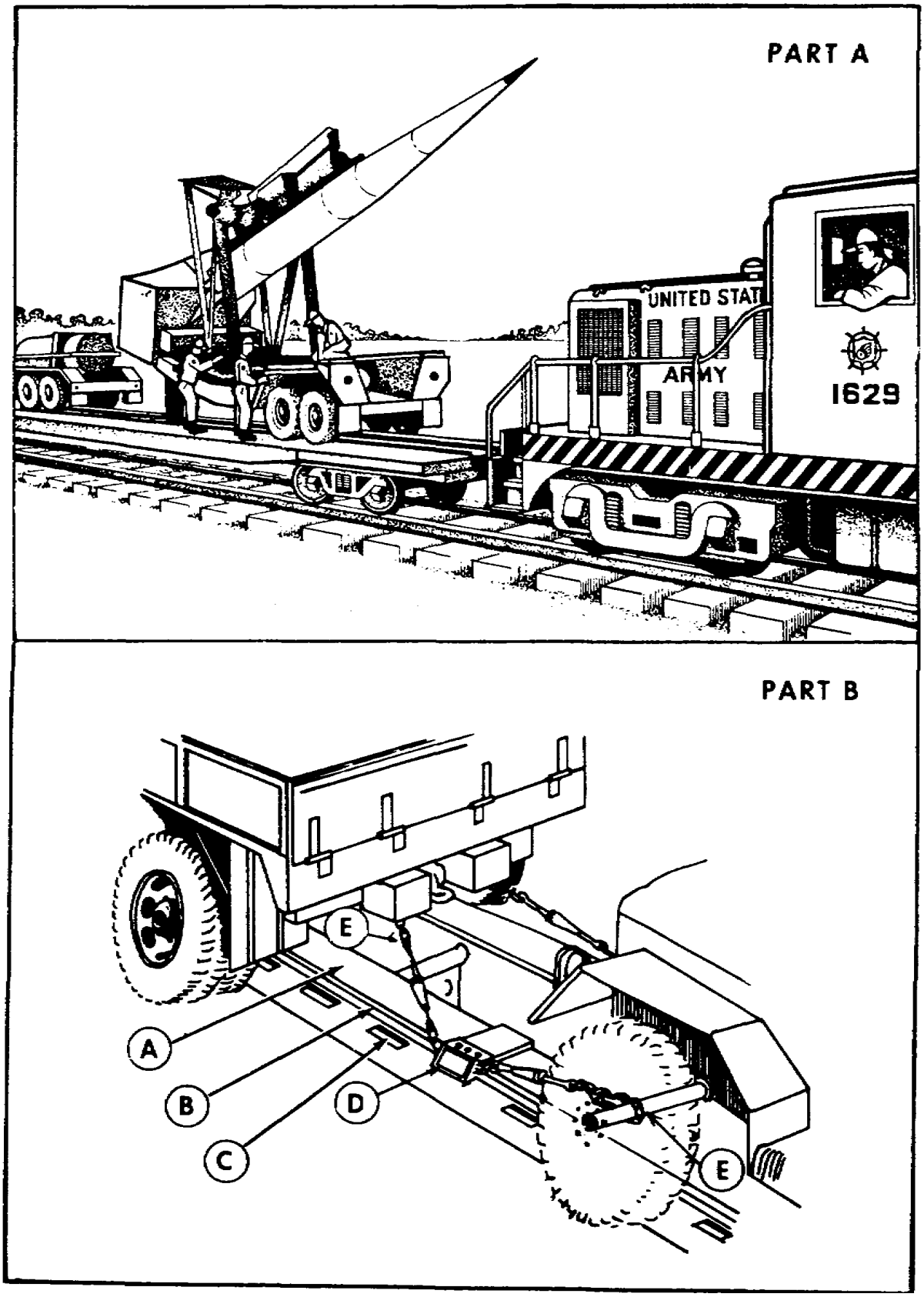



Figure 1.5. Cushioned Rub-Rail Car.

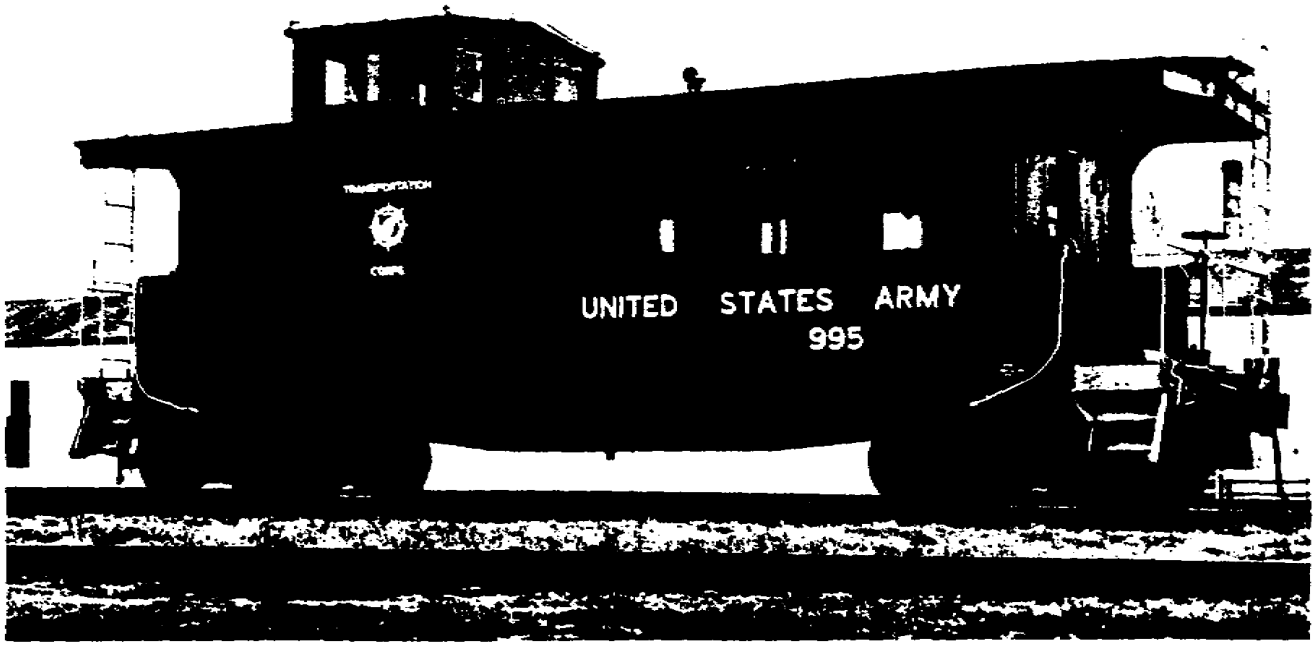
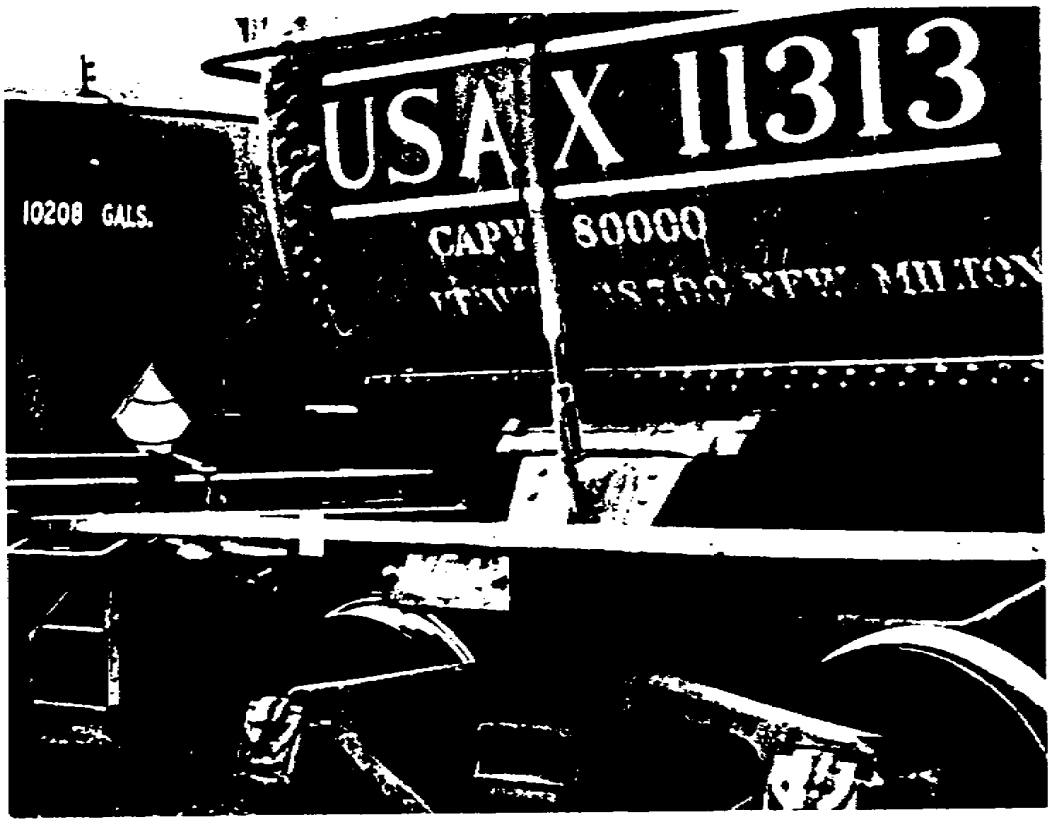



Figure 1.6. Typical Caboose.

## 1.3. PUBLICATIONS USED IN INSPECTING AND MAINTAINING RAILWAY EQUIPMENT

The publications used in the inspection and maintenance of Army rail equipment are Army Regulation (AR) 750-2200-1, Technical Bulletin (TB) 55-2200-207-15/1, and Technical Manuals (TM) 38-750, 55-202, and 55-203. They specify the forms inspector: are to use when checking equipment and that repairmen are to use when working on it. The forms are discussed later in the text.

Some Army rail equipment may be used on commercial lines in this country. To be suitable for use in the interchange system, this equipment must meet the standards set by the Association of American Railroads (AAR) and the Interstate Commerce Commission (ICC) for commercial rail equipment. The Army rules and regulations mentioned coincide with those of the ICC and the AAR. To identify Army equipment suitable for use in the interchange system, it is marked USAX or DODX, as figure 1.7 shows. Equipment marked USA cannot be operated over commercial railway lines; it is used at the installation where it is located for training and experimental purposes, or it may be part of the fleet designed for use on foreign railroads. Military rail equipment used in interchange service is under the control of the Military Traffic Management Command (MTMC).



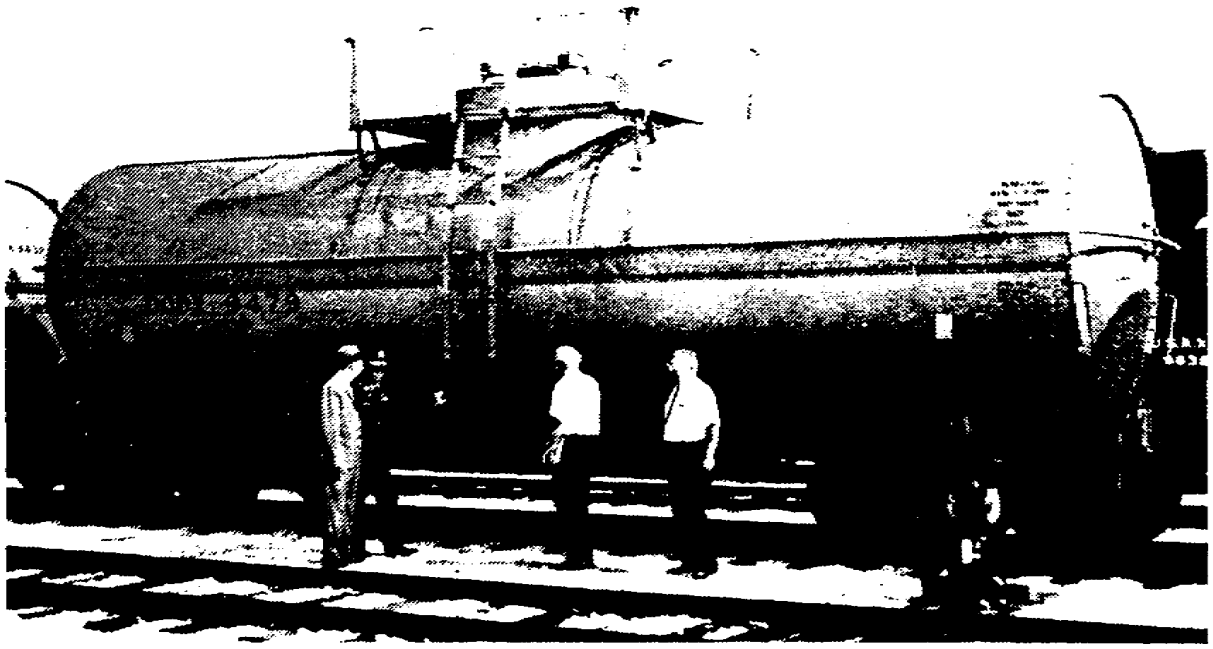



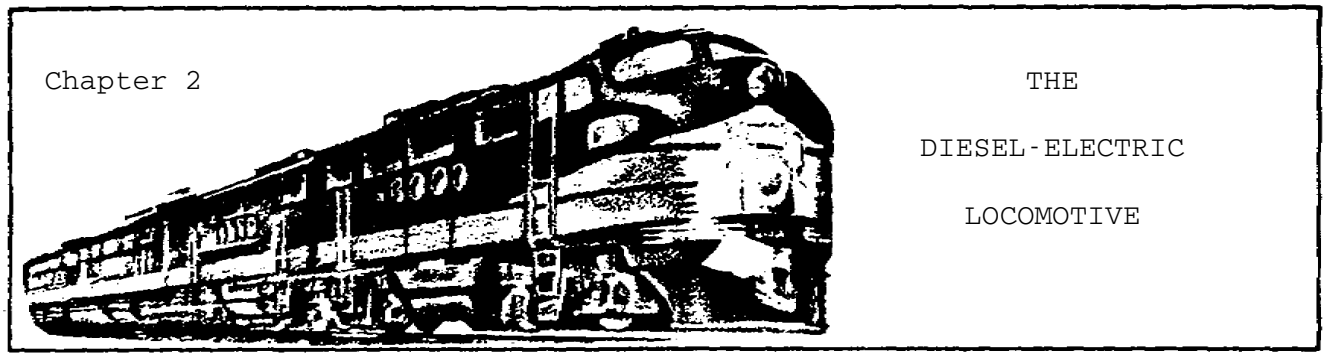
Figure 1.7. Rail Cars With USAX and DODX Markings.

## 1.4. SUMMARY

The transportation railway service moves many tons of supplies and equipment to support a military mission in a theater of operations; therefore, most of the trains it operates are freight trains. The two basic Army diesel-electric locomotives are the 0-6-6-0, 120-ton, 1,600-horsepower engine and the lighter 0-4-4-0, 60-ton, 400-horsepower engine. Locomotives are classified according to their wheel arrangement under the Whyte Classification System.

Each kind of Army railway car has basically the same design except for its superstructure which is designed for specific purposes. For example, a boxcar is suitable for carrying freight subject to pilferage or weather damage. If the need arises, however, a boxcar can be used to transport other types of freight or troops. The caboose at the rear of the train is used mainly to carry the train conductor and rear brakeman. Emergency and safety equipment are also stored in it for use when accidents or breakdowns occur on the road. Army rail equipment is inspected and maintained according to regulations drawn up to correspond with rules prescribed by the ICC and the AAR for commercial rail equipment. Army publications specify the forms to be used in the inspection and maintenance of equipment.

Now that you have had a brief description of the three basic parts of a train--the locomotive, the rail cars, and the caboose--and a short discussion on the publications governing the inspection and maintenance of Army rail equipment, the next chapter gives a detailed discussion of the diesel-electric locomotive.



# Chapter 2

# THE DIESEL-ELECTRIC LOCOMOTIVE

## 2.1. INTRODUCTION

A diesel-electric locomotive is primarily a powerplant mounted on wheels with controls, whereby the power can be used to propel railway equipment. Electrical equipment is used to transmit power from large internal combustion engines to the driving wheels. The powerplant consists of one or two multicylinder engines which deliver from 150 to 1,600 horsepower or more at a top speed of from 800 to 1,700 revolutions per minute (rpm). The engine is directly connected to a generator which furnishes the electrical power to the traction motors which drive the locomotive through spur gears on the driving axles.

In the lines you have just read are mentioned a number of the major components of the diesel-electric locomotive, the subject of section I of this chapter. Discussed in section II is an important part of the overall maintenance program for all types of rail equipment--preventive maintenance. A sound preventive maintenance program greatly increases equipment availability and efficiency. Proper inspection and maintenance of Army diesel-electric locomotives help to keep them rolling. However, both require completing various forms and records, the subject of section III.

## Section I. Major Components

## 2.2. GENERAL

A modern diesel-electric locomotive is an assembly of many components; however, this section explains only its major ones--what they are and how they function. In the paragraphs to follow are discussed the engine itself, the three kinds of generators, the air compressor, the fuel and water tanks, and the trucks. As you study, refer often to figure 2.1 which illustrates how the equipment on a diesel-electric locomotive is arranged. Also, refer to the glossary in appendix H for explanations of technical terms that may be unfamiliar to you.

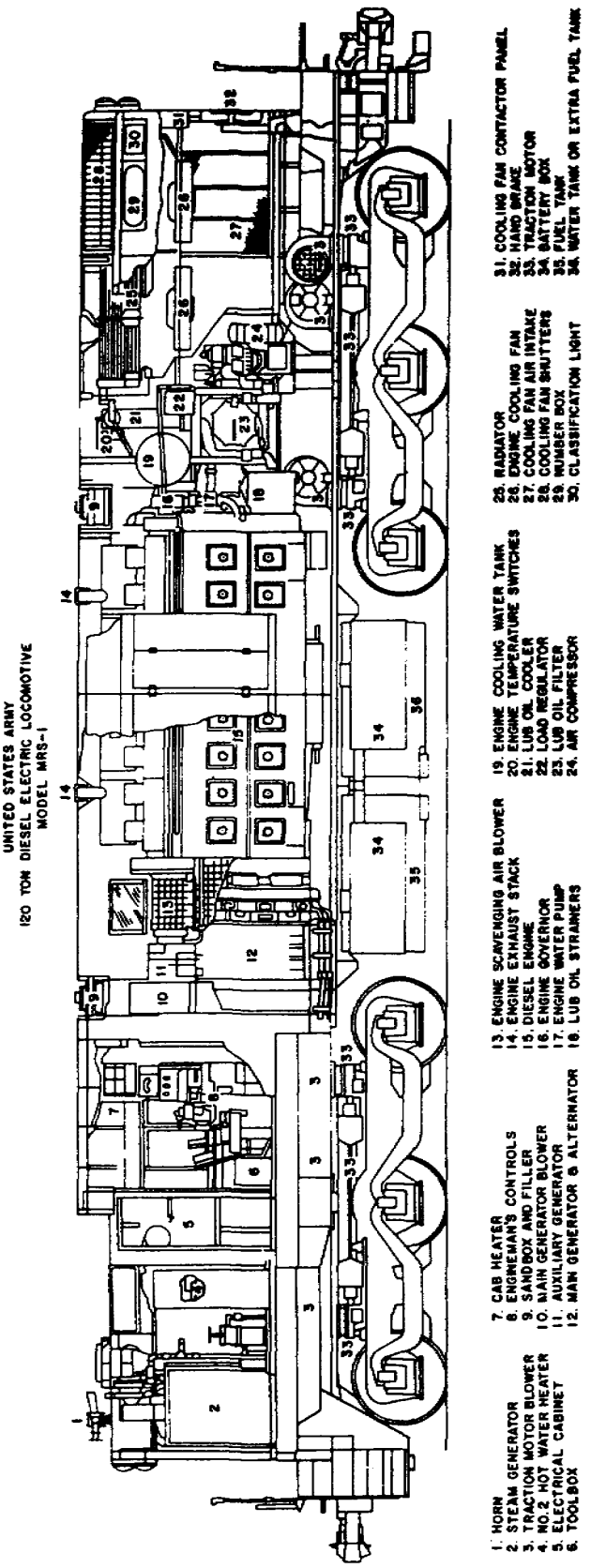



Figure 2.1. Arrangement of Equipment of Diesel-Electric Locomotive.

## 2.3. DIESEL ENGINE

A diesel engine is an internal combustion, oil-burning engine using compression ignition. Such an engine gets its power from the burning of a charge of fuel within a confined space called a cylinder. Ignition occurs when the fuel is ignited solely by the heat of compression, caused by injecting the fuel into the highly compressed, and thereby highly heated, air in the cylinder. A typical diesel engine designed for use in a diesel-electric locomotive is shown in figure 2.2. What are the advantages and function of this engine?

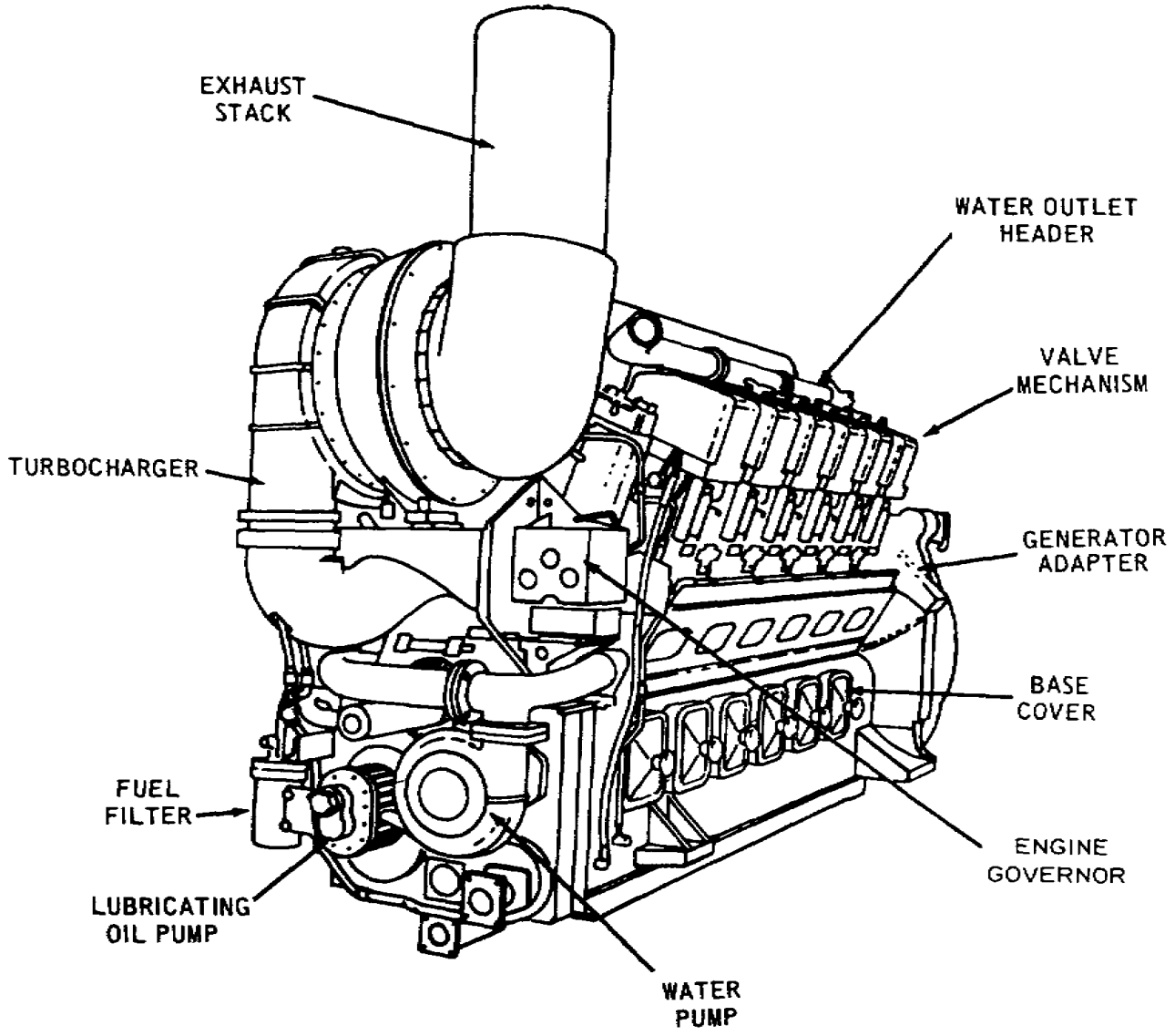



Figure 2.2. Diesel Engine.

a. Advantages. The principal economic advantage a diesel engine has over other internal combustion engines is fuel economy. This results from the high compression ratio and the proportionately

higher expansion and thermal efficiency of the diesel. Its constant torque throughout the speed range provides good pulling power at low speeds. Also, it performs well and is reliable in all kinds of weather. In addition, a diesel engine is much safer because its fuel is not as volatile as gasoline. And, too, the exhaust gases are not as dangerous as those of automobile engines because they are directed upward and dissipated into the atmosphere.

b. Function. The diesel engine changes heat energy into mechanical energy for turning a generator, to produce the electrical energy needed to operate the traction motors supplying motive power. Some of the mechanical energy is also used to operate such auxiliary equipment of the locomotive as the air compressor that supplies the air pressure for the airbrake system of the entire train.

## 2.4. GENERATORS

All diesel-electric locomotives have at least two generators, its main and auxiliary ones, and sometimes a third, a steam generator. Their functions are described in the subparagraphs following.

a. The main generator, such as the one shown in figure 2.3, converts the power output of the diesel engine into electrical power for operating the traction motors, discussed later in this subparagraph. Note the main generator's location on the locomotive, just forward of the engineman's controls, in figure 2.1 at the part numbered 12 and its blower, at the part numbered 10.

The main generator is directly connected to the diesel engine which turns the armature within the main field. With the generator directly connected to the diesel engine, the armature's speed varies with engine speed between approximately 350 and 1,800 rpm for small engines and 300 to 1,000 rpm for large engines. Even though the speed of rotation varies, the main fields are designed to produce up to 1,200 volts of direct current with a constant kilowatt output. The armature is built and balanced to withstand high-speed rotation and all the vibrations incurred in operating with a diesel engine.

The traction motors receive electrical energy from the generator and convert it to mechanical energy at the wheels of the locomotive. The motors are geared to the locomotive axles, and, by driving the axles and turning the wheels, they supply the locomotive's tractive effort. The motors are mounted on the axles in the trucks of the locomotive.

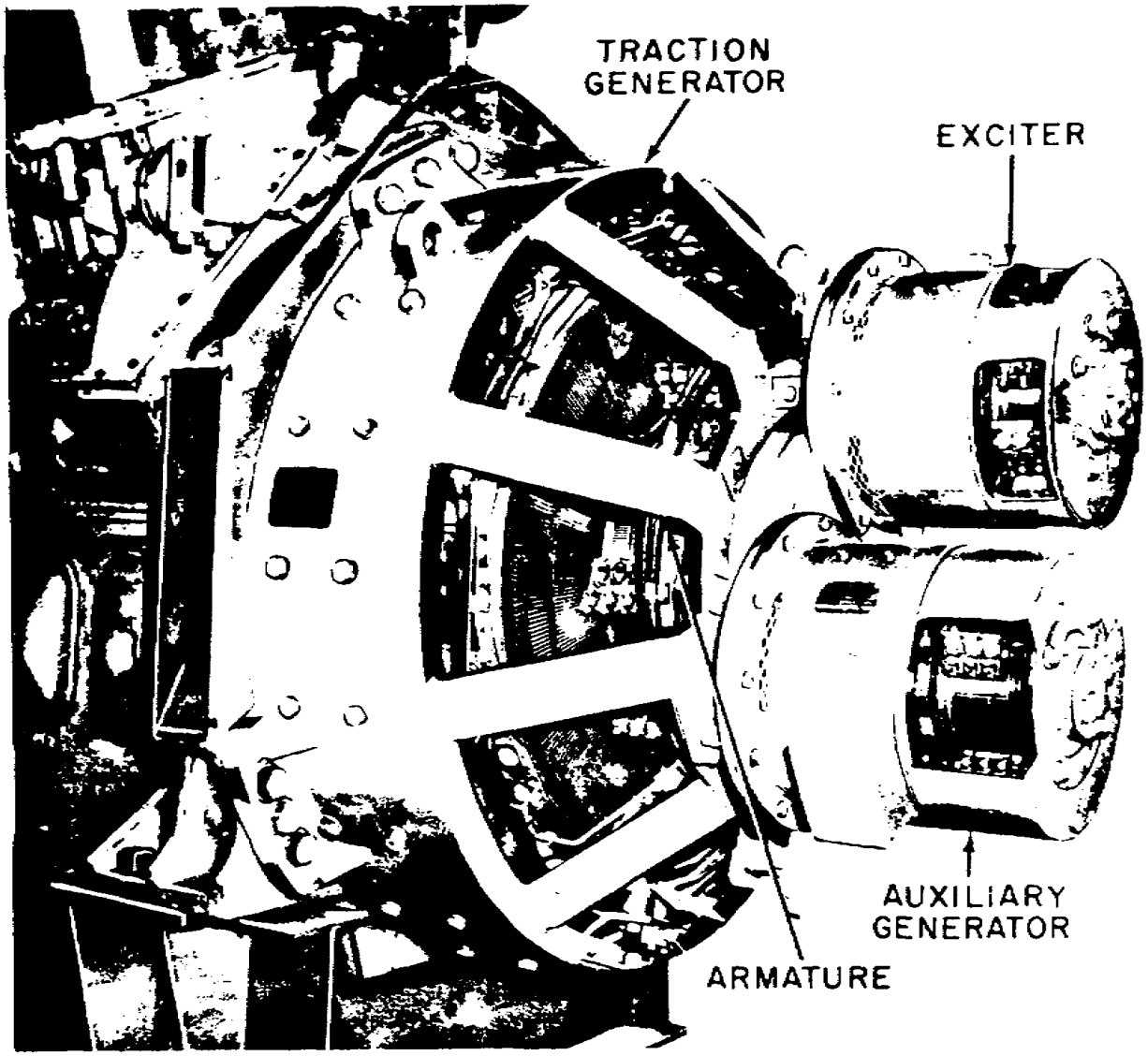



Figure 2.3. Main Generator.

b. The auxiliary generator produces about 10 kilowatts of electricity for the power needed to operate control equipment. It also charges the storage battery and supplies current for the low-voltage circuits required for the lighting of the locomotive, operating the fuel pump motor, and exciting the main field. Once the battery has supplied the power to start the diesel engine, the auxiliary generator begins to operate. It is either belt or gear driven from the shaft of the diesel engine or the main generator, and it is usually mounted on the latter's frame, as shown in figure 2.3. The auxiliary generators shown in figure 2.1 at the part numbered 11 and in figure 2.3 are gear driven from the main generator's shaft.

c. A steam generator is installed on locomotives used for passenger and ambulance trains to produce steam heat for the cars

in cold weather. It is an independent, oil-fired heating unit that operates automatically once it has been started, In figure 2.1, the steam generator is the part numbered 2.

## 2.5. AIR COMPRESSOR

An air compressor, such as the one shown in figure 2.4, compresses the air used to operate much of the equipment on a diesel-electric locomotive. Such equipment includes airbrake systems, reversers, electro-pneumatic contactors, sanders, and window wipers. The compressor may be engine driven either directly by belts from the main generator's shaft or through a flexible coupling to it. The air compressor has a two-compression cycle. Two

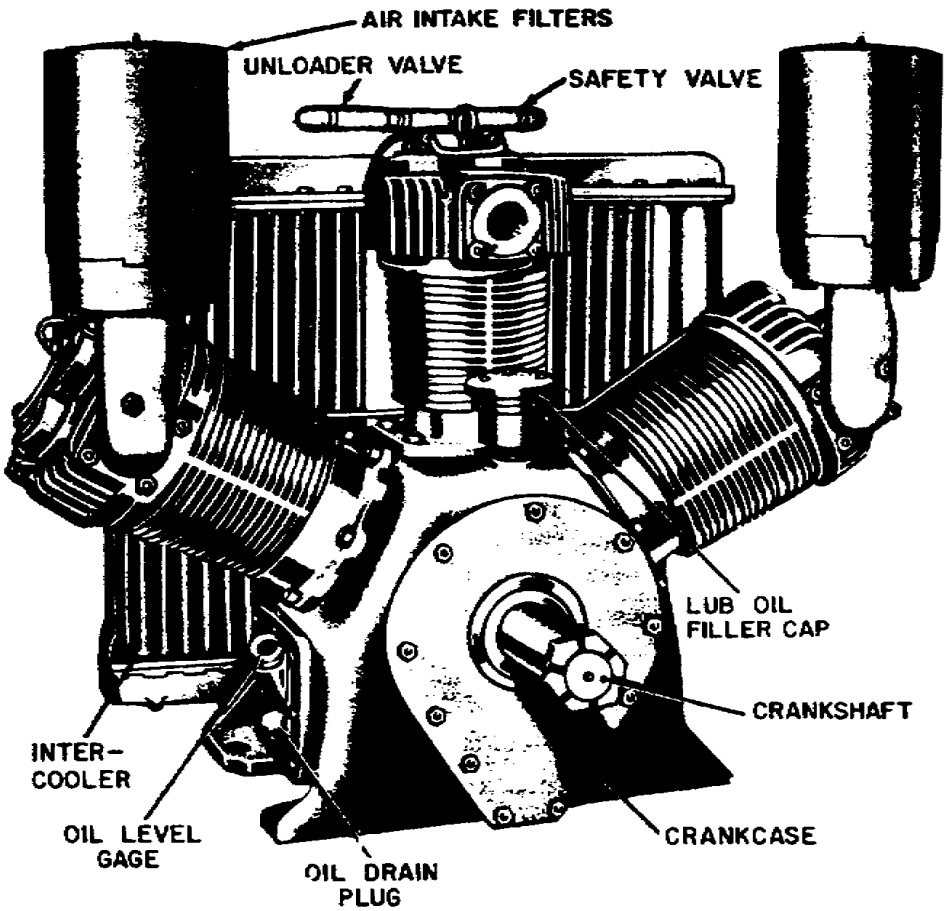



Figure 2.4. Air Compressor.

low-pressure cylinders compress air which then passes through a cooling system to a high-pressure cylinder that compresses it still further before feeding the air to the main reservoir. This reservoir is kept at a pressure of 125 to 140 pounds.

## 2.6. TANKS

Both fuel and water tanks are carried on a diesel-electric locomotive. The fuel tank, usually suspended beneath the underframe between trucks, contains fuel oil for operating the diesel engine. Note the parts numbered 35 and 36 on figure 2.1. A water-expansion tank containing water for cooling the engine is located at the highest point in the engine-cooling water system, the part numbered 19 on figure 2.1. This system is designed to carry away and disperse the excess heat generated in the engine.

## 2.7. TRUCKS

The main function of the trucks is to provide a connection between the axles and wheels and the locomotive itself. The trucks must carry the weight of the locomotive superstructure and distribute it through the wheels to the rails. They also absorb lateral thrusts and ride over uneven rails without excessively tilting and swaying the locomotive. The trucks also provide mountings for the brake rigging and traction motors.

Army diesel-electric locomotives have either two 6-wheel swivel 3-motor trucks or two 4-wheel swivel 2-motor trucks. Figure 2.5 shows a 4-wheel swivel 2-motor truck used on the 0-4-4-0 diesel-electric locomotive. The main difference between the 4-wheel and the 6-wheel truck is that the weight of the locomotive is distributed over a wider surface by a 6-wheel one; therefore, it has a greater working surface on the rails, giving the locomotive more tractive effort or pulling power.

## 2.8. SUMMARY

A diesel-electric locomotive is made up of many complex parts. Is internal combustion diesel engine burns diesel fuel oil ignited by the heat of compressed air within a cylinder, a process known as compression ignition. The main generator is connected to the engine, and its mechanical energy output turns the generator to produce the electric current needed to power the traction motors that turn the locomotive's wheels.

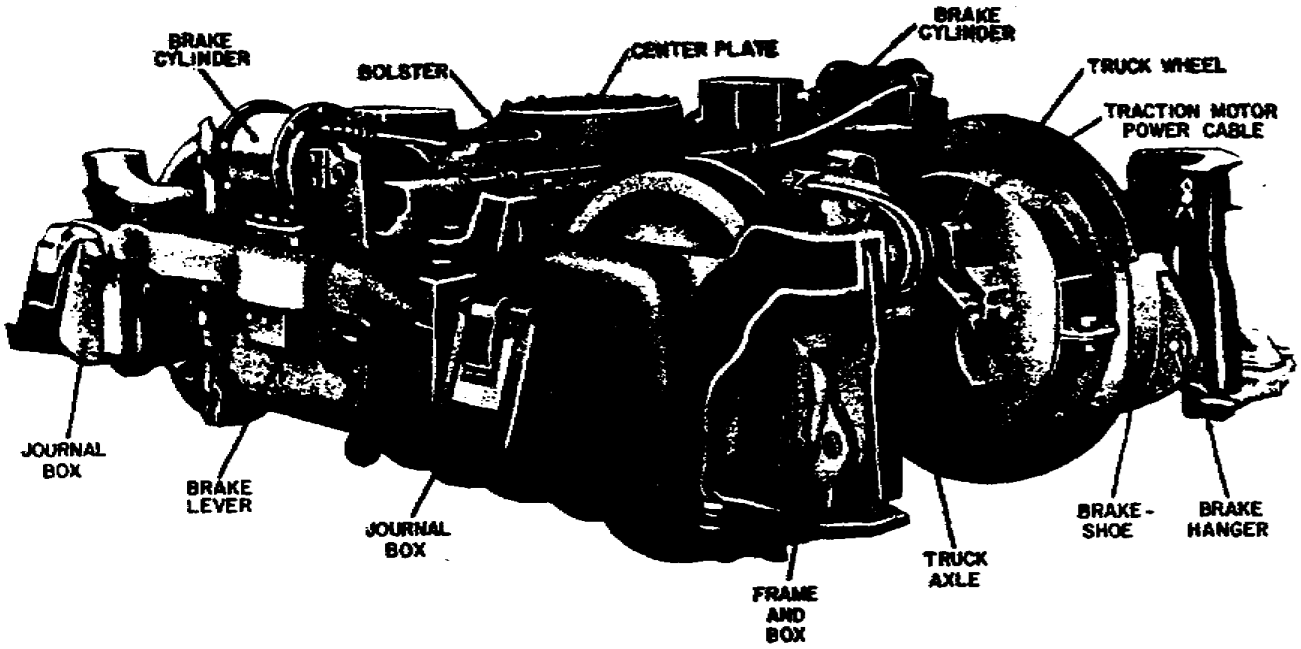



Figure 2.5. Four-Wheel Swivel Truck.

The auxiliary generator provides the power needed to operate control equipment, to charge the storage battery, and to supply current for the train's low-voltage circuits. A steam generator is needed on passenger and ambulance trains for cold-weather heating of cars. The air compressor, with its two-compression cycle, compresses air which is stored in the main reservoir. Air for the train's braking system is supplied from this source.

A diesel-electric locomotive has both fuel and water tanks. The fuel tank contains the fuel oil for operating the engine. The water-expansion tank is part of the engine cooling system, designed to carry off the excess heat of the engine. Trucks carry the weight of the locomotive superstructure and distribute it through the wheels to the rails. Trucks may be either 4-or 6-wheel. The latter provides a greater working surface on the rails and thereby greater tractive effort or pulling power than the 4-wheel.

## Section II. Preventive Maintenance

### 2.9. GENERAL

A well-planned and well-executed preventive maintenance program results in greater operational efficiency and increased availability of railway equipment. Preventive maintenance is an important part of any overall maintenance program. Not only does it safeguard against emergencies but also reduces the cost of replacing parts.

Although the weight of diesel-electric locomotives ranges upward from 25 tons and their horsepower from 150, the same general preventive maintenance procedures apply to all of them. Some of the important preventive maintenance checks on diesel-electric locomotives are discussed in this section; however, they are not all-inclusive. No satisfactory substitute has ever been found for commonsense; no conscientious equipment operator or inspector limits his inspection to any set checklist. He is constantly alert for any defects in his equipment and for any sign that leads him to believe it may be developing defects. For example, if a locomotive engineer observes a defective electric wire, he would not attempt to operate his locomotive until the defect has been checked thoroughly and any necessary repairs made. The checkpoints given here are only a guide to good preventive maintenance. The five paragraphs to follow discuss the oil, water, fuel, air pressure, and commutator checkpoints to be inspected. Then the next three paragraphs, in turn, discuss the engine overspeed trip, the ground relay, and the end receptacles.

## 2. 10. OIL CHECKPOINTS

The oil level in the diesel engine and the pressure of that oil must be checked as well as the oil level in the engine governor and in the air compressor. Details are given in the subparagraphs following.

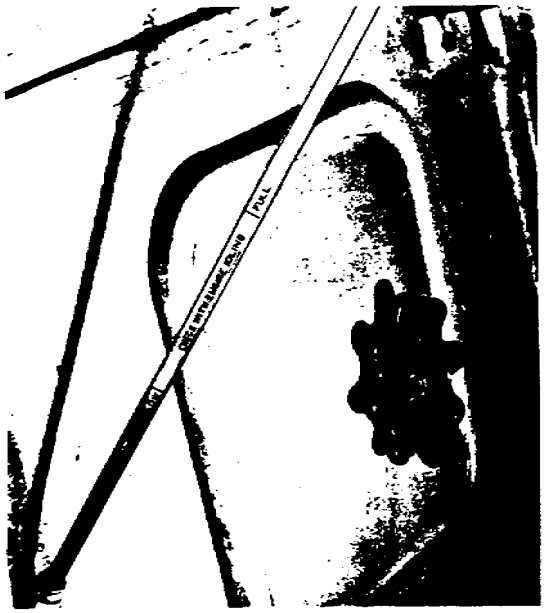



Figure 2.6. Engine Lubrication Dipstick.

a. Oil level in the diesel engine. Check the oil level in the diesel engine by using the bayonet-shaped dipsticks located on either side of the engine. The location and markings on one of the dipsticks are shown in figure 2.6. When the engine has been stopped for 30 minutes or more, most of the oil will have drained to the bottom of the engine; at that time, the oil level shown on the dipstick should be above the full mark. With the engine idling, the oil is hot and circulating through the engine, and a reading taken at that time should show the oil level on the dipstick between low and full.

b. Lubricating oil pressure gage. The diesel engine lubricating system's oil pressure gage is located in the locomotive cab. Observe the gage frequently while the locomotive is being operated; investigate any deviation from normal readings. Improper oil pressure causes excessive engine wear and possible engine breakdown.

c. Lubricating oil supply in engine governor. The engine is equipped with a governor to regulate its speed according to various throttle settings. This is done by altering the amount of fuel introduced into the cylinder. The governor has its own oil lubricating system. Figure 2.7 shows the oil level sight gage on one type of engine governor. This gage has two marks; the oil level should be between them for safe operation.

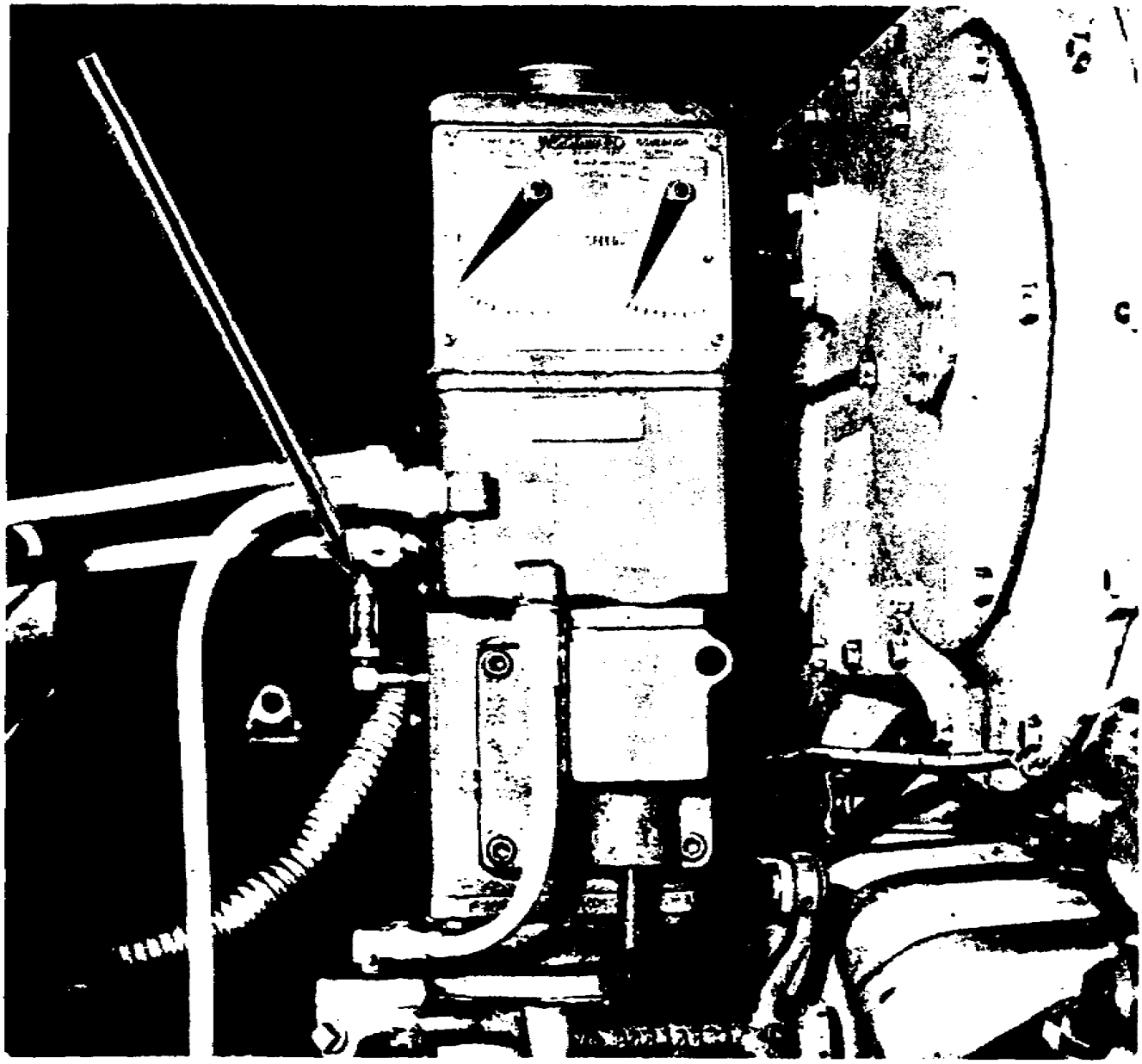


Figure 2.7. Engine Governor Oil Level Sight Gage.

d. Lubricating oil supply in air compressor. As discussed in paragraph 2.5, the air compressor is needed to operate a great deal of the equipment on the locomotive; it has its own oil pumps and pressure lubricating system. When the engine is stopped, the oil level in the compressor crankcase is checked with a bayonet-shaped dipstick, located as shown in figure 2.8. The level should be between the low and high marks.

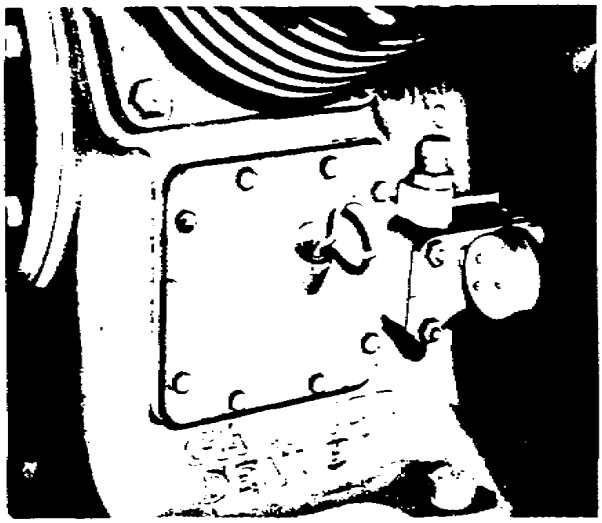


Figure 2.8. Location of Air Compressor Lubrication Dipstick.

## 2.11. WATER CHECKPOINTS

The Army's diesel-electric locomotives have water-cooled engines. In carrying out preventive maintenance procedures, both the level and temperature of the water must be checked. Subparagraphs a and b give the details.

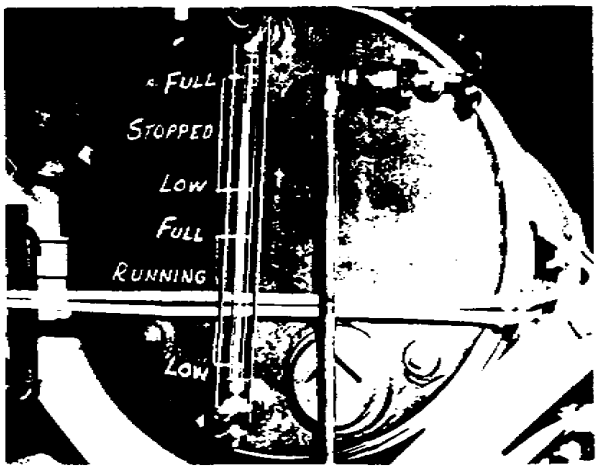



Figure 2.9. Water reservoir and Marked Gage.

a. Level. The water used to cool the diesel engine is stored in a reservoir equipped with a gage. Figure 2.9 shows the markings on a typical one. The water level should be between low and full at one of the readings, depending upon whether the engine is running or stopped. The engine should not be operated if no water appears in the gage.

b. Temperature. The engine water temperature gage, located in the locomotive cab, shows the temperature of the water in the engine cooling system. Recommended operating temperatures on different locomotive models vary. On one, the range is from 160° to 170° F.; on another, from 175° to 180° F. After the engine of the latter model is started, it is idled until the temperature is normal--120° F. or more--before pulling any cars.

## 2.12. FUEL CHECKPOINTS

Each locomotive has at least two fuel checkpoints to be inspected before operating the engine. They are the fuel-flow glasses and the fuel cutoff valve, discussed in the subparagraphs to follow.

a. Flow. Located on the duplex filter assembly are two fuel-flow sight glasses. The fuel flow in the right glass, the one nearest the engine, should be clear and free of bubbles for proper engine operation. Figure 2.10 shows the duplex filter assembly and the two fuel-flow glasses.

b. Cutoff valve. In an emergency or by accident, the fuel cutoff valve can be tripped by a pull cord to stop the supply of fuel to the engine. Whenever the valve is tripped, it must be reset; it must be open for the engine to operate. Look at figure 2.11. The yoke normally holds the valve open, but when the lever is raised, the yoke also comes up, depresses the valve stem, and stops the fuel flow. To reset the valve, the lever is depressed, making the yoke slide into place and raise the valve stem. Fuel is once more flowing into the engine.

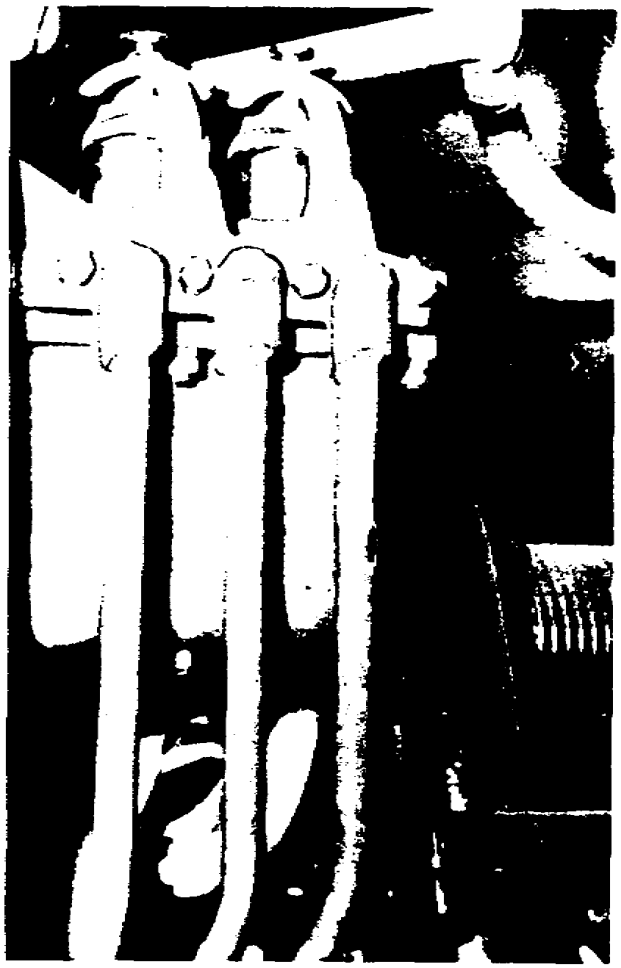


Figure 2.10. Duplex Fuel Filter Assembly.

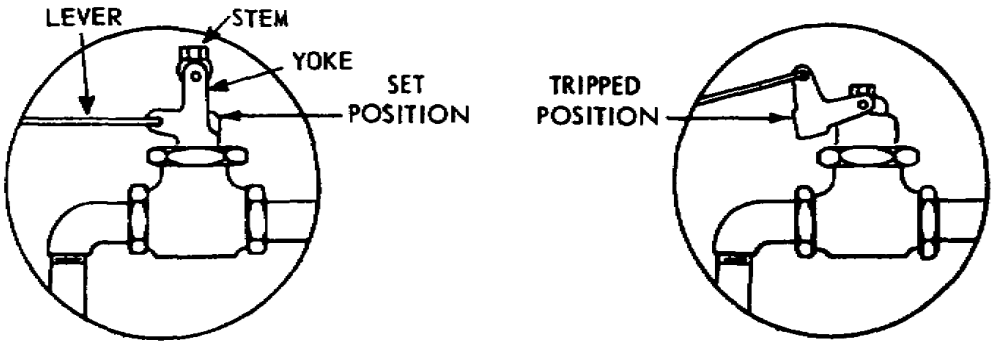



Figure 2.11. Fuel Cutoff Valve.

## 2.13. AIR PRESSURE CHECKPOINTS

Control or instrument panels containing the many different gages and switches may be located at different places in the locomotive cab. Their arrangement may vary with each diesel-electric locomotive, but they are always in a conspicuous place. The instrument panel normally contains two air gages, one to show the air pressure in the main reservoir and the other to show the air pressure in the brake pipe and cylinder. The gages are tested once every 3 months and whenever any irregularity is noted. An accurate test gage or deadweight tester is used in making the test; any air gage found incorrect is repaired before being used again.

## 2.14. COMMUTATOR CHECKPOINTS

The main generator is turned by a direct drive connection with the diesel engine. The electric current that the generator produces is passed from the commutator through brushes and into the locomotive electrical power system. Figure 2.12 shows the alternator slip rings for a.c. power to roof cooling fans and traction motor blowers, with brushes and brush holders in place. Proper generator or alternator operation and electrical output depend upon the commutator or slip rings being clean and free of defects, the brush holders being correctly positioned, and the brushes being free of excessive wear. The commutator or slip rings are inspected for cleanliness; no oil, carbon deposits, or dirt should accumulate on either; and the segments of the rings should not be nicked or cracked or show burned or blackened spots. If the plates are defective, repairs should be made before the locomotive is operated. The brush holders should be securely in place and positioned 1/8 inch above the commutator or slip rings. The brushes contained by the brush holders should ride evenly on the commutator or slip rings; if they show excessive wear, they should be replaced. If dirt or carbon is permitted to accumulate on the brush holders, a short circuit may occur. If the brushes are worn excessively or are defective, an open circuit may occur. The same preventive maintenance inspection should be made of the auxiliary generator; one is shown in figure 2.13. In this illustration, the inspection plate has been removed to reveal a brush holder and brush.

## 2.15. ENGINE OVERSPEED TRIP MECHANISM

When the diesel engine's speed becomes excessive, an overspeed trip mechanism located in the cab stops the engine by preventing further fuel injection into the cylinders. The resetting procedure varies with different locomotives. Some trip mechanisms are reset

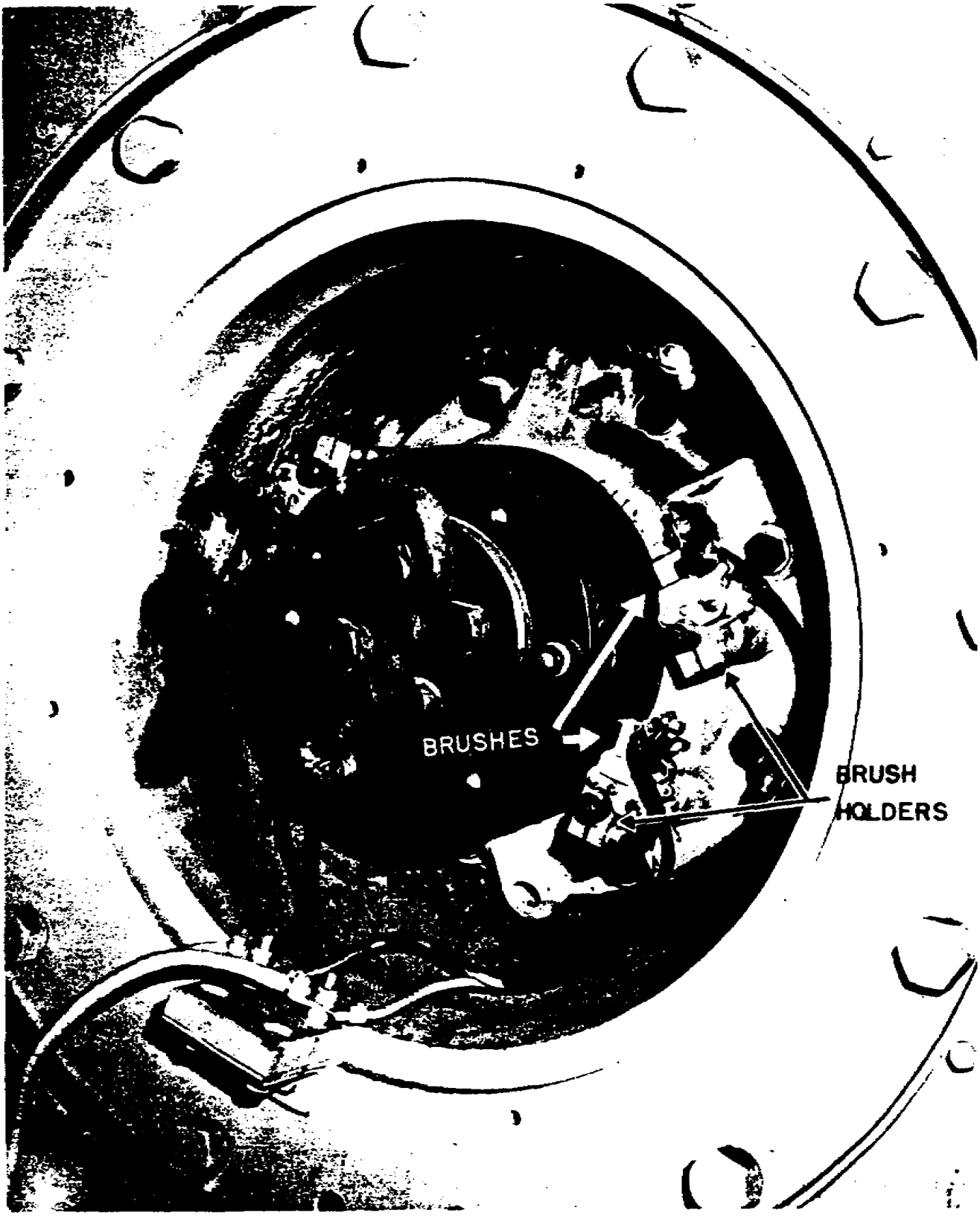



Figure 2.12. Alternator Slip Rings With Brush Holders and Brushes in Place.

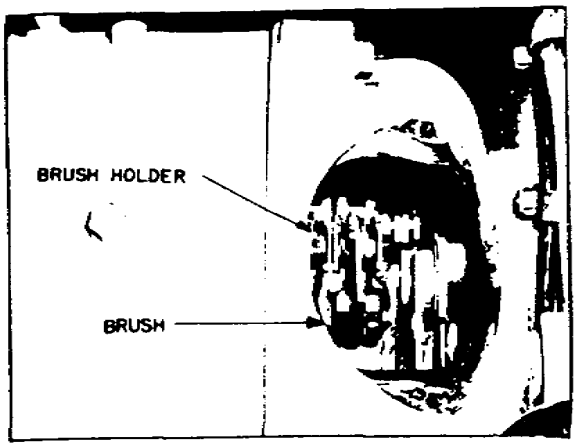



Figure 2.13. Auxiliary Generator With a Brush and Brush Holder Visible.

2.16. GROUND RELAY

A ground relay is installed in the main power circuit to warn the crew if a ground develops in the circuit. When one occurs, the relay trips, causing an indicator light to come on or an alarm bell to sound, and on some locomotives, reducing the engine speed to idle and disconnecting the traction motors. A red indicator, visible through the trans parent cover on the relay box, appears when the relay has been tripped. When the reset button, located on the ground relay cover, is pressed, power can once more be delivered. Because the ground relay is a safety device, it should be checked before the locomotive is operated. The typical ground relay illustrated in figure 2.15 shows it after it has been reset. Never use the ground relay cutout switch (fig. 2.15) because a great deal of power circuit damage could result.

by a hand lever, others by push button; however, the resetting procedure is always apparent on sight. Since the engine overspeed trip is a safety device preventing the engine from excessive high speed, it should always be inspected before the locomotive is operated. Figure 2.14 shows an engine overspeed mechanism operated by a lever.

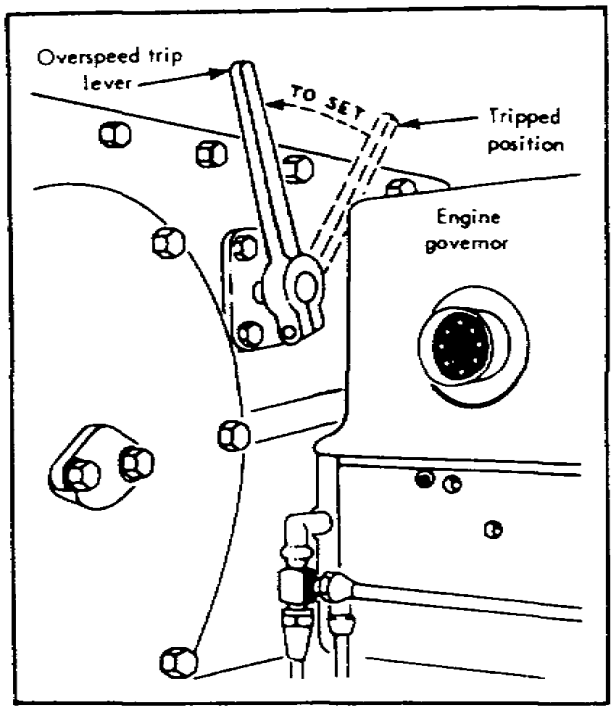



Figure 2.14. Lever-Operated Engine Overspeed Trip Mechanism.

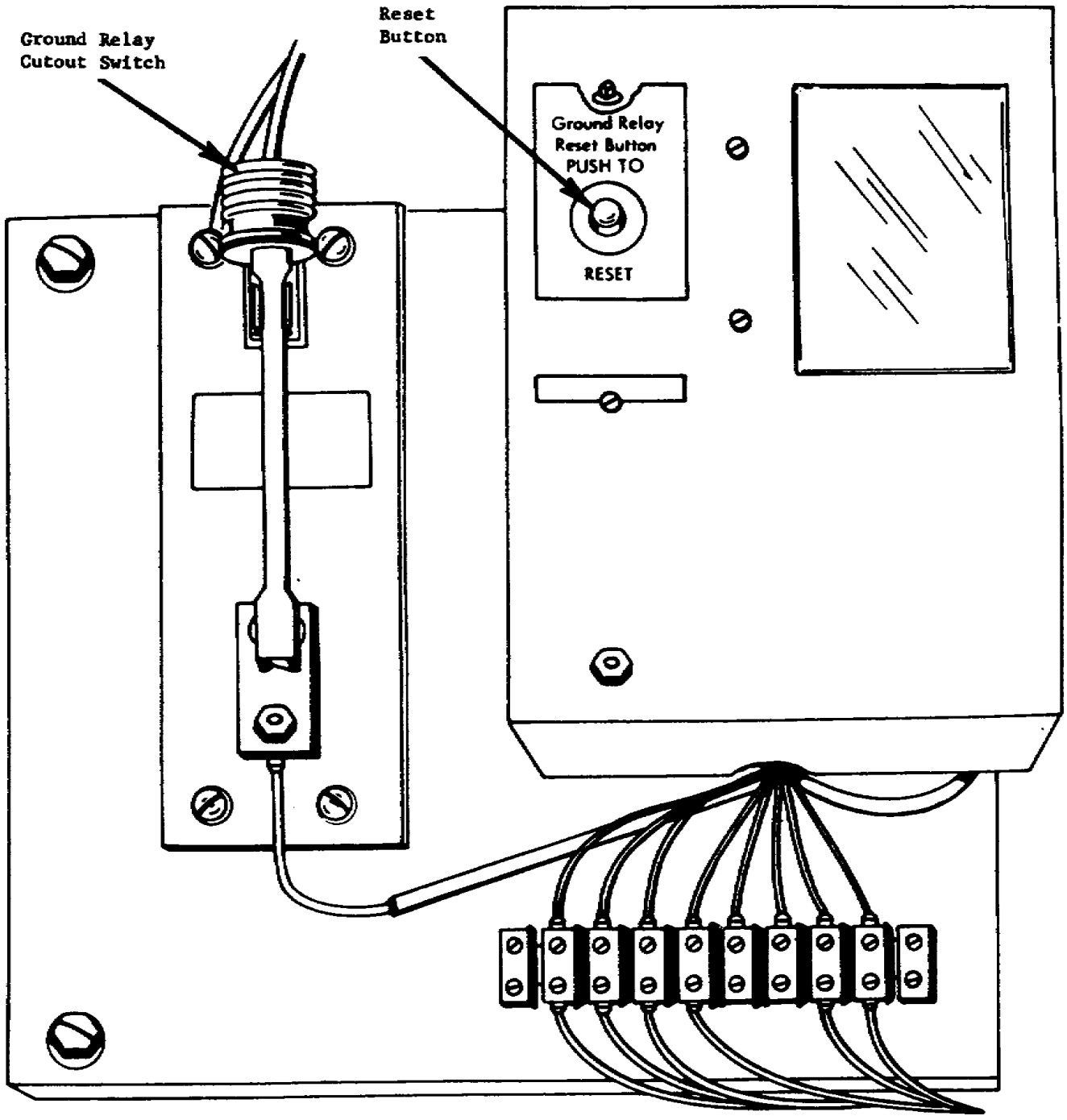



Figure 2.15. Ground Relay.

2.17. MULTIPLE-UNIT END RECEPTACLES

The multiple-unit end receptacles on diesel-electric locomotives are used when two or more coupled locomotives are operated as one locomotive from one cab. This is called multiple-unit operation. The receptacles make it possible to join the electrical control circuits of the locomotives. A plug attached to a jumper

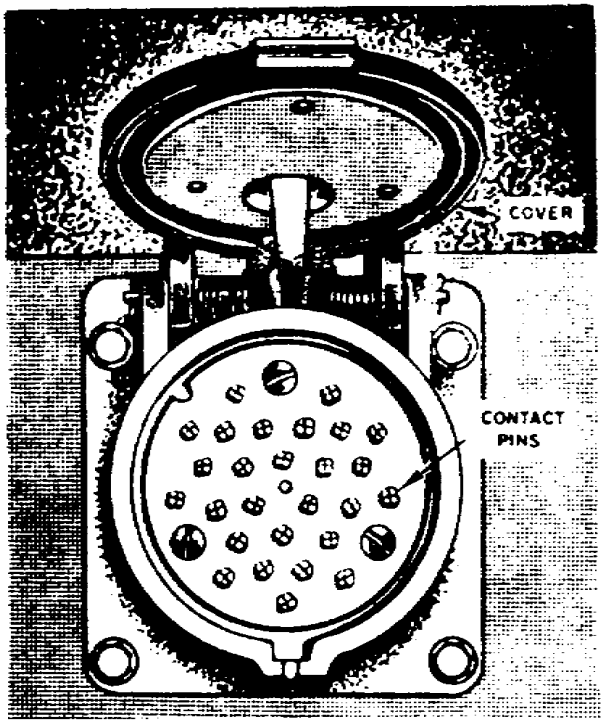



Figure 2.16. Multiple-Unit End Receptacle.

containing the control wires is inserted in the end receptacle to make the connection. Each end receptacle should be inspected for cracks in the insulation, bent or broken contact pins, and broken cover springs. Figure 2.16 pictures a typical multiple-unit end receptacle; note the 27 contact pins.

2.18. SUMMARY

An effective preventive maintenance program is necessary to guard against breakdown of equipment and reduce the expense involved in replacing parts. Although checklists and guidelines may be provided for making preventive maintenance inspections, a good inspector does not limit himself to a set list but observes his equipment keenly for any sign of developing defects. A locomotive operator, for example, observes the instrument panel in the cab containing the various gages and controls. They include air pressure gages, oil pressure gages in the engine lubricating system, and water temperature gages. Excessive deviations from normal readings on the gages may point out deficiencies that could develop into serious defects.

## Section III. Inspection and Maintenance Forms

2.19. GENERAL

Publications governing the inspection and maintenance of Army diesel-electric locomotives require the use of various forms and records. This section contains only a general discussion of them. For details on preparation and distribution, the units responsible for inspecting and maintaining the equipment must have the appropriate publications on hand and follow the instructions therein. Technical Manual 38-750, The Army Maintenance Management System (TAMMS), and Technical Manual 55-202, Operation and Maintenance of Diesel-Electric Locomotives, are the two needed.

## 2.20. MAINTENANCE REQUEST

The Maintenance Request, DA Form 2407, shown in figure 2.17, is designed to provide maintenance information to all management levels. On railway equipment, it is used to submit equipment improvement recommendations (EIR), report modification work orders (MWO) accomplished, and record maintenance requested and accomplished. The 2407, a multiple-copy form, has copies designated as follows: receipt, national maintenance point (NMP), control, organization, and file. All but the receipt copy have three sections each: maintenance request, work accomplished and equipment improvement recommendations. The receipt copy has sections I and III only with instructions for using the form at the various maintenance levels instead of section II. On the back of the file copy are some of the codes used in preparing the form; the complete list of codes and an explanation of some of them are given in appendix A of TM 38-750.

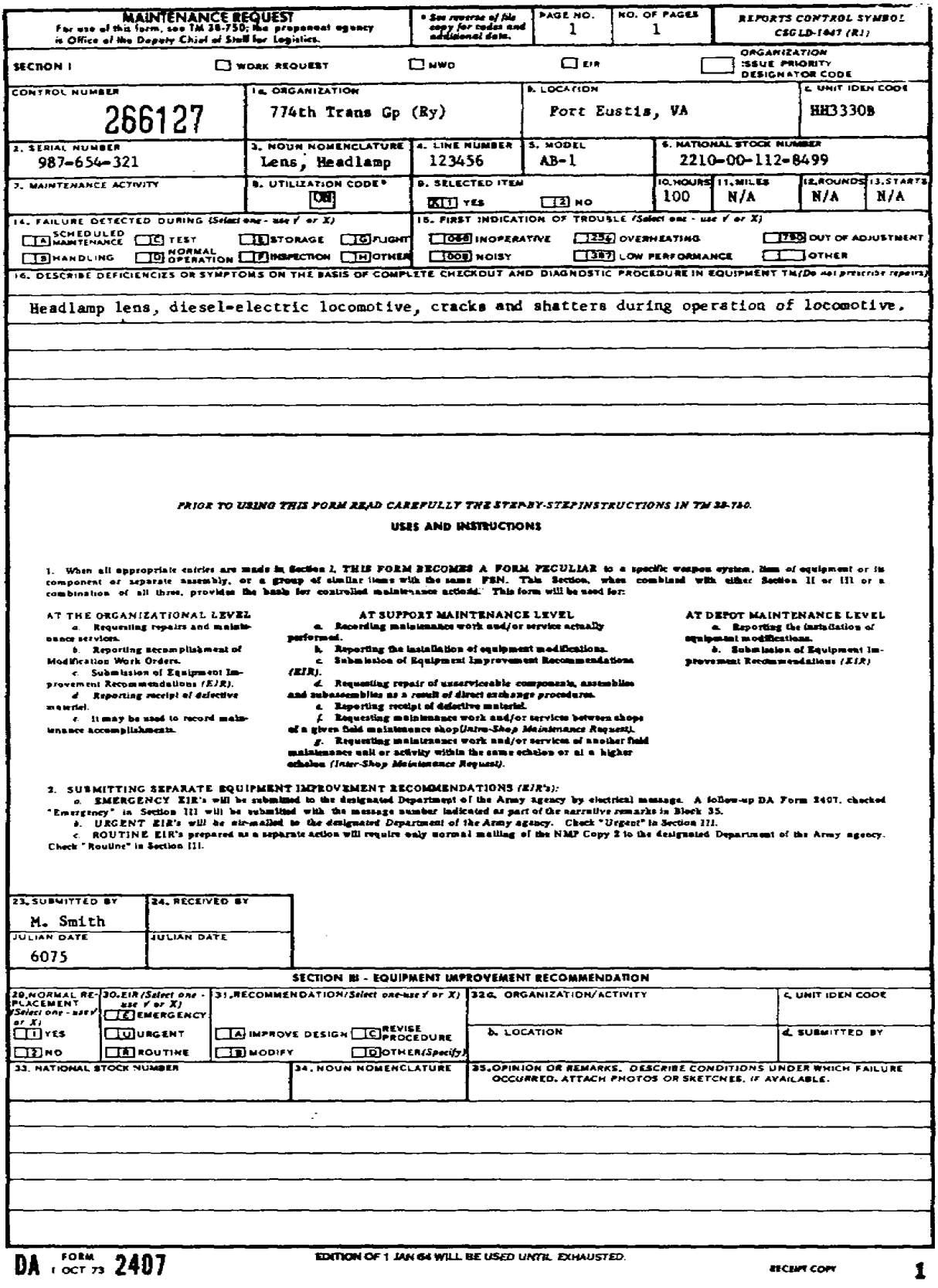
Figure 2.17 is an illustration of the DA Form 2407 with only section I completed. The requesting organization fills out this section and sends the form, along with the equipment, to the support activity. After the repairs are finished, the support activity completes section I and returns the equipment to the requesting agency.

## 2.21. EQUIPMENT DAILY OR MONTHLY LOG

As implied by the title, DA Form 2408-1, Equipment Daily or Monthly Log, serves two purposes. It provides both a daily and a monthly record of information relating to the operation of equipment. All Army diesel-electric locomotives have two 2408-1 forms in their log books--one for a daily log, as shown in figure 2.18, and one for a monthly log, as shown in figure 2.19. Each is discussed in the following subparagraphs.

a. The daily log shows a day-to-day record for a month of the hours the locomotive was operated, the fuel and lubricants added during operation, and the number of days the locomotive was deadlined. At the end of each day's operation, the engineman inspects the locomotive and then makes the entries in columns a through g on form 2408-1. At the end of each month, information in columns b, c, d, and h of the daily log is compiled and entered on the 2408-1 monthly log. The daily log is retained for 90 days and then destroyed.

b. The monthly log is a compilation of information taken from the daily log. The entries on the monthly log give the total hours



**MAINTENANCE REQUEST**
For use of this form, see TM 38-750; the proponent agency is Office of the Deputy Chief of Staff for Logistics.

* See reverse of this copy for codes and additional data.

PAGE NO. 1 | NO. OF PAGES 1 | REPORTS CONTROL SYMBOL CSGLD-1647 (R1)

SECTION I | ☐ WORK REQUEST | ☐ NWO | ☐ EIR | ☐ ORGANIZATION ISSUE PRIORITY DESIGNATOR CODE

| CONTROL NUMBER | 1a. ORGANIZATION | b. LOCATION | c. UNIT IDEN CODE |
|---|---|---|---|
| 266127 | 774th Trans Gp (Ry) | Fort Eustis, VA | HH3330B |

| 2. SERIAL NUMBER | 3. NOUN NOMENCLATURE | 4. LINE NUMBER | 5. MODEL | 6. NATIONAL STOCK NUMBER |
|---|---|---|---|---|
| 987-654-321 | Lens, Headlamp | 123456 | AB-1 | 2210-00-112-8499 |

| 7. MAINTENANCE ACTIVITY | 8. UTILIZATION CODE* | 9. SELECTED ITEM | 10. HOURS | 11. MILES | 12. ROUNDS | 13. STARTS |
|---|---|---|---|---|---|---|
| | [X] | [X] 1 YES ☐ 2 NO | 100 | N/A | N/A | N/A |

14. FAILURE DETECTED DURING (Select one - use ✓ or X)
☐ A SCHEDULED MAINTENANCE ☐ C TEST ☐ E STORAGE ☐ G FLIGHT
☐ B HANDLING ☐ D NORMAL OPERATION ☐ F INSPECTION ☐ H OTHER

15. FIRST INDICATION OF TROUBLE (Select one - use ✓ or X)
☐ 068 INOPERATIVE ☐ 254 OVERHEATING ☐ 759 OUT OF ADJUSTMENT
☐ 008 NOISY ☐ 387 LOW PERFORMANCE ☐ OTHER

16. DESCRIBE DEFICIENCIES OR SYMPTOMS ON THE BASIS OF COMPLETE CHECKOUT AND DIAGNOSTIC PROCEDURE IN EQUIPMENT TM (Do not prescribe repairs)

Headlamp lens, diesel-electric locomotive, cracks and shatters during operation of locomotive.

*PRIOR TO USING THIS FORM READ CAREFULLY THE STEP-BY-STEP INSTRUCTIONS IN TM 38-750.*

**USES AND INSTRUCTIONS**

1. When all appropriate entries are made in Section I, THIS FORM BECOMES A FORM PECULIAR to a specific weapon system, item of equipment or its component or separate assembly, or a group of similar items with the same FSN. This Section, when combined with either Section II or III or a combination of all three, provides the basis for controlled maintenance actions. This form will be used for:

AT THE ORGANIZATIONAL LEVEL
a. Requesting repairs and maintenance services.
b. Reporting accomplishment of Modification Work Orders.
c. Submission of Equipment Improvement Recommendations (EIR).
d. Reporting receipt of defective material.
e. It may be used to record maintenance accomplishments.

AT SUPPORT MAINTENANCE LEVEL
a. Recording maintenance work and/or service actually performed.
b. Reporting the installation of equipment modifications.
c. Submission of Equipment Improvement Recommendations (EIR).
d. Requesting repair of unserviceable components, assemblies and subassemblies as a result of direct exchange procedures.
e. Reporting receipt of defective material.
f. Requesting maintenance work and/or services between shops of a given field maintenance shop (Intra-Shop Maintenance Request).
g. Requesting maintenance work and/or services of another field maintenance unit or activity within the same echelon or at a higher echelon (Inter-Shop Maintenance Request).

AT DEPOT MAINTENANCE LEVEL
a. Reporting the installation of equipment modifications.
b. Submission of Equipment Improvement Recommendations (EIR)

2. SUBMITTING SEPARATE EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIR's):
a. EMERGENCY EIR's will be submitted to the designated Department of the Army agency by electrical message. A follow-up DA Form 2407, checked "Emergency" in Section III will be submitted with the message number indicated as part of the narrative remarks in Block 35.
b. URGENT EIR's will be air-mailed to the designated Department of the Army agency. Check "Urgent" in Section III.
c. ROUTINE EIR's prepared as a separate action will require only normal mailing of the NMP Copy 2 to the designated Department of the Army agency. Check "Routine" in Section III.

| 23. SUBMITTED BY | 24. RECEIVED BY |
|---|---|
| M. Smith | |
| JULIAN DATE | JULIAN DATE |
| 6075 | |

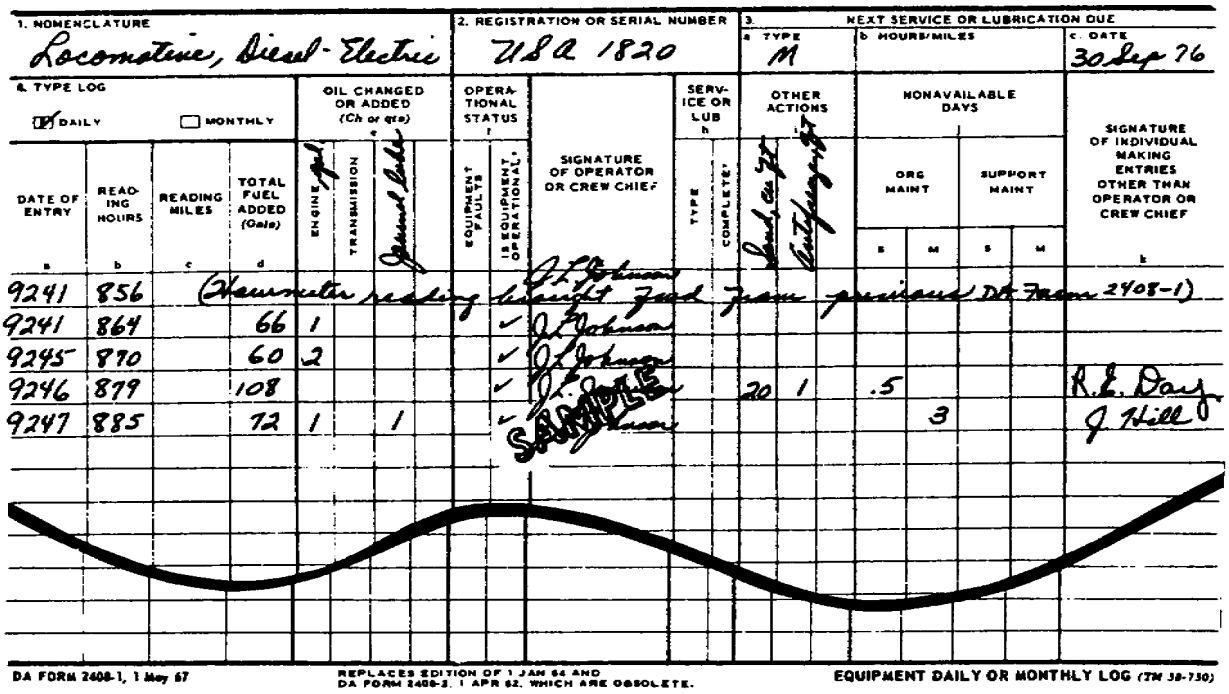
**SECTION III - EQUIPMENT IMPROVEMENT RECOMMENDATION**

| 29. NORMAL REPLACEMENT (Select one - use ✓ or X) | 30. EIR (Select one - use ✓ or X) | 31. RECOMMENDATION (Select one-use ✓ or X) | 32a. ORGANIZATION/ACTIVITY | c. UNIT IDEN CODE |
|---|---|---|---|---|
| ☐ 1 YES | ☐ E EMERGENCY | ☐ A IMPROVE DESIGN ☐ C REVISE PROCEDURE | b. LOCATION | d. SUBMITTED BY |
| ☐ 2 NO | ☐ U URGENT | ☐ B MODIFY ☐ D OTHER (Specify) | | |
| | ☐ R ROUTINE | | | |

| 33. NATIONAL STOCK NUMBER | 34. NOUN NOMENCLATURE | 35. OPINION OR REMARKS. DESCRIBE CONDITIONS UNDER WHICH FAILURE OCCURRED. ATTACH PHOTOS OR SKETCHES, IF AVAILABLE. |
|---|---|---|
| | | |

DA FORM 1 OCT 73 2407 — EDITION OF 1 JAN 64 WILL BE USED UNTIL EXHAUSTED. — RECEIPT COPY — 1

Figure 2.17. Maintenance Request, DA Form 2407.

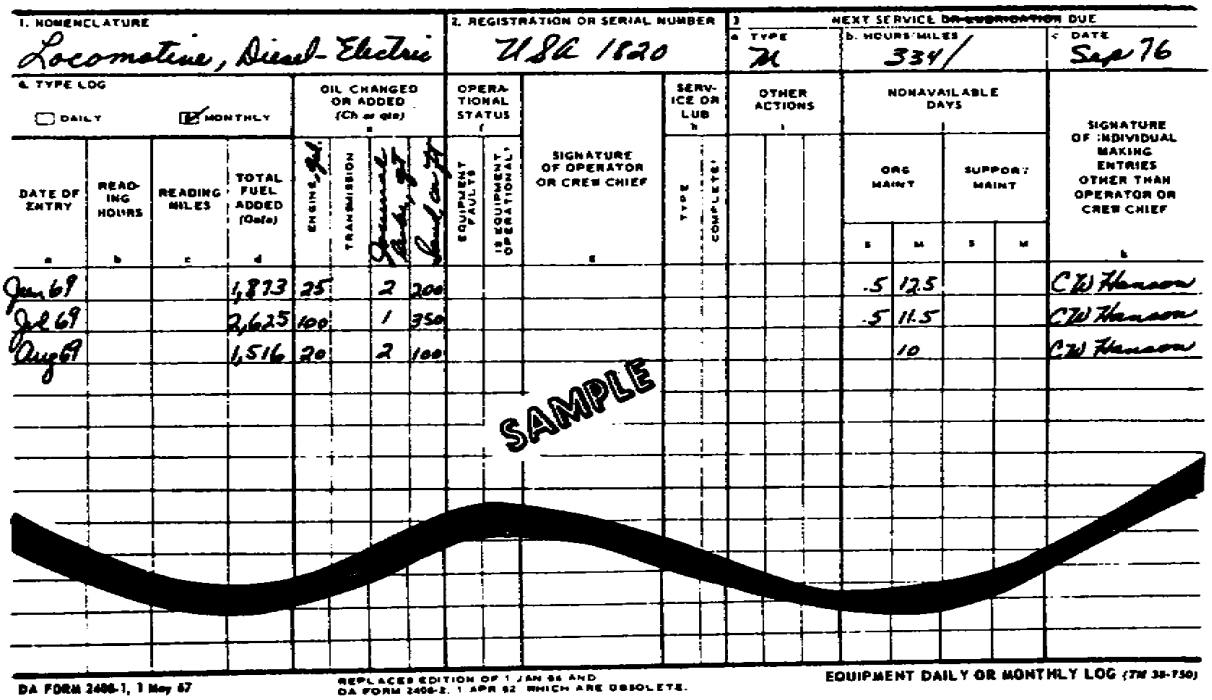

1. NOMENCLATURE: Locomotive, Diesel-Electric
2. REGISTRATION OR SERIAL NUMBER: USA 1820
3. NEXT SERVICE OR LUBRICATION DUE: a. TYPE M; c. DATE 30 Sep 76
4. TYPE LOG: ☑ DAILY ☐ MONTHLY

| DATE OF ENTRY | READING HOURS | READING MILES | TOTAL FUEL ADDED (Gals) | OIL CHANGED OR ADDED (Ch or qts) ENGINE | TRANSMISSION | Ground Lube | OPERATIONAL STATUS f EQUIPMENT FAULTS | OPERATIONAL STATUS f EQUIPMENT OPERATIONAL | SIGNATURE OF OPERATOR OR CREW CHIEF g | SERVICE OR LUB h TYPE | SERVICE OR LUB h COMPLETED | OTHER ACTIONS i | NONAVAILABLE DAYS j ORG MAINT S | ORG MAINT M | SUPPORT MAINT S | SUPPORT MAINT M | SIGNATURE OF INDIVIDUAL MAKING ENTRIES OTHER THAN OPERATOR OR CREW CHIEF k |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | b | c | d | | | | | | | | | | | | | | |
| 9241 | 856 | (Hourmeter reading | | | | | | ✓ | J.E. Johnson | Brought Fwd | | Fwd, Co Ft | | | | | From previous DA Form 2408-1) |
| 9241 | 864 | | 66 | 1 | | | | ✓ | J. Johnson | | | | | | | | |
| 9245 | 870 | | 60 | 2 | | | | ✓ | J. Johnson | | | | | | | | |
| 9246 | 879 | | 108 | | | | | ✓ | J. Johnson | | | 20 | 1 | .5 | | | R.E. Davis |
| 9247 | 885 | | 72 | 1 | | 1 | | ✓ | J. Johnson | | | | | | 3 | | J. Hill |

SAMPLE

DA FORM 2408-1, 1 May 67 — REPLACES EDITION OF 1 JAN 64 AND DA FORM 2408-2, 1 APR 62, WHICH ARE OBSOLETE. — EQUIPMENT DAILY OR MONTHLY LOG (TM 38-750)

Figure 2.18. Equipment Daily Log, DA Form 2408-1.


1. NOMENCLATURE: Locomotive, Diesel-Electric
2. REGISTRATION OR SERIAL NUMBER: USA 1820
3. NEXT SERVICE ~~OR LUBRICATION~~ DUE: a. TYPE M; b. HOURS/MILES 334/; c. DATE Sep 76
4. TYPE LOG: ☐ DAILY ☑ MONTHLY

| DATE OF ENTRY | READING HOURS | READING MILES | TOTAL FUEL ADDED (Gals) | OIL CHANGED OR ADDED (Ch or qts) ENGINE | TRANSMISSION | Ground Lube | OPERATIONAL STATUS f EQUIPMENT FAULTS | OPERATIONAL STATUS f EQUIPMENT OPERATIONAL | SIGNATURE OF OPERATOR OR CREW CHIEF g | SERVICE OR LUB h TYPE | SERVICE OR LUB h COMPLETED | OTHER ACTIONS i | NONAVAILABLE DAYS j ORG MAINT S | ORG MAINT M | SUPPORT MAINT S | SUPPORT MAINT M | SIGNATURE OF INDIVIDUAL MAKING ENTRIES OTHER THAN OPERATOR OR CREW CHIEF k |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | b | c | d | | | | | | | | | | | | | | |
| Jun 69 | | | 1,873 | 25 | | 2 | 200 | | | | | | .5 | 12.5 | | | C.W. Hanson |
| Jul 69 | | | 2,625 | 100 | | 1 | 350 | | | | | | .5 | 11.5 | | | C.W. Hanson |
| Aug 69 | | | 1,516 | 20 | | 2 | 100 | | | | | | | 10 | | | C.W. Hanson |

SAMPLE

DA FORM 2408-1, 1 May 67 — REPLACES EDITION OF 1 JAN 64 AND DA FORM 2408-2, 1 APR 62, WHICH ARE OBSOLETE. — EQUIPMENT DAILY OR MONTHLY LOG (TM 38-750)

Figure 2.19. Equipment Monthly Log, DA Form 2408-1.

the locomotive was operated during the month, total fuel and lubricants added, and total number of days the locomotive was nonoperational. The 2408-1 monthly log is a permanent record; it is not destroyed.

## 2.22. EQUIPMENT MODIFICATION RECORD

The DA Form 2408-5, Equipment Modification Record, is used to record the requirements for and the application of all authorized modifications of equipment. As shown in figure 2.20, the form is divided into two major sections: modifications required (block 4), and modifications completed (block 5). Information on required modifications is transcribed from a DA Modification Work Order (MWO) or other modification directive to the block 4 section of the form by the equipment owner. Information relating to completion of the modification is entered in block 5 by the activity making the modification.

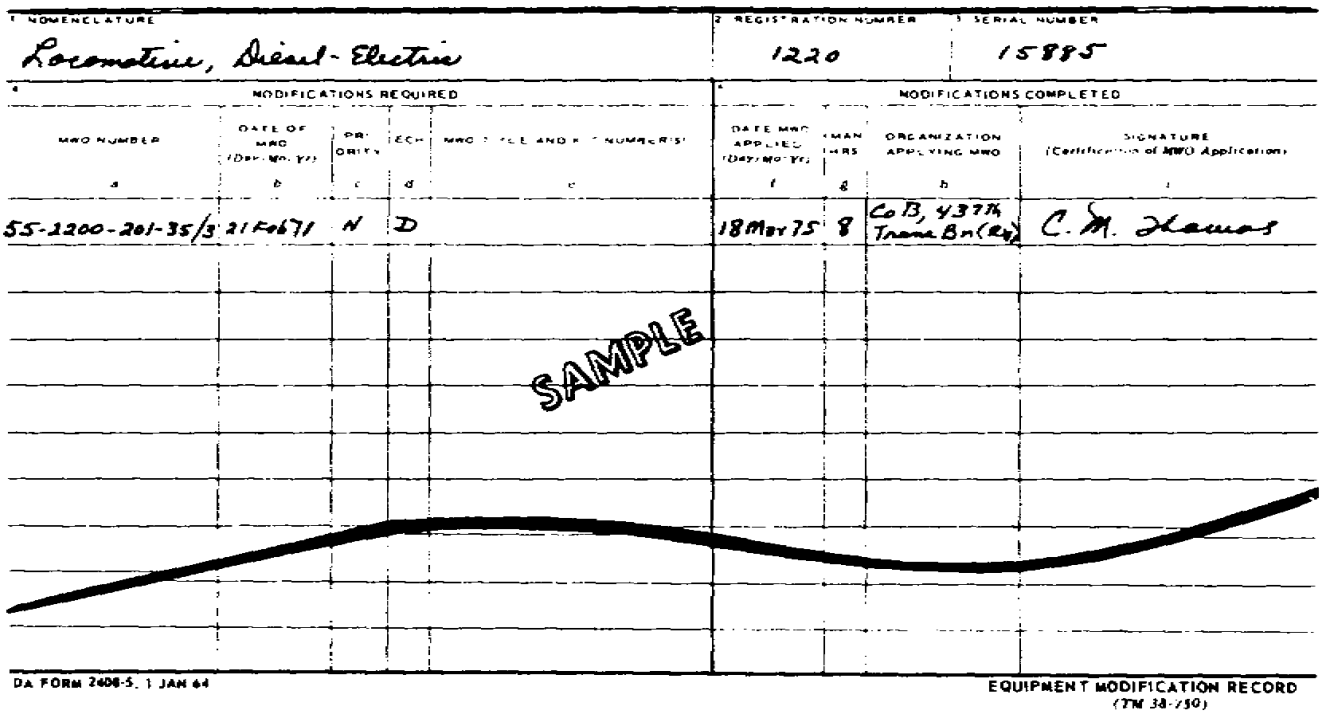



Figure 2.20. Equipment Modification Record, DA Form 2408-5.

## 2.23. AIR BRAKE INSPECTION REPORT FOR LOCOMOTIVES AND LOCOMOTIVE CRANES

The Air Brake Inspection Report for Locomotives and Locomotive Cranes, DA Form 4171-R, is designed to determine the condition of the air brake equipment and insures compliance with regulations of the Federal Railroad Administration, Department of Transportation. The form, shown in figure 2.21, is used to record the inspection, cleaning, servicing, and repair of air brake components at least every 6 months or as indicated on the form. It is prepared in duplicate, and the individual performing the service or maintenance records the appropriate dates of inspection and repair.

The repair and testing are performed at DS/GS level. The officer in charge countersigns the form. The original copy of the form is placed under a transparent cover in the locomotive cab; the other copy is retained by the using unit. The completed forms are retained until the next scheduled air brake inspection and testing and then destroyed.

**AIR BRAKE INSPECTION REPORT FOR LOCOMOTIVES AND LOCOMOTIVE CRANES**

DATE: 15 Oct 75

LOCOMOTIVE OR CRANE NO.: 1820

OPERATED BY: JAMES C. STONE

IN ACCORDANCE WITH DEPT OF TRANSPORTATION FEDERAL RAILROAD ADMINISTRATION ORDER AND TM 55-202 THE AIR BRAKE EQUIPMENT DESIGNATED BELOW WAS CLEANED, OILED AND TESTED ON THE DATES SHOWN. RULE 208 a, b & c (10/15/67)

| ITEM | PERIOD | DATE PERFORMED | ITEM | PERIOD | DATE PERFORMED |
|---|---|---|---|---|---|
| DIRT COLLECTORS OR FILTERS | 6 MOS | 15 Oct 75 | FEED AND REDUCING VALVES | 12 MOS | 15 Oct 75 |
| DISTRIBUTOR OR CONTROL VALVE | 24 MOS | 15 Oct 75 | BRAKE CYLINDER RELAY | 12 MOS | 15 Oct 75 |
| AUTOMATIC BRAKE VALVE | 24 MOS | 15 Oct 75 | VENT VALVES | 12 MOS | 15 Oct 75 |
| INDEPENDENT BRAKE VALVE | 24 MOS | 15 Oct 75 | DOUBLE CHECK VALVES | 24 MOS | 15 Oct 75 |
| ROTAIR AND RELAY VALVES | 12 MOS | 15 Oct 75 | DIAPHRAGM CUT OFF VALVE | 24 MOS | 15 Oct 75 |
| EQUALIZING PORTION | 24 MOS | 15 Oct 75 | CHARGING CUT OFF VALVE | 24 MOS | 15 Oct 75 |
| MAGNET VALVES (OVERSPEED) | 24 MOS | 15 Oct 75 | CHECK VALVE BETWEEN RESERVOIRS | 24 MOS | 15 Oct 75 |
| FOOT VALVES (SAFETY CONTROL) | 24 MOS | 15 Oct 75 | ALL PORTIONS NIA VALVE | 24 MOS | 15 Oct 75 |

I James C. Stone, CERTIFY THAT THE AIR BRAKE EQUIPMENT INDICATED ABOVE WAS CLEANED, OILED AND TESTED AND THAT IT WAS PLACED IN SERVICE IN GOOD OPERATING CONDITION.

THE ABOVE WORK WAS PERFORMED UNDER MY SUPERVISION AND I BELIEVE THIS REPORT TO BE TRUE AND CORRECT.

E. F. Collins, OFFICER IN CHARGE

DA Form 4171-R, 1 FEB 74 1902-75

Figure 2.21. Air Brake Inspection Report for Locomotives and Locomotive Cranes, DA Form 4171-R.

## 2.24. DAILY INSPECTION WORKSHEET FOR DIESEL-ELECTRIC LOCOMOTIVES

In addition to the forms just discussed, DD Form 862, Daily Inspection Worksheet for Diesel-Electric Locomotives, is used in performing the daily inspection and maintenance of the locomotive. Figure 2.22 shows the front of the 862, and figure 2.23 the back.

In making the daily inspection, a visual check and an operational test run of the locomotive are performed each day it is in service. The DD Form 862 is filled out by both the locomotive engineer and the maintainer or inspector. It is divided into sections A, B, C, and D. Section A, or the operator's report, is filled out by the locomotive engineer. He operates the locomotive and notes

**DAILY INSPECTION WORKSHEET FOR DIESEL ELECTRIC LOCOMOTIVES AND LOCOMOTIVE CRANES**

| UNIT NUMBER | OPERATING HRS | DATE |
|---|---|---|
| USA 1819 | 8 | 4 Feb 76 |

INSTALLATION: Fort Eustis, Virginia

**INSTRUCTIONS**

*Mechanical deficiencies encountered during operation will be recorded by equipment Operator, in the "A - Operators Report" portion of the form. The remaining items will be completed by qualified maintenance personnel. Check each item "OK" or "Defective". Maintainer initials and dates to the right of items marked "Defective" to signify necessary repairs were accomplished. Items which are not applicable to the equipment being inspected should be marked N/A. In the remarks column enter additional work or other qualifying data, such as: Repairs required beyond the scope of organization maintenance. For details in repairs, maintenance and inspection, use the applicable manuals for each model and type of equipment.*

**A - OPERATORS REPORT**

| ITEM NUMBER | REPAIRS NEEDED (Reported by Road Inspector or Operator) | CORRECTED (Mechanic's Initials) |
|---|---|---|
| 1 | Left front sander valve leaks when not operated | J.M.J. |
| 2 | Governor controller pressure to 5/c # | J.M.J. |

| 1. CLEAN UNIT | 2. LUBE OIL PRESSURE | | 3. WATER PRESSURE | | 4. BATTERY AMMETER | | 5. LOAD METER | |
|---|---|---|---|---|---|---|---|---|
| | NUMBER 1 | NUMBER 2 | NUMBER 1 | NUMBER 2 | NUMBER 1 | NUMBER 2 | NUMBER 1 | NUMBER 2 |
| | 35 | — | 150 | — | Ch. | — | FCC | — |
| ☒ YES ☐ NO | 6. MAIN RESERVOIR PRESSURE 140 # | | 7. EQUALIZING RESERVOIR PRESSURE 70# | | 8. BRAKE PIPE PRESSURE 70 # | | 9. CONTROL AIR PRESSURE 55 # | |

SIGNATURE OF ROAD INSPECTOR

SIGNATURE OF OPERATOR: Pfc Wells

**B - MAINTAINER'S REPORT**

| ITEMS | CHECK ONE OK | CHECK ONE DEFECTIVE | CORRECTED (Mechanic's Initials) |
|---|---|---|---|
| 1. Lubricate complete locomotive in accordance with applicable DA lubrication order | X | | |
| 2. Check and replenish: a. Water supply | X | | |
| b. Fuel | | X | J.M.J. |
| c. Battery water | X | | |
| d. Sand | X | | |
| e. Wheel flange lubricator | N/A | | |
| 3. Horn, Bell, Lights and Windshield wipers | | X | J.M.J. |
| 4. Brake equipment, Sanders, Shutters, etc. | | X | J.M.J. |
| 5. Cooling fan and drive | X | | |
| 6. Couplers, Locks and Levers | X | | |
| 7. Brake Rigging and Pins | X | | |
| 8. Brake shoes and brake cylinder piston travel | X | | |
| 9. Cab heater and Standby heater | X | | |
| 10. Footboards, Doors, Grab Irons & Safety devices | X | | |
| 11. Loose electrical wires | X | | |

DD FORM 1 FEB 74 862 PREVIOUS EDITION IS OBSOLETE.

Figure 2.22. Daily Inspection Worksheet for Diesel-Electric Locomotives, DD Form 862, (Front).

B - MAINTAINER'S REPORT (Continued)

| ITEMS | CHECK ONE | | CORRECTED (Mechanic's Initials) | ITEMS | CHECK ONE | | CORRECTED (Mechanic's Initials) |
|---|---|---|---|---|---|---|---|
| | OK | DEFECTIVE | | | OK | DEFECTIVE | |
| 12. Loose Bolts, Nuts and Pins | X | | | 19. Check Engine Warm Up | X | | |
| 13. All hoses and Belts | X | | | 20. Check Friction Clutches | — | — | |
| 14. Leaks a. Fuel and Lube Systems | X | | | 21. Check Air Operated Clutches | — | — | |
| b. Cooling System | X | | | 22. Check Turntable | - | — | |
| c. Air System | X | | | 23. Check Boom and Hoisting Brakes | — | — | |
| d. Intake and Exhaust System | X | | | 24. Rollers and Pins | — | — | |
| 15. Wheels and Journals | X | | | 25. Cables and Sheaves | - | — | |
| 16. Drain Moisture from Air Reservoirs & Intercoolers | X | | | 26. Hook or Bucket | — | — | |
| 17. Drain Air Boxes and Check Operation of Crankcase Exhauster | X | | | 27. Transmission | - | — | |
| 18. Check for Unusual Noises | X | | | | | | |

C - ADDITIONAL WORK OR OTHER QUALIFYING DATA

REMARKS

D - AUTHENTICATION

| SIGNATURE OF INSPECTOR | SIGNATURE OF FOREMAN |
|---|---|
| James R. Smith SP2 | Frank L. Johnson Gf. TC |

Figure 2.23. Daily Inspection Worksheet for Diesel-Electric Locomotives, (Back).

any faults. At the bottom of section A are nine items that he checks, if applicable to his locomotive, before he goes off duty. He turns in the 862 to the railway equipment company (B company). An inspector makes the checks in section B, as shown in figure 2.22, and a mechanic corrects the faults noted and places his initials in the column headed Corrected. The mechanic uses section C to list faults he was unable to correct, if necessary. An inspector then examines the work of the mechanic to insure that it has been done correctly and signs the form in the proper space in section D. The foreman, or commander of the railway equipment company, also signs the form in the space provided in section D. The 862's are then filed and kept until the monthly inspection is made, at which time all the daily forms are destroyed.

## 2.25. INSPECTION AND REPAIR REPORT OF LOCOMOTIVES AND LOCOMOTIVE CRANES

The Inspection and Repair Report of Locomotives and Locomotive Cranes, DD Form 1336, is used for monthly and annual inspections. Figure 2.24 shows it completed for a monthly inspection. Figure 2.25 shows it completed for an annual inspection. This report establishes the condition of locomotives and locomotive cranes

**INSPECTION AND REPAIR REPORT OF LOCOMOTIVE AND LOCOMOTIVE CRANES** ☒ Thirty Day ☐ Annual

31 March, 19 76 — Locomotive or Locomotive Crane No. USA 2607

Operated by Fort Eustis, Va.

In accordance with the act of Congress approved February 17, 1911, amended March 4, 1915, and June 7, 1924, and the rules and instructions issued in pursuance thereof, the parts and appurtenances of locomotive unit No. 2607 were inspected on 30 March, 19 76 at Ft Eustis, Va. All defects disclosed by said inspection were properly repaired, except as noted on the reverse side of this report and the parts and appurtenances were left in the condition reported below.

1. This locomotive unit is propelled by Diesel - Electric
2. Hydrostatic test of NC pounds was applied to main air reservoirs.
   Date of previous test as shown by reports on file was 27 Feb 1976
3. Were main air reservoirs hammer tested? NA
   Date of previous test as shown by reports on file was 27 Feb 1976
4. Were drawbars and pins removed and inspected? NA
   Date of previous removal as shown by stamping on the parts NA
5. Were articulated connection pins removed and inspected? NA
   Date of previous removal as shown by stamping on the pins
6. Condition of draft gear and draw gear is Good - NA
7. Condition of brake and signal equipment is Good - Good
8. Condition of running gear is Good
9. Condition of fuel storage and supply system is Good - Good

I certify that I made the inspections and tests above reported in Items No. 1 through 9 and that statements therein are true and correct.

M L Davis

I certify that I made the inspections and tests above reported in Items No. _____ and that statements therein are true and correct.

10. Date of previous insulation tests as shown by reports on file was 27 Feb 19 76
    Were insulation tests applied at this inspection? No

| Name of circuit | Normal voltage | Test voltage |
|---|---|---|
| Control | 32 | |
| Power | 600 | |

11. Condition of current collectors is NA
12. Condition of control equipment is Good
13. Condition of control circuits and terminals is Good Good
14. Condition of power equipment is Good
15. Condition of power circuits and terminals is NA
16. Condition of lightning arresters is
17. Were meters tested? NO Date meters were previously tested as shown by reports on file was 27 Feb 19 76

I certify that I made the inspections and tests above reported in Items No. 10 through 17 and that statements therein are true and correct.

I certify that I made the inspections and tests above reported on Items No. _____ and that statements therein are true and correct.

The above work has been performed under my general supervision and I believe the report is true and correct.

Robert J Alexander, Officer in Charge
CPT. TC

DD FORM 1336, 1 FEB 74 PREVIOUS EDITION IS OBSOLETE. 3512-75

Figure 2.24. Inspection and Repair Report of Locomotives and Locomotive Cranes (Monthly), DD Form 1336.

**Front**

**INSPECTION AND REPAIR REPORT OF LOCOMOTIVE AND LOCOMOTIVE CRANES**

☐ Thirty Day ☒ Annual

31 March, 19 76

Locomotive or Locomotive Crane No. USA 2607

Operated by Fort Eustis, VA

In accordance with the act of Congress approved February 17, 1911, amended March 4, 1915, and June 7, 1924, and the rules and instructions issued in pursuance thereof, the parts and appurtenances of locomotive unit No. USA 2607 were inspected on 30 March, 19 76 at Fort Eustis, VA. All defects disclosed by said inspection were properly repaired, except as noted on the reverse side of this report and the parts and appurtenances were left in the condition reported below.

1. This locomotive unit is propelled by Diesel Electric
2. Hydrostatic test of _____ pounds was applied to main air reservoirs.
   Date of previous test as shown by reports on file was 28 March 75
3. Were main air reservoirs hammer tested? Yes
   Date of previous test as shown by reports on file was 28 March 75
4. Were drawbars and pins removed and inspected? None
   Date of previous removal as shown by stamping on the parts None
5. Were articulated connection pins removed and inspected? None
   Date of previous removal as shown by stamping on the pins None
6. Condition of draft gear and draw gear is Good - Good
7. Condition of brake and signal equipment is Good
8. Condition of running gear is Good - Good
9. Condition of fuel storage and supply system is Good

I certify that I made the inspections and tests above reported in Items No. 1 through 9 and that statements therein are true and correct.

F J Curtis

I certify that I made the inspections and tests above reported in Items No. _____ and that statements therein are true and correct.

_____

10. Date of previous insulation tests as shown by reports on file was 28 March 19 75

Were insulation tests applied at this inspection? Yes

| Name of circuit | Normal voltage | Test voltage |
|---|---|---|
| Control | 32 | 32 |
| Power | 272 | 400 |

11. Condition of current collectors is Good
12. Condition of control equipment is Good
13. Condition of control circuits and terminals is Good - Good
14. Condition of power equipment is Good
15. Condition of power circuits and terminals is Good - Good
16. Condition of lightning arresters is None
17. Were meters tested? Yes Date meters were previously tested as shown by reports on file was 28 March 19 75

I certify that I made the inspections and tests above reported in Items No. 10 through 17 and that statements therein are true and correct.

Jerry R Smith

I certify that I made the inspections and tests above reported on Items No. _____ and that statements therein are true and correct.

_____

The above work has been performed under my general supervision and I believe the report is true and correct.

Alexander T Good, Officer in Charge

DD FORM 1336, 1 FEB 74 PREVIOUS EDITION IS OBSOLETE.

**Reverse**

Note defects not properly repaired:

☐ Locomotive or ☐ Locomotive Crane No. USA 2607 was out of service the entire calendar months of:

State of Virginia
City ~~County~~ of Newport News } ss:

On this 31 day of March 19 76, personally appeared before me M J LeCream and signed the reverse side of this report, each of whom deposes and says that he personally made the inspections and tests reported in items the number of which precede his signature, and that the statements therein are true and correct.

Subscribed and sworn to before me this 31 day of March, 19 76.

State of Virginia
City ~~County~~ of Newport News } ss:

M J LeCream
(Adjutant or Notary Public)

Figure 2.25. Inspection and Repair Report of Locomotives and Locomotive Cranes (Annual), DD Form 1336.

to determine compliance or noncompliance with Federal Railway Administration (FRA), Department of Transportation (DOT), regulations. It also shows the maintenance and repairs needed to comply with FRA, DOT regulations. This dual-purpose form (30-day and annual) is used to record and report the conditions and maintenance requirements resulting from the daily inspections (par. 2.24). Also, the annual report is to be completed after each depot overhaul. Items on the 30-day report are to be recorded by qualified organizational level personnel. The annual report is to be prepared in triplicate by qualified DS, GS, or depot level personnel. The inspector signs the form. The officer in charge countersigns it. "Condition" is to be shown as "good", "fair", or "bad". When 'bad" is used, it indicates that the part or parts are not in a safe or suitable condition or are in violation of regulations.

2.26. SUMMARY

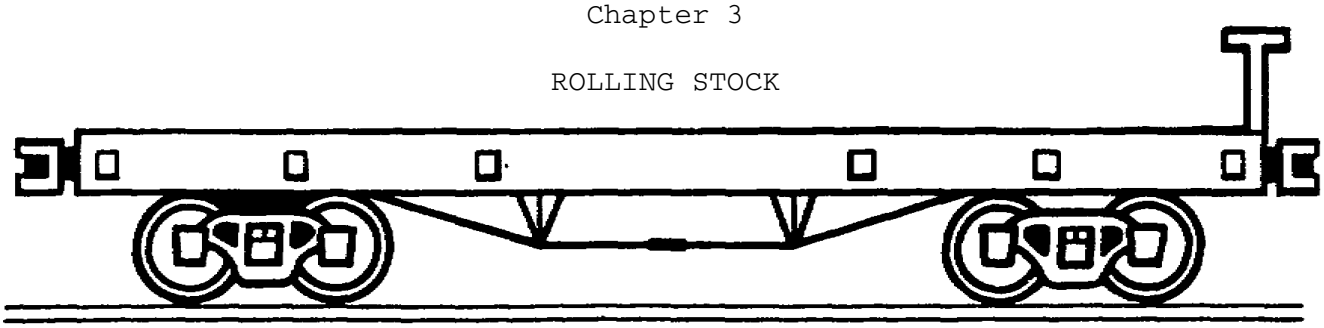
The inspection and maintenance of Army equipment locomotives require that certain forms and records must be completed. Among other things, they are used to record both scheduled and performed preventive maintenance, load tests, equipment faults, and criteria tests and checks; to request direct or general support maintenance; to record the accomplishment of a maintenance work order; to submit an equipment improvement recommendation; and to collect maintenance data.

The forms used for inspection and maintenance of diesel-electric locomotives include the Maintenance Request, DA Form 2407; Equipment Daily or Monthly Log, DA Form 2408-1; Equipment Modification Record, DA Form 2408-5; Daily Inspection Worksheet for Diesel Electric Locomotives, DD Form 862; and Air Brake Inspection Report for Locomotives and Locomotive Cranes, DA Form 4171-R.

The maintenance request is used to request maintenance and modifications to locomotives and to record them when accomplished. The DA Forms 2408-1 and 2408-5, a part of the locomotives historical records, record daily and monthly usage and maintenance of a locomotive and its requirements for and application of all authorized modifications. The DD Form 862 is used in the daily inspection and maintenance of the locomotive and the DA Form 4171-R for recording the condition of the locomotive's air brake equipment and the maintenance performed to bring it up to Federal Railway Administration standards.

Chapter 3

# ROLLING STOCK



## 3.1. INTRODUCTION

Tonnage movements are the primary interest of the transportation railway service; therefore, freight cars are the most important units of its rolling stock. This chapter discusses rolling stock in general because, as stated earlier, all railway cars have the same general design except for the superstructure. Explained are the common components of railway cars, the preventive maintenance checks, and the inspections and maintenance performed on them as well as the forms that inspectors and other maintenance men use. You may notice an overlap in the discussion on preventive maintenance for rolling stock and locomotives. It exists because some of the components discussed in this chapter are common to all types of railway equipment. The three sections into which chapter 3 is divided discuss, in turn, the common components, the preventive maintenance, and the forms for the inspection and maintenance of rolling stock.

## Section I. Common Components

### 3.2. General

Examine the structure of any freight car, and you will find that it has four components in common with all other freight cars--the underframe, the truckassembly, the coupler, and the draft gear. Interchanging railway cars among commercial railroads, a long-established practice, brought about the need to standardize freight car construction. Efficient maintenance and operation required standard components. While the superstructure of a freight car may be designed for a specific use, below the deck each U.S. railway car is much like any other. The four common components are discussed in paragraphs 3.3 through 3.6.

3.3. UNDERFRAME

The rail car underframe is the framework that receives the shock and pulling stresses to which the car is subjected when it is being moved over the railroad. It supports the deck and superstructure of the car and carries the weight of the load in the car. Figure 3.1 shows the underframe construction of a typical freight car, viewed from the bottom, to show the body bolster center plates. What are the most important parts of the underframe? They are the center sill, body bolsters, draft gear pockets, side sills, end sills, and floor stringers; they are discussed in the subparagraphs following.

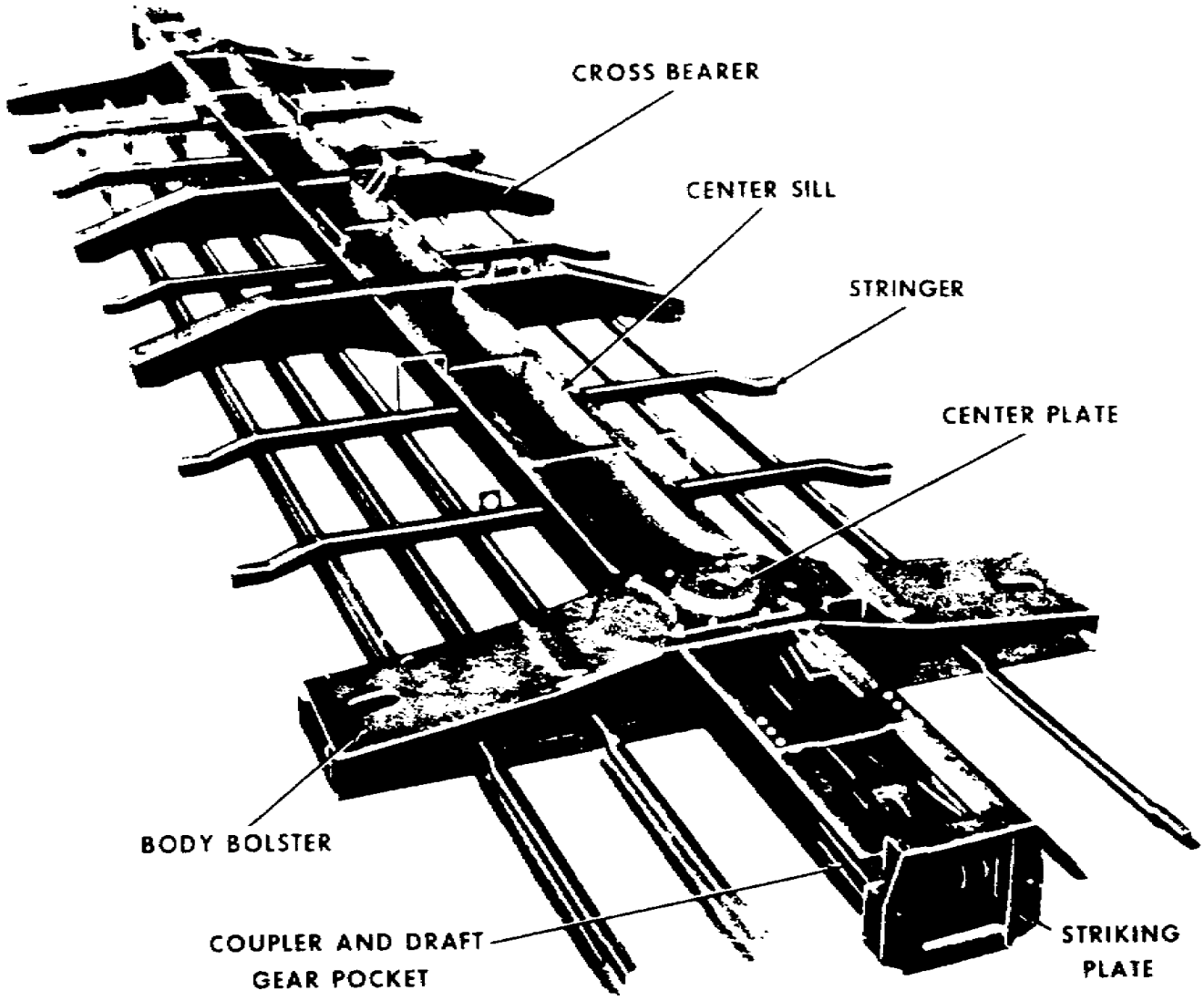



Figure 3.1. Underframe.

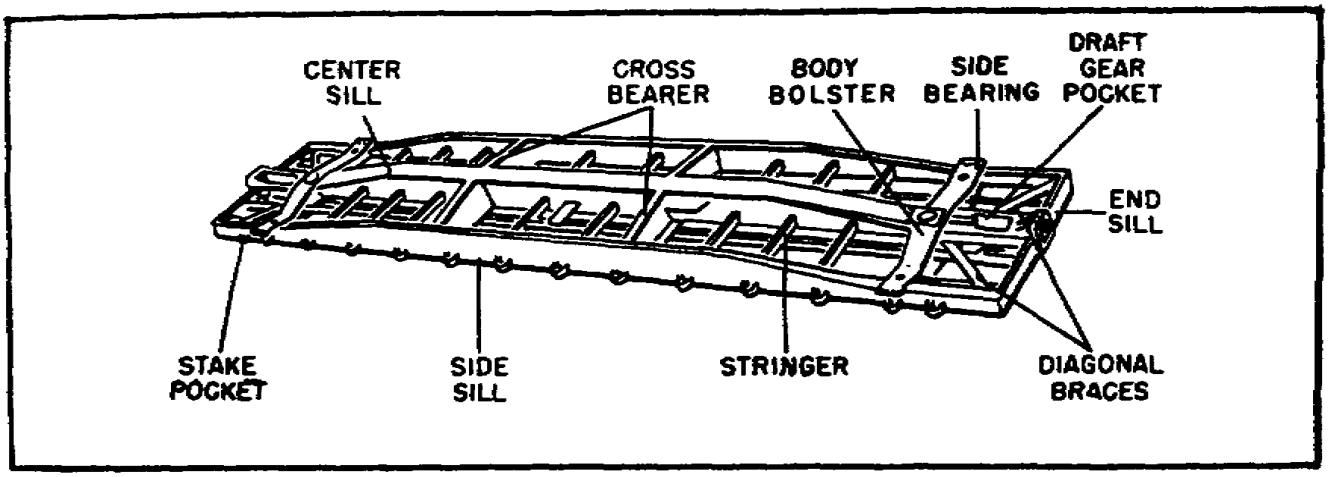
a. The center sill is a longitudinal structural member that forms the backbone of the underframe. It supports the other members of the underframe and transmits the push-and-pull stress

throughout the length of the car. It contains the couplers and draft gears in pockets at either end.

b. The body bolsters are transverse members of the car underframe located over the center of the trucks. Resting on the truck bolsters, they transmit the weight carried by the center sill to the trucks through the mated body bolster and truck bolster center plates. The body bolsters contain side bearings that steady the car and prevent excessive rocking while it is in motion.

c. The draft gear pockets are the receptacles located at either end of the center sill that receive the draft gear and couplers. The striking plates or castings are part of the coupler and draft gear arrangement. The draft gear is discussed further in paragraph 3.6.

d. Other members required to complete the underframe are side sills, end sills,. and floor stringers. They provide the tremendous strength necessary for railway car operation and the mounts for the decking that carries the load. These members are identified in the inserted sketch.




3.4. TRUCK ASSEMBLY

The wheeled assemblies at each end of the car are called trucks. Each may have one, two, or more pairs of wheels. Most freight equipment in the United States has 4-wheel trucks. Railway cars and diesel-electric locomotives use the same type of truck assemblies, discussed in paragraph 2.7. The trucks support the underframe and superstructure; they swivel enough to ride the rails and negotiate curves readily. An important feature of these assemblies is that the essential parts most likely to require repair or replacement are easily reached. A typical freight car truck is shown in figure 3.2. Study it as you read the following subparagraphs in which some of the assembly's parts are discussed.

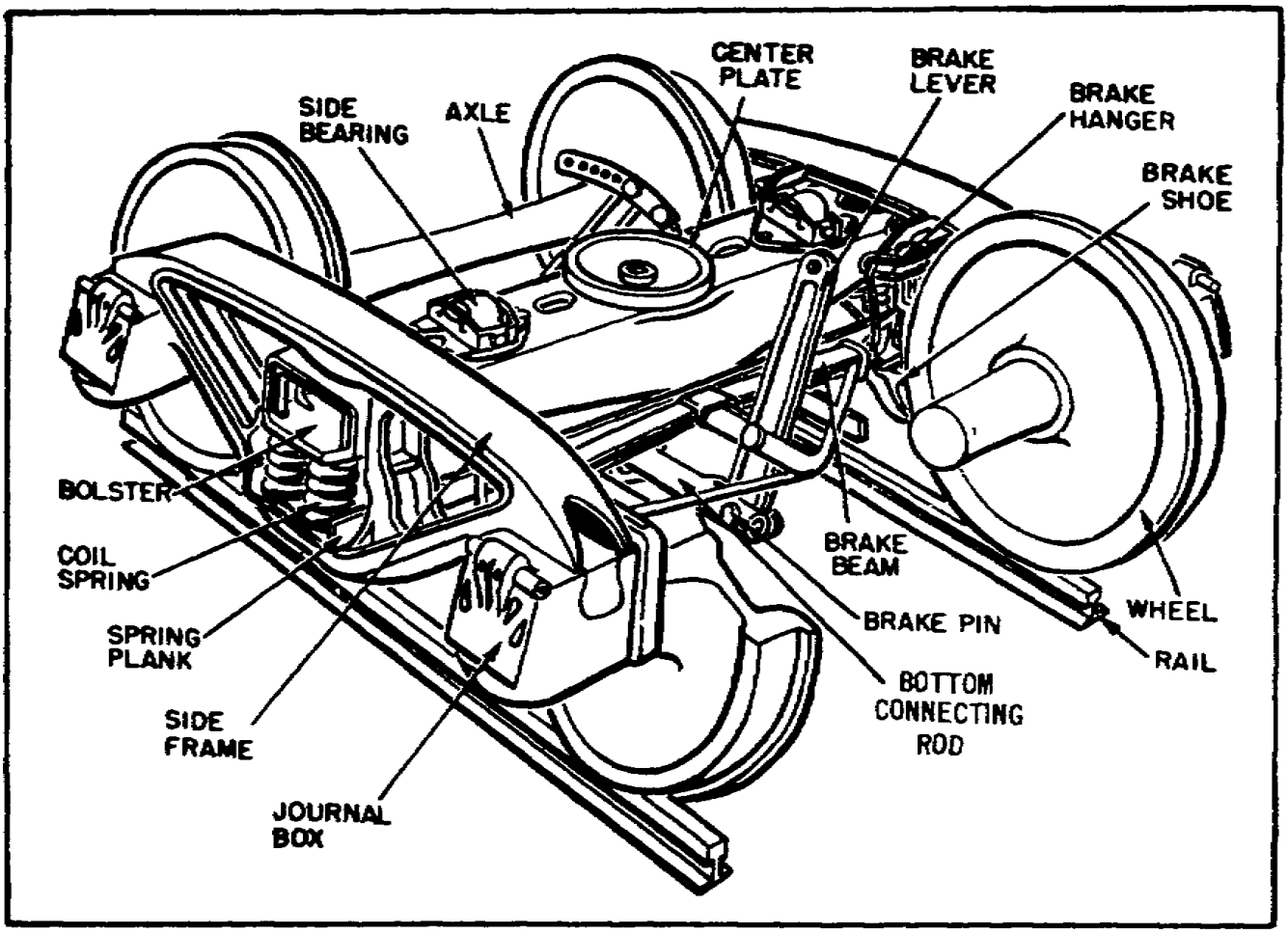
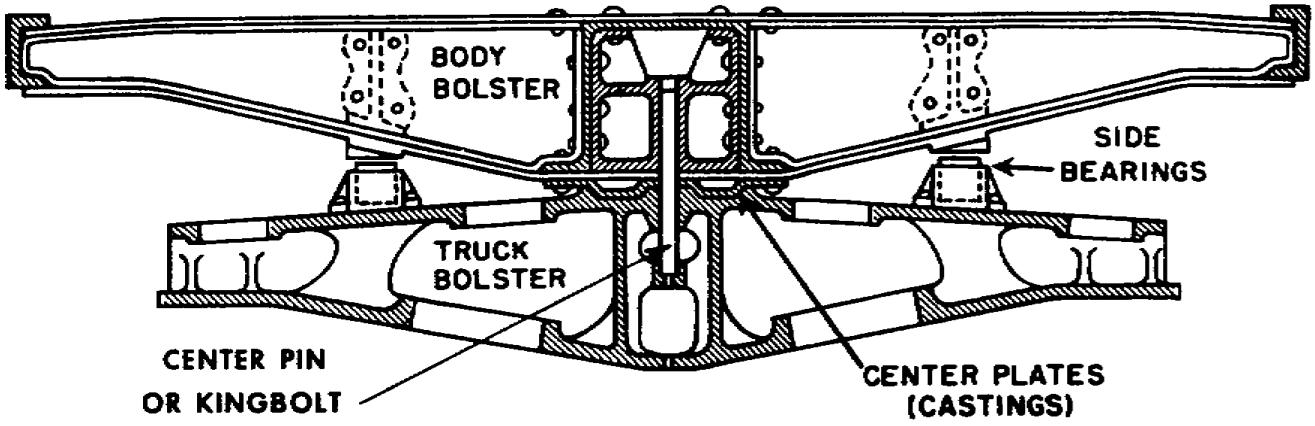



Figure 3.2. Freight Car Truck Assembly.

a. Truck bolster. The cross member in the center of a truck is the truck bolster, which is designed to support the car's underframe and load. The truck bolster is set crosswise of the truck and the matching car body bolster rests on it, secured by the weight of the car and the matching of the center plates on the bolsters. On freight cars, a loose center pin or kingbolt acts as a guide to match the center plates during assembly when the car body is lowered into position on the truck. If used on passenger cars, the center pin connects the two bolsters so that the truck will not separate from the car body. Study the relationship of the components in the inserted sketch. The weight of the car's underframe and its load are transferred through the bolsters, through a system of springs and bearings, and through the axles and wheels to the rails.




b. Side frame. On the outside of the truck wheels is the side frame; it extends from one axle to the other and forms the side of the truck. The two side frames on each truck contain sets of coil springs upon which the truck bolster sits. The springs distribute the car's weight equally through the side frames onto the axle journals located at each end of the side frames.

c. Wheel and axle assembly. A combination of two axles and four wheels make up a wheel and axle assembly for a general freight car. Each axle has two wheels that are pressed upon the axle under pressure ranging from 70 to 150 tons. For some passenger equipment and high-speed freight cars, however, the wheel and axle assembly consists of three axles and six wheels. But on either the general or the other types of freight cars, the ends of the axles or journals are highly polished and extend into journal boxes, to provide a working surface for the bearings and a means for lubricating the axle and bearing.

d. Brake rigging. The cylinder, piston, rods, and levers necessary to transmit air pressure to the brakeshoes and wheels are included in the brake rigging. Each car has an independent braking system, powered by compressed air supplied by a compressor located on the locomotive.

e. Journal box. An important component of the truck assembly is the journal box; it encloses the bearing and wedge assembly, the axle journal, and necessary waste packing or lubricator pad, and lubricant. One box is located at each end of each axle. They require more maintenance than any other part of a railway car. The journal boxes provide for the lubrication of the axles and bearings. A typical journal box assembly, shown in figure 3.3, contains the components described next.

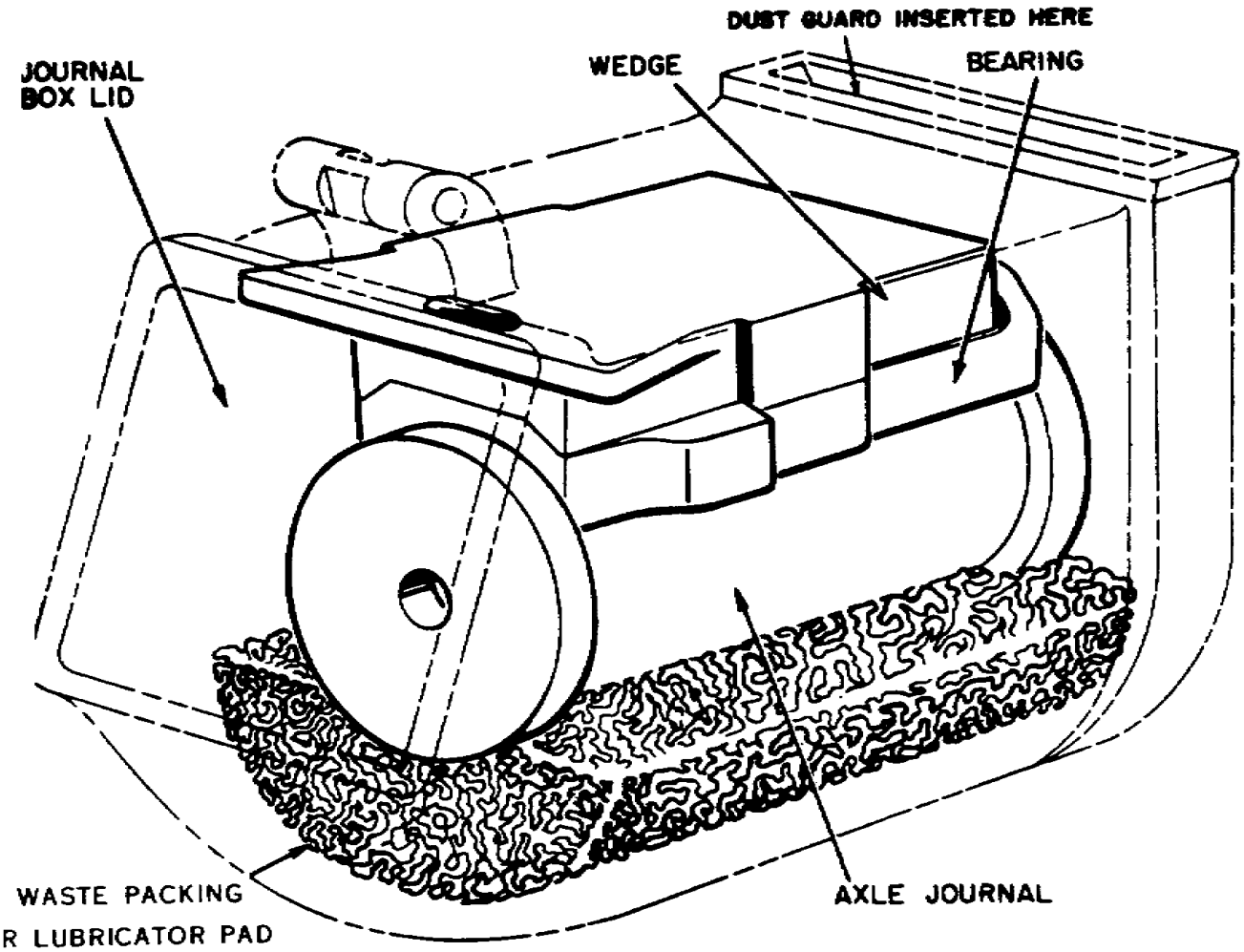



Figure 3.3. Journal Box Assembly With Friction Bearing.

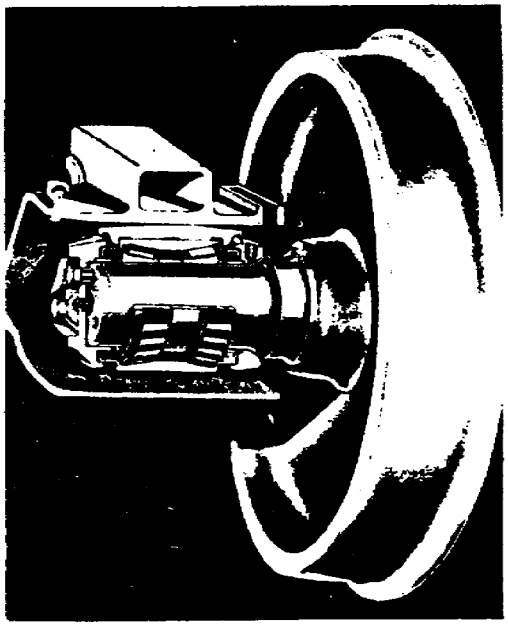
(1) Journal--end of the axle, or the part of an axle on which the journal bearing rests.

(2) Waste packing--cushioning made of fibrous material placed in the bottom of the journal box. Saturated with a lubricant, the packing feeds the lubricant to the journal and bearing. A commercial spring-type lubricator pad has been substituted for waste packing on most U.S. commercial railroads.

(3) Wedge--holds the bearing in place and distributes weight from the side frame to the journals, through the wheels, to the rails.

(4) Bearing--device that provides a smooth working surface against the journal. The friction bearing is a brass casting with a babbitt lining. It transfers friction heat to the top of the journal box through which it escapes to the atmosphere by the passage of cool air over the journal box.

Journal roller bearings are being used to a great extent worldwide on both passenger and freight cars. Because these bearings have sealed lubrication units, they can run for 3 years without requiring any added lubricant. Also, they have almost totally eliminated 'hotbox"--overheated journal--problems, provide better riding qualities for the car, and lessen wheel and truck wear. Two general types are in use: cylindrical and tapered hard steel bearings fitted snugly to the axle journal. The tapered bearing is shown in the insert.



3.5. COUPLERS

Railway cars are connected and disconnected by a coupler. In the continental United States (CONUS) and some foreign countries, the automatic coupler is used; some other foreign countries use the hook-and-link coupler. Both types are described in the subparagraphs following.

a. The automatic coupler, shown in figure 3.4, is best described as a rotating hook. It is automatic only to the extent that it couples cars when they are moved into contact with each other; it must be uncoupled manually. The main parts of the automatic coupler are the head, knuckle and pin, and shank.

(1) The head of the coupler has guard arms on which alining wings are mounted. This apparatus alines the coupler knuckles of opposing cars and positions them for coupling.

(2) The knuckle and pin are the moving parts of the coupler that perform the coupling action. Shaped like a hook, the knuckle rotates on a pin; once it has rotated to the closed position, a block drops into place to hold it closed:

(3) The shank is a continuation of the head providing a connection with the draft gear. The shank transmits shock and pulling stress to the draft gear which distributes them to the underframe of the car.

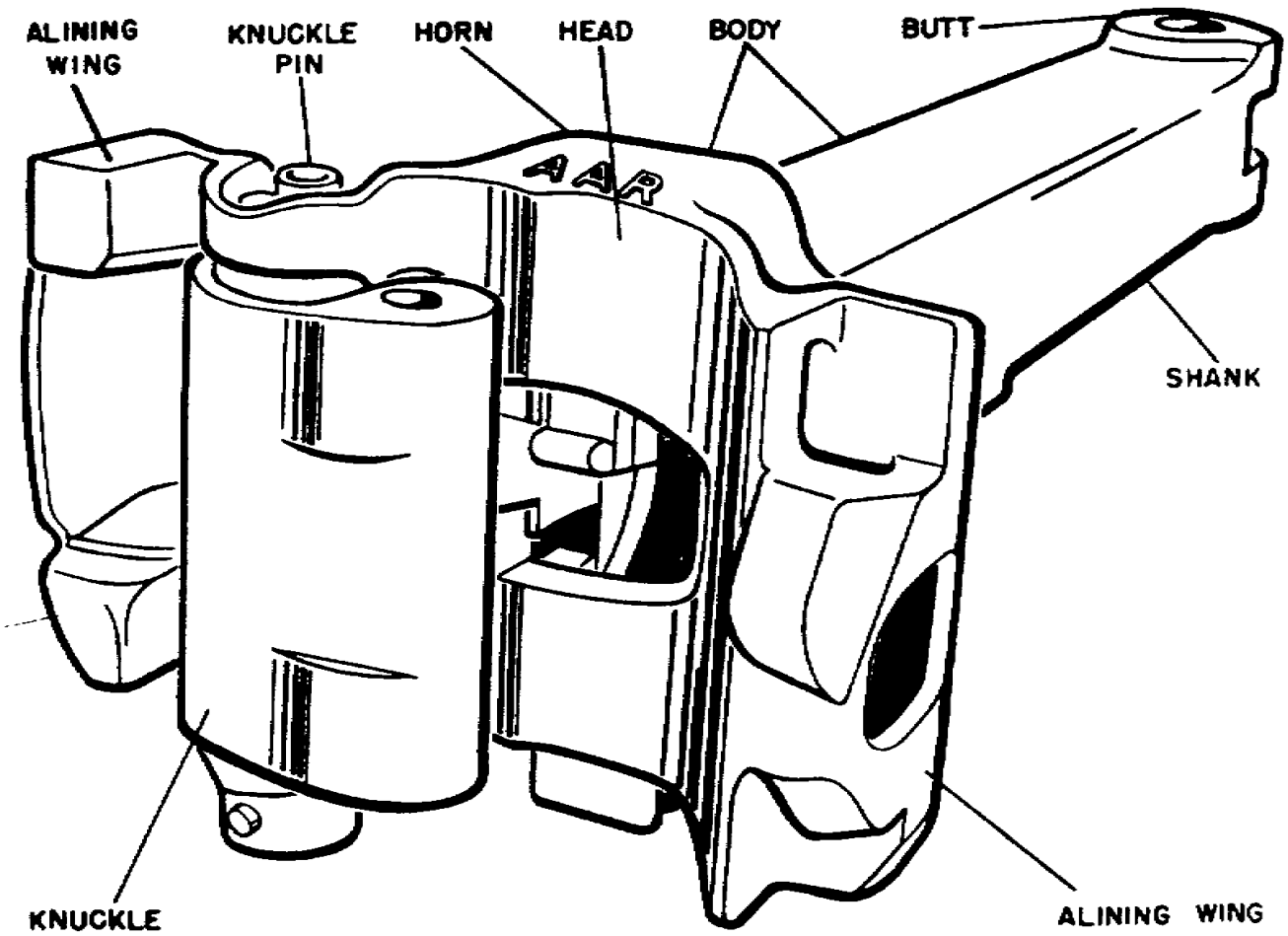



Figure 3.4. Automatic Coupler.

b. The hook-and-link coupler, the kind used on some Army railway cars to be operated in foreign countries, is equipped with a draw hook and turnbuckle. Each car has a hook, a connecting link, and a pair of end buffers. Figure 3.5 shows two railway cars with hook-and-link couplers connected. To couple the cars, they are pushed together and the connecting link placed over the opposing hook. Then the links are tightened by the turnbuckle, and all slack is taken up between the cars. The end buffers are spring loaded to absorb the shock of coupling and to keep the car bodies from striking each other.

## 3.6. DRAFT GEAR

Located at each end of a car is a draft gear that connects the coupler to the underframe and absorbs the coupling shock and the shock of increases in train speed or pulling stresses. Most Army rolling stock is equipped with a friction draft gear. Figure 3.6 shows three different types. Fitting into a pocket in the underframe, the draft gear distributes the coupling shock over the car underframe. The location of the draft gear pocket can be see in figure 3.1. In most theaters of operations, the draft gear of railway cars is designed

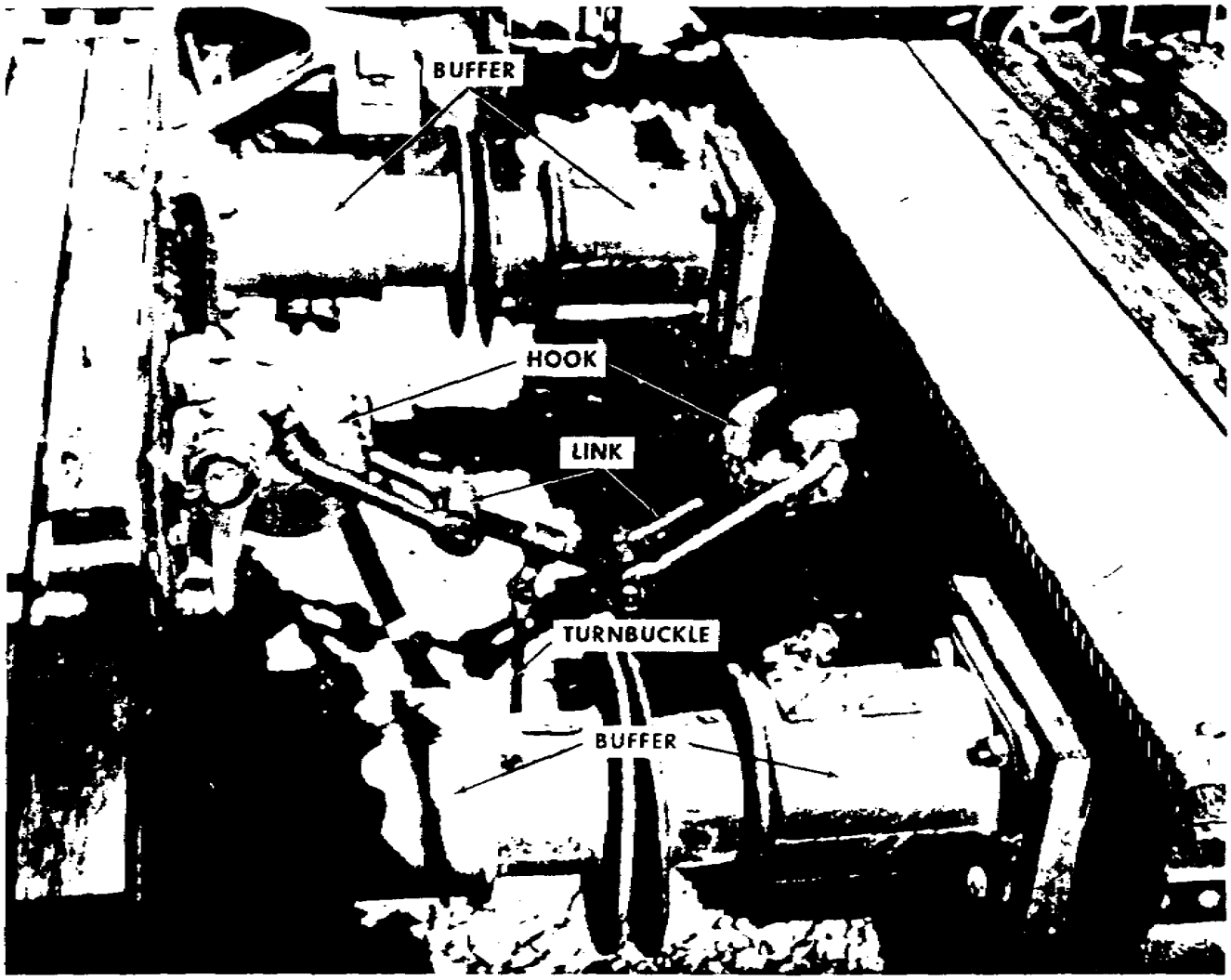



Figure 3.5. Two Railway Cars With Hook-and-Link Couplers Connected.

to absorb pulling stresses only, whereas coupling shock is absorbed by buffers set approximately 35 inches to each side of the centerline of the draft gear. The buffers are labeled in figure 3.5.

## 3.7. SUMMARY

Interchanging cars among commercial railroads has brought about the standardization of rail car components to achieve efficient operation and maintenance. With the exception of the superstructure, the design of all railway cars is generally the same. Some of their components--underframe, truck assembly, couplers, and draft gear--are common to all rail equipment. The underframe receives the shock and pulling stresses of the moving car, supports the car's deck and superstructure, and carries the weight of the cargo. The truck assembly is the wheeled assembly at each end of the car which

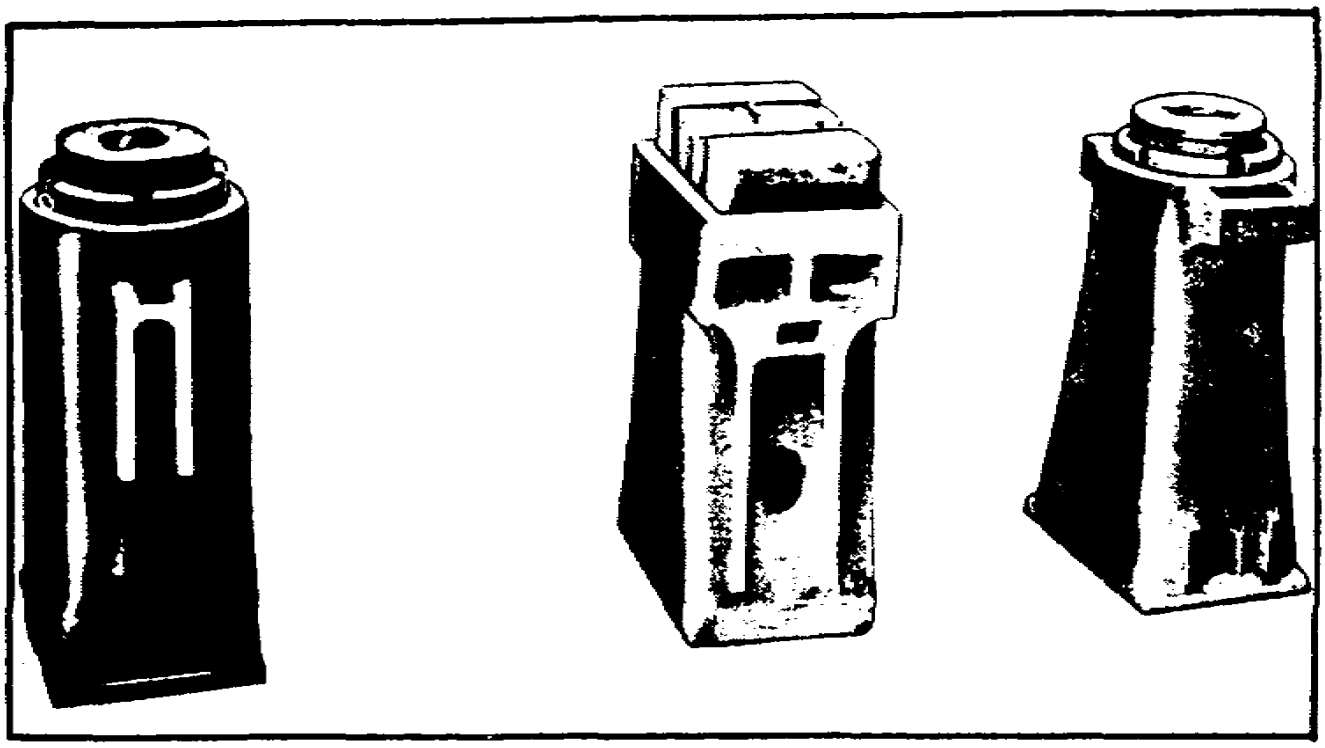


Figure 3.6. Friction Draft Gears.

supports the underframe and superstructure. To connect two cars, a coupler is used. An automatic one is used in the United States and in some oversea areas while the hook-and-link coupler is common in others. The draft gear joins the coupler to the underframe and absorbs the coupling shock as well as that which comes from sudden acceleration or from pulling stresses.

## Section II. Preventive Maintenance

### 3.8. GENERAL

The various designs of railway car superstructures serve many purposes, but the major components and the preventive maintenance on them are the same. This is generally true for rolling stock found in theaters of operations. Preventive maintenance on railway cars is important because it increases the availability of this equipment and decreases the possibility of breakdowns. Inadequate maintenance ties up equipment in repair tracks and shops and decreases rail transport capability.

Of all the components of railway equipment, the truck assemblies receive the greatest amount of maintenance and require the most attention.

The preventive maintenance checks of the truck assembly can be divided into four groups: the general truck assembly, truck brake rigging, journal boxes, and wheels. They are discussed in the next

four main paragraphs. As you study them, refer to figure 3.2 where the parts of a typical truck assembly are labeled. Maintenance of safety appliances is discussed briefly in paragraph 3.13.

## 3.9. GENERAL TRUCK ASSEMBLY

The general truck assembly should be inspected overall for defective, cracked, or broken parts. Other than the journal boxes, the only part of this assembly that needs lubrication is the wearing area of the center plate. The truck center plate provides a recess for the center pin and a wearing surface to match the wearing surface of the body center plate. This connection between the truck and the car underframe allows the truck to swivel beneath the rigid car underframe to permit the car to negotiate curves properly. The center plate should always be well lubricated with a heavy, tacky, or graphited lubricant applied with a paddle. Normally, no grease fittings are provided for lubricating the center plate.

## 3.10. BRAKE RIGGING

Although not all of the brake rigging is located on the truck, most of the mechanical parts are attached to it. Generally the same kinds of brake parts are used on all trucks, and they should be inspected closely to prevent the necessity for heavy maintenance and increase the performance of the equipment. The following subparagraphs discuss preventive maintenance indicators on the truck brake rigging.

a. Brakeshoe. The part of the brake rigging that actually performs the braking action is the brakeshoe. When the brakes are applied, the shoe is pushed against the wheel tread causing a great increase in the friction resistance to the roll of the wheel. Until recently, brakeshoes were made of cast iron, and many of them are still in use. However, since they cause sparking, they are gradually being replaced by composition shoes that last longer and eliminate the danger of causing fires. The shoe is made of a softer material than the wheel so that wear occurs on the shoe instead of the wheel tread. The brakeshoes should be checked to see that they are tightly attached to the brake hangers and that they seat perfectly against the wheel treads without binding on or against the wheel flanges. When the brakes are released, the brakeshoes should separate from the wheel treads at least 1/8 inch. The shoes should be replaced when their thickness is less than 1/2 inch.

b. Brake hangers. The alinement of the brake hangers is important because they hold and position the brakeshoes. The hangers should keep the brakeshoes in proper alinement with the wheel tread.

c. Brake piston rod travel. On conventional two-axle, four wheel trucks, the brake cylinder is usually attached to the car underframe. The brake piston rod extends from the brake cylinder and is attached to the brake lever through a system of rods and levers; the cylinder and the piston rod are shown in figure 3.7. Between full brake application and complete brake release, the piston should travel only 7 to 9 inches.

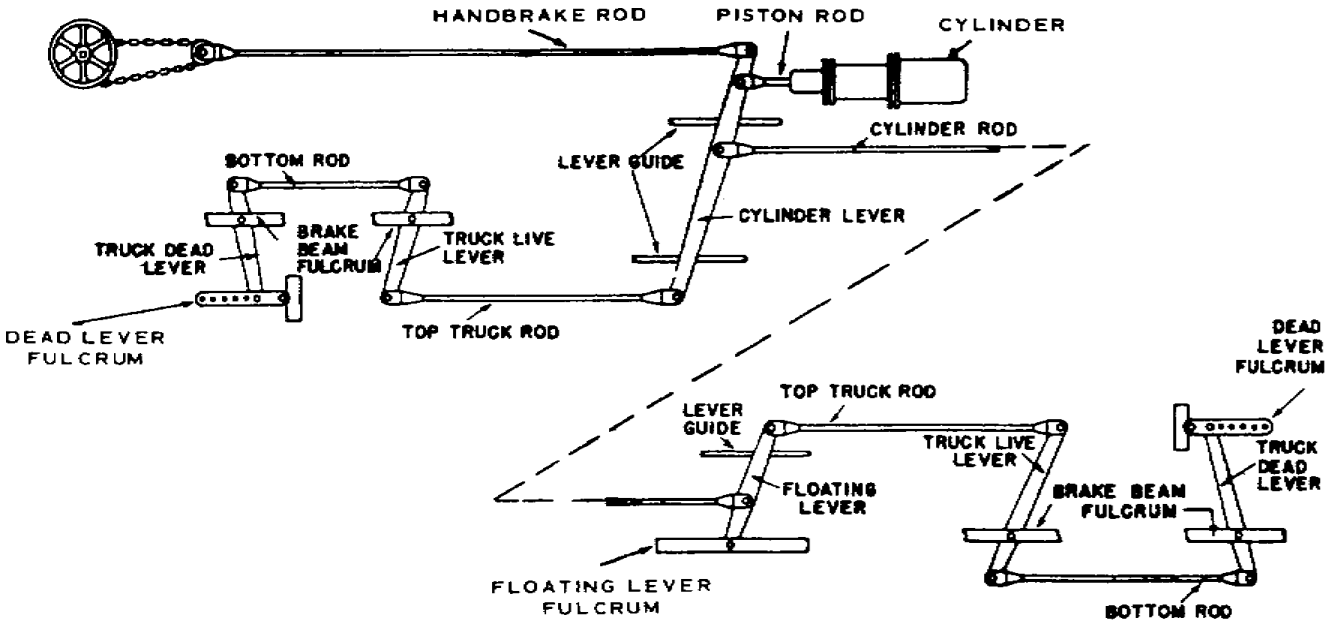



Figure 3.7. Brake Rigging.

A railway car with a depressed center or any other obstruction in the center has its brake cylinders mounted on the trucks. Figure 3.8 shows a truck-mounted brake cylinder. The tolerance for the truck-mounted brake piston rod travel is the same as that for the one mounted on the underframe--7 to 9 inches.

## 3.11. JOURNAL BOX

The journal box is a part of the truck assembly that requires careful and frequent inspection and maintenance. Failure to lubricate a journal box assembly properly could cause serious accidents and unnecessary delays and expense in train operation. The following subparagraphs discuss the preventive maintenance checks on the journal box assembly with friction bearing.

a. Waste grabs and scratches on the journal. The journal is a highly finished, rolled-and-ground end to the axle. If loose threads or lint from the packing, called waste grabs, get wedged between the journal and bearing, they scratch the surface of the

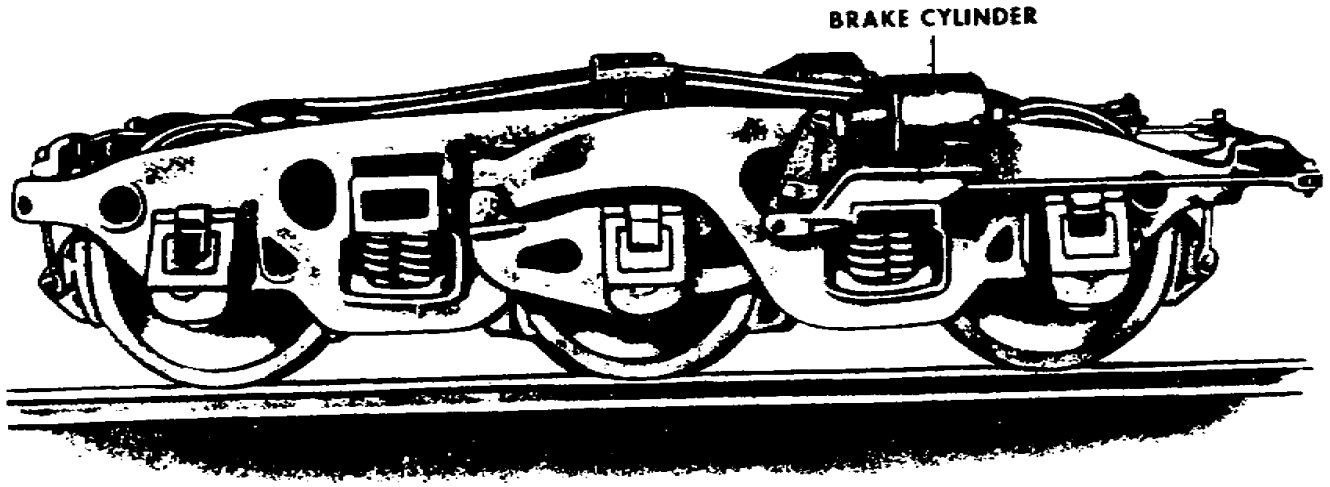



Figure 3.8. Truck-Mounted Brake Cylinder.

journal, cut off lubrication in the area, and cause the journal to overheat. Normally, friction heat is transferred to the bearing, the wedge, the journal box, and the atmosphere. But when there is a waste grab, the heat increase is greater than the heat transfer, and a hotbox results. When this happens, the lubricant and packing ignite and the overheating increases. Excessive overheating of the journal changes the composition of the metal and causes the journal to break and the car to derail. If scratches are visible on the journal, the wedge and bearing should be removed and a check made for waste grabs. If waste is present between the bearing and journal, it should be removed.

b. Waste packing or lubricator pad. The journal and bearing are supplied lubricant by waste packing or a lubricator pad. The location is labeled in figure 3.3. When kept properly lubricated, the packing prevents waste grabs from becoming lodged between the journal and the bearing.

c. Brass and wedge. As subparagraph 3.4e(4) states, the journal friction bearing is made of brass with a babbitt metal lining. It is often referred to in railroad terminology as "the brass. " When the journal box lid is opened, the ends of the bearing and wedge can be inspected. No breaks or cracks should be visible on either the bearing or the wedge, and they should be properly positioned at the

top center of the journal--not slipped to one side. The ends of the bearing and wedge should show no wear; worn ends show improper bearing and wedge position.

d. Water and lubrication. The journal surface should be lubricated. Dryness of the journal end signifies inadequate lubrication which may have resuited from water in the packing. The journal box should be checked carefully for water. In cold weather, water may freeze around the threads of the packing and retard the flow of lubricant to the journal. In warm weather, water may settle to the bottom rear of the journal box, forcing the lighter oil up and out through the dust guard well. Water problems are generally caused by loose or poorly fitting lids that admit snow or water.

e. Journal box. The journal box should not be broken or cracked, and its lid should close securely to prevent dust, dirt, water, and other foreign matter from entering the box. No loose threads or particles of waste should be hanging outside the box lid.

## 3.12. WHEEL DEFECTS

The two general classes of railway wheels used on commercial and military railroads in the United States are made of either wrought or cast steel. Wheels are usually classified according to the manufacturing process used in making them. Treads and flanges are specially treated in the manufacturing process to increase their hardness and durability. Wheels are also classified as to whether they are multiple, two, or one wear.

The importance of inspecting for wheel defects must be stressed. Any serious wheel defect causes undue wear on rails and rail equipment parts and can cause the car and train to derail. The high cost of track repair, the destruction of expensive rail equipment, and the danger to human life make the close and frequent inspection of wheels imperative. Major wheel defects are discussed in the subparagraphs following.

a. Thin flange. When checking wheels, inspectors use a special wheel gage. A thin flange is evident if the flange fits into a predesigned cut in the wheel gage. For example, when the flange fits into the 1-inch cut in the gage, the wheel should be changed to another position on the car to decrease flange wear. However, when the flange fits into the 15/16-inch slot on the gage, the condemning limit has been reached and the wheel must be replaced. Figure 3.9 demonstrates the use of the wheel gage to detect this defect.

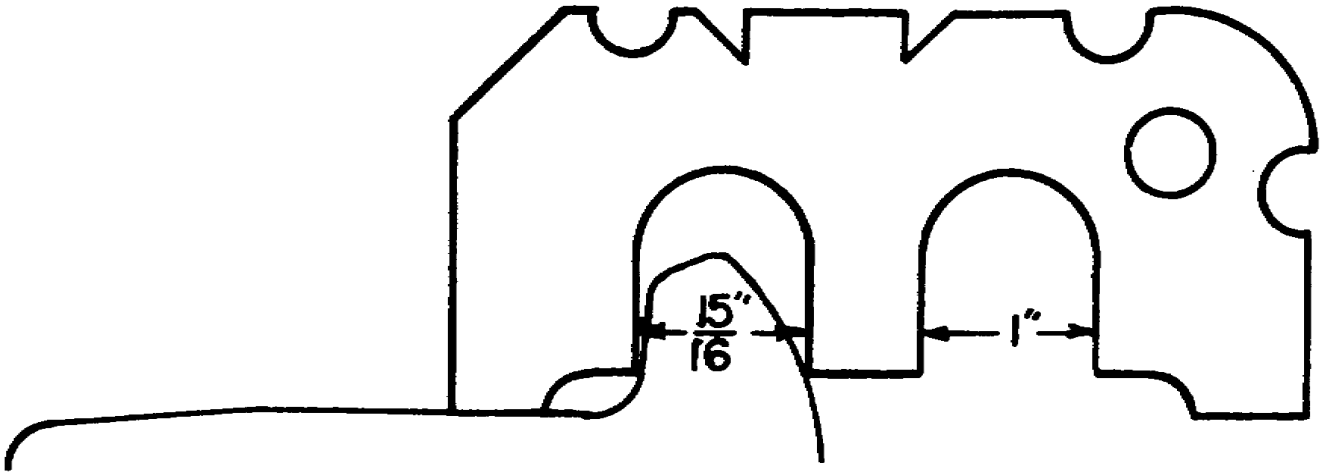



Figure 3.9. Wheel Having Thin Flange Defects With Gage in Place.

b. Seams. One of the most serious wheel defects is a seam or lengthwise crack in the tread. When a seam is located close to the flange, it can cause the flange to break off the wheel. If a seam is detected within 3 3/4 inches of the flange, the wheel must be removed. Figure 3.10 shows a wheel with a seam within the condemnable limit.



Figure 3.10. Wheel With Seam Defect.

c. Slid flat. A violent application of the brakes locks the wheels causing them to skid along the rails. Such skidding results in worn flat spots on the wheel treads called slid flat spots. If a wheel tread has a slid flat area 2 1/2 inches or more in length, the wheel must be replaced. If the wheel has two or more adjoining slid flat spots each 2 inches or more in length, the wheel is condemnable. Passenger car wheels must not have slid flat spots in excess of

1 inch. Figure 3.11 shows a single slid flat defect measuring more than 2 1/2 inches; figure 3.12 shows two adjoining slid flat spots each exceeding the 2-inch limit.



Figure 3.11. Single Slid Flat Wheel Defect.

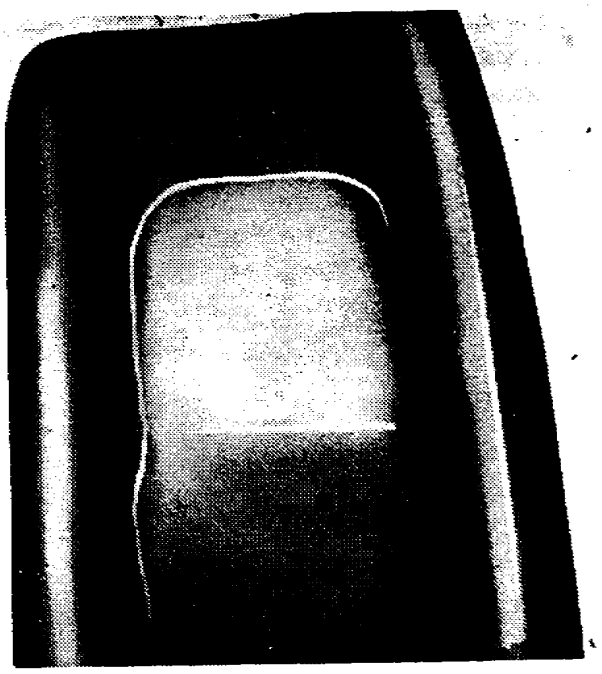


Figure 3.12. Adjoining Slid Flat Defects.

d. Broken rim. Sometimes inspectors condemn wheels and remove them from service when they detect chipped places on the outside edge of the rim; however, a small amount of chipping does not impair their serviceability. The wheel should not be condemned until the rim is broken off a distance of 3 3/4 inches from the flange when the break slopes inwardly. Figure 3.13 illustrates the methods of gaging broken rims; the two wheels shown have reached the condemnable limit.

e. Cracked plate. Any wheel with a cracked plate should be removed from service. Such a crack almost always originates in either the hub or the rim. A 2-to

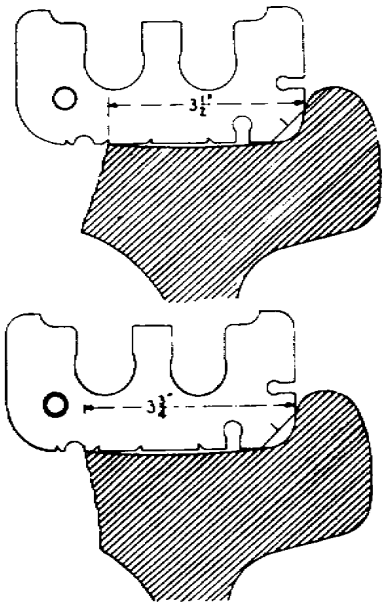



Figure 3.13. Wheels With Broken Rim Defects.

3-inch crack in the plate can grow into a so-called "cupid's bow" crack, as part A of figure 3.14 shows. Its name is derived from the bowlike shape the crack assumes when the two ends turn outward toward the rim. A cracked plate is easily detected by a careful inspection of the wheels. However, if such a crack is neglected, it can extend through the rim, as part B of figure 3.14 shows, and cause the wheel to fail.

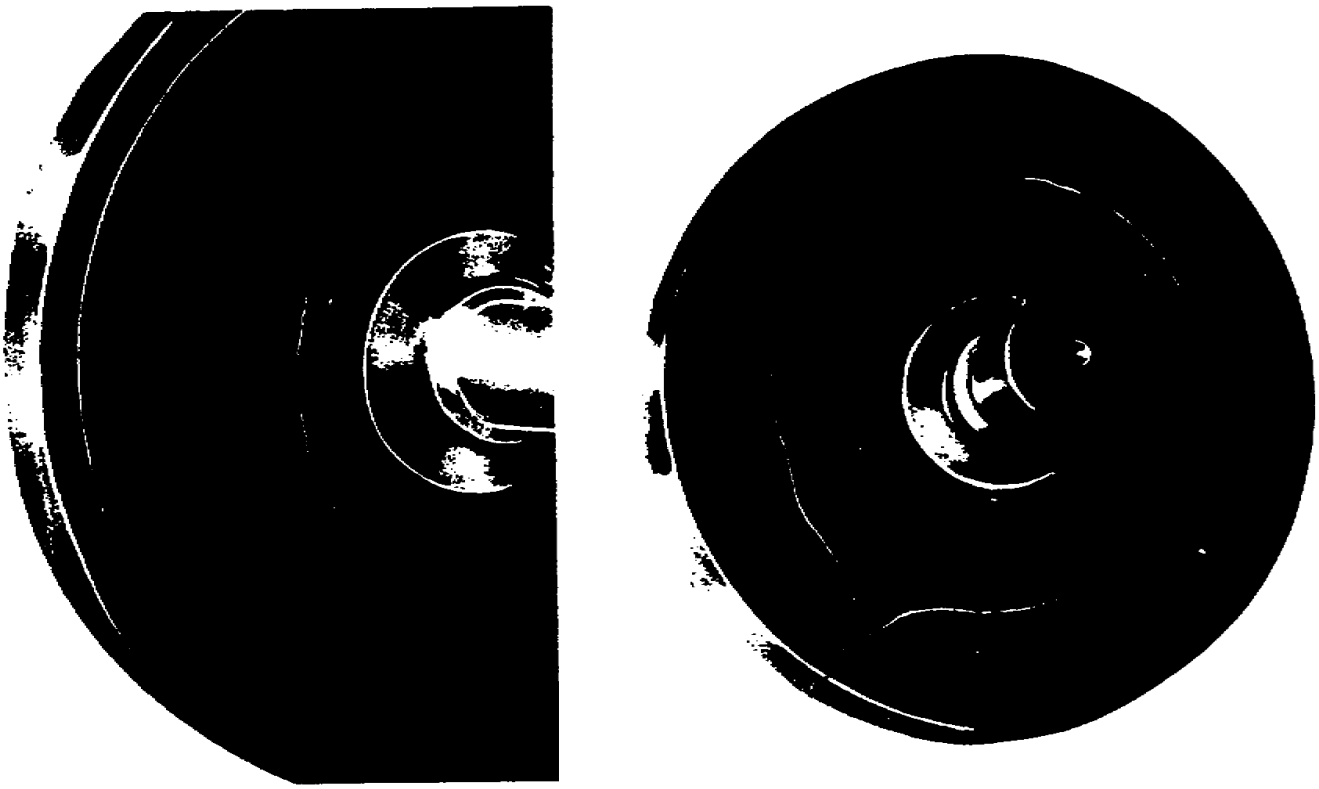


Figure 3.14. Cracked Plates.

f. Tread worn hollow. A gage is provided for condemning wheels for worn hollow treads, as shown in figure 3.15. When the two ends of the gage touch the rim and the flange but the bottom nipple on the gage does not touch the tread, the wheel has reached the condemnable limit and must be removed from service. The real limit of a tread worn hollow defect is the height of the flange and this is what the gage is based on. Wheels should not be condemned for having treads worn hollow before the gage limit is actually reached.

g. Out of round. If a wheel has a worn spot in the tread more than 3/64-inch deep, it is out of round and has reached the condemnable limit. A wheel with this defect causes damage to the track, equipment, and lading when the train is traveling at high speeds. Figure 3.16 shows the gage applied to a defective 33-inch wheel.

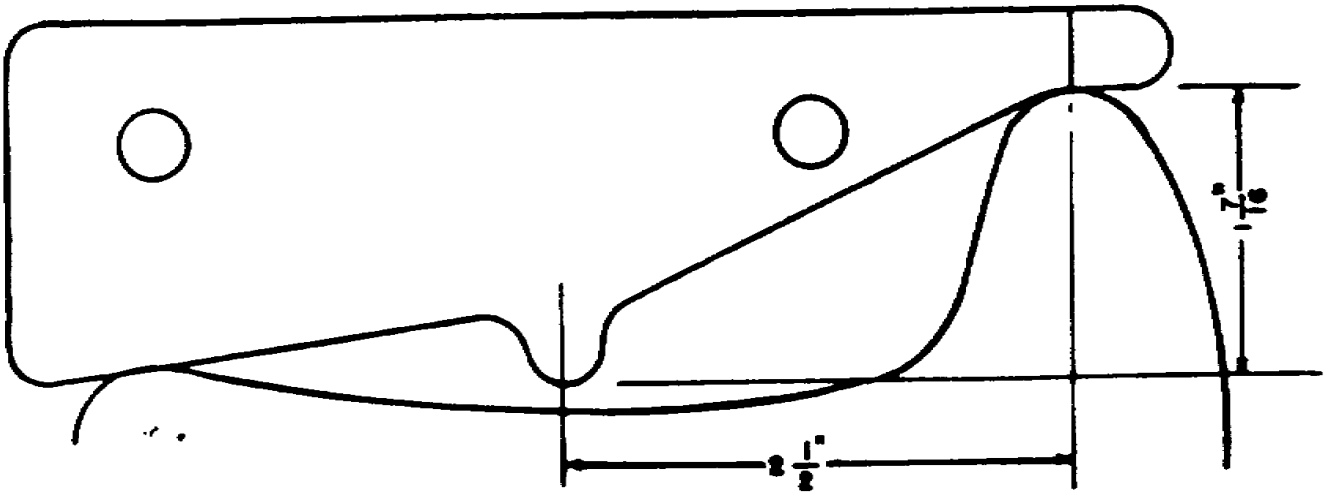


Figure 3.15. Wheel Having Tread Worn Hollow Defect With Gage in Place.

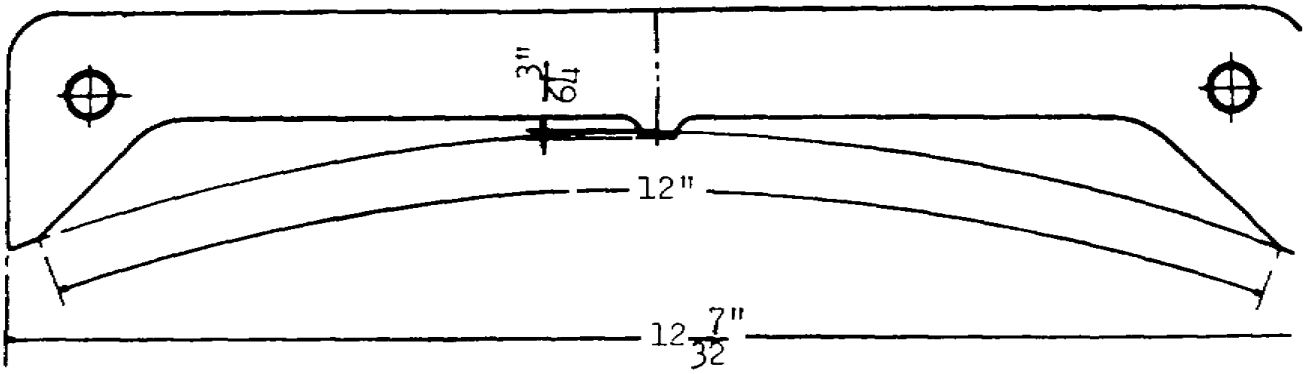



Figure 3.16. Wheel Out of Round With Gage in Place.

## 3.13. SAFETY APPLIANCES

The steps, running boards, and handholds of all railway equipment are safety appliances. Lives and limbs of railway workmen are greatly endangered if these items are broken, loose, or bent. Safety appliances should be inspected frequently and any defects reported and repaired immediately. Figure 3.17 shows a typical railway car and its safety appliances.

## 3.14. SUMMARY

Preventive maintenance is essential to the operational readiness of railway cars because it can reduce greatly the possibilities of expensive and time-consuming heavy repairs. All car components should have frequent preventive maintenance checks, particularly the truck assemblies since they must support the car and be able to ride the rails and negotiate curves properly. Safety appliances on cars should be inspected often and any defective ones repaired immediately to avoid endangering the lives of railway workmen.

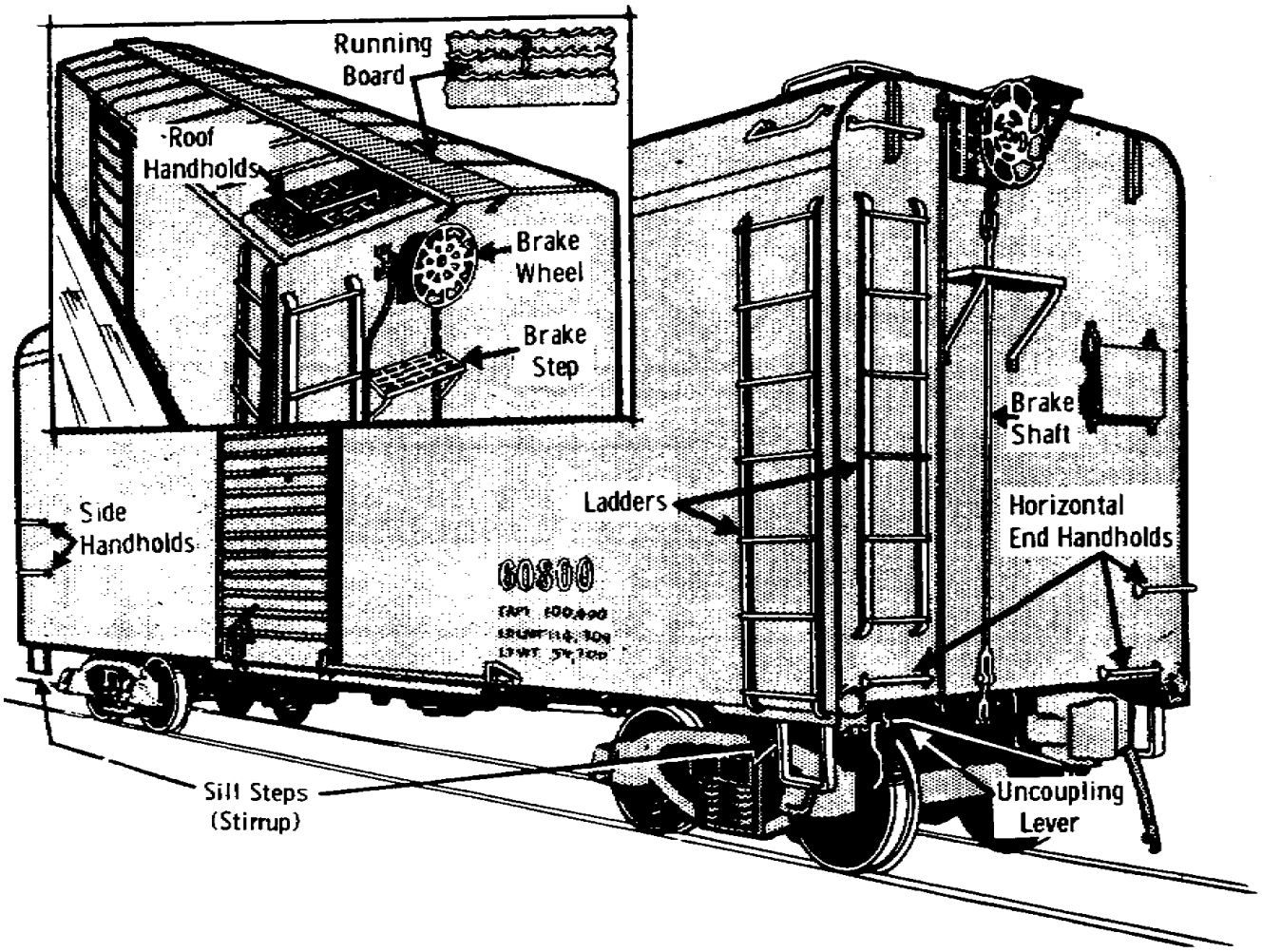



Figure 3.17. Railway Car Safety Appliances.

## Section III. Inspection and Maintenance

### 3.15. GENERAL

When railway cars are inspected and defects are noted, the proper forms must be used to point out the defects to the repairmen at the car repair track, to record the maintenance performed, and to insure that the cars are not placed in service until the defects are corrected. This section discusses the forms used in the inspection and maintenance of railway cars; however, it gives only general information on the entries to be made on them. Anyone responsible for completing the forms must have Technical Manual 55-203, Maintenance of Railway Cars, that describes their entries. Before the discussion of the forms begins, paragraph 3.16 explains the kinds of inspections made.

### 3.16. INSPECTION OF RAILWAY CARS

Inspection of railway cars differs from that of locomotives in that railway cars have only one periodic or scheduled inspection--the

annual. However, they are inspected with a frequency consistent with their use. The more a car is used the more it is inspected and, of course, the more maintenance it needs. Other than the annual inspection, railway cars are normally inspected at loading points and at receiving and departure yards upon arrival and departure.

a. At loading points. Although shippers are responsible for loading rail cars properly, transportation railway service inspectors are responsible for checking them at loading points before accepting the cars for movement. They inspect each car to insure that it has been properly loaded and secured so that the load cannot shift while in transit. The lading should be so positioned that its weight is properly distributed on the car. The inspectors check the car for any damage that may have occurred while it was being loaded; they also check it for proper lubrication. Railway cars should not leave loading points until this inspection has been made.

b. On arrival. When railway cars arrive at a receiving yard, they are thoroughly inspected. They are visually inspected for defects and lubrication points are checked. Such light repairs as repacking a journal box or replacing a broken cotter key or a worn brakeshoe are made while the cars are in the receiving yard. The brake system is also tested during the arrival inspection. The brakes are applied to resist the pull of the locomotive so that the slack is taken up as the train stops. The draft gears are stretched out as a result of this action, and inspectors begin at each end of the train checking couplers, draft gears, side frames, wheels, underframes, and airbrake piston travel. The journal box lids are opened and the packing and lubrication checked. Inspectors place a Bad Order Card (DA Form 55-164) on cars having defects that cannot be readily repaired in the receiving yard. The bad-order cars are moved to the repair, or rip track, where they are repaired as soon as possible. ("Rip" stands for repair, inspect, paint.) When the arrival inspection is finished, the cars are moved to the classification yard where they are classified or sorted according to destination or to content.

c. On departure. After railway cars have been classified, they are moved to the departure yard and made up into trains. Inspectors again travel the length of the train making a test of the train's airbrake system. At the same time, they make another general inspection and insure that the journal box lids are closed.

d. Annual inspection. Once each year, a car is inspected, and the date of the inspection is stenciled on the car. When a car arrives at a railway yard and the inspectors note that the annual inspection is due, they notify the yardmaster who has the car moved

to the car repair track if the car is empty. If loaded, it continues to its destination; but when next entering a yard empty, the car is moved to the car repair track to undergo the annual inspection.

## 3.17. FIELD INSPECTION DATA FOR RAIL CARS

Field Inspection Data, USA, USAX, USNX, DODX, Rail Cars, DD Form 1335, is used as a checklist when inspecting both freight and passenger rail cars. The checklist must be supported by a narrative recorded on DA Form 2407. The DD Form 1335, shown in figure 3.18, lists the items to be checked in performing the inspection. All of the required Information to be listed in the heading of the form for a specific rail car is stenciled on the side of the car. This includes the capacity, weight, dates of inspections, and dates of last tank and valve tests. The body of the form lists the items to be checked, a condition column, and a remarks column which gives an abbreviated description of the defect. The form is retained by the designated DS/GS rail support unit until the required repairs have been completed and then the forms are destroyed. In the absence of a DS/GS unit, the forms are forwarded to USATSC, ATTN: AMSTS-M.

## 3.18. AIR BRAKE DEFECT TAG

The Air Brake Defect Tag, DA Form 55-161, as shown in figure 3.19, is used by a car inspector or train conductor to tag a car having inoperative brakes. The form, made of red cardboard with black lettering, is attached to the brake pipe of the car having defective brakes so that the defect is noticed readily. The car is sent to the car repair track for repair before it can depart from the terminal. In CONUS, inspectors or other maintenance men, after completing repairs, make a "repairs made" notation on the tag and then forward it to the officer in charge at the installation. In a theater of operations, after a similar notation is made, the tag is forwarded to the officer in charge of air brake repairs in the transportation railway battalion.

## 3.19. INSPECTOR'S RECORD

The Inspector's Record, DA Form 55-162, is used by car inspectors to report all defects on cars they inspect. Defective cars include those having defective handbrakes, those already carded for repair tracks, those carded for reweighing, and those found defective for any other reason. In a theater of operations, the completed report is sent to the officer in charge of car repairs in the transportation railway battalion. In CONUS, the form is forwarded to the

**FIELD INSPECTION DATA**
**USA, USAX, USNX, DODX RAIL CARS**

NAME OF INSPECTOR: J. L. King
SHOP: Ft Eustis VA

| CLASS | INSPECTION LOCATION | DATE | CAR NUMBER |
|---|---|---|---|
| BoxCar 2220 | Ft Eustis VA | 9 August 75 | USAX 7341762 |

| TEST | | PRESSURE | | GAL | LWT | LDWT |
|---|---|---|---|---|---|---|
| TANK | VALVE | TANK | VALVE | | | |
| — | — | — | — | — | — | — |

| AIR DATE | JOURNAL PADS | TYPE | DATE BUILT | DATE LAST INSP | ACI |
|---|---|---|---|---|---|
| 9 August 75 | 5½ X 10 | MILLER | 1968 | 1972 | ☐ YES ☒ NO |

| ITEM | CONDITION SAT | CONDITION RPR | CONDITION RENEW | REMARKS (Check) |
|---|---|---|---|---|
| TANK SHELL LEAKING | | | | ☐ YES ☐ NO |
| SLABBING ☐ METAL ☐ WOOD | | | | ☐ DECAYED ☐ MISSING |
| RUNNING BOARD ☐ METAL ☐ WOOD | | | | ☐ RIVETS LOOSE |
| TANK BANDS | | | | ☐ LOOSE ☐ BROKEN |
| DECK LINING | | | | DATE ____ TYPE ____ |
| SILL STEPS/GRAB IRONS/HAND RAILS, LADDERS | ✓ | | | ☐ LOOSE ☐ BENT ☐ BROKEN |
| COUPLERS, SHANK, SIDEWALL, KNUCKLES, PINS, LOCKLIFT | ✓ | | | ☐ WORN ☐ CRACKED ☐ ALINEMENT ☐ LOW ☐ INOPERATIVE |
| STRIKER CASTINGS | ✓ | | | ☐ CRACKED ☐ BROKEN ☐ LOOSE RIVETS |
| DRAFT GEAR, YOKE, FOLLOWER, KEY, CUSHIONING DEVICE | ✓ | | | ☐ WORN ☐ BROKEN ☐ MISSING ☐ POUNDING |
| DRAFT LUGS | | | | ☐ LOOSE RIVETS ☐ MISSING |
| SIDE BEARINGS | | | | ☐ ADJUST ☐ MISSING ☐ NO CLEARANCE |
| SIDE FRAME - BOLSTER - COLUMN GUIDES | | | | ☐ BROKEN ☐ PATCHED ☐ PLATED ☐ STRIKING ☐ WORN |
| SPRING PACKAGE | | | | ☐ COMPRESSED ☐ MISSING ☐ BROKEN ☐ PLATES ☐ WOOD |
| MODIFICATIONS ☐ YES ☐ NO STAKEPOCKETS | | | | ☐ SHIELDS ☐ STRAPS ☐ OTHER (Specify) ☐ CRACKED ☐ BENT |
| HANDBRAKE SHAFT - WHEEL | ✓ | | | ☐ SHIM ☐ RR & R ☐ RENEW |
| WHEELS | ✓ | | | ☐ FLANGE ☐ CRACKED ☐ FLAT SPOTS ☐ THIN RIM |
| AXLES - JOURNALS | ✓ | | | ☐ COLLAR ☐ HEAT ☐ R J STAMP ☐ FILLET |
| JOURNAL BOXES AND LUBRICATORS | ✓ | | | ☐ LOW OIL ☐ MISSING |
| CENTER PLATES | ✓ | | | ☐ BROKEN ☐ LOOSE RIVETS |
| ROLLER BEARING, ADAPTORS, LUGS | ✓ | | | ☐ HEAT ☐ WATER ☐ WORN ☐ MISSING ☐ SEALS ☐ BROKEN |
| DEFECT CARD HOLDER, PLACARD HOLDERS, ROUTE BOARDS | ✓ | | | ☐ TIGHTEN ☐ REPLACE |
| PAINT CONDITION | ✓ | | | |
| MECHANICAL CONDITION CODE | | | | |

SIGNATURE OF EQUIPMENT SPECIALIST: J L King
APPROVED: Peter C Jacks Capt TC

DD FORM 1 FEB 74 1335
REPLACES DD FORM 1335, 1 SEP 62, WHICH IS OBSOLETE.

Figure 3.18. Field Inspection Data, USA, USAX, USNX, DODX, Rail Cars, DD Form 1335.

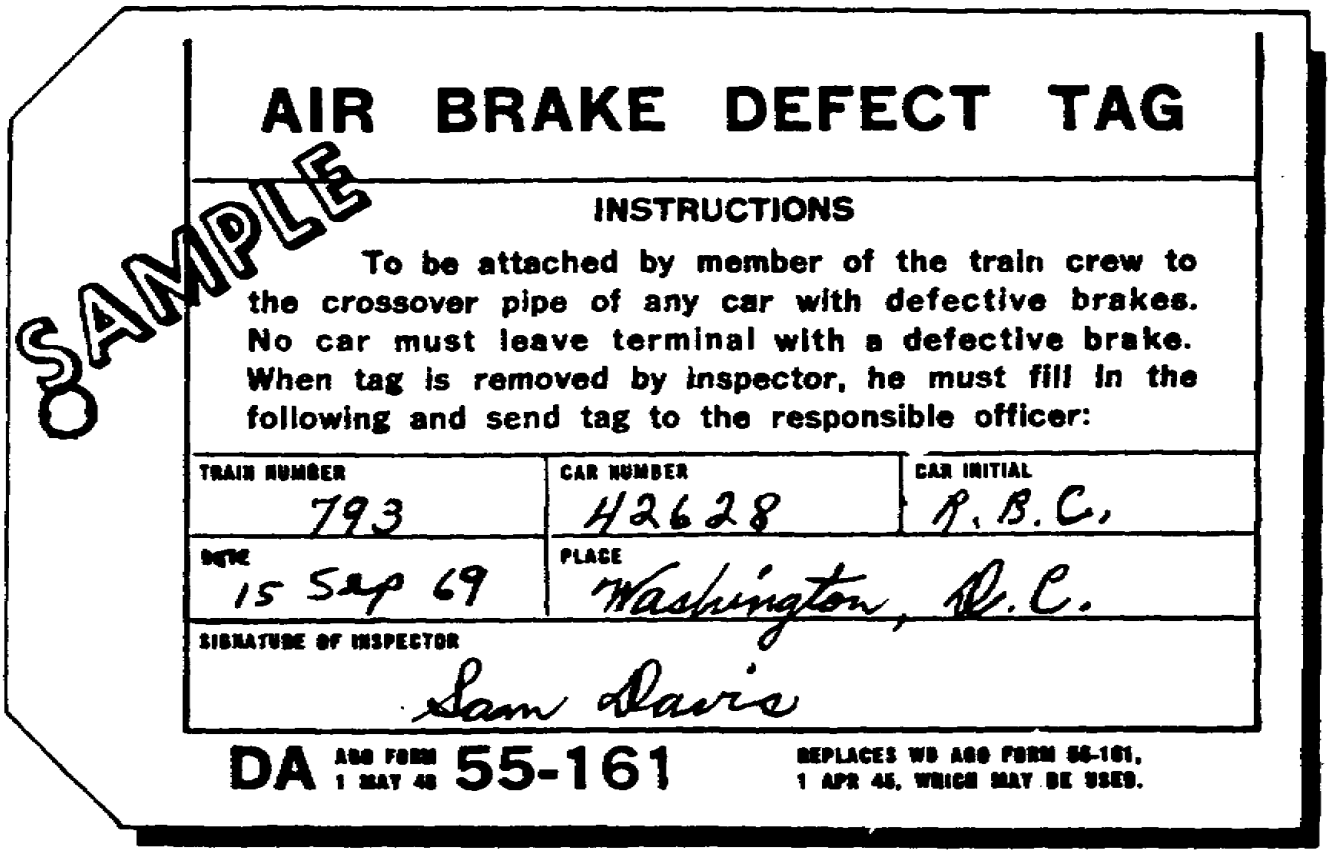



Figure 3.19. Air Brake Defect Tag, DA Form 55-161.

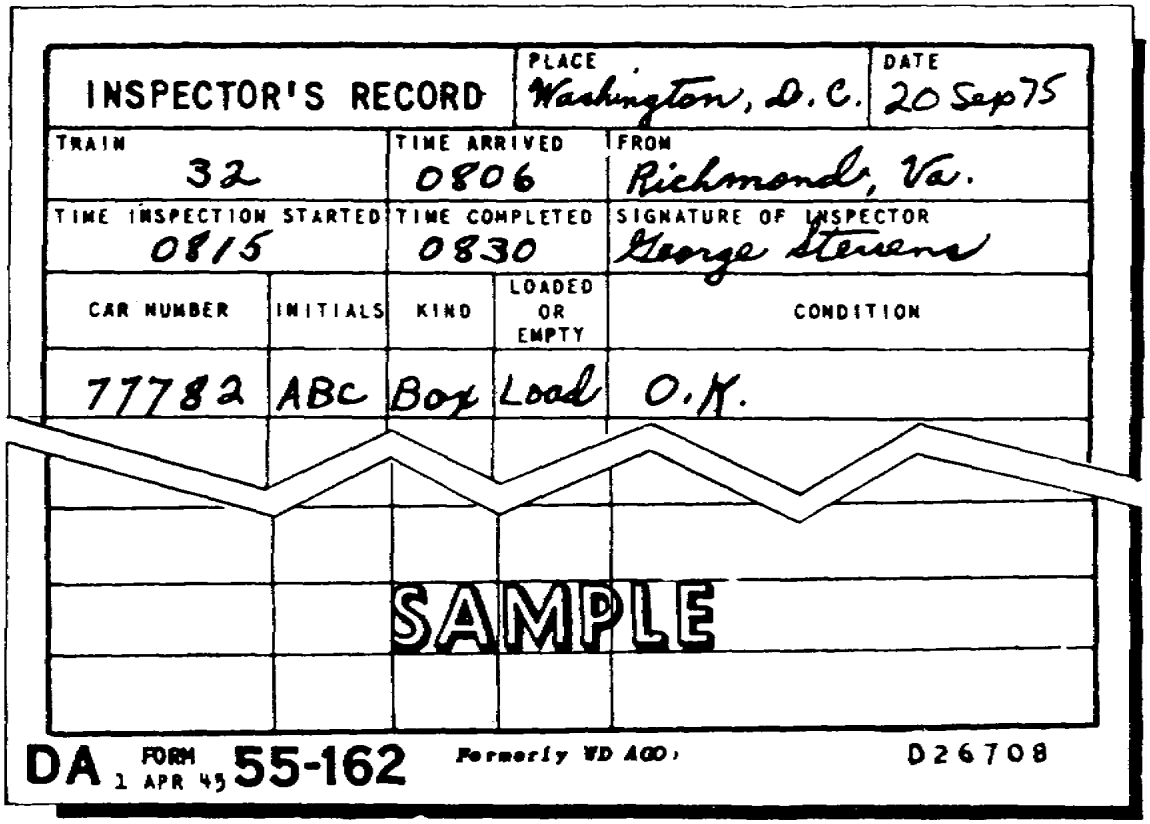
installation transportation officer at the installation where the inspection is made. On the sample 55-162 shown in figure 3.20, note that the inspector found no defects and marked "O. K." under condition.

3.20. CAR INSPECTOR'S TRAIN REPORT

The chief car inspector uses the Car Inspector's Train Report, DA Form 55-163, to report the inspection of each train arriving at or departing from terminals or originating points where car inspectors are located. In a theater of operations, the form is filed by the officer in charge of car repairs in the transportation railway battalion; in CONUS, it is filed at the installation. On the sample form shown in figure 3.21, note that entries are divided into two groups: those for the train coming in and those for it going out.

3.21. BAD ORDER CARD

A Bad Order Card, DA Form 55-164, is used by car inspectors in yards or other places where cars are checked to indicate that they are not safe for service. When an inspector finds a car needing repairs that require moving it to a repair track, he writes the necessary information on two 55-164's, one of which is shown in figure 3.22. Notice on the sample that this includes the date, defect, car



INSPECTOR'S RECORD

PLACE: Washington, D.C.

DATE: 20 Sep 75

| TRAIN | TIME ARRIVED | FROM |
|---|---|---|
| 32 | 0806 | Richmond, Va. |

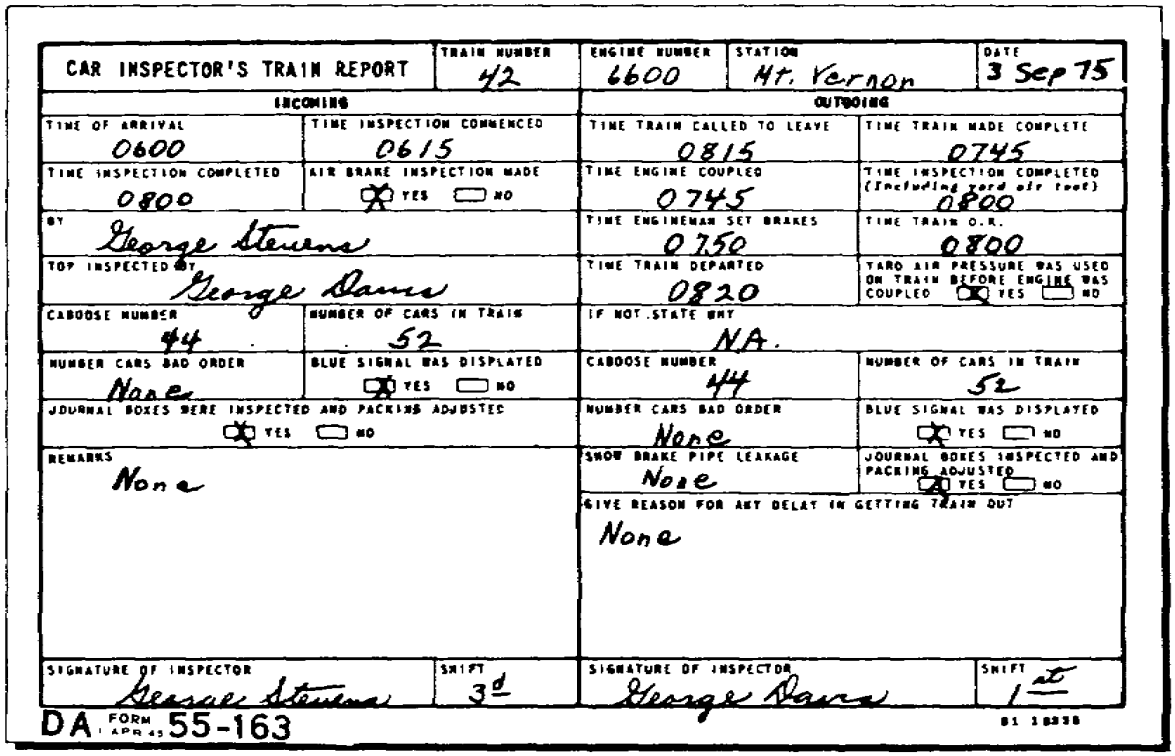
| TIME INSPECTION STARTED | TIME COMPLETED | SIGNATURE OF INSPECTOR |
|---|---|---|
| 0815 | 0830 | George Stevens |

| CAR NUMBER | INITIALS | KIND | LOADED OR EMPTY | CONDITION |
|---|---|---|---|---|
| 77782 | ABC | Box | Load | O.K. |

SAMPLE

DA FORM 1 APR 45 55-162 Formerly WD AGO D26708

Figure 3.20. Inspector's Record, DA Form 55-162.



CAR INSPECTOR'S TRAIN REPORT

TRAIN NUMBER: 42

ENGINE NUMBER: 6600

STATION: Mt. Vernon

DATE: 3 Sep 75

INCOMING

| TIME OF ARRIVAL | TIME INSPECTION COMMENCED |
|---|---|
| 0600 | 0615 |

| TIME INSPECTION COMPLETED | AIR BRAKE INSPECTION MADE |
|---|---|
| 0800 | [X] YES [ ] NO |

BY: George Stevens

TOP INSPECTED BY: George Davis

| CABOOSE NUMBER | NUMBER OF CARS IN TRAIN |
|---|---|
| 44 | 52 |

| NUMBER CARS BAD ORDER | BLUE SIGNAL WAS DISPLAYED |
|---|---|
| None | [X] YES [ ] NO |

JOURNAL BOXES WERE INSPECTED AND PACKING ADJUSTED [X] YES [ ] NO

REMARKS: None

SIGNATURE OF INSPECTOR: George Stevens — SHIFT: 3d

OUTGOING

| TIME TRAIN CALLED TO LEAVE | TIME TRAIN MADE COMPLETE |
|---|---|
| 0815 | 0745 |

| TIME ENGINE COUPLED | TIME INSPECTION COMPLETED (Including yard air test) |
|---|---|
| 0745 | 0800 |

| TIME ENGINEMAN SET BRAKES | TIME TRAIN O.R. |
|---|---|
| 0750 | 0800 |

| TIME TRAIN DEPARTED | YARD AIR PRESSURE WAS USED ON TRAIN BEFORE ENGINE WAS COUPLED |
|---|---|
| 0820 | [X] YES [ ] NO |

IF NOT, STATE WHY: NA.

| CABOOSE NUMBER | NUMBER OF CARS IN TRAIN |
|---|---|
| 44 | 52 |

| NUMBER CARS BAD ORDER | BLUE SIGNAL WAS DISPLAYED |
|---|---|
| None | [X] YES [ ] NO |

| SNOW BRAKE PIPE LEAKAGE | JOURNAL BOXES INSPECTED AND PACKING ADJUSTED |
|---|---|
| None | [X] YES [ ] NO |

GIVE REASON FOR ANY DELAY IN GETTING TRAIN OUT: None

SIGNATURE OF INSPECTOR: George Davis — SHIFT: 1st

DA FORM APR 45 55-163 81 18938

Figure 3.21. Car Inspector's Train Report, DA Form 55-163.

initials and number, whether the car is loaded or empty, place where car is inspected and tagged, and the inspector's name. The inspector then places a card on each side of the defective car. On a car having wooden sides, the cards are attached just below the car number; if the car has steel sides, the cards are placed on boards provided for the purpose.

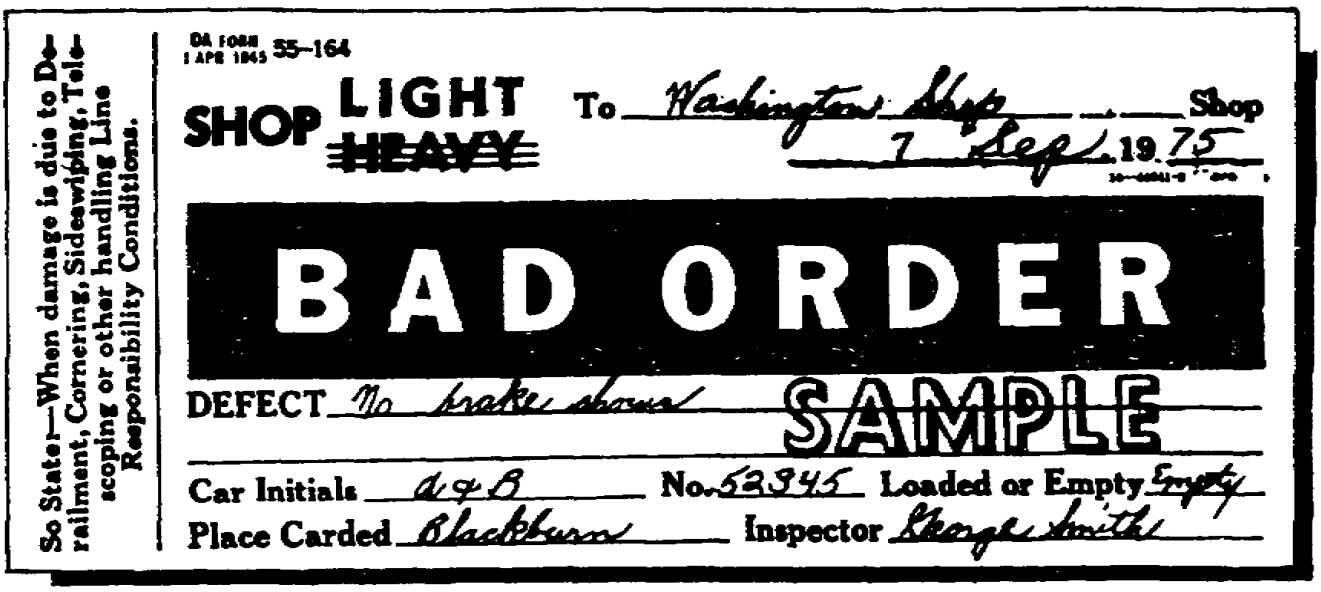



Figure 3.22. Bad Order Card, DA Form 55-164.

If the side of the card used has the large words "Bad Order" appearing on a black background, this signifies that a loaded car may be moved to a destination within the local switching district for unloading before repairs have to be made. It may also signify that a bad-order empty car can be moved from one shop or repair point to another for repairs. However, if the side of the card used has the large words "Bad Order" on a red background, the car can be moved only to the repair track and repairs must be made before the car is used again. Most terminals have both light and heavy repair tracks. By crossing out one or the other of the words light or heavy on the card, the inspector shows which repair track the car should be moved to.

Bad order cards are not removed from a car until repairs have been completed, and then only by those authorized to remove them. In both CONUS and theaters of operations, the inspector responsible for the repairs removes and destroys the cards when he declares the car ready for further service.

## 3.22. SUMMARY

The only periodic inspection of railway cars is made annually. However, they are also inspected at loading points and upon arrival

and departure at receiving and departure yards. At loading points, they are checked for proper loading, possible damage, and proper lubrication. At a receiving yard, a thorough inspection is made for defects, lubrication points are checked, and the brake system is tested. At the departure yard, the airbrake system is again tested and journal box lids are checked to be sure they are closed. Following an annual inspection, the date of the inspection is stenciled on the car. Among the forms the inspectors use in railway car inspection and maintenance are the Inspection Report for Railway Cars, the Airbrake Defect Tag, the Inspector's Record, the Car Inspector's Train Report, and the Bad Order Card.

**CORRESPONDENCE COURSE OF THE**
**U.S. ARMY TRANSPORTATION SCHOOL**
**SOLUTIONS**

TRANS SUBCOURSE 675.....Maintenance of Diesel-Electric Locomotives and Rolling Stock.

(All references are to Reference Text 675.)

LESSON 1

| Weight | Exercise | | | Weight | Exercise | | |
|---|---|---|---|---|---|---|---|
| 3 | 1. | T. | (par. 2.4a) | 3 | 12. | D. | (par. 2.10b) |
| 3 | 2. | T. | (par. .2.4) | 3 | 13. | A. | (par. 2.13) |
| 3 | 3. | F. | (par. 2.4) | 3 | 14. | B. | (par. 2.12b) |
| 3 | 4. | T. | (par. 2.12a) | 3 | 15. | C. | (par. 2.14) |
| 3 | 5. | T. | (par. 2.4a) | 3 | 16. | D. | (par. 2.17) |
| 4 | 6. | F. | (par. 2.3a) | 3 | 17. | A. | (par. 2.15) |
| 4 | 7. | T. | (par. 1.2a) | 3 | 18. | B. | (par. 2.16) |
| 4 | 8. | F. | (par. 2.4) | 3 | 19. | C. | (par. 2.14) |
| 4 | 9. | T. | (par. 2.3) | 3 | 20. | C. | (par. 2.24) |
| 4 | 10. | F. | (par. 2.3b) | 3 | 21. | A. | (par. 2.21) |
| 3 | 11. | C. | (par. 2.11b) | 3 | 22. | D. | (par. 2.20) |

LESSON 2

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 3 | 1. | T. | (par. 3.11d) | 4 | 5. | T. | (par. 3.2) |
| 3 | 2. | F. | (par. 3.5b) | 4 | 6. | T. | (par. 3.4c) |
| 4 | 3. | T. | (par. 3.2) | 4 | 7. | F. | (par. 3.10c) |
| 4 | 4. | T. | (par. 3.3c) | 4 | 8. | E. | (par. 3.12b) |

| Weight | Exercise | Weight | Exercise |
|---|---|---|---|
| 4 | 9. D. (par. 3.12f) | 3 | 20. B. (par. 3.10a) |
| 4 | 10. A. (par. 3.12g) | 3 | 21. D. (par. 3.19) |
| 4 | 11. B. (par. 3.12c) | 3 | 22. E. (par. 3.20) |
| 4 | 12. C. (par. 3.12e) | 3 | 23. A. (par. 3.21) |
| 3 | 13. E. (par. 3.4) | 3 | 24. C. (par. 3.18) |
| 3 | 14. A. (par. 3.3b) | 3 | 25. B. (par. 3.17) |
| 3 | 15. C. (par. 3.3a) | 3 | 26. A. (par. 3.21) |
| 3 | 16. D. (par. 3.4e(1)) | 3 | 27. B. (par. 3.6) |
| 3 | 17. E. (par. 3.4e(4)) | 3 | 28. C. (par. 3.16b) |
| 3 | 18. D. (par. 3.4a) | 3 | 29. A. (par. 3.4e(4)) |
| 3 | 19. C. (par. 3.4a) | 3 | 30. C. (par. 3.13) |

## Appendix II

## GLOSSARY

Airbrake--brake apparatus in which the mechanism is activated by air pressure exerted on various parts of the apparatus.

Airbrake hose--flexible tube made of alternating layers of rubber and canvas used to connect the brake pipes between cars and between the cars and the locomotive in a train.

Alternating current--electric current that reverses its direction at regularly recurring intervals.

Alternator--electric generator for producing current.

Armature--rotating part of an electric motor or generator.

Army Equipment Record Procedures--TM 38-750 which provides procedures for the control of operation and maintenance of all Army equipment. They apply to all units, organizations, and activities under the jurisdiction of the Department of the Army.

Auxiliary generator--device for generating electric power to be used for driving the auxiliary equipment of diesel motive power.

Axle--cylindrical steel or wrought iron shaft on which a pair of wheels is mounted by pressing on with a hydraulic wheel press.

Babbitt metal--alloy consisting mainly of tin and copper used for journal box bearings.

Body bolster--transverse member of the underframe over the truck that transmits the load carried by the longitudinal sills to the truck through the center plates.

Body center plate--metal plate attached to the underside of the body bolster.

Body side bearing--upper one of two side bearings; it is attached to the body bolster. (See Side bearings.)

Brake cylinder--cast iron cylinder attached to a car or locomotive underframe or truck frame that contains the brake piston to which the brake piston rod is attached.

Brake lever--lever used as a part of the foundation brake gear.

Brake pipe--iron pipe connecting the engineer's brake valve on a locomotive with the brake apparatus on all the cars in a train, and connected between adjoining cars by flexible hose couplings.

Brake piston rod--rod attached to the piston in a brake cylinder.

Brakeshoe--piece of metal shaped to fit the tread of a wheel and used to push against the wheel tread to perform the braking action.

Brush--device usually made of carbon or graphite that contacts the commutator of a motor or generator or slip rings of an a. c. motor or alternator to convey electricity to and from the armature or rotor.

Brush holder--metal bracket or support attached to the frame of an electric motor or a generator, but insulated from it, used for holding one or more brushes.

Center plate--one of a pair of plates having circular grooves which fit one into the other and support the car or locomotive on the trucks, which allows them to turn freely under the car. The body or male center plate is attached to the underside of the body bolster or, in cast steel bolsters, an integral part of the casting; the female or truck center plate is attached to the top side of, or cast integral with, the truck bolster.

Center sill--central longitudinal member of a car underframe; the sill that forms the backbone of the underframe.

Commutator--device used to reverse the direction of electric current in any circuit.

Compression ignition--ignition of a fuel charge by heat generated by compressing air in a cylinder.

Coupler--appliance for connecting and disconnecting railway cars and locomotives.

Current--flow of electrical energy in a circuit.

Cylinder--cylindrical chamber in which fuel oil is burned to force the piston down and rotate the crankshaft and thus drive the engine.

Defect--materiel deficiency or malfunction.

Direct current--electric current flowing in one direction continuously as distinguished from alternating current.

Direct support (DS) maintenance--category of maintenance authorized for and performed by designated maintenance activities in direct support of using organizations. This maintenance is limited to the repair of end items or unserviceable assemblies on a return to user basis.

Draft gear--unit that forms the connection between the coupler rigging and center sill of car underframe that disperses coupling shocks and pulling stresses.

Drawbar pull--actual pulling power of a locomotive less the effort necessary to move the locomotive.

Driving axle--axle on which two coupled driving wheels are mounted.

Equipment log--historical records pertaining to the receipt, operation, maintenance, modification, transfer, and disposal of an item of Army equipment.

Field--region where magnetic forces act; also known as magnetic field.

General support (GS) maintenance--category of maintenance authorized for and performed by designated TOE and TD organizations in support of the Army supply system; repair or overhaul of material to required maintenance standards in a ready-to-use condition based upon applicable supported Army area supply requirements.

Generator--machine that transforms mechanical energy into electrical energy.

Governor, engine--device for holding engine speed approximately constant regardless of the load or keeping it from exceeding a predetermined speed within the limits of the engine. This is accomplished by the governor altering the amount of fuel introduced into the cylinder.

Hotbox--overheated journal caused by excessive friction between bearing and journal, lack of lubricant, or foreign matter.

Inspection--instrument by which commanders at all levels can determine the serviceability of equipment and the efficiency of maintenance.

Journal--end of an axle, or that part of an axle on which the journal bearing rests.

Journal bearing--block of metal, usually brass or bronze, in contact with the journal, on which the load rests.

Journal box--metal housing enclosing the journal, bearing, and wedge, which holds oil and packing for lubricating the journal.

Journal box wedge--block of metal or liner used between the top of a journal box and its bearing to hold the bearing in place.

Julian date--method for giving a date showing the year and day of that year; for example, 16 June 1969 is written 9167; 9 is the last digit of the year 1969, 167 is the number of the day counting from the beginning of the calendar year.

Lubrication--use of oil, grease, or other substance between moving parts of machinery for reducing friction, resistance, and heating caused by the motion of the parts in contact.

Lubricator--any device, such as an oil or grease cup, for holding a lubricant and supplying it to wearing surfaces.

Lubricator pad--commercial spring-type pad that supplies lubricant to the journal box bearing. Used instead of waste packing, which see, on most U.S. commercial railroads.

Main reservoir (airbrake)--cylindrical tank in which compressed air is stored for use in the airbrake system.

Materiel readiness--condition of materiel to perform its primary mission.

Piston--metal disk with packing which works back and forth in a cylinder and transmits the force exerted upon its top or crown to a connecting rod and crank.

Piston travel (airbrake)--amount of movement of a piston when forced outward as the brakes are applied.

Preventive maintenance--care and servicing of equipment to maintain it in satisfactory operating condition by providing inspection, detection, and correction of incipient failures either before they occur or before they develop into major defects.

Rotor--rotating field of an alternator or a. c. motor.

Side bearings--bearings or supports attached to body or truck bolsters on each side of the center plates to provide stability and prevent excessive rolling or rocking of the car or locomotive.

Side sill--outside longitudinal member of a car underframe.

Slip ring--brush contact ring of an alternator.

Steam generator--small boiler used to convert water to low-pressure steam for heating a train.

Stringer--floor nailing strip or a steel member which acts as a support for a nailing strip.

Traction motor--electric motor that drives an individual axle of a diesel-electric locomotive

Tractive effort--horizontal force at the rails that the locomotive driving wheels can exert provided they do not slip.

Tread--(See Wheel tread.)

Truck--assembly that supports a car or locomotive at either end and provides for attachment of axles and wheels.

Truck bolster--cross member in the center of a truck on which a car body or locomotive rests. The truck bolster is connected to the body bolster of a car or locomotive by the center plates and a center pin or kingbolt which passes through both plates.

Truck side bearing--lower one of two side bearings; it is attached to the top of the truck bolster. (See Side bearings.)

Underframe--framework that receives buffing and pulling stresses and carries the weight of the floor and body of a rail car; includes all the framing below the floor, the center and side sills, bolsters, crossbearers, and crossties.

Waste packing--threads of wool or cotton saturated with lubricating oil or grease and placed in a journal box to contact the lower half of the journal and lubricate the journal. (See Lubricator pad.)

Wheel flange--projecting rim of the periphery (outer edge) of a wheel for keeping it on the rail.

Wheel tread--exterior cylindrical surface of a wheel next to the flange that comes in contact with the rail.

## Appendix I

## REFERENCES

### Army Regulations

| | |
|---|---|
| AR 310-25 | Dictionary of United States Army Terms |
| AR 320-50 | Authorized Abbreviations and Brevity Codes |
| AR 750-2200-1 | Maintenance of Rail Equipment |

### Technical Bulletins

| | |
|---|---|
| TB 55-2200-207-15/1 | Inspection and Maintenance Checklist for Diesel-Electric Locomotives |

### Technical Manuals

| | |
|---|---|
| TM 38-750 | The Army Maintenance Management System (TAMMS) |
| TM 55-202 | Operation and Maintenance of Diesel-Electric Locomotives |
| TM 55-203 | Maintenance of Railway Cars |

# INDEX


| | Paragraph | Page |
|---|---|---|
| Air compressor | 2.5 | 16 |
| oil checkpoints of | 2.10d | 21 |
| Air pressure checkpoints | 2.13 | 23 |
| Air Brake Defect Tag, DA Form 55-161 | 3.19 | 58 |
| Airbrake Inspection Report for Locomotives and Locomotive Cranes | 2.23 | 31 |
| Alternator | 2.14 | 23 |
| Appliances, safety, rolling stock | 3.13 | 55 |
| Army railway equipment, typical | | |
| caboose | 1.2c | 6 |
| locomotives | 1.2a | 3 |
| rolling stock | 1.2b | 4 |
| Arrangement of locomotive wheels | 1.2a | 3 |
| Automatic coupler | 3.5a | 44 |
| Auxiliary generator | 2.4b | 15 |
| Bad Order Card, DA Form 55-164 | 3.21 | 60 |
| Bolster | | |
| body | 3.3b | 40 |
| truck | 3.4a | 41 |
| Brake hangers | 3.10b | 48 |
| Brake piston rod travel | 3.10c | 49 |
| Brake rigging | 3.4d | 42 |
| Brakeshoe | 3.10a | 48 |
| Broken rim | 3.12 | 51 |
| Caboose | 1.2c | 6 |
| Car, multilevel rack | 1.2b | 4 |
| Car, piggyback | 1.2b | 4 |
| Car inspection | 3.16 | 56 |
| Car Inspector's Train Report, DA Form 55-163 | 3.20 | 60 |
| Center sill | 3.3a | 39 |
| Commutator | 2.14 | 23 |
| Components | | |
| diesel-electric locomotive | 2.1-2.7 | 11-17 |
| journal box assembly | 3.4e | 42 |
| railway car | 3.2-3.6 | 38-45 |
| truck assembly | 3.4 | 40 |
| Coupler | 3.5 | 44 |
| automatic | 3.5a | 44 |
| hook-and-link | 3.5b | 45 |

| | Paragraph | Page |
|---|---|---|
| Cracked plate | 3.12e | 53 |
| Cutoff valve, fuel | 2.12b | 22 |
| Daily Inspection Worksheet for Diesel-Electric Locomotives, DD Form 862 | 2.24 | 32 |
| Defects, wheel | 3.12 | 51 |
| DA Forms | | |
| 55-161 | 3.18 | 58 |
| 55-162 | 3.19 | 58 |
| 55-163 | 3.20 | 60 |
| 55-164 | 3.21 | 60 |
| 2407 | 2.20 | 28 |
| 2408-1 | 2.21 | 28 |
| 2408-5 | 2.22 | 31 |
| 4171-R | 2.23 | 31 |
| DD Forms | | |
| 315 | 3.17 | 58 |
| 862 | 2.24 | 32 |
| 1336 | 2.25 | 35 |
| DODX equipment | 1.3 | 8 |
| Diesel engine | 2.3 | 13 |
| advantages of | 2.3a | 13 |
| fuel checkpoints of | 2.12 | 22 |
| function of | 2.3b | 14 |
| oil checkpoints of | 2.10 | 19 |
| water checkpoints of | 2.11 | 21 |
| Draft gear | 3.6 | 45 |
| Engine cooling system | | |
| temperature of water in | 2.11b | 21 |
| water level in | 2.11a | 21 |
| Engine overspeed trip mechanism | 2.15 | 23 |
| Equipment Daily or Monthly Log, DA Form 2408-1 | 2.21 | 28 |
| Equipment Modification Record, DA Form 2408-5 | 2.22 | 31 |
| Field Inspection Data, USA, USAX, USNX, DODX, Rail Cars, DD Form 1335 | 3.17 | 58 |
| Fuel | | |
| checkpoints | 2.12 | 22 |
| flow | 2.12a | 22 |
| Generator | | |
| auxiliary | 2.4b | 15 |
| main | 2.4a | 14 |
| steam | 2.4c | 15 |

| | Paragraph | Page |
|---|---|---|
| Ground relay | 2.16 | 25 |
| Hook-and-link coupler | 3.5b | 45 |
| Inspecting railway cars | 3.16 | 56 |
| annually | 3.16d | 57 |
| at departure yards | 3.16c | 57 |
| at loading points | 3.16a | 57 |
| at receiving yards | 3.16b | 57 |
| Inspection and maintenance forms | | |
| locomotive | 2.19-2.26 | 27-37 |
| rolling stock | 3.15-3.21 | 56-60 |
| Inspection and Repair Report of Locomotives and Locomotive Cranes | 2.25 | 35 |
| Inspector's Record, DA Form 55-162 | 3.19 | 58 |
| Journal box | 3.4e | 42 |
| inspection and maintenance of | 3.11 | 49 |
| Locomotive, diesel-electric | 1.2a | 3 |
| components of | 2.1-2.7 | 11-17 |
| preventive maintenance of | 2.9 | 18 |
| Main generator | 2.4a | 14 |
| Maintenance Request, DA Form 2407 | 2.20 | 28 |
| Mechanism, engine overspeed trip | 2.15 | 23 |
| Multilevel rack car | 1.2b | 4 |
| Multiple-unit end receptacles | 2.17 | 26 |
| Oil checkpoints | | |
| air compressor | 2.10d | 21 |
| diesel engine | 2.10a, b | 19, 20 |
| engine governor | 2.10c | 20 |
| Out of round wheel defect | 3.12g | 54 |
| Piggyback car | 1.2b | 4 |
| Plate, cracked | 3.12e | 53 |
| Pockets, draft gear | 3.3c | 40 |
| Power operation | 2.14 | 23 |
| Preventive maintenance on | | |
| diesel-electric locomotive | 2.9 | 18 |
| rolling stock | 3.8 | 47 |
| Railway equipment, typical Army | 1.2 | 3 |
| Receptacles, multiple-unit end | 2.17 | 26 |
| Regulations for inspecting and maintaining railway equipment | 1.3 | 8 |
| Rolling stock | 1.2b | 4 |
| common components of | 3.2-3.7 | 38-46 |
| preventive maintenance of | 3.8 | 47 |
| Safety appliances of rolling stock | 3.13 | 55 |
| Seams, defective wheel | 3.12b | 52 |

| | Paragraph | Page |
|---|---|---|
| Side frame | 3.4b | 42 |
| Slid flat wheel defect | 3.12c | 52 |
| Slip rings | 2.14 | 23 |
| Steam generator | 2.4c | 15 |
| Tank | | |
| fuel | 2.6 | 17 |
| water | 2.6 | 17 |
| Thin flange wheel defect | 3.12a | 51 |
| Traction motor | 2.4a | 14 |
| Truck assembly | 3.4 | 40 |
| preventive maintenance checks of | 3.9-3.12 | 48-51 |
| Truck bolster | 3.4a | 41 |
| Trucks, locomotive | 2.7 | 17 |
| Underframe | 3.3 | 39 |
| body bolsters of | 3.3b | 40 |
| center sill of | 3.3a | 39 |
| draft gear pockets of | 3.3c | 40 |
| other members of | 3.3d | 40 |
| USA equipment | 1.3 | 8 |
| USAX equipment | 1.3 | 8 |
| Water checkpoints of diesel engine | 2.11 | 21 |
| Wheel | | |
| and axle assembly | 3.4c | 42 |
| arrangement | 1.2a | 3 |
| defects | 3.12 | 51 |
| Whyte Classification System | 1.2a | 3 |
| Worn hollow tread defect | 3.12f | 54 |