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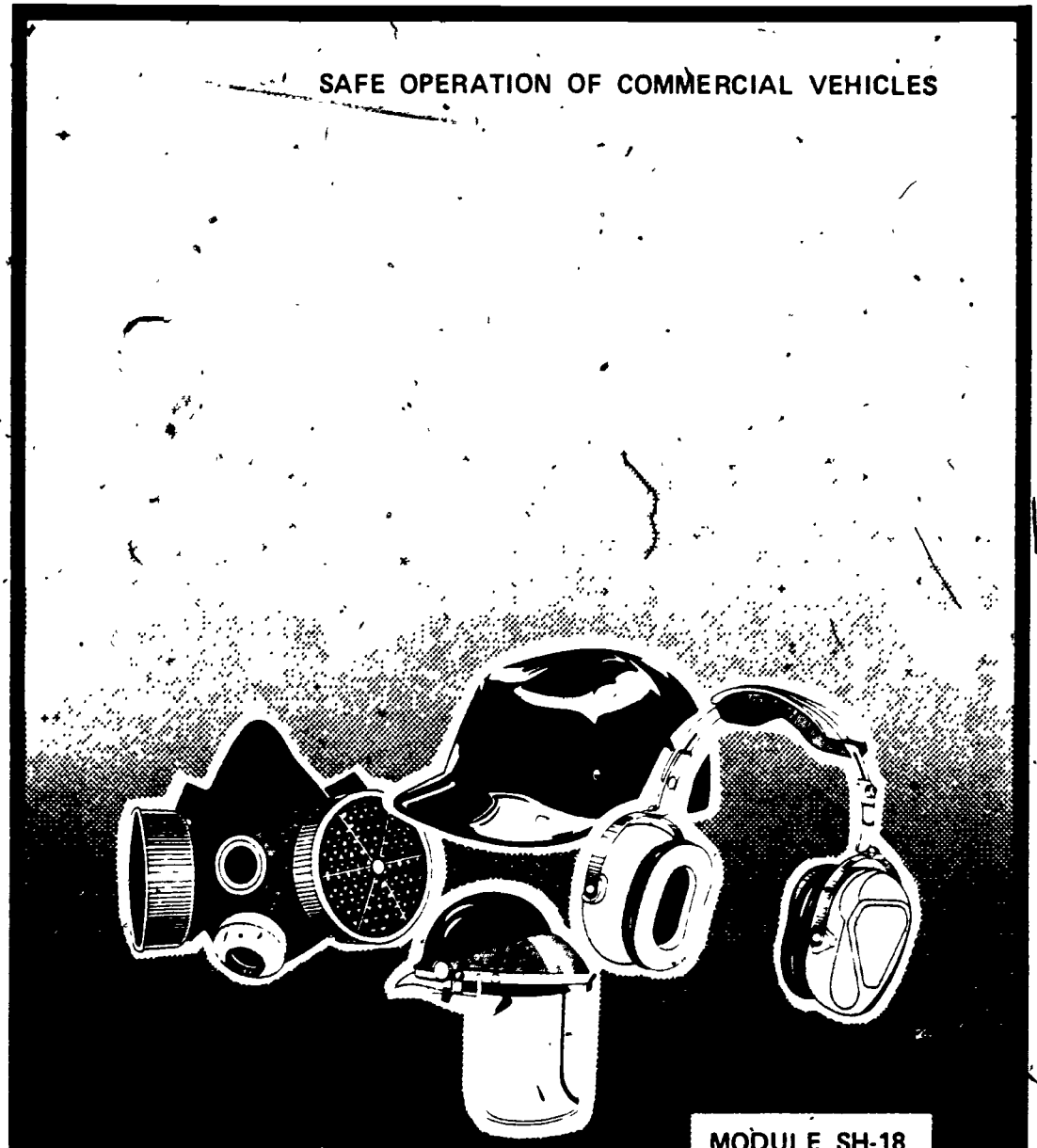
ABSTRACT

This student module on safe operation of commercial vehicles is one of 50 modules concerned with job safety and health. This module discusses causes of vehicle accidents, economic reasons for accident control, and considerations for preventive maintenance. Following the introduction, 11 objectives (each keyed to a page in the text) the student is expected to accomplish are listed (e.g., Explain the role of the safety supervisor). Then each objective is taught in detail, sometimes accompanied by illustrations. Learning activities are included. A list of references and answers to learning activities complete the module. (CT)

SAFETY AND HEALTH

SAFE OPERATION OF COMMERCIAL VEHICLES



MODULE SH-18

ORD

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INTRODUCTION

Commercial vehicle operation is one of the most skilled occupations in the United States today. The motoring public has little awareness of the skills and abilities required of the commercial vehicle driver (operator). The person who fulfills the desire to become a safe operator becomes a member of an elite group, the individual members of which possess the ability to exercise good judgment and exceptional self-control in almost any traffic situation.

A commercial vehicle is any vehicle that is operated in conjunction with a commercial enterprise. It may be a lightweight delivery van with a gross vehicle weight of less than 10,000 pounds, or it may be a special rig that has the capacity to carry loads of over 100,000 pounds. Such vehicles may have only two axles and four tires, or they may be multiaxled and have any number of tires (from 10 to 48). As the size and weight of the vehicle change, so must the operator's driving techniques.

This module will help to acquaint the prospective operator with causes of vehicle accidents, economic reasons for accident control, considerations for preventive maintenance, precautions for trucking of hazardous materials, and techniques for safe driving.

OBJECTIVES

Upon completion of this module, the student should be able to:

1. List five economic reasons for prevention of vehicular accidents. (Page 3)
2. Describe government and company driver training rules. (Page 7)
3. List four guidelines or procedures that should be followed by a driver who has been in an accident. (Page 9)
4. List the five points of the Harold L. Smith System of Space-Cushion Driving. (Page 10)
5. Explain the role of the safety supervisor. (Page 14)
6. State ten recommended safety devices for trucks. (Page 15)

7. Describe five safe loading practices. (Page 20)
8. Briefly describe the objectives of a preventive maintenance program. (Page 26)
9. Explain the safety check that a driver should make on equipment before each dispatch. (Page 27)
10. Discuss the general precautions taken when trucking hazardous materials (including causes of accidents, protective clothing, firefighting equipment, and warning signs). (Page 30)
11. List and describe the unique characteristics of liquid, compressed gas, and dry-bulk carriers. (Page 32)

SUBJECT MATTER

OBJECTIVE 1: List five economic reasons for prevention of vehicular accidents.

There are two causes of commercial vehicle accidents: driver error and mechanical difficulty. Driver error is the major cause of accidents. Inattention, fatigue, poor judgment, and physical condition are a few of the factors that contribute to human error in driving. Instances do occur in which two people happen to be at the "wrong place at the wrong time" for a true accident. However, the driver is ultimately responsible in at least seventy-five percent of accidents.

Perhaps the most common cause of these "driver error" accidents is driving too fast for existing conditions. Other reasons for collisions include these poor driving practices:

- Driving over the center line.
- Following too closely.
- Passing improperly.
- Turning improperly.
- Failing to yield the right of way.

Sometimes mechanical failures cause accidents (about 50% of the time). No driver can be totally aware of all mechanical defects; however, the driver must realize that a truck is simply a piece of machinery and it can fail. Therefore, the driver should not become complacent but should be constantly alert to mechanical failure and be able to react - not panic - if something should fail.

Some of the serious mechanical failures that can occur are listed below:

- Tires can blow out; lug nuts can come loose.
- Brake failure can occur as a result of a blown compressor or air line.
- Power steering, if the truck has it, can go out.
- Lights can go out; the driver should know where the circuit breakers are located.

Insurance companies go to great lengths to accumulate facts and figures regarding vehicular accidents. Using these statistics, the insurance companies can calculate the "odds" in their favor; accordingly, they can set the rate of insurance premiums that a trucking company must pay. They also determine the minimum age limit for company drivers and what kind of driving record a driver must have before he can be hired. For example, in order for a person to drive for "Cross-Turn" Ready-Mix Company, that person must be at least twenty-one years of age, with no more than one moving violation within the last three years, no accidents, and no convictions for driving under the influence of alcohol. In order for a person to drive for "Coast-to-Coast" Transportation, an insurance company may demand that a driver be at least 25 years of age, have at least three years of interstate all-weather driving experience, and have no moving violations in the last three years and only one moving violation in the last five years.

In order to keep insurance premiums at the lowest possible rate, trucking companies must comply with what their insurance companies ask. If they do not, then the insurance companies penalize the trucking companies by:

- Increasing the rates.
- Increasing the deductible. The deductible is the amount of repair cost that the company pays. (For example, the cost of fixing a wrecked vehicle is $6,000. The trucking company pays the first $1,500; the insurance company pays the rest.)
- Insisting that a trucking company terminate a present driver because of his personal (in car) driving record.

Whether one drives a car or a large commercial vehicle, an insurance company investigates a person's driving habits and determines if the person is a bad risk. Even a person who has never had a moving violation or an accident in a commercial vehicle shows a pattern of driving habits. The insurance company recognizes this, determines which drivers are a potential risk, and asks the firm to terminate the higher risk driver or pay a higher insurance premium.

Some of the factors that determine the insurance premium that a company is required to pay are listed below:

- Type of truck (brand name).
- Cost of a new unit.

- Present age of vehicle.
- Type of loads hauled.
- Population density in which truck travels.
- Radius traveled from home base.
- Population density where truck is based.
- Accident percentage over a given period of time.
- Ages of drivers.
- Driving records of drivers.

There may be other items by which an insurance company determines the amount of a premium to charge a given company; those listed above are a few of the major ones. It should be clear that driver candidates must maintain good driving habits and a clean driving record.

Most trucking companies have safety supervisors, or "road" bosses who take care of driver safety and investigate accidents. In addition, they work closely with insurance investigators from their insurance company. The time spent on investigating an accident varies according to the complexity of the accident situation, and the time thus spent increases company costs and insurance premiums. The ultimate goal of the company and the driver is to maintain an accident-free record. It takes less time to be safe than to take a chance and have an accident. By taking chances a person saves minutes, but when an accident occurs, hours, days, weeks, and even months are lost. This time and the resultant economic loss can never be made up.

One must consider the actual cost of a truck to really understand the reasoning behind the company's demand that drivers operate vehicles in a safe way. A new dump truck "starts" at $45,000 and goes up in price from there - depending on the make of the vehicle and the accessories that the owner chooses to put on it. A new engine (400 hp and up) might cost more than $16,000. It should be no surprise that the employer tries to get as many miles as possible from the engine before having it overhauled. With tires costing $175 each (bias cord) to $250 each (radials), tire repairs alone can break a small company. Shop rates for work on vehicles are set at up to $25 per hour. With costs as staggering as these, it becomes imperative that the commercial vehicle operator take the utmost care of the equipment with which he is entrusted.

There is one additional point to consider. When a vehicle is "laid up" for repairs, loss of revenue occurs. As expenditures are made to fix the vehicle, money usually earned from its operation is not available.

Besides damage to the vehicle in an accident, physical damage to other property has to be considered. Usually this is covered by insurance. In an effort to keep insurance premiums down, sometimes the company will pay the damages. Often employees will pay the damages in order to protect their job. Whatever the case may be, someone has to pay. These are the types of property that may have to be replaced because of driver negligence:

- Other vehicles.
- Building repair.
- Fences.
- Broken sidewalks (ready-mix operation).
- Sewer lines (building roads and streets).
- Shrubs, trees, and so forth.

One must remember that most commercial operations are service-oriented. When a driver fails to serve a client properly, business may be lost. This causes an economic loss to the company. Should the driver become injured or be the cause of another employee getting injured, another type of loss is incurred. Even though the injured employee can be replaced, the new employee may not be familiar with the people with whom he or she is working. The result is loss of efficiency and productivity. Many trucking companies have determined the cost of training a new driver or a replacement driver to be about $5,000 per employee. In other words, it costs that much before the driver starts making money for the company.

ACTIVITY 1:*

1. Name the two causes of commercial vehicle accidents.

   a. _____

   b. _____

*Answers to Activities begin on page 34.

2. List five ways in which a company may lose money when a vehicular accident occurs.

   a. _____
   b. _____
   c. _____
   d. _____
   e. _____

3. Name three driver-related errors that can cause accidents.

   a. _____
   b. _____
   c. _____

4. Name three mechanical difficulties that can cause accidents.

   a. _____
   b. _____
   c. _____

OBJECTIVE 2: Describe government and company driver training rules.

There are two ways that an individual may learn to drive a commercial vehicle:

- Get into the vehicle and learn by trying.
- Attend a qualified truck driving school.

The first way is the quicker of the two, and that is its only advantage. The new driver will learn all the "old-timer's tales," and many of the "shortcuts" used by experienced drivers. This course of action is like someone's trying to run the high hurdles before learning to walk.

The qualified truck driving school will take potential drivers step-by-step through the various skills that a driver should have. The school will also teach the prospective driver about regulations that affect commercial vehicle operation.

The trucking industry is one of the most highly regulated industries in the United States, subject to federal regulations, state regulations, and

city regulations. There are no standard rules that fit all governmental subdivisions. All vehicles weighing over 10,000 pounds and dealing in an interstate commodity, whether they operate locally, intrastate (within the state) or interstate (between the states), come under the Bureau of Motor Carrier Safety (BMCS) regulations. A handbook is published by the BMCS and everydriver should be familiar with its contents. Every state and local law is superceded by the BMCS laws if the BMCS law is more strict. All large trucking companies are required to give new drivers a 66-question exam developed by the U.S. Department of Transportation (DOT), the final authority for commercial vehicles. Under the direction of the DOT is the FHWA (Federal Highway Administration) and under the FHWA is the Bureau of Motor Carrier Safety (BMCS). The BMCS is the governing agency for safety of commercial vehicles on our nation's highways. Along with the 66-question exam (answers to which can be found in the latest edition of the BMCS regulations handbook), a driving (road) test will be given to determine the skills of the driver. All of this is required by federal law. For all vehicles over 10,000 pounds GVW (gross vehicle weight) the company is required to get a copy of an applicant's driving and employment record for the past three years. That record is reviewed on a yearly basis as long as the employee remains with the company.

States and cities may require more stringent laws appropriate to their particular areas. It is the responsibility of the driver of any commercial vehicle to become familiar with such laws.

The driver must adhere not only to federal, state and local laws, but also to company rules. Speeding through company yards, exceeding company speed limits, and tampering with company vehicles are just a few of the violations that the beginning driver must avoid.

ACTIVITY 2:

(Circle either True or False.)

1. Truckers do not have to comply with local regulations, but only federal and state.

   True False

2. All companies are required to give new drivers the 66-question DOT exam.

   True False

3. Cities and states may require more stringent laws than the federal government does.

True False

OBJECTIVE 3: List four guidelines or procedures that should be followed by a driver who has been in an accident.

Regardless of all the rules and regulations and the efforts of drivers to be safe, accidents do occur. There are several guidelines or procedures that should be followed by a driver who has been involved in an accident.

1. Render first aid if it is necessary and if you are qualified to do so.
2. Do not say anything that is not required. Do not swear, shout or vocalize any emotional outburst. Anything might be heard by a bystander and be misconstrued. Any bystander is a potential witness.
3. Get witnesses! Do not walk up to a person and say "Will you be my witness?" Simply ask the person's name. Get the license numbers of vehicles that have people in them. Get the addresses of buildings that have people looking out of the windows at the accident scene. Describe the location of the windows and the number of people looking out those windows. (Law enforcement officers are excellent witnesses.)
4. Exchange driver information. A form for this information is usually provided by the local law enforcement officer investigating the accident.

For any other information, contact the person who is the company safety officer or "road boss." Let that person do the talking. Usually the driver involved in the accident is not required to offer anything more than the information required on an information exchange sheet.

Many states have an accident report form that all persons involved in the accident must fill out, and this must be completed by the driver.

If a driver is involved in an accident with a parked car, then the driver is obligated to make every effort to locate the driver of the parked car. If unsuccessful in that attempt, the driver is obligated by law to leave name, address, vehicle number, driver's license number, phone, and insurance agent's name attached to the damaged vehicle.

ACTIVITY 3:

List four guidelines to be followed by a driver who has been involved in an accident.

1. _____
2. _____
3. _____
4. _____

OBJECTIVE 4: List the five points of the Harold L. Smith System of Space-Cushion Driving.

Defensive driving can be defined as driving in such a manner as to prevent accident situations.

There are many areas to be considered in defensive driving. The "space-cushion" technique developed by Harold L. Smith is based on five rules that enable the driver using them to drive for a period of many years without leaving so much as a skid mark on the pavement. These are the five rules:

1. Aim high in steering.
2. Get the big picture.
3. Keep your eyes moving.
4. Leave yourself an out.
5. Be sure they can see you.

Aim High in Steering

Aiming high in steering means that the driver should observe the traffic pattern beyond the vehicle. He or she must look ahead one to two blocks in the city or one-fourth of a mile or more on the freeway. In this way, any potential dangers that require braking can be perceived in time for the driver to bring the vehicle to an easy stop rather than a hard panic stop. This precaution is especially important for operators of large, heavy, commerical vehicles. Although quick stopping of these vehicles is possible, the wear and tear on the brake drums, linings, axle ends (spindles), lugs, tires, suspension, drive train, and so forth, is enormous. To prolong the

life of the rig and keep maintenance costs low as well as to avoid accidents as a result of mechanical failure, the driver should make smooth stops whenever it is possible to do so.

Get the Big Picture

The "big picture" means the driver's surroundings as observed within a kind of imaginary picture frame. This frame should extend from curb to curb and from the front to the back of the vehicle. By moving the eyes within this picture, the driver can define the size of the space cushion (the amount of space around the vehicle) needed for safe driving. As speed is increased the size of the space cushion must be increased for optimum safety.

Keep the Eyes Moving

A major cause of fatigue among today's driver is staring. Many drivers have a bad habit of not looking around as they drive. A trained driver should keep the eyes moving not only to stay alert, but also to visually record all the objects surrounding the vehicle and space cushion. Basically, this means being aware. Drivers should adhere to a circular pattern, moving the eyes every few (three to eight) seconds. For instance, the driver might begin the eye sweep pattern by looking at (1), the rear-view mirror. (See Figure 1.) In doing so, objects on the left side of the vehicle are also recognized. Then on to (2), the forward vision, which includes using the principles, "aim high in steering," and "get the big picture." The driver should look to (3), the dash, to

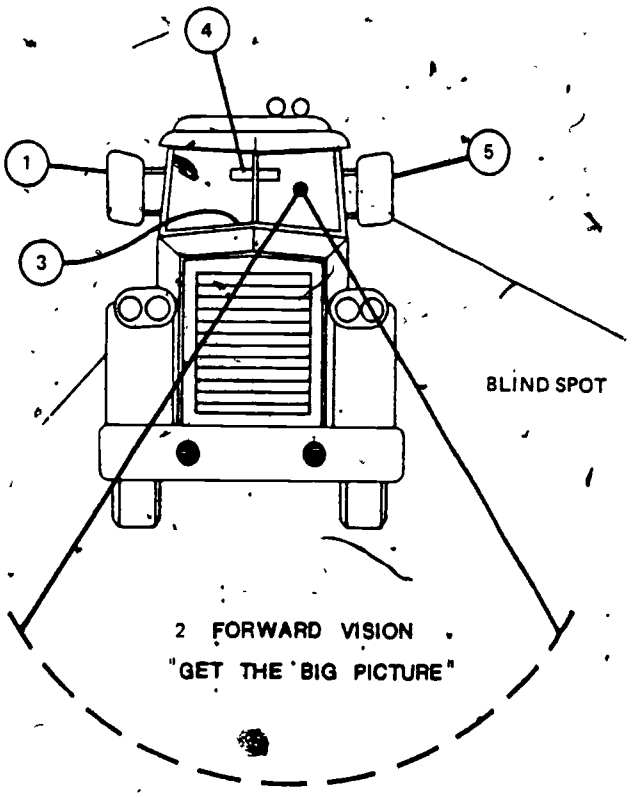

Figure 1. Keep the eyes moving.

check gages and speedometer, then to (4), the rear-view mirror, to see what is beind, and (5) a glace out from the right front to the right side, and then to the right rear, should complete the pattern. Drivers should also be aware of the blind spot (the section that cannot be seen).

It is important that the driver does not stare at anything. A momentary glance should be sufficient to implant any potential danger in the mind. Peripheral (side) vision will also contribute to the driver's "picture." Keeping the eyes moving does not mean that one has to be able to turn the head as an owl does. It simply means having a total awareness of what is around the vehicle.

Good eye habits require training oneself to look for things that look out of place or that might be a potential hazard. Most motorists see what they expect to see. The driver who has been correctly trained looks for particular things. A driver of a commercial vehicle has restricted vision because of the size of the rig (Figure 2). Therefore, extra caution has to be exerted. Spot mirrors as well as regular mirrors help a truck driver to get a getter idea of what is around the rig. The driver should be aware that shadows of a vehicle in the blind spot can identify a potential hazard from the rear.

Leave an Out

The three areas of the "Smith System" just discussed make a critical difference in whether or not the driver can escape from an accident situation, should such a situation arise.

By "aiming high" and "getting the big picture," a driver who has been keeping his or her eyes moving will know where the escape path is. There are actually only three things a driver may do to get out of a crash:

- Steer right.
- Steer left.
- Brake and hold (go straight).

Abruptly turning a large commercial vehicle can cause the vehicle to roll, so the driver must be sure that the "out" is a safe one.

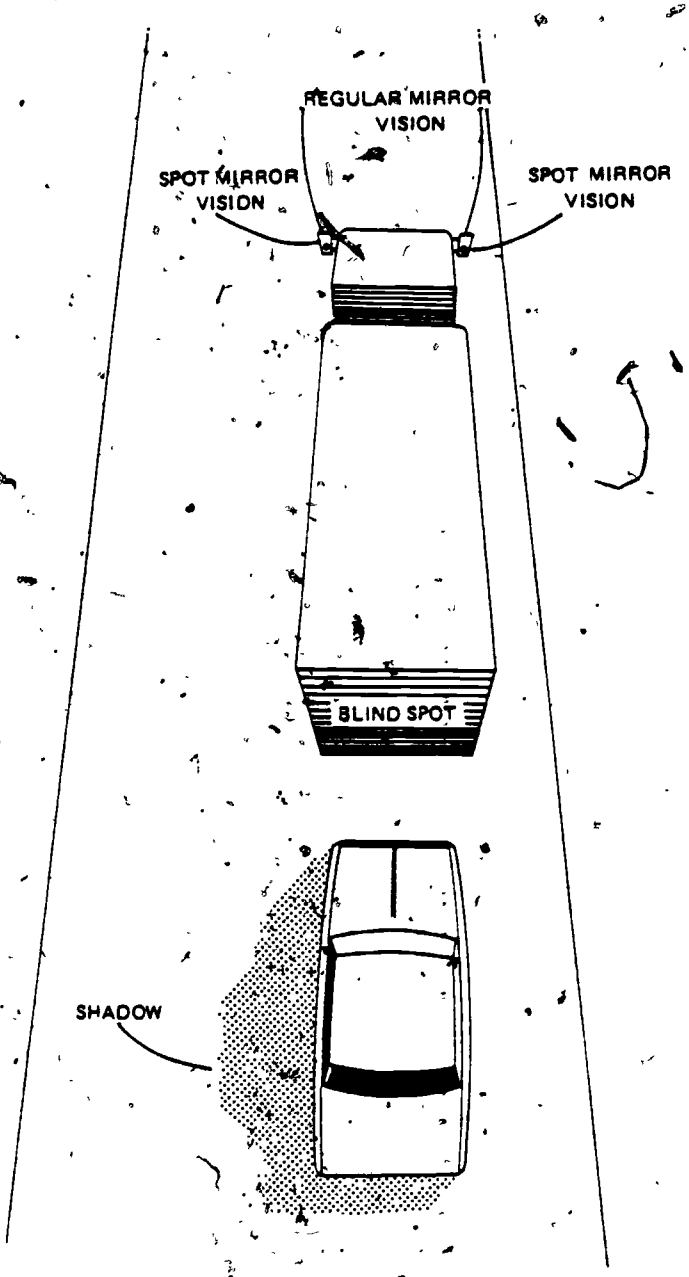

Figure 2. Spot mirrors and regular mirrors aid the driver.. A shadow may indicate the location of a vehicle in the blind spot.

Establish Eye Contact

To be sure that drivers at the curb, at intersections, in driveways, and so on, become aware that a rig or vehicle is approaching, the truck driver should establish what is called "eye contact." This is done by

looking into the eyes of the potential hazard driver. Ways to accomplish this might be:

- Turn lights on and off.
- Tap on the horn.
- Use turn signals.

Once eye contact is established, the driver can be reasonably certain that the yielding vehicle will wait. In case it does not, the driver of the rig should be prepared for evasive action.

ACTIVITY 4:

1. List the five basic rules of the Harold L. Smith System of Space-Cushion Driving.
   a. _____
   b. _____
   c. _____
   d. _____
   e. _____
2. List two driving practices that are especially dangerous in large, heavy, commercial vehicles.
   a. _____
   b. _____

OBJECTIVE 5: Explain the role of the safety supervisor.

Many companies have a "road boss" or safety supervisor. This person's role is to help the driver to maintain a safe driving attitude. Other responsibilities might include:

- Training of drivers.
- Accident prevention and investigation.
- Ensuring driver compliance with company and safe driving rules.
- Settlement of insurance claims.

The safety supervisor's job is a difficult and extremely responsible one.

The person holding this job usually has a background of experience with the company or in the special transportation field in which the company is engaged.

Periodically, the safety supervisor will ride with the driver and provide assistance or advice where it is necessary or appropriate. A conscientious driver will be grateful for constructive help, especially since a good relationship between the truck driver and the road boss can result in greater job security for the driver.

ACTIVITY 5:

List at least four responsibilities of the safety supervisor.

1. _____
2. _____
3. _____
4. _____

OBJECTIVE 6: State ten recommended safety devices for motorized trucks.

The Department of Transportation reported recently that since 1966 there has been a 67% increase in vehicle registration, a 42% increase in licensed drivers, and a 65% increase in vehicle driven miles. In 1979 alone, there were 51,083 traffic fatalities. Heavy and medium trucks accounted for 1,341 of these.

As the nation grows and highway traffic increases, the need for truck transportation also increases. The higher horsepower and weight allowances on commercial vehicles adds to the potential for accidents. In light of these facts, the need for careful drivers and well-equipped trucks should be apparent.

Certain safety equipment is considered standard and necessary for motorized trucks. All commercial vehicles are required by the Federal Bureau of Motor Carrier Safety to have certain safety items operational.

1. Directional signals with amber lenses are required at the front and signals with red lenses at the back of the vehicle.

2. Operational windshield wipers are required; two are highly recommended.

3. A windshield defroster should be provided. Electric outside mirror defrosters are available also.

4. Every commercial vehicle is required by law to have one all-purpose fire extinguisher of appropriate size on board.

5. Power steering is helpful but not necessary; it is good especially for local driving when a lot of turning is required. For highway driving, the standard cam and lever may be sufficient.

6. A low air pressure warning system (audible or visible type) is required. The warning device is activated at around 70-80 pounds, depending on the vehicle.

7. Rock guards must be placed over drive tires. These are good especially for sand and gravel haulers. Many of the interstate rigs do have small fenders set just ahead of the front drive axle. In addition to rock guards, all trucks are required to have "mud-flaps" behind their driver wheels. These flaps must be as wide as the tire and must cover varying portions of the height of the tire. (See Figure 3.) Specifications differ from state to state, from 50% of the height of the tire (Utah) to at least eight inches from the ground (Arizona).

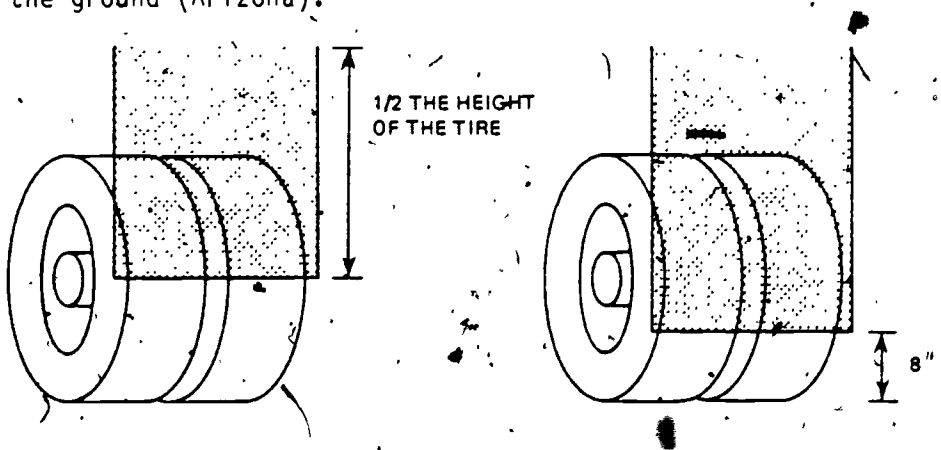

Figure 3. Mud flaps vary in length from state to state.

8. Federal law requires that all vehicles have at least two mirrors. Large commercial vehicles have these mirrors mounted externally - one on the driver's side and one on the passenger's side. As indicated in item three, electric defrosters for mirrors are optional.

9. Back-up lights are optional, but are a good safety item on any truck. On end dumps they are especially handy for backing to the unloading stop at night. On semi-truck trailers, these lights might be found mounted on the "headache" rack and are helpful for backing into a trailer or tying down a flatbed load.

10. An audible back-up signal must be provided for heavy-duty trucks where the rear view is obstructed; buzzers or bells are frequently used. These back-up devices are used primarily where there is close contact with other equipment and/or people, such as in black-topping operations or local construction.

11. There must be nonslip surfaces on fenders, floors and steps. The usual means of providing this is with an abrasive material coated with a stick-on substance that makes direct application easy. During seasons of high precipitation, having nonslip surfaces is an excellent precaution. Some trucks have metal grid steps, and these can be somewhat dangerous should the driver exit from the vehicle and drag a hand across one of the steps. This danger is quite real, but when it is used with driver caution, the grid step is an excellent nonslip device.

12. Safety belts must be provided and used.

13. High-quality tires are essential. Tire selection should be based on several things: type of haul (longline or local), area traveled (on or off-road), weather conditions, amount of weight carried (per tire), and commodity hauled (sand, gravel, liquid, scrap metal, and so on). For longline haulers, the favored choice today seems to be the tubeless radial tire. All new Peterbilts now come from the factory equipped with the Michelin X2A tire, unless otherwise specified. Still, the old style, tube-type, bias-cord tire is quite popular, and does have its place in today's truck transportation. Whatever kind of tire is selected, it is best to buy the top quality. Lower and medium grade tires will cost more money in the long run.

14. To ensure that large commercial vehicles can be identified easily at night, reflective lenses and/or markings must be placed at particular locations on the vehicles. Shown in Figure 4 are the common locations of reflectors and marker (clearance) lights. The light lenses on the rear of a truck have to be of reflective quality. Amber lights are always located in the front and middle (with the exception of the amber rear turn signals), and red lights always face the rear. (The only vehicles that are allowed to have red lenses facing the forward position are law enforcement and emergency vehicles.) Even on a flatbed trailer, lights and reflectors are mandatory. Also, to enable vehicles approaching from the rear to see their trucks more clearly, some truckers add reflective tape to the back of their trailers. The purpose of these measures is to make sure that other drivers see the truck. (Remember the Smith System's directive: make eye contact.)

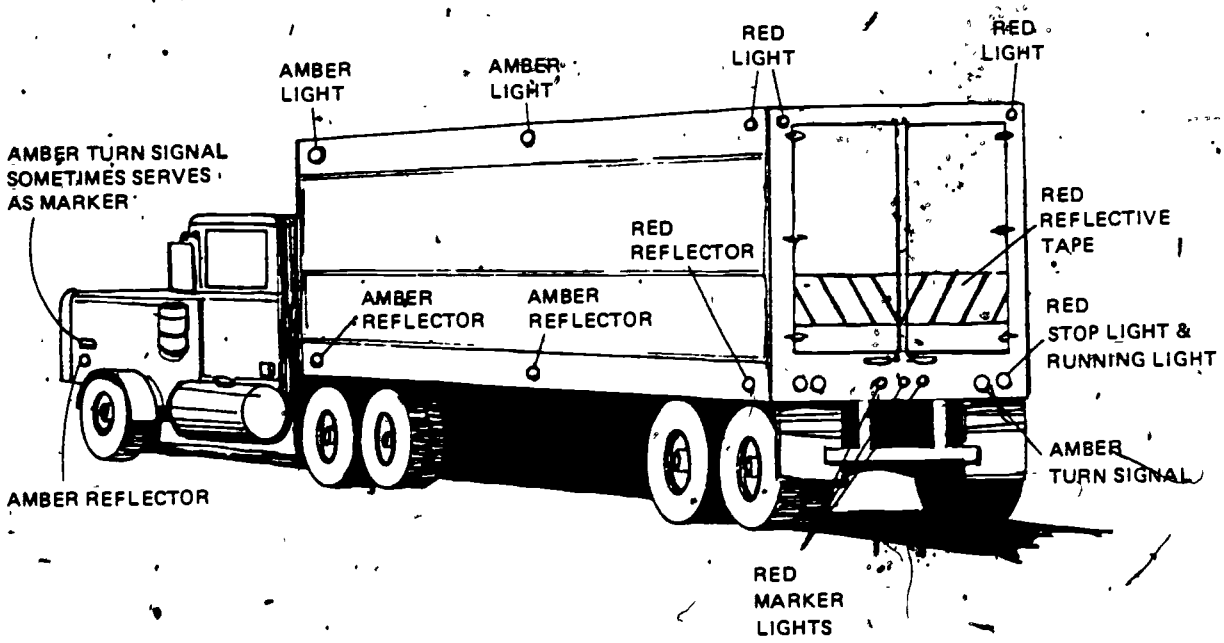

Figure 4. Common locations of reflectors and marker lights.

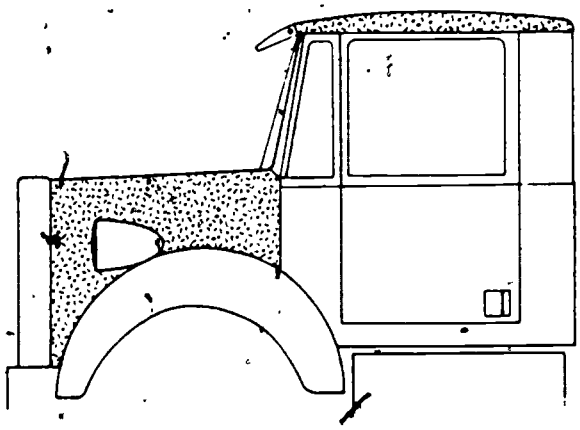

Figure 5. Cross-hatching shows formerly metal parts that are now fiberglass.

Trucks, unlike cars, have not been as susceptible to the growing demand for new, nonstandard safety devices as many safety experts would like them to be. An explanation of this is not readily available. The old trucks (pre-1965) were built like battleships, and almost any vehicle that they encountered came out "second best." Recently, with the struggle to lighten the weight of the truck tractor, safety seems to have beome a lower priority. In several of the truck tractors manufactured today, parts that used to be made of metal are mostly fiberglass. (Figure 5.) Good heavy gage steel is giving way to aluminum.

However, there are still several all steel-bodied tractors on the road today.

One of the safety devices tried in recent years was the controversial FMUSS-121 brake system. This computerized system was designed to give maximum braking ability without wheel lock-up.

- Maximum braking means that the brakes are applied to such a degree that the imprint of the tire tread is left on the road surface, but there are no skid marks.
- Wheel lock-up means that the tires actually slide, leaving skid marks on the surface of the pavement. When a tire skids, it loses traction. When traction is lost, the ability to stop is decreased.

The computerized braking system was not a new idea; it was used on heavy bombers during World War II. The problems with the system then were the same ones experienced in the late 1970s with the "121" system. The trouble was complete brake failure at low speeds (10 mph and under). Because of the difficulties encountered with the "121" system, a moratorium was placed on its manufacture. Brakes on the front (steering) axle are generally still required on truck tractors. A steering axle with brakes on it increases the truck's ability to stop. One fear of the experienced drivers was that if brakes were on the steering axle, the ability to steer during a slide (loss of traction) would be lost. This obstacle was overcome by employing the use of a "limiting valve" that decreased the amount of air going to the brakes on the steering axle. As a result, when operators are driving on a slick or potentially slick surface, the limiting valve is applied and the ability to steer is maintained.

The federal government is attempting to encourage private enterprise to develop an "anti-jack-knife" device that will prohibit a trailer from coming around more than fifteen degrees.

Truck sanders and DOT-approved tire chains, both for use in snowy weather, are two of the safety devices now used on big trucks.

Other than the items mentioned, there are very few "nonstandard" safety devices on big trucks. In general, no attempt to engineer safety has been as effective in reducing accidents as safe driving practices.

ACTIVITY 6:

1. At what pressure is the low air warning buzzer activated? _____
2. What are the maximum dimensions for mud flaps in most states? _____
3. What device is used to help keep outside mirrors clean in bad weather? _____
4. Name the two types of audible back-up signals. _____, _____
5. Name the two types of nonslip surface applications. _____, _____
6. Name the two types of truck tires used today. _____, _____

OBJECTIVE 7: Describe five safe loading practices.

Every state and many cities and counties have weight restrictions, and the federal government has weight restrictions on those freeways and highways that come under its jurisdiction. Most highways are not constructed to meet the weights and forces that commercial vehicles exert upon them. In order to keep deterioration to a minimum, federal, state, and local agencies regulate the weights allowed on certain thoroughfares.

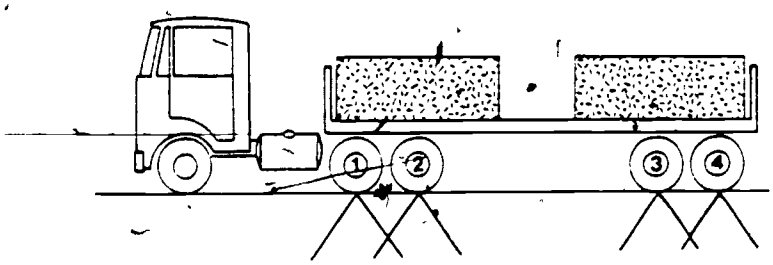

Figure 6. Weight is centered over the midpoints of the front and rear axles.

The weight of the load does not exert pressure perpendicularly; it "cones out" (Figure 6). For that reason, the driver of a "semi" must pay particular attention to load distribution. Notice that in Figure 6 the load is not centered on the trailer. Rather, it is centered over the midpoints of the front and rear axles. (This is assuming that the two parts of the load

equal the same weight.) It should also be understood that both axles on a set of tandems do not weigh out equally. If axles three and four weigh 34,000 pounds, axle three might weigh 17,500 lbs and axle four might weigh 16,500 lbs. The same applies to axles one and two - two would carry the greater amount of weight. Therefore, the inside axles exert more pressure per square inch on the surface of the road than do the exterior axles. Another important factor is that the force exerted on the road surface increases with speed. On these premises, and more complicated ones, weight compliance laws are set up. Truckers must obey these laws.

There are four areas concerning weight of which a trucker must be aware. These four areas are gross weight, axle weight, exterior bridge, and interior bridge. Concerning gross weight, these distinctions are made:

- Gross weight is the total amount the entire rig weighs with its load.
- Tare weight is the same as empty weight, (the weight of the rig by itself.
- Net weight is the weight of the load itself.

A truck has to be registered for the amount of weight that the operator wishes to gross. A truck is also restricted by a regulation that dictates how much weight the bridge can carry. There are two types of bridge restrictions that apply to trucks - the regular or exterior bridge; and the interior bridge, as shown in Figure 7 and explained below:

- Bridge - That distance from the center of the steering axle to the center of the rearmost axle.
- Interior Bridge - That distance from the center of the foremost drive axle to the center of the rearmost axle.

The shorter the interior bridge, the less weight the trucker is allowed to carry.

Each state has its own set of weight tolerances pertaining to rigs. Every driver is responsible for knowing the weight laws pertaining to the area(s) through which he or she will be traveling.

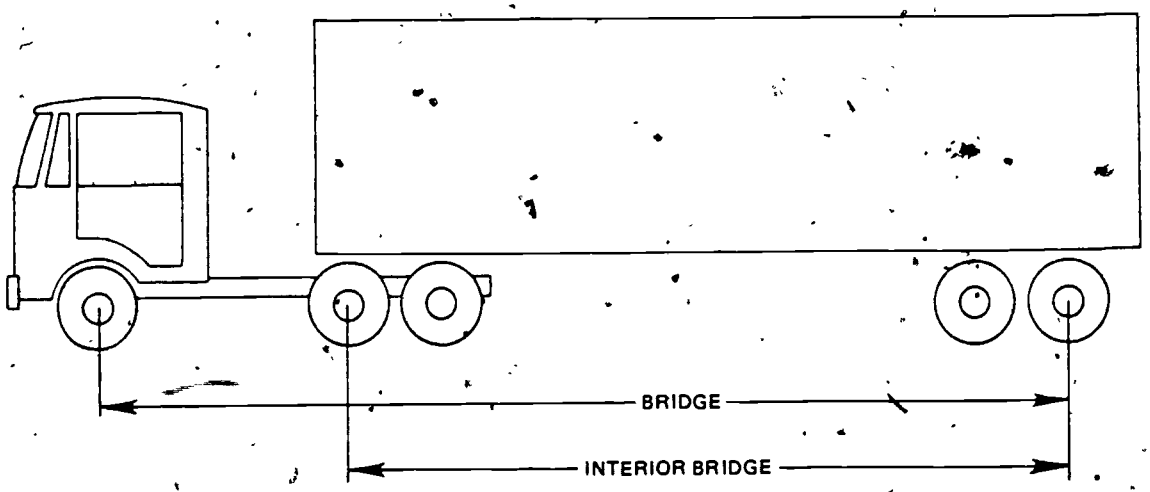

Figure 7. Bridge and interior bridge.

Axles are considered in groups (Figure 8) and a driver must always consider the amount of weight on these axles. Although a trucker may be complying with the law concerning gross weight, one or more sets of axles may still be overweight.

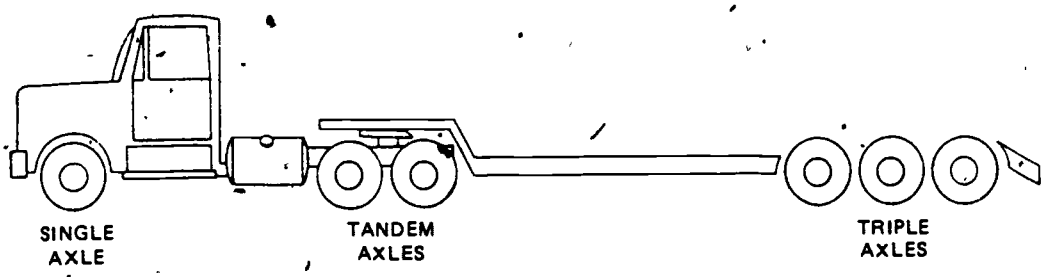

Figure 8. Axles are considered in groups.

In summary, the length and bridge of the truck dictates the amount of weight a trucker can legally gross. But as truckers comply with gross weight, they must also comply with axle weight restrictions. Responsibility for weight complicance rests upon the driver.

Loads that need to be tied down are usually flatbed-type loads. The trailer shown in Figure 8 is a kind of flatbed. It is referred to as a "single-step" lowboy and is used to haul heavy equipment. Other types of loads that require tying down are steel, lumber, containerized (boxed) freight, structural steel, pipe, and any type of load that can be put on a

flatbed trailer. Chains and binders are a common type of tie-down; cables and straps (that require winches to tighten them) are another kind. A "cheater bar" is sometimes used to gain more leverage. In some states, cables are not allowed as the sole means of tying down a load. The main points that should be remembered are (1) the load must be tied securely, and (2) unnecessary risks should not be taken while tying down the load. Cheater bars have been the cause of several accidents simply because the person using them did not exercise due caution.

After the initial tie-down of a load, the driver should stop a couple of times during the first fifty miles of travel and retighten the chains (cables, straps). Some drivers prefer to place the binders (boomers) on the driver side of the trailer to make it easier to watch them in the mirror. Many drivers like to put the binders on the right side so that when tightening is necessary, the drivers will be away from the traffic side and their exposure to traffic will be reduced.

Federal regulations stipulate that any load extending beyond the sides of a truck or trailer must be marked by a red flag (12" x 12") and have adequate marking lights on the sides and rear of the load during nighttime travel. For further regulations for the particular area in which a driver might be operating, it is wise to obtain a copy of the chauffeur's manual of that particular state and read their laws.

On straight trucks, a load that is carried on the truck may not extend more than six inches to the right side, and not beyond the fenderline on the driver's side. The load may not extend more than three feet beyond the front of the vehicle nor six feet to the rear. If the load goes beyond four feet to the rear, then it must be flagged properly and red-lighted for night travel.

In the early days of trucks, the braking systems were extremely poor. Eventually, heavier trucks were equipped with the newly invented air-brake system. With this system, these large vehicles gained much better stopping ability. (See Figure 9.)

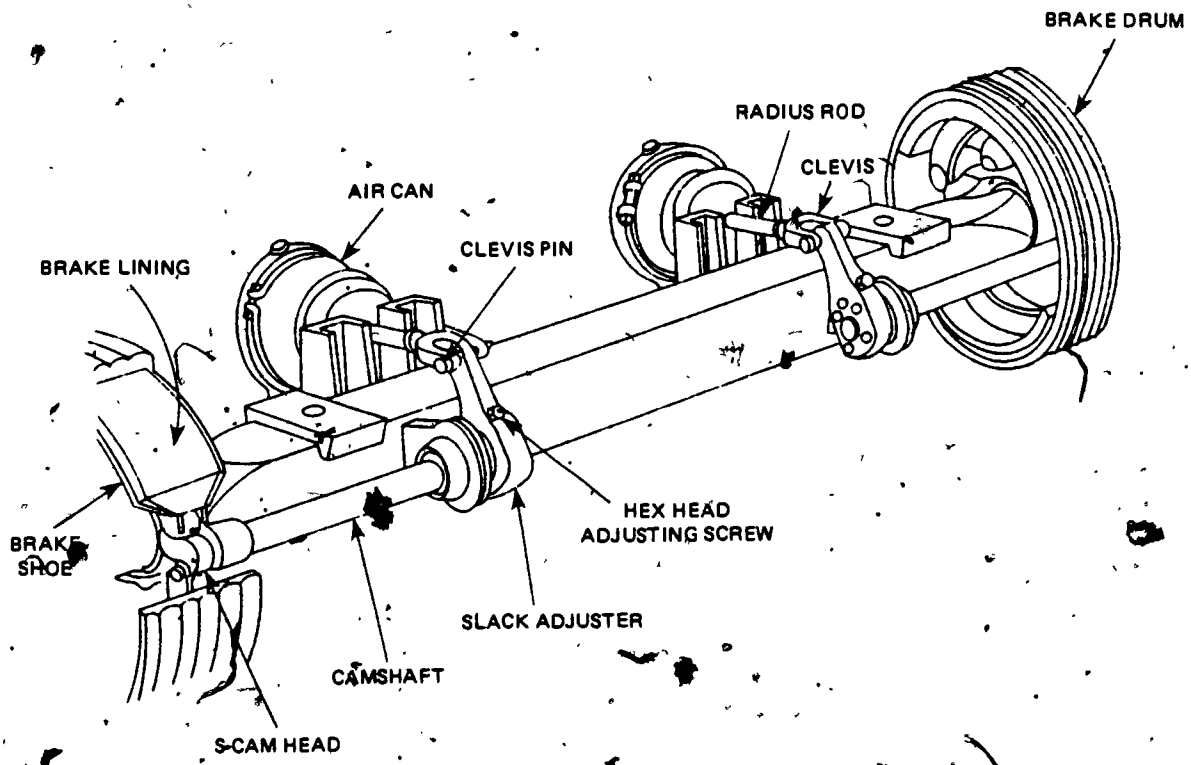

Figure 9. Air brake system.

Even the early air brake system had problems; the linings were thin and narrow and heated up quickly. As a consequence, truckers were always in fear that on a long grade their brakes would get hot and fade, and they would have to cope with a runaway truck. Now the linings are wider, thicker, and constructed of better material. Brake fade still occurs occasionally, but with engine brakes and retarders, runaways are becoming rare. Those runaways that do occur are usually the result of an inexperienced or over-confident driver driving beyond his or her capabilities.

The parking brake (or maxi-brake) is a device that is activated when the air is cut off from the cannister, and a heavy coil spring is allowed to spread and apply the brakes on any particular axle on which it is mounted. The maxi-brake (Figure 9) was invented because the old air-brake system would allow air to leak. After the truck was parked for a while, the air pressure would get low enough to allow the brakes to release. If the truck happened to be on any kind of a grade, it would roll away and crash into whatever obstruction it encountered.

For many years, maxi-brakes were used only on tractors. Recently they have been applied to trailers as well. With these protective devices on both tractor and trailer, it is virtually impossible for the air to bleed off and the vehicle to roll away.

In addition to setting the brake of a parked vehicle, it is also an excellent idea to block both the tractor and trailer. A simple 4" x 4" x 12" block (Figure 10) would be sufficient. This block can be carried on the frame of the tractor or trailer, or under the sleeper (if the truck has one) or at any convenient place on the rig. It takes only a couple of seconds to place the block under the wheels and this precaution can save a lot of trouble and misery on the driver's part. These blocks should also be used while hooking or unhooking the trailer.

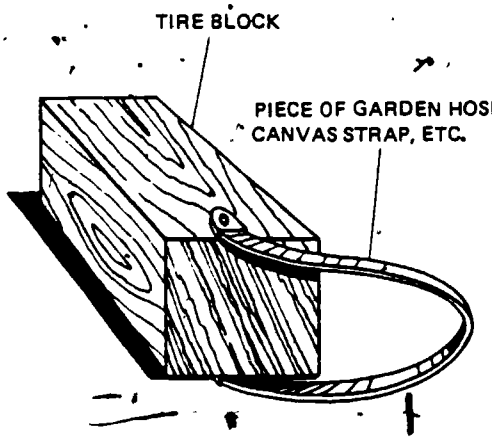

Figure 10. Brake block.

Many of the trucks on the road today are equipped with air ride seats. These are far more comfortable than the seats of earlier years. Before starting on a trip of any length, a driver should spend as much time as necessary to adjust the seat to obtain a comfortable position. This should always be done while the truck is sitting still, never while it is in motion. There should be no obstacles or close (uncomfortable) objects that might curtail the freedom of the driver's arm movements behind the wheel.

Drivers should avoid pinch-points; this means that hands, fingers, feet, and body should be kept away from any situation or place that can squash them. Dropping a unit-glass hood (whole hood and fenders in one piece) can pinch fingers or catch the driver's leg between the hood and the running board. Similarly, getting one's fingers pinched between a binder (boomer) and a chain can be very painful. Many workers have had their fingers severely pinched while remounting a tire onto the rim. This may not be a serious injury, but it is a painful one.

A person should never walk between a moving truck and a close stationary object, or between the back of the tractor and the front of the trailer

(while the vehicle is moving). Drivers have had their feet crushed, legs broken, and toes amputated by truck wheels rolling over them.

ACTIVITY 7:

(Fill in the blanks.)

1. The three levels of government that issue weight restrictions are _____, _____, and _____.
2. As weight presses down it _____ _____.
3. The distance from the center of the foremost drive axle to the center of the rearmost axle is the _____ _____.
4. The total amount the entire rig weighs with its load is the _____ _____.
5. The force exerted on the road surface increases with _____.
6. Besides setting the parking brake, the driver may wish to _____ the tractor or trailer to ensure stability.

OBJECTIVE 8: Briefly describe the objectives of a preventive maintenance program.

The main objective of a preventive maintenance program is to prevent costly accidents and breakdowns that can result from mechanical difficulties. The true cost of an accident is sometimes incalculable, since it may involve loss of life or health, but any accident or breakdown is costly. Major breakdowns on the road cause delayed schedules and require high-priced service calls. When mechanical service is rendered on a regularly scheduled basis, these costs can be avoided.

Where a fleet operation is concerned, preventive maintenance can ensure that the maximum number of vehicles are on the line and ready for use. The biggest saving is realized when the life of the vehicle is prolonged.

Trucks may last up to four years longer (six or seven years instead of three or four) with adequate maintenance. Also, steel-belted radial tires can be capped two or three times, producing a big savings in tire carcass costs.

Another significant benefit of a preventive maintenance program is greater peace of mind for the driver. The driver is then able to give better attention and fuller concentration to driving.

The main objective of preventive maintenance is to prevent accidents or breakdown from these types of mechanical difficulties:

- Broken rims.
- Wheel bearing failure.
- Tire blow-outs.
- Brake failure (lack of adjusting, worn linings, and so forth).
- Air and electrical system failure.

ACTIVITY 8:

List three savings that can be realized through a preventive maintenance program.

1. _____
2. _____
3. _____

OBJECTIVE 9: Explain the safety check that a driver should make on equipment before each dispatch.

Drivers should make a check of mechanical equipment before each dispatch. A check list is usually found on the driver's daily log. Table 1 gives a list of preventive maintenance checkpoints and related questions that should be answered for each point.

TABLE 1. PREVENTIVE MAINTENANCE CHECKPOINTS FOR DRIVER.

BRAKES

Properly adjusted?
Linings legal?
Drums in good condition?

All linkages connected?
No air leaks in system?

LIGHTS

Head, rear, stop, side marker - all working properly?

TURN SIGNALS

Lenses intact?
Four-way flashers working?

TIRES

Legal tread depth?
No cuts or bruises on sidewalls?
Handholds matched for access to inside valve stems?
All lug nuts tight?
No cracked rims?

WINDSHIELD WIPERS

Both work?
Have good blades?

STEERING MECHANISM

If power, is fluid level up?
Belt that drives is adequately snug?
If cam and lever, no excess play?
Wheel returns freely without sticking?
King pin and tie-rod ends not worn?
Tires balanced and aligned?

MUFFLER AND EXHAUST SYSTEM

All connections tight?
No leakage?
Braces tight?
Muffler protector intact?
No holes in system?

GLASS (windshield, side windows, and mirrors)

No cracks?
Cleaned properly?
Pitted windshield replaced?
Mirrors adjusted?

CONNECTING LINES

Free from grease?
Supported so as not to chafe on frame or get caught in drive-line?
Safety cables and chains properly connected and in acceptable condition?

INSTRUMENTS (fuel, water-temperature, oil pressure, tachometer, speedometer)

Working properly?
Illuminating lights working properly?

EMERGENCY EQUIPMENT (flares and/or reflectors, red flags [3, 12" x 12"], fire extinguisher [at least 3/4 full], jack and lug wrench, first aid kit [optional] and flashlight)

In place and ready for use as required by Federal law?
Tire chains available if slick roads expected?
Extinguisher secured and fully charged?

SUSPENSION

No cracked springs?
Torsion not allowing truck to sag?
Air bags not leaking?
Wheels have no leaking seals?

ACTIVITY 9:

1. Which of the following is not a main checkpoint area for the driver?
   a. Instruments.
   b. Emergency equipment.
   c. Brakes.
   d. Engine compression.
   e. Connecting lines.
2. Which of the following main checkpoints might be affected by worn tie-rod ends?
   a. Steering.
   b. Brakes.
   c. Exhaust system.
   d. Instrument panel.
3. Tires must be checked for which of these factors?
   a. Tread depth and inflation.
   b. Tread depth, inflation and tight lug nuts.
   c. Tight lug nuts, inflation, and cracked rims.
   d. Cuts and bruises on sidewalls, handholds, and tread depth.
   e. c and d.

OBJECTIVE 10: Discuss the general precautions taken when trucking hazardous materials (including causes of accidents, protective clothing, fire-fighting equipment, and warning signs).

Part 397 of the Motor Carrier Safety Regulations pocketbook deals with the transportation of hazardous materials. (See Figure 11 for indicators of hazardous materials.). Each driver should become aware of the rules that govern these commodities. The MCSR pocketbook contains vital information, and drivers should comply rigidly with the information therein. Accidents that occur during the transportation of hazardous materials can be categorized into two groups: those involving lack of knowledge, and those involving lack of precautions. The driver is responsible for both of these causes.

Rules covered in the MCSR pocketbook pertain to parking, marking, and routing of vehicles carrying hazardous materials. Parking rules specify the following points regarding transporters of hazardous materials:

- Allowed parking distance from traveled roads, bridges, tunnels, dwellings, and workplaces.
- Requirements for owner's consent when vehicles transporting A and B explosives are parked on private property.
- Rules regarding attendance of such vehicles when they are parked.
- Allowed parking or passing distance from an open fire (no closer than 300 feet in most cases).

Vehicles carrying hazardous materials must be clearly marked with placards indicating the nature of the hazard. In addition, the driver must have in possession a bill of lading (loading) that names and describes the material and gives pertinent instructions regarding it.

The driver and a representative of the company should route (map) out the highways the truck is to take. Unless there is no practical alternative, a truck that contains hazardous materials must be operated over routes that do not go through or near heavily populated areas, tunnels,

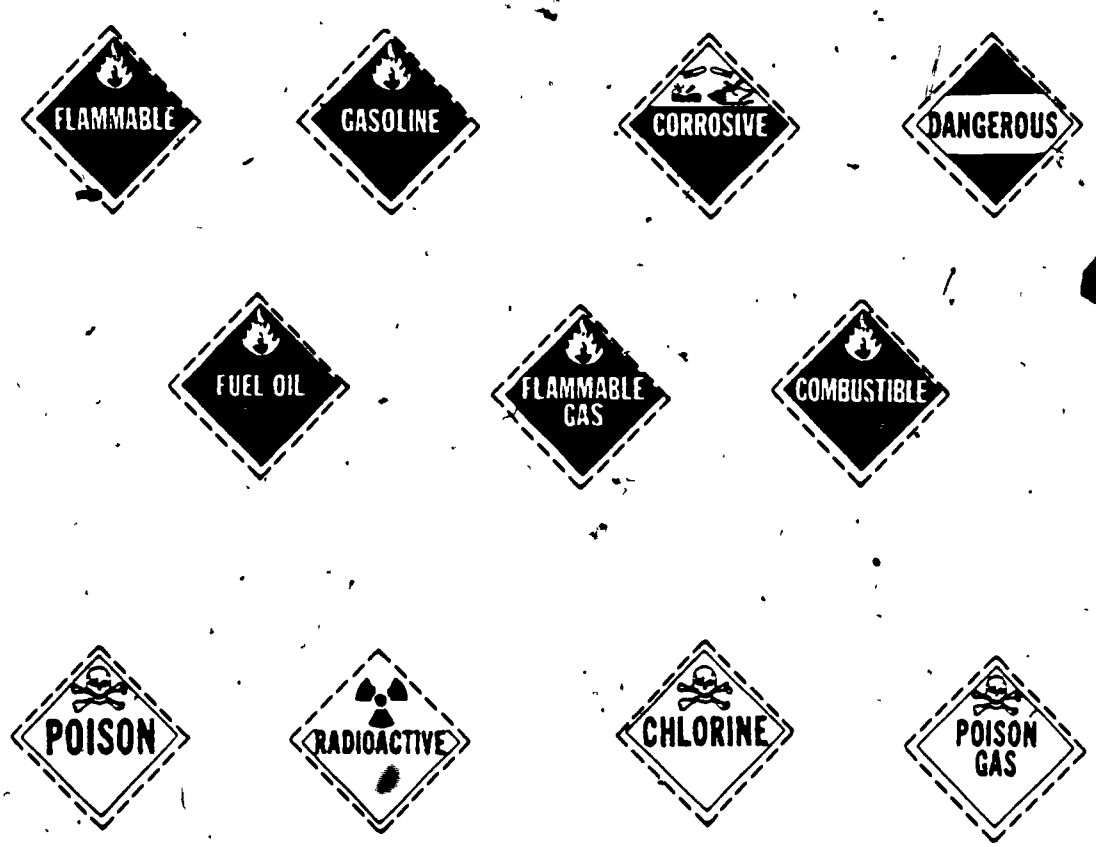

Figure 11. Indicators of hazardous materials.

narrow streets, alleys, or any place where there might be large assemblies of people.

The tires of a vehicle transporting hazardous materials must be kept properly inflated. They must be checked at least once every 100 miles or every two hours. The driver must also check the tires at the beginning of each trip and each time the vehicle is parked.

ACTIVITY 10:

(Circle one.)

T F 1. A bill of lading contains only the name and a description of the hazardous material.

T F 2. The driver only should map out the route for the hazardous material.

T F 3. Trucks carrying hazardous materials can pass but not park within 300 feet of an open fire.

T F 4. The driver must obtain the owner's consent when parking on private property a vehicle carrying A and B explosives.

OBJECTIVE 11: List and describe the unique characteristics of liquid, compressed gas, and dry-bulk carriers.

The trucking industry has come upon a unique and relatively innovative manner of transporting bulk dry commodities such as cement, lime, wheat, rock dust, and flour. The method of handling involves the use of a trailer that loads through domes on the top. At the delivery point the trailer is pressurized, thus forcing the load out through a manifold at the bottom of the bins (sections). This type of trailer is known as a "pneumatic" trailer or, more commonly, an "air-slide" (see Figure 12). The air pressure is developed by a compressor that feeds air into the tank. Pressure is built up to 12-15 pounds per square inch (psi) before the gates on the bottom of the bins are opened. Valves are adjusted to allow the trailer to maintain 12-15 psi within the tank and also a certain amount of "line" pressure. In this manner, the tank literally "blows" the load off. An operator must be especially careful to completely vent the trailer before disconnecting hoses and/or cracking the dome lids.

All trailers of this type are required to be equipped with safety relief (pop-off) valves. In the event the air pressure inside the trailer exceeds the safe limit, the relief valve is forced open. This relieves internal pressure on the tank and eliminates or reduces the chance of the tank rupturing.

Because of the types of loads that the "air-slide" trailer is able to haul (oxidizers, chemical, and so forth), the driver must stay outside the truck while loading or unloading is in process. This will allow a visual check on the pressure valves and enable the driver to open and close the gates on each bin as it unloads. The driver should be equipped with safety eye protectors, as well as a dust mask or respirator. These protective

devices will protect the driver from the dust and toxic fumes that will accompany the unloading of certain materials.

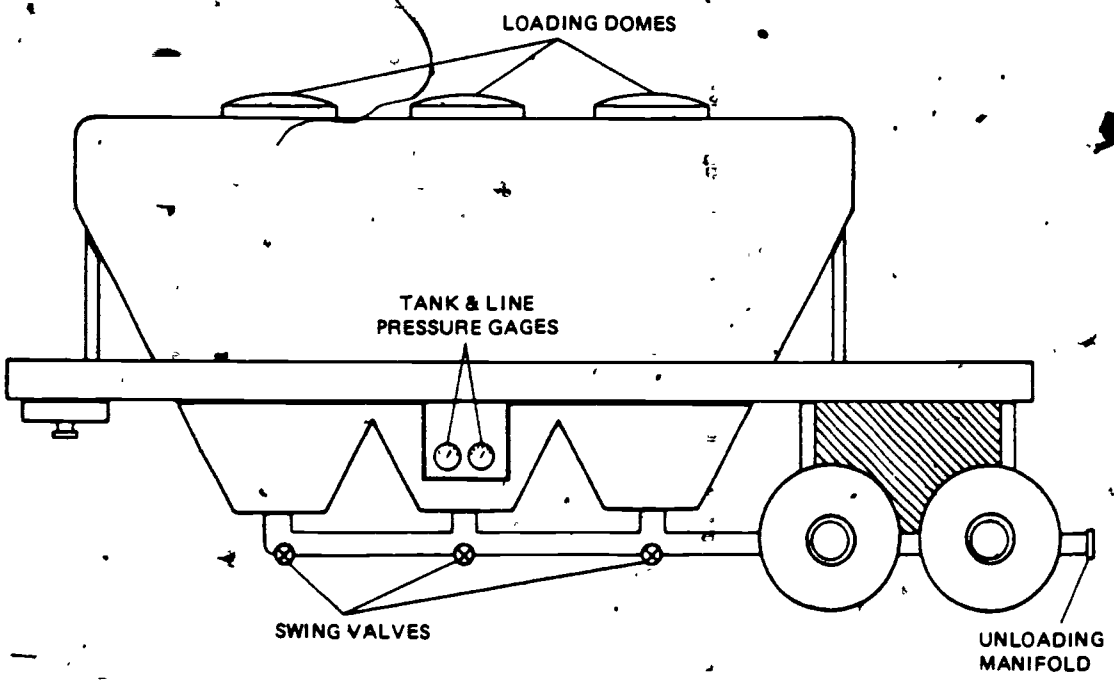

Figure 12. One type of pneumatic (or air-slide) trailer for handling dry bulk materials.

ACTIVITY 11:

List the types of materials for which an air-slide trailer is used.

1. _____
2. _____
3. _____

REFERENCES

Aetna Life and Casualty. "Forces of Nature." (16 mm film)

Keller, J.J. and Associates, Inc. Federal Motor Carrier Safety Regulations Handbook. Wisconsin: 1978.

Mack Trucks, Inc. Mack Maintenance Manual. Allentown, PA: Mack Trucks, Inc.

ANSWERS TO ACTIVITIES

ACTIVITY 1

1. a. Driver fault.
   b. Mechanical difficulty.
2. a. Increase in insurance premiums and/or deductible.
   b. Accident compensation to the worker.
   c. Investigation of accidents.
   d. Cost of repair of vehicle.
   e. Loss of revenue while vehicle is laid up for repair.
3. Any three of the following:
   a. Speeding.
   b. Driving on the center line.
   c. Following too closely.
   d. Passing improperly.
   e. Turning improperly.
   f. Failing to yield the right-of-way.
4. Any three of the following:
   a. Blown-out tires.
   b. Disintegrated turbocharger.
   c. Engine failure.
   d. Power steering failure.
   e. Lights.
   f. Gear lock-up.
   g. Loss of coolant.

ACTIVITY 2

1. False.
2. True.
3. True.

ACTIVITY 3

1. Keep quiet.
2. Render first aid.
3. Get witnesses.
4. Exchange driver information.

ACTIVITY 4

1. a. Aim high.
   b. Get the big picture.
   c. Keep eyes moving.
   d. Leave an out.
   e. Establish eye contact.
2. a. Hard braking.
   b. Abrupt turning.

ACTIVITY 5

1. Training of drivers.
2. Accident prevention and investigation.
3. Driver compliance with rules.
4. Settlement of insurance claims.

ACTIVITY 6

1. 70-80 lbs.
2. As wide as the tires and covering 50% of them.
3. Mirror heater (defrosters).
4. Buzzers, bells.
5. Stick-on abrasive material, metal grid.
6. Bias cord, steel-belted radial.

ACTIVITY 7

1. Local, state, federal.
2. Cones out.
3. Interior bridge.
4. Gross weight.
5. Speed.
6. Block.

ACTIVITY 8

1. Prevents accidents, with all attendant costs.
2. Prevents delayed schedules and road calls caused by breakdowns.
3. Prolongs life of vehicle, including tires.

ACTIVITY 9

1. d
2. a
3. e

ACTIVITY 10

1. F
2. F
3. F
4. T

ACTIVITY 11

1. Liquids.
2. Compressed gases.
3. Dry bulk.