

4. OPERATIONS

The dump truck is the backbone of the FMT II classification. The more the operator knows how it works and how best to operate it; the better prepared the operator will be to undertake any dump truck operation. Under normal training circumstances, the operator should first become familiar with the fundamentals of dump truck operation.

Clutch and Transmission

Standard single axle dump trucks are equipped with a five-speed or six speed transmission. Vehicles with manual transmissions have a clutch pedal which is used to engage or disengage the clutch plates, connecting or disconnecting the engine from the transmission. With the clutch pedal released (extended), the clutch is engaged, which in turn drives the transmission and rear wheels. Depressing the clutch pedal releases the clutch, permitting selection of transmission gear changes.

Clutches will last many thousands of miles if properly used and maintained. Remember that excessive heat caused by riding the clutch or using the clutch as a foot rest will wear down the clutch before its time. **DO NOT RIDE OR SLIP THE CLUTCH.** Once a clutch is fully engaged, there is no heat generated and little or no wear. During the brief period when the clutch is engaging, considerable heat is generated. By riding or slipping the clutch, the period of partial engagement is lengthened, causing unnecessary heat and wear.

Start the dump truck in a gear that will move the truck forward with the engine at idle speed. An empty vehicle can be started in a higher gear than a fully loaded one. Starting in a gear too high for the load will cause the clutch to slip. If the engine must be "revved" up to prevent stalling, the gear selection is too high. As you release the clutch pedal and the clutch begins to engage, the engine speed will drop slightly. When this happens, increase the engine speed and fully engage the clutch. Increasing the engine speed before engaging the clutch could damage the clutch and drive train.

Do not shift until the vehicle has reached the proper speed. Upshifting before the vehicle has reached the right speed is almost as bad as starting off in a higher gear. When the difference between the vehicle speed and the engine speed is too great, the clutch is forced to slip.

Clutch brake

A clutch brake is used to stop the transmission input shaft rotation so that the initial first or reverse gear selection can be engaged while the vehicle is at a dead stop. When using the clutch brake, fully depress the clutch pedal and shift the transmission into either first or reverse gear.

Operating a ceramic clutch

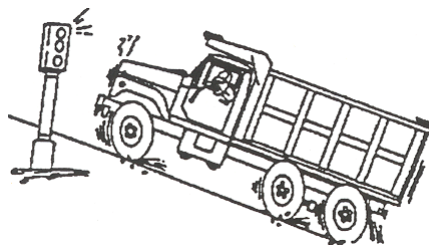
- Start in a low gear.
- While operating a ceramic clutch, engage the clutch before giving the engine any fuel (engine should be at idle).
- The operator should not try to slip the ceramic clutch by raising the engine rpm and riding or feathering the clutch pedal.

In order to properly upshift or downshift, do the following.

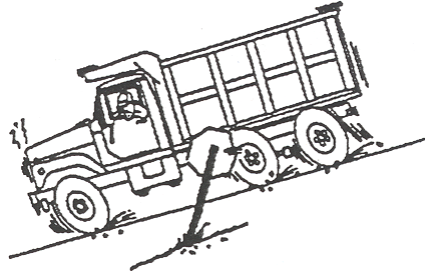
1. Depress the clutch pedal to disengage the clutch.
2. Shift the transmission into neutral.
3. Release the clutch.
4. Re-depress the clutch and shift into the desired gear.
5. Finally, release the clutch pedal to engage the clutch.

If you are upshifting, wait until the engine speed matches the transmission output speed of the gear you desire to shift into. If you are downshifting, accelerate the engine with the transmission in neutral and the clutch released, until the engine speed matches the input speed of the gear you desire to shift into.

The operator should also remember the following simple rules of clutch usage. **Never attempt to hold a vehicle on a hill with the clutch.** In other words, never attempt to use the clutch, while in gear, as a brake in order to hold a dump truck on an incline.



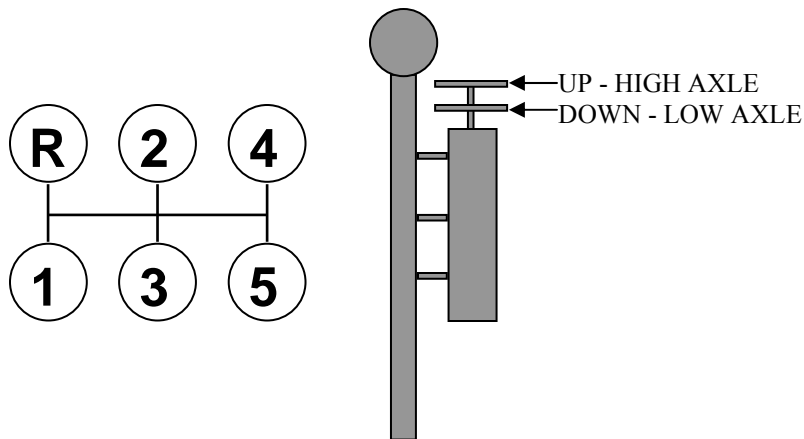
NEVER coast with the clutch disengaged and NEVER engage the clutch while coasting. Re-engaging the clutch during or after coasting will cause a tremendous shock to the clutch and the whole drive train. This could lead to internal engine damage and/or clutch and flywheel failure.



Transmission

To start the dump truck in a forward movement, you must start in the lowest gear or the gear that will not stall the engine. Always come to a complete stop before shifting to reverse or first gear. Under normal conditions, the operator will start in first gear and work up through the gear pattern. Do not skip gears (first gear, low range to second gear, high range, etc.). The transmission is synchronized from second through fifth gear. As the dump truck gains speed and momentum, the operator will shift through the gears. See the steps below in order to get a better idea of the gear shifting process. Those operator's that are studying for the tandem dump truck, refer to the tandem section at the back of this guide.

5 SPEED TRANSMISSION
2 SPEED AXLE



5 SPEED TRANSMISSION

I. UPSHIFTING TRANSMISSION

1. Release parking brake
2. Depress clutch pedal
3. Shift into first gear
4. Release clutch at idle rpm (1,000 -1,500)
5. Depress accelerator, increasing RPM
6. As speed increases, release accelerator, depress clutch pedal, and shift in the next highest gear
7. Repeat steps 5 and 6

II. DOWNSHIFTING TRANSMISSION

1. Depress clutch pedal
2. Shift into neutral
3. Release clutch pedal and increase engine speed
4. Depress clutch pedal
5. Shift transmission into desired lower gear

2 SPEED AXLE

III. UPSHIFTING TWO-SPEED AXLE

1. Keep accelerator down and move rear axle switch to high Range (see illustration above)
2. Release accelerator and depress clutch pedal
3. Release clutch pedal and apply accelerator at the same time

IV. DOWNSHIFTING TWO-SPEED AXLE

1. Keep accelerator down and move rear axle switch to low range
2. Rapidly depress clutch pedal, accelerate slightly, and release clutch pedal

V. SPLIT SHIFTING (UPSHIFTING TRANSMISSION AND DOWNSHIFTING AXLE)

1. Shift transmission as indicated in i and ii
2. Move rear axle switch to low range before releasing clutch pedal (as indicated in iv)

VI. DOWNSHIFTING TRANSMISSION AND UPSHIFTING AXLE

1. Move rear axle switch to high range and release accelerator
2. Then shift the transmission as in ii

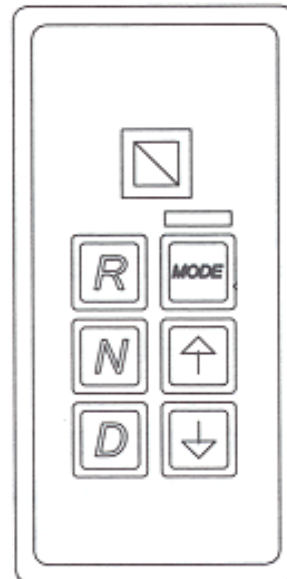
VII. CLUTCHING AND SHIFTING PRECAUTIONS

1. Clutch must always be pressed down when changing gears
2. Do not ride the clutch pedal
3. Always start truck in first gear and axle in low range
4. Never coast with transmission in neutral
5. Come to a full stop before shifting from a forward gear to reverse and vice versa

ALLISON AUTOMATIC

If your vehicle is equipped with a push button shifter, your control has the following selections:

- R (reverse)
- N (neutral)
- D (drive)
- MODE button
- Up arrow (upshift)
- Down arrow (downshift)
- Digital display



When a range button is pressed, a tone will sound. If the CHECK TRANS light (located on the instrument panel) is illuminated, the shifter control pad will be disabled and no tones will be heard. The SELECT indicator displays a chosen operation (if the Electronic Control Unit determines the shift is acceptable) and the transmission will shift to the starting range.

Selection of a specific gear can be accomplished by pressing the up or down arrow button after engaging the D (drive) button. The monitor will display the gear when it is attained. An example of this would be if the up arrow button selects 4th gear as the highest gear allowed, a 4 will be displayed in the monitor. The transmission will start in 2nd gear and progress to 3rd then 4th. The transmission will not shift higher than the gear selected, but will downshift automatically when the vehicle slows down.

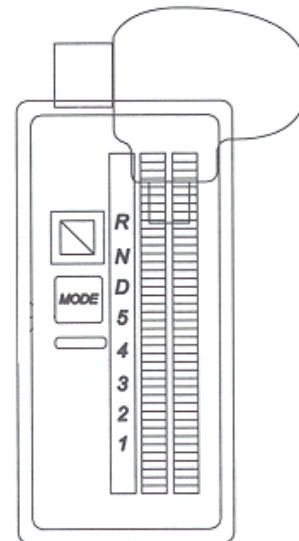
Select the D (drive) position to return to normal driving. In the D (drive) position, the transmission will start in 1st or 2nd gear, depending on the transmission series.

The MODE button may be used to activate a second shift schedule (this is typically programmed for **Economy** which will enable the transmission to shift at a lower rpm to conserve fuel).

If your vehicle is equipped with a gearshift lever, this selector is an electro-mechanical control and has up to six forward speeds and one reverse range.

In case of engine shutdown (running out of fuel), while the transmission is in gear, the transmission will remain in gear until the ignition key is turned to the OFF position.

If equipped with a gearshift lever, the transmission will return to N (neutral) (when the ignition key is turned to OFF) but the engine cannot be restarted until the gearshift lever has been moved to the N (neutral) position



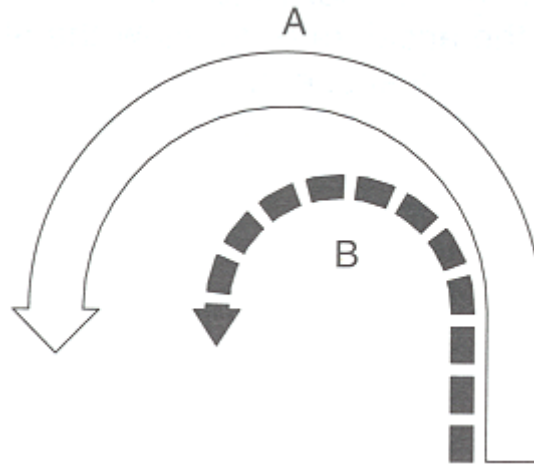
If equipped with a push button shifter pad control, after the ignition is turned off, the transmission will automatically shift to N (neutral) and the monitor on the shift pad will display N (neutral) when the ignition key is turned to the ON position.

WARNING: These transmissions have no P (park) position. Before leaving the driver's seat, always shift into N (neutral) and set the parking brake.

Differential Lock

The differential lock provides maximum traction under slippery conditions. When the differential lock is engaged, the clutch collar completely locks the differential case, gearing, and axle shafts together, maximizing traction of both rear drive wheels and protecting against spinout.

The turning radius is greatly increased when the differential is locked.

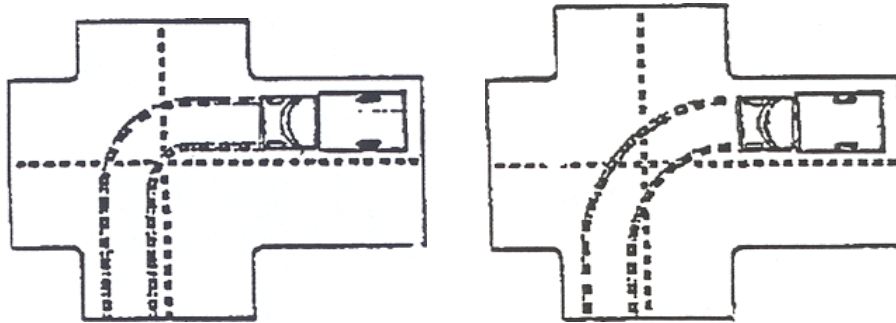


- A. Turning Radius when differential is locked (engaged) – Understeer condition
- B. Turning Radius when differential is unlocked (disengaged)

Warning: Lock the differential only when the vehicle is standing still or moving less than 25 mph. Never lock the differential when the vehicle is traveling down steep grades or when the wheels are slipping. This could damage the differential or lead to loss of vehicle control.

Once you have learned the basic elements of moving the dump truck, the next step is to learn how to maneuver the vehicle on the road. Although this portion of the operations may be very obvious and redundant, it is a good idea to refresh your memory to the basic driving skills.

Turns & curves



LEFT-HAND TURNS

1. Signal your turn in advance.
2. Check conditions before turning.
3. Complete the turn without stopping.
4. Make the turn without the rear wheels striking other vehicles or the curb.
Don't cut corners.

Backing

This is one of the most accident-prone maneuvers. The cardinal rule is, "avoid backing if at all possible". The following illustrations demonstrate some of the backing maneuvers and procedures. Rear-ward visibility is limited to the mirrors, so the safe operator, does not have a spotter to assist in backing, will get out of the truck and look to make sure the way is clear. There is a "cone of danger" or blind spot immediately behind the truck which even the conical mirrors cannot cover. If in doubt when backing, stop, get out and take another look, pick a reference point to back towards, and use a spotter to assist you if possible. Use your mirrors, back up slowly, and don't lean out of the cab.

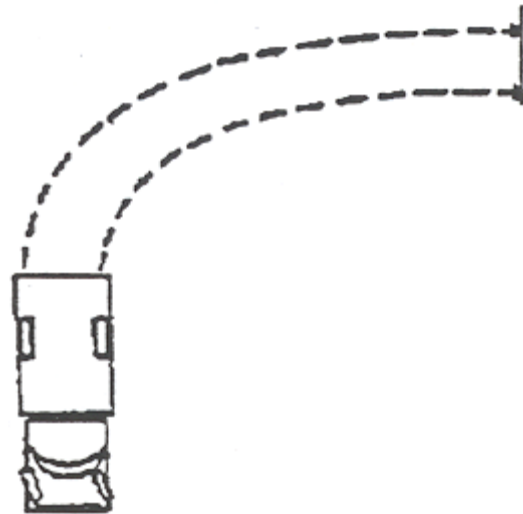
STRAIGHT LINE BACKING

1. CHECK TO MAKE SURE AREA IS CLEAR.
2. PICK OUT A REFERENCE POINTS.
3. USE THE REAR VIEW MIRRORS AS MUCH AS POSSIBLE.



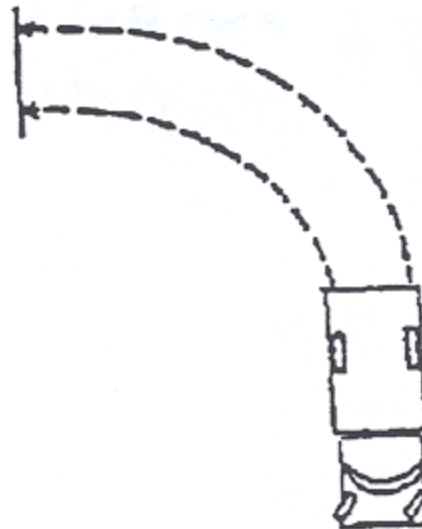
LEFT SIDE BACKING

1. POSITION TRUCK SO YOU CAN SEE:
2. PICK OUT A REFERENCE POINTS.
3. USE THE REAR VIEW MIRRORS AS MUCH AS POSSIBLE.



RIGHT OR BLIND SIDE BACKING

1. FOLLOW LEFT-SIDE BACKING PROCEDURES.
2. USE REAR VIEW MIRRORS AS LONG AS POSSIBLE.
3. LEAVE TRUCK AND REINSPECT AREA AS OFTEN AS NECESSARY TO RE-ESTABLISH REFERENCE POINTS.



Braking

The operator must become familiar with the basic function of "braking". One of the basic elements of operating a single axle or tandem dump truck is the ability to stop the vehicle in a safe and professional manner.

The objective of using the braking system is to slow down and stop the vehicle while in use. The emergency braking system is used only when the primary braking system has failed or when added braking power is required due to an unusual situation.

The first points that an operator must understand is that of gravity and motion. Gravity is known as weight being placed on an object and motion is the force at which an object travels through space. As a dump truck gains weight, the center of gravity is displaced by moving from a low point to a high point. In other words the weight being applied by the force of motion will shift from a low center of gravity (an empty dump truck) to a high center of gravity (a loaded dump truck). This shift in gravity will affect the motion that the vehicle is going and will require either more or less braking. The operator needs to consider how much space or cushion is needed to stop an empty or fully loaded dump truck.

The operator should keep the following steps in mind.

- Never slam, ride or habitually tap the brakes.
- Always look ahead and predict how much cushion you will need in order to stop the dump truck safely. Use the following formula to establish the proper braking distance.
 1. Perception distance (**Pd**)
 2. Reaction distance (**Rd**)
 3. Braking distance (**Bd**)

$$\mathbf{Pd + Rd + Bd = Total Stopping Distance}$$

- Never pump the brakes while driving at a high speed.
- The total Stopping distance is greater when the dump truck is loaded with materials. Materials may shift when operating the dump truck. This will have a direct effect on braking.

A fully-loaded truck may weigh upwards of twenty tons and will require much more energy or force to slow or stop than a lightly-loaded or empty vehicle. Always maintain the air pressure between 90 to 120 psi for maximum braking effort. Anticipate slowing and apply brakes sooner than you might otherwise expect. Watch the tachometer; down-shift when necessary; keep speed consistent with road traffic and weather conditions.

Rely on the braking effect of the engine to help control the speed when descending hills. Brakes will fade from overuse and air pressure may deplete. Operating the engine with a closed throttle and transmission/rear axle in reduced gear is the method that should be used to control speed downhill. If the selected gear will not hold the desired speed, an improper gear selection has been made. Come to a full stop and let the brakes cool. Then continue down the grade in a lower gear range.

Do not attempt to gear down if the engine has reached maximum speed (rpm) in any gear range since it will be impossible to shift into a lower gear. The common rule to follow in using the engine and transmission/rear axle to control vehicle speed is to select the same gear going down the hill that would be required to ascend the hill. There are some exceptions such as going down a short hill with good visibility and no hazards.

The use of brakes on a long and/or steep downgrade is only a supplement to the braking effect of the engine. Once the vehicle is in the proper low gear, the following is the proper braking technique.

1. Apply the brakes just hard enough to feel a definite slowdown
2. When your speed has been reduced to approximately 5 mph below your “safe” speed, release the brakes. This brake application should last for about 3 seconds.
3. When your speed has increased to your “safe” speed, repeat steps 1 and 2

For example, if your “safe” speed is 40 mph, you would not apply the brakes until your speed reaches 40 mph. You now apply the brakes hard enough to gradually reduce your speed to 35 mph and then release the brakes. Repeat this as often as necessary until you have reached the end of the downgrade

The Emergency brake should only be used when all other braking systems fail. Judgement on the operator's part will prevail over a given situation that may warrant the use of the emergency brake system.

Single or tandem axle dump trucks with air brakes, have an air brake system that is considered a "split system or dual system". The purpose of the split system is to provide a means of stopping the vehicle should a failure occur in either the primary or secondary brake system.

The two systems have separate air lines, air reservoirs, and air gauges. Both systems are activated simultaneously by the service brake pedal. Some vehicles have two gauges and some have two needles in one gauge. The primary system is for the rear brakes and the secondary system is for the front brakes. In the event, air pressure loss occurs in one system, the remaining system continues to provide braking action. **The vehicle must never be operated when a system failure has occurred.**

This means that if one of the systems does not charge up to between **90 and 120** psi. The operator should not use the vehicle until the system is repaired. **Under no circumstances will the operator or shop supervisor allow any dump truck to leave the shop, if one of the air pressure gauges does not register the proper air pressure.**

Single or tandem axle dump trucks with hydraulic brakes should note that the system uses a disc type with a split system piping. This system is known as the Hydro-Max Booster. It is a hydraulic assisted system that is powered by a hydraulic pump. The system also has a back-up power assist in the event of a malfunction in the hydraulic power pump system or loss of engine power. This back-up is electrically powered. The electric power back-up is designed to cycle whenever the engine is not operating and the key is in either the "ON" or "OFF" position.

If the vehicle is equipped with a split brake system, the operator is assured a reasonable brake control should one of brake system fails. If this should happen, the operator must utilize a longer brake pedal stroke to actuate the remaining brake system. Brake control of the vehicle will occur somewhere between the mid-position of the pedal travel and as the pedal approaches the floor board. An increase in pedal effort is required as the remaining section of the system picks up the vehicle load normally controlled when both systems are functioning. **Remember that the stopping distance may not be as short under the failed condition since only one section of the split system is operating. The vehicle should be operated only with extreme caution and return to the shop at once.**

Use the "Jacob Brake" that may be available in your dump truck to assist in braking. Most tandem dump trucks are equipped with a Jake Brake and should be used when going down hill or when appropriate. It is nothing more than a valve release that allows the compressed air from the engine piston chamber to escape.

Loading

Part of operating a dump truck, is the ability to load and unload materials from the dump bed. In order to accomplish this task the operator must become familiar with several steps required to load and unload from a dump truck. The loading capacity is different for single axle and tandem axle dump trucks. Prior to loading a dump truck, the operator must understand the principle of **Gross Vehicle Weight**. Gross Vehicle Weight is the total weight of a single vehicle plus its load.



Gross Vehicle Weight (G.V.W.)

Part of operating a single and tandem axle dump truck is knowing what the **G.V.W.** is for that vehicle. The **G.V.W.** varies among the units used by SHA and may be found either on the registration card, the driver's side door, or a placard somewhere in the cab. To get an average "empty" weight, go to a state weight scale station and record the "empty weight". Depending on the front end loader scoop and the weight of the material, the usual capacity of a single axle dump truck is about 1 1/2 to 2 scoops.

The objective is to stay within the weight limit of the established **G.V.W.** The driver should know the water-level volume of the body without sideboards. An example of a single and a tandem axle dump truck with average inside dimensions follows.

Single axle dump trucks

Length: 9.0 ft.
Width: 7.0 ft.
Depth: 2.08 ft.

Tandem axle dump trucks

Length: 14.0 ft.
Width: 7.0 ft.
Depth: 4.5 ft.

The volume may be calculated easily by multiplying the dimensions by each other and then dividing by 27 (cubic feet):

Single axle

$$\frac{9 \times 7 \times 2.08}{27} = 5 \text{ Cubic Yards.}$$

Tandem axle

$$\frac{14 \times 7 \times 4.5}{27} = 16 \text{ Cubic Yards.}$$

To complete the calculation, the operator must also have a general idea of the weight of material being loaded; for example, 3,000 pounds per c.y. for Graded Aggregated Sub-base (crusher run). Simply multiply the weight of the material in pounds per c.y. by the volume of the body in c.y.:

Single axle

$$5 \times 3,000 = 15,000 \text{ pounds.}$$

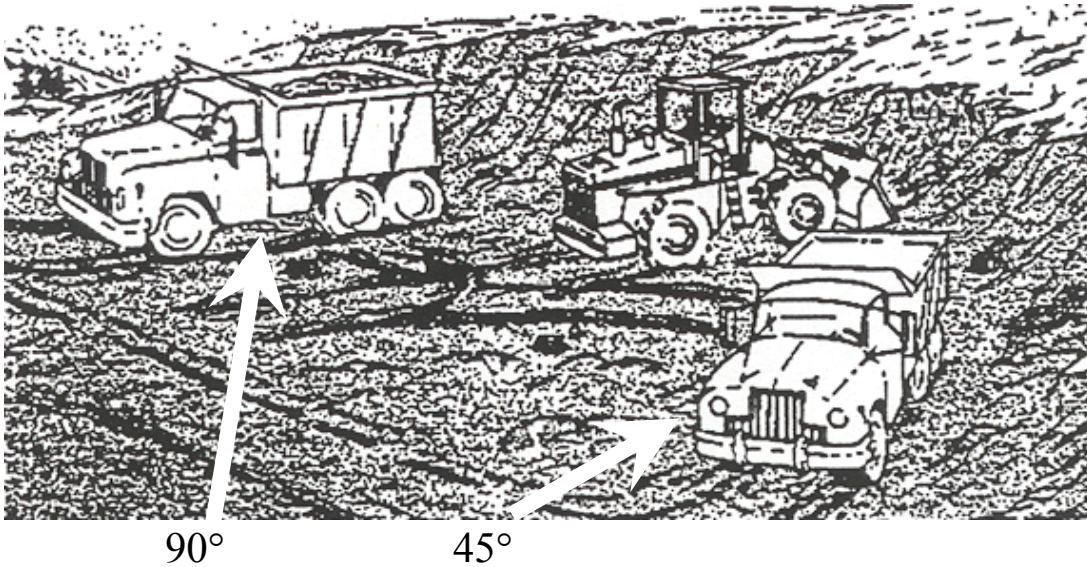
Tandem axle

$$16 \times 3,000 = 48,000 \text{ pounds.}$$

Add this weight to the known empty weight to determine gross weight of the unit. If the gross weight exceeds the documented **G.V.W.**, the load must be lessened. The purpose of this calculation is to keep the weight of the material plus the vehicle weight below **G.V.W.**.

The Single axle dump truck is 33,200 **G.V.W.** and for the tandem axle dump truck it is 60,000 **G.V.W.**.

When working with a loader at a stockpile, position your truck so the loader operator does not have to make more than a 45-degree turn from the stockpile to the truck. If you get out of the truck, position yourself in front of and about 30 feet away from the truck. Stay within sight of the loader operator. (see illustration below)



Following a belt loader is one operation that requires continuous backing by the dump truck. It is a good and safe practice to use horn signals that both you and the loader operator are familiar with.

Maryland Motor Vehicle Law states that no part of the load may be within six inches of the top of the sideboards, unless the load is properly covered. SHA's policy, states that all loads be covered. A good practice would be to keep all material six inches below the top of the sideboards even when covered.

Dumping

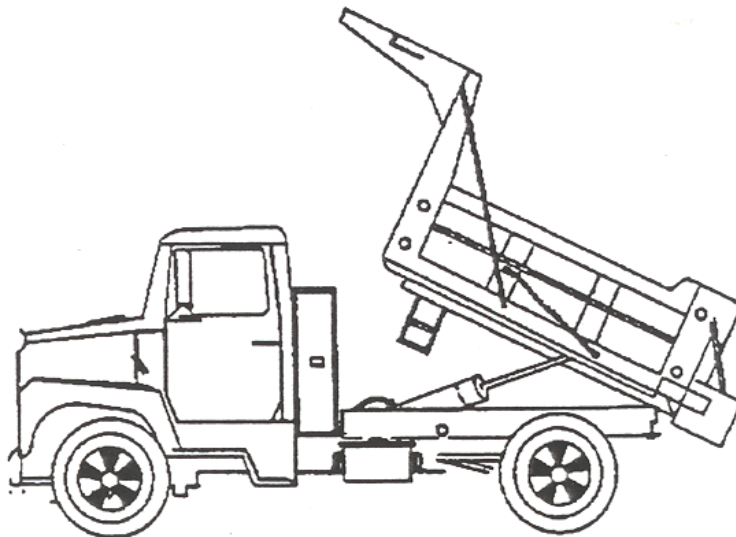
SHA vehicles are equipped with a constant-running hydraulic pump which powers all the hydraulically driven systems, eliminating the power-take-off control usually found in older trucks.

The hydraulic control levers are located to the right of the operator. The one closest to the operator is the dump body hoist control. Pull the lever to the rear to raise the dump bed and push the lever forward to lower it.

When dumping a load, the tailgate should be tripped before the body is raised. For single axle dumps pull the handle, located behind the driver's door, down to release the tailgate. The tandem axle dump truck has a tailgate release switch.

Increase engine rpm to raise the dump bed faster. Drive ahead to clear the pile after dumping and before lowering the dump bed. Lower the dump bed completely and re-latch the tailgate. On single axle dump trucks, move the tailgate lever up and check the tailgate hooks for a firm lock. For tandem dump trucks, re-engage the tailgate release switch. Once you have completed your dumping and the dump bed is secured, get out of the dump truck and brush off any loose material.

The operator may be required to spread the load while dumping. The depth of the spread is regulated by truck speed and adjusting the tailgate spreader chains. In a spreading operation, the bed is partially raised while the truck is driven ahead and the tailgate tripped to begin spreading. Continue to raise the body until the load is emptied. Know the approximate height of the body in both raised and lowered positions and be conscious of overhead obstructions.



DUMPING SAFETY

- Never dump with the truck parked sideways on a slope.
- Dump truck should be level as possible when dumping.
- Watch for overhead obstructions when dumping.

NOTE: Single axle dump trucks in use by SHA range in height from 9' to 11' to the top of the beacon with the bed down and from 14' to 18' with the bed raised. Tandem axle dump trucks range in height from 10' to 11' to the top of the beacon with the bed down and from 20' to 21' with the bed raised.

- Never drive down the road with an empty dump bed in the raised position.
- Always cover the load in the dump bed when traveling on public highways.
- Do not overfill the dump bed.
- Always latch the tailgate immediately after dumping.
- Always clean around and in back of the tailgate after loading and dumping.

Trailer Towing

Make a pre-trip inspection of the trailer before and after hooking to the towing vehicle. Inspect the pintle hook on the truck for cracks and loose or missing bolts. Make certain the retaining latch will close and lock in place. Check the truck rings used to hook the trailer safety chains.

Inspect the front of the trailer starting with the hookup ring. This point of contact must be free of defects to prevent separation of trailer from towing vehicle. Inspect the frame up to the trailer bed for any defects.

Inspect the safety chains for proper length which is long enough to support a tight turn but short enough so as not to drag on the ground. Check chains for weak links and hooks for safety latch. Make certain chains are large enough to support trailer weight should the trailer get disconnected. Safety chains are crossed (X) under the trailer frame and hooked to the truck's rings. Crossing the chains will provide support for the trailer in the event of a breakaway. Reference – Federal Motor Carrier Safety Regulations 393.70 (8)(i).

Inspect electrical connections for corrosion and broken prongs, and cable for exposed or broken wires.

Check the breakaway cable for ease of disconnect and that all trailer brakes engage. (See the reference – Federal Motor Carrier Safety Regulations below). Make certain the breakaway battery is fully charged and securely mounted on the trailer frame.



Inspect the rest of the trailer frame for cracks, rust, and broken welds. Check the trailer deck for debris, broken or missing boards, and steel support structure. Inspect the ramps if equipped.

Inspect the tires for tread depth, cuts, and proper inflation. Check the wheels (rims) for cracks and illegal welds. Check for loose or missing lug bolts and nuts.

Check all trailer lights for broken lenses and working status.

Federal Motor Carrier Safety Regulation

Each commercial motor vehicle must have brakes adequate to stop and hold the vehicle or combination of vehicles (e.g. truck and trailer). Reference – Federal Motor Carrier Safety Regulation § 393.40

Vehicles (trailers) equipped with an electric brake system must have a service brake system that meets the applicable requirements of § 393.42 (acting on all wheels), § 393.48 (operable at all times), § 393.49 (single valve to operate all brakes), and § 393.52 (able to stop in a specified distance).

Every commercial motor vehicle (includes trailers) shall be equipped with brakes acting on all wheels. The exception is any full trailer, semi trailer, or pole trailer (loaded or unloaded) with a gross weight of 3,000 pounds or less is not required to be equipped with brakes if the axle weight of the trailer does not exceed 40 percent of the towing vehicle's total weight. Reference – Federal Motor Carrier Safety Regulation § 393.42

Every trailer required to be equipped with brakes shall have brakes that apply automatically and immediately upon breakaway from the towing vehicle. All trailer brakes must apply upon breakaway from the towing vehicle. The brakes must remain in the applied position for at least 15 minutes. Reference – Federal Motor Carrier Safety Regulation § 393.43

Note: If the trailer has brakes, make sure they meet the above Federal Motor Carrier Safety Regulations.

Electric Trailer Brakes

Trucks towing a trailer with electric brakes should have a power adjust controller usually dash mounted within operator's reach. This device allows the operator to adjust the brake power output to match the weight placed on the trailer. The more weight on the trailer, the more the operator moves the adjustment bar up. Lock the trailer brakes and then move the adjustment bar down to a point just below where the brakes lock up.

Electric Breakaway System

The trailer must have an emergency battery backup system that provides electrical power to the brake magnets during the trailer breakaway brake activation process. This battery must have sufficient charge to activate and hold the electrical brakes for 15 minutes.

There is a breakaway switch with a pull pin and cable which, when attached to the tow vehicle, will provide electrical activation of the trailer brakes when the trailer disconnects from the tow vehicle.