spartan motors inc.

CUSTOM BUILT VEHICLES AND CHASSIS

p.o. box 440 1000 reynolds road charlotte, michigan 48813

phone (517) 543-6400 fax (517) 543-SPAR telex 466261

SPARTAN CHASSIS INTERNATIONAL CLUB

The Spartan Chassis Owners Club is designed so you can continue to communicate with the factory and vice versa.. This involves quarterly newsletter, gatherings, F.M.C.A. rallies, chassis seminars, an annual rally at Spartan, plus more! It is our desire to educate you on the chassis; how it runs, works, available options, etc.. Plus, we will let you know of chassis related changes. This communication allows us to both grow and prosper.

There is currently no membership fee. You will find an application enclosed. If you want to become a member and receive our quarterly newsletter, please fill out the application and return it to Spartan Motors, Inc.

spartan motors inc.

CUSTOM BUILT VEHICLES AND CHASSIS

p.o. box 440 1000 reynolds road charlotte, michigan 48813

phone (517) 543-6400 fax (517) 543-SPAR telex 466261

APPLICATION FOR MEMBERSHIP

SPARTAN CHASSIS INTERNATIONAL

3214 South 117th Street, Omaha, NE 68144 (402) 333-8768

PLEASE PRINT

FMCA# _____

LAST NAME: _____ HUSBAND _____ WIFE _____

ADDRESS: _____

CITY/STATE/ZIP: _____

PHONE NUMBER WITH AREA CODE: (___) _____

COACH MANUFACTURER: _____

MODEL: _____ YEAR: _____ LENGTH: _____

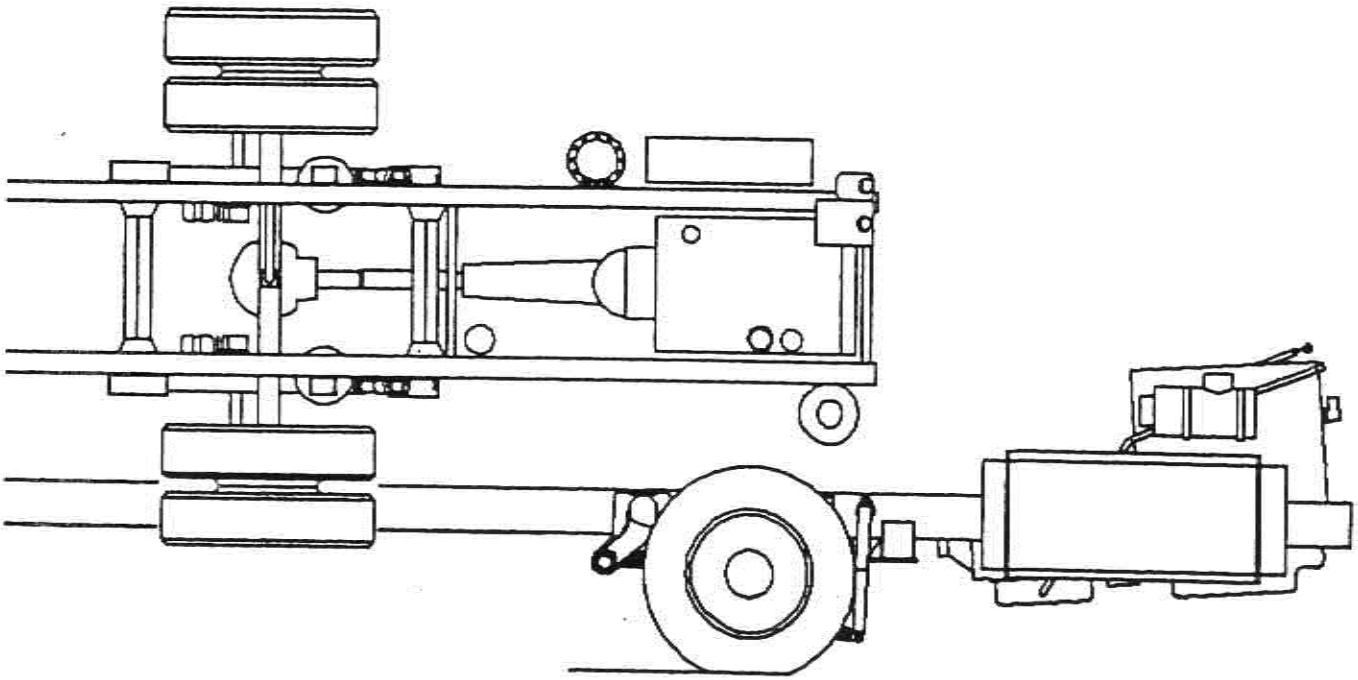
ENGINE: _____ VIN # _____

SIGNED: _____

DATE: _____

* Please notify Spartan Motors of any address changes.

MOTORHOME CHASSIS OWNER'S MANUAL



SPARTAN MOTORS

1000 Reynolds Road • Charlotte, Michigan 48813 • 517/543-6400

DANGER!!

EXCEEDING THE GROSS VEHICLE WEIGHT RATING OF THIS CHASSIS CAN RESULT IN SERIOUS INJURY OR DEATH

NOTE:

UNEVEN SIDE TO SIDE LOADING OF CHASSIS CAN CAUSE DOG TRACKING UNEVEN TIRE WEAR, AND ADVERSE HANDLING CHARACTERISTICS WHICH COULD RESULT IN SERIOUS INJURY OR DEATH

" W A R N I N G "

CHASSIS EQUIPPED WITH MANUAL SLACK ADJUSTERS ON THE BRAKES MUST BE PERIODICALLY INSPECTED AND PROPERLY ADJUSTED. SERVICE INTERVALS WILL VARY DEPENDING ON THE BRAKE LINING AND DRIVERS BRAKING HABITS.

FAILURE TO INSPECT REGULARLY AND PERFORM THE REQUIRED ADJUSTMENTS WILL RESULT IN LOSS OF BRAKING EFFECTIVENESS!!

spartan motors inc.

CUSTOM BUILT VEHICLES AND CHASSIS

p.o. box 440 1000 reynolds road charlotte, michigan 48813
phone (517) 543-6400 fax (517) 543-SPAR telex 466261

Dear Spartan Motors Customer:

Thank you for your confidence in purchasing a vehicle equipped with a Spartan Motors chassis — the highest quality diesel chassis on the market today.

So that we may stay in touch with you and grow along with you, a Family Motor Coach Association chapter of Spartan Motors Chassis Owners International has been formed. This club, currently Spartan-sponsored, publishes a quarterly newsletter and organizes gatherings and activities. We encourage you to become a member by contacting the name and address listed below, or for membership information, please contact Ms. Courtney Grundstrom at (517) 543-6400, ext. 214.

Should you become a member you will receive a Spartan Motors emblem that you may mount on your coach if you wish. Most owners mount these emblems on the side or back of the coach.

May your traveling be safe and enjoyable.

Spartan Motors, Inc.

Spartan Motors Chassis Owners International
Scope: International
Tom Waldbridge F89923, President
Leo Ebbesen F74587, Vice President
Martin Pierce F57064, Vice President
W. O. "Bill" Boyd L6077, Vice President
Gwen Carson F43813, Secretary/Treasurer
Marsh Carson F43813, National Director
Tom Walbridge F89923, Alternate National Director
Chapter Mailing Address:
Spartan Motors, Inc.
3214 S. 117th Street
Omaha, NE 68144
Phone: (402) 333-8768
Chartered: March 8, 1989

OPERATOR / WARRANTY SERVICE MANUAL

TABLE OF CONTENTS

This manual provides seven chapters of useful information about your Spartan chassis. Reviewing this quick-reference guide will familiarize you with the manual format and chapter contents.

Contents pages at the beginning of each chapter further assist in quickly locating information.

Introduction

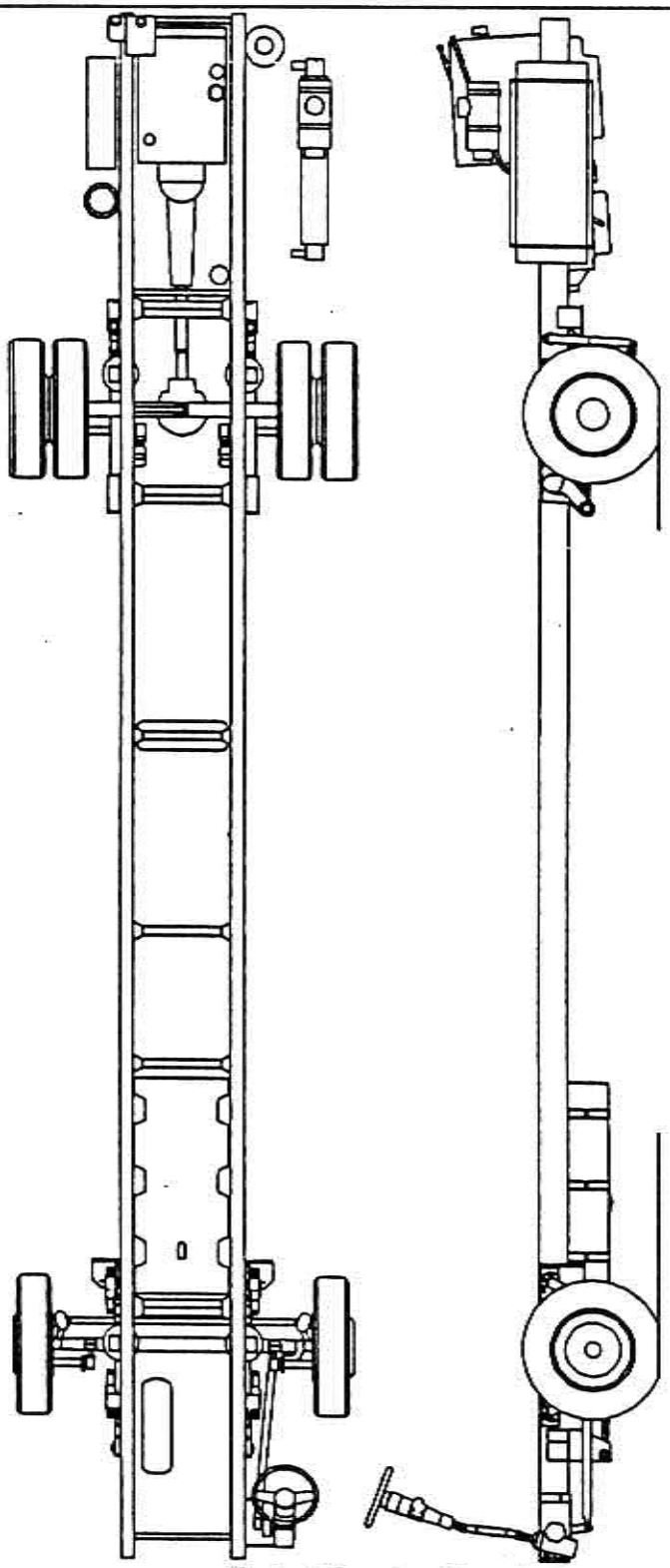
INTRODUCTION

TABLE OF CONTENTS

1

SPARTAN SERVICE CENTERS

When it comes to service, remember that your authorized Spartan Service Center knows your chassis best. For the name and address of a service center in your area, please contact the Spartan Motors Warranty Department at 1-800-543-4334.



Typical Spartan Chassis

INTRODUCTION

CHAPTER 1

☞ Unless otherwise noted, information pertains to ALL Spartan chassis. ☜

ABOUT THIS OPERATOR'S MANUAL

This manual presents basic information on the operation, maintenance, and warranty of your vehicle's **Spartan Chassis only.**

The RV constructed on the Spartan chassis is covered in the owner's manual supplied by the RV manufacturer.

BEFORE YOU GO ANY FURTHER . . .

Stop and take care of these five critical reminders:

1. It is extremely important that you mail in your Spartan Motors Warranty Owner's Registration. This will allow your vehicle to be serviced under warranty.

   NOTE: THIS WARRANTY WILL BECOME NULL AND VOID IF YOUR SPARTAN OWNER VEHICLE REGISTRATION FORM IS NOT RETURNED WITHIN THIRTY DAYS AFTER THE DATE OF PURCHASE.

   IMPORTANT: Any vehicle with an odometer reading greater than 4,000 miles at the time that the original owner takes delivery, will be eligible for Spartan Warranty (see warranty statement for description) coverage for the balance of 24,000 miles minus the odometer reading or one year whichever is less.

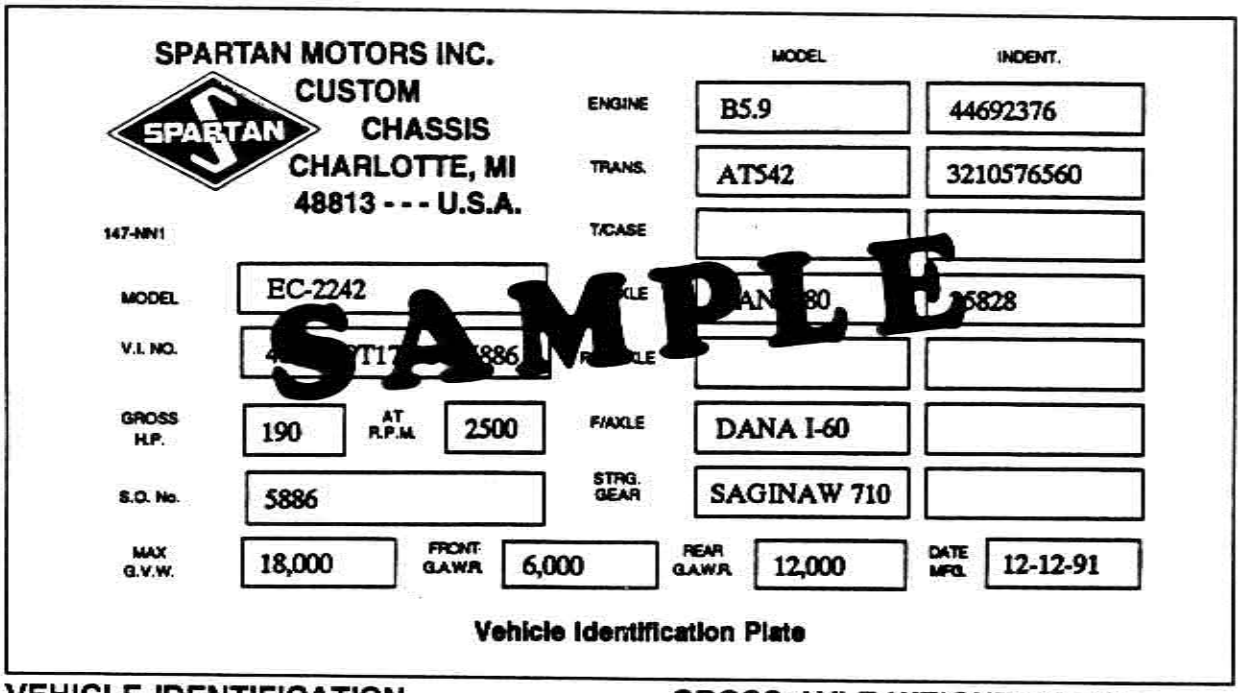
2. Be sure you understand that the base chassis warranty is effective for 12 months or 24,000 miles, whichever comes first. **This base warranty applies to the first owner only.** Some components used in the manufacture of this chassis carry their own warranties of longer duration, and some of these warranties are transferable to the second owner. These are identified elsewhere in this owner's/warranty manual.

3. You should consider purchasing the emergency spare parts kit from Spartan Motors. Items such as filter elements and belts may not be as readily available as you would like because you have purchased a heavy-duty premium chassis, rather than an automobile.

   Emergency spare parts kits are available for the EC, IC, and MH model chassis. When ordering these kits, please give the following information to the parts department:
   - Vehicle Identification Number
   - Chassis Model Number
   - Alternator size

4. Before you drive, please obtain a copy of your state's commercial driver's license manual. Although you do not need this license in order to legally operate your RV, the manual provides excellent how-to information on the operation of larger diesel chassis equipped with air brakes and hydraulic brakes. Reading it and following its guidelines will be very helpful to you as you begin to drive your new vehicle.

5. Finally, take a moment to study the chassis nameplate and familiarize yourself with the assemblies that make up the chassis. As you go through each system, turn to the Maintenance Summary on page 1-12, as well as the appropriate chapter, and read the operating tips and preventive maintenance requirements. Careful study of the nameplate and manual at this early stage could easily ward off future repairs.



Vehicle Identification Plate

VEHICLE IDENTIFICATION

The vehicle identification plate provides the vehicle owner with name of manufacturer, engine type, year of manufacture, etc.

Model	Description
EC	Economy Class
IC	Intermediate Class
MH	Mountain Master

In addition, the above plate shows the "Vehicle Identification Number", and the "As Manufactured" Gross Vehicle Weight Rating for the vehicle.

VEHICLE LOAD CAPACITY

Your vehicle load capacity is determined by weight, not volume. Maximum vehicle weights (front axle, rear axle, and total) for your vehicle are shown on your vehicle data plate.

GROSS AXLE WEIGHT RATING

The Gross Axle Weight Rating (GAWR) is equal to the lowest load rating of either the tires, wheels, axle assembly, suspension, or brakes on a given axle.

GROSS VEHICLE WEIGHT RATING

The Gross Vehicle Weight Rating (GVWR) is the maximum total weight of the vehicle. This is determined by adding together the GAWR of the front and rear axle.

WHEN ORDERING PARTS . . .

Always include information from the vehicle's identification plate to assure receiving the correct parts.

Note: *Due to constant product improvement, chassis specifications are subject to change without notice.*

OPERATING TIPS

A WORD OF CAUTION ABOUT DRIVING YOUR VEHICLE

Spartan Motors recommends that you obey posted speed limits. Driving too fast for conditions is unlawful and dangerous, and it creates the possibility that you may lose control of the vehicle and suffer personal injury. Under some circumstances, driving at very high speeds for extended periods of time may also result in damage to vehicle components, creating a risk of failure and potential loss of vehicle control. You may find it necessary to reduce your driving speed for road, traffic, or weather conditions.

NEW VEHICLE BREAK-IN

Your new vehicle does not need an extensive break-in. Do try not to drive continuously at the same speed during the first 1,000 miles, as parts tend to wear more evenly when operated at varying speeds initially. Approximately 100 miles of city driving are required to fully break in a new set of brake linings. Repeated heavy stops should be avoided during this period. **You should drive your new vehicle at least 500 miles before using it to tow a trailer.**

Don't add anti-friction compounds or special break-in oils to the engine during the first few thousand miles of operation, since these additives may prevent piston ring seating. Consult the engine manual for information on oil usage.

STARTING YOUR VEHICLE UNDER NORMAL CONDITIONS

1. Make sure battery disconnect switch on rear electrical panel is in the ON position (MH model chassis only).

2. Make sure the parking brake is applied by pulling out on the yellow, diamond-shaped parking brake knob, or by setting your park brake lever to the on position. (The parking brake lamp on the dash should light up when the ignition key is in the run position whenever the parking brake is applied.)

3. Make sure the gear shift selector is in the neutral (N) or park (P) position.

   Note: *Not all transmissions are equipped with a park (P) position. If your gear shift selector does not have a park position use neutral and be sure to apply parking brakes. Engine will not start if gear shift selector is in any position other than park or neutral.*

   Warning: Never rely on the park (P) position to properly park your vehicle, always use your park brake system.

4. Make sure all accessories are turned off.

5. Turn the ignition key to the run position and check to see that all warning lights are functioning. The parking brake lamp and the engine low oil pressure warning lamp should light, and the buzzer should sound. The low air pressure warning lamps for brake systems #1 and #2 will also light up if the air pressure in either brake system is below 60 psi.

Note: Spartan Motors supplies as minimum the following warning systems.

1. Low engine oil pressure (below 5 psi).
2. High engine temperature (above 230 degrees).
3. Low air pressure (below 60 psi).
4. high transmission oil temp. (above 305 degree).
5. Low brake fluid level (EC 2000 & EC-1K).
6. Low coolant light and buzzer (MM, IC & EC-1K).

STARTING YOU VEHICLE UNDER NORMAL CONDITIONS (Continued)

WARNING: If the lights and buzzers are not as described here, return to your dealer or call Spartan Motors for corrections or repairs. Since all Spartan RV Chassis have rear mounted engines, proper operation of the engine monitoring systems is required to prevent costly damage and repairs

6. Depress the accelerator pedal to approximately half throttle position.

7. Turn the ignition key to start position to engage starter.

   CAUTION: To prevent starter damage, do not engage the starter for more than 15 seconds. Wait two minutes between each attempt to restart.

8. Once the engine starts, return the accelerator pedal to the idle position and let the engine idle for 3 to 5 minutes before applying a load.

9. Engine oil pressure MUST be indicated on the gauge within 15 seconds after starting. As engine oil pressure builds, the low oil pressure lamp will turn off. If the air pressure in either brake system is low, the respective warning lamp will remain lit until that system reaches a minimum pressure of 60 psi. The buzzer will remain on until the engine has reached the minimum safe oil pressure and brake system #1 has reached a minimum air pressure of 60 psi.

   Note: *The buzzer is not connected to air brake system #2. Air brake system #2 will not build air pressure until a minimum of 90 psi has been reached in brake system #1.*

   WARNING: Do not attempt to move the vehicle until the low air pressure warning lamps for both brake systems #1 and #2 have turned off.

   On the EC-2242 models chassis with air/hydraulic brakes and EC-1K with hydraulic boost brakes, do not attempt to move the vehicle if the low brake fluid lamp is lit. Check the brake fluid reservoir for fluid.

10. Once both brake systems have pressurized, depress the brake pedal and release the parking brake by pushing in the yellow, diamond-shaped parking brake knob, or by moving the park brake lever to the off position.

    Note: *The parking brake should not be released until both brake systems contain a minimum of 60 psi.*

    WARNING: When shifting between drive to reverse you must first bring the vehicle to a complete stop and the engine speed must be at idle.

11. Move the gear shift selector to the desired gear.

    WARNING: Never idle the engine in closed areas. Never sit in a parked or stopped vehicle for any extended amount of time with the engine running. Exhaust gases may build up. These gases are harmful and potentially lethal.

CARBON MONOXIDE AND OTHER DEADLY EXHAUST FUMES

Carbon monoxide is a colorless, odorless gas which is frequently present with other exhaust fumes. Therefore, if you ever smell exhaust fumes of any kind inside your vehicle discontinue driving it and have it inspected immediately by your dealer so the condition can be corrected. Do not drive with exhaust fumes present.

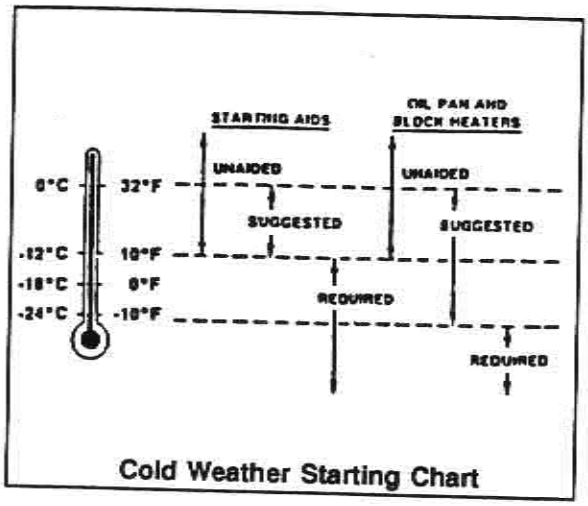
To guard against the possible entry of carbon monoxide into your vehicle, the exhaust system and body ventilation system should be properly inspected by a competent technician as follows:

- Each time the vehicle is serviced.
- Whenever you detect a change in sounds from the exhaust system.
- Whenever the vehicle has been damaged by impact with another vehicle, object, and/or road obstruction.

To afford proper ventilation, all air inlet vents should be kept clear of snow, leaves, and other debris.

COLD WEATHER STARTING

- Follow the normal starting procedures.
- Refer to the Cold Weather Starting Chart as a cold weather starting aid.



Cold Weather Starting Chart

Starting Engines Equipped With an Ether Starting Aid (Optional Equipment)

- Depress the accelerator pedal all the way to the start position and release it.
- Put the transmission in the neutral (N) position.
- Set the main electrical switch in the ON position.
- While cranking the engine, inject a metered amount of starting fluid.
- Continue operation as usual.

Starting Engine Oil Pan or Engine Block Heaters

- Plug in the heater at least three hours prior to operation. The amount of time required depends on the surrounding temperature.
- Once engine is heated, follow normal starting and operation procedures.

Note: *All Spartan diesel chassis are equipped with engine block heaters. Oil pan heaters are an optional item.*

PARKING YOUR VEHICLE

If you examine the gear shift selector, you will notice that the remote mounted shift selector does not include park (P) position, because no park position is built into the transmission. To prevent the coach from rolling when parked, you must place the gear shift selector in the neutral (N) position and apply the parking brake by pulling out the yellow, diamond-shaped parking brake knob.

If you have purchased a Spartan Chassis that is equipped with a column mounted shift selector, you will notice a park (P) position. Although the park (P) position is on the column shift selector, the operator should NEVER select this position as a means of "parking" the vehicle. The correct way to prevent the coach from rolling when parked, you must place the gear shift selector in the neutral (N) position and apply the parking brake.

SHUTTING DOWN YOUR VEHICLE

- Bring the vehicle to a complete stop.
- Keeping the brake pedal depressed, place the gear shift selector in neutral (N) position, and apply the parking brake by pulling out the yellow, diamond-shaped parking brake knob, or by moving the park brake lever to the on/park position the parking brake lamp on the dash should light up.
- Release the brake pedal.

Note: *If you have been driving at highway speeds, allow the engine to idle for three to five minutes before shutting it off. This allows the engine to cool gradually and uniformly.*

Note: Avoid excessive idling. It is better to shut an engine off and restart it than to allow it to idle for a prolonged period of time.

- Turn the ignition switch to the OFF position.

ABOUT YOUR SPARTAN CHASSIS BRAKE SYSTEM

On the MH and IC model chassis, an air brake system uses compressed air from an engine-driven air compressor to apply the service brakes on the front and rear axles.

On the EC-2000 series chassis, an air/hydraulic brake system uses compressed air from an engine-driven air compressor to provide boost to the hydraulic fluid brake system, which applies the foundation brakes on the front and rear axles.

On the EC-1K series,a hydraulic boost system uses pressurized fluid to provide a boost in which applies the foundation brakes on the front and rear axles.

Even though both air brake and the air/ hydraulic brake systems use an air dryer between the air compressor and the air tanks, moisture will still collect in the air tanks and can eventually damage the system. It is recommended that this moisture be drained from the tanks before starting each trip and once per week while the coach is in operation. To drain the tanks, open the drain valve(s) on bottom of each tank and let air escape until no trace of moisture exists. Then close the valve(s).

The air system's reserve capacity is large enough to allow twelve full brake applications in the event of an air compressor failure.

CAUTION: Be sure to monitor the air gauge while driving. If any of the brake system indicator lights or the buzzer turn on, stop the vehicle immediately and have a qualified service person investigate the problem.

In the event of an air leak, spring-applied brakes on the rear axle (MH and IC chassis), or on the rear of the transmission (EC chassis), will automatically be applied when brake system air pressure drops below 35-45 psi.

STOPPING YOUR VEHICLE

Depress the brake pedal. Control the brake pressure by varying the pressure on the pedal, bringing the vehicle to a smooth, safe stop. When making emergency stops, be very careful to brake in a manner that allows you to maintain steering control.

***Note:** Remember that your vehicle weighs much more than a conventional automobile; therefore, stopping distances will be greater.*

BREAKING ON DOWN HILL GRADES

Prior knowledge of the steepness of downhill grades is valuable information to the driver, but not usually available for all conditions. Be alert for steep grades and winding road signs. **RULE OF THUMB:** Start down the grade, at the same speed you wish to be at, at the bottom of the grade. Shift the transmission to a lower gear(s) to keep the engine RPM at or near governed RPM (2300-2400). Monitor your speed. If your speed increases approximately 5 MPH faster than your desired speed (say your desired speed is 40 MPH and you attain 45 MPH) apply the brakes with a moderately heavy pressure to bring the speed back to 40 MPH or below, and release the brakes. **DO NOT RIDE THE BRAKES.** Re-apply the brakes as required to slow the vehicle back to your desired speed. Repeat this process until no longer required.

Note: For those coaches equipped with the optional engine exhaust brake, energize the brake by flipping the switch "ON" and removing your foot from the accelerator pedal. Downshift the transmission as required to keep the engine at 2300-2400 RPM. Apply the brakes in a slow moderate manner as described above. Monitor the transmission temperature gauge if so equipped since the exhaust braked engine can absorb almost as much horsepower as required to go up the hill.

WARNING: It is the drivers responsibility to monitor all gauges and warning devices while operating this vehicle.

INSTRUMENTATION, WARNING INDICATOR DEVICES AND LIGHTING CONTROLS (Chapter 7)

Most coaches have gauges, warning lamps, indicator lamps, and a warning buzzer that monitor the following functions:

Gauges

Standard gauges are provided to indicate fuel level, battery voltage, engine oil pressure, engine coolant temperature, vehicle road speed, engine RPM, brake system #1 rear brake air pressure, and brake system #2 front brake air pressure.

Optional gauges are available to indicate transmission temperature and hours of engine operation.

Warning Lamps

Lights are provided to indicate low engine oil pressure, engine high coolant temperature, brake system #1 low air pressure, brake system #2 low air pressure, transmission high temperature, low engine coolant, and low brake fluid (EC model chassis only).

> ***Note:*** *If a warning lamp or buzzer turns on while driving the coach, it indicates a system fault has caused and requires immediate attention and appropriate action. In most cases, you should find a safe place to pull over and stop. Determine the system problem. If low air pressure is indicated, shut off the engine. If high engine temperature is indicated, let the engine idle so that circulation of cooled water can reduce the temperature. if low coolant is indicated, shut off the engine, as there is no water for coolant. If high transmission temperature is indicated, place the transmission in neutral and run the engine at 1200 to 1500 RPM until the buzzer turns off. If an air brake system fault has occurred, the problem must be repaired before continuing driving.*

Indicator Lamps

Lights are provided to indicate left and right turn signal, head lamp high-beam on, and parking brake applied.

Warning Buzzer

A buzzer is provided to indicate low engine oil pressure, high engine coolant temperature, high transmission temperature, brake system #1 low air pressure, engine low coolant, and low brake fluid (EC model chassis only).

DRIVING YOUR VEHICLE UPHILL

- Although this vehicle is equipped with an automatic transmission, it is strongly recommended you move the gear shift selector to the next lower range when climbing steep long grades instead of waiting for the transmission to shift itself. This way, the engine will be able to run near its peak horsepower RPM, improving engine performance and allowing the engine and transmission cooling systems to operate at peak effectiveness.

- No harm will come to either the engine or transmission by downshifting at normal road speeds.

- You may find you can actually reach higher road speeds with the transmission in a lower gear and engine running near full throttle than with the transmission in high gear and the engine lugging at a low RPM.

> ***Note:*** *On extremely steep hills the transmission temperature may tend to increase. Normal transmission operating temperature range as measured at the torque converter outlet is 230° to 270°F. The maximum temperature for non-retarder models is 300°F. If over-heating occurs, find a suitable place to stop the vehicle, apply the parking brake, place the transmission in neutral ("N"), and accelerate the engine to 1,200 to 1,500 RPM. This should reduce the fluid temperature to operating level within a short time. If high levels persist, consult the transmission and/or engine operator's manual.*

> ***Note:*** *When climbing grades, do not decrease engine RPM while downshifting.*

DRIVING IN HIGH TEMPERATURES

- Observe the following precautions when driving your vehicle under high temperature conditions: Check the engine and transmis-

sion temperature gauges on the dash panel to be sure both systems are within normal operating range.

- If transmission temperature increases excessively, stop at a suitable place, apply the parking brake, place the transmission in neutral and accelerate the engine to 1,200 to 1,500 RPM. This should reduce the fluid temperature to operating level within a short time.

- If overheating persists, consult the transmission and/or engine operator's manual.

  Note: *Due to varying climates and load conditions, there may be times when the vehicle must be driven at a slower speed than you desire in order to keep the temperatures of the engine and transmission at operating level. Typically you will notice this on extremely hot days, or when driving uphill.*

FUEL ECONOMY

Because fuel consumption is higher during the new vehicle break-in period, accurate fuel economy normally cannot be determined until your vehicle has been driven at least 1,000 miles. To calculate fuel economy, divide the number of miles driven by the number of gallons of fuel used. In metric figures, multiply the number of liters used by 100 and divide the result by the number of kilometers traveled. This will give you the number of liters used per 100 kilometers, which is the normal method used to compare fuel economy in metric units. Do this for several tank fulls to obtain an average.

IMPROVING FUEL ECONOMY . . .

There are two important factors you can control to improve your fuel economy: the mechanical condition of your vehicle, and how you drive it.

Perform Periodic Maintenance

A well-tuned, properly maintained vehicle will deliver better fuel economy than a neglected vehicle. To be sure that your vehicle is in top operating condition for maximum fuel economy, follow the maintenance schedule provided in each chapter of this manual.

<u>CAUTION</u>: ***It is the driver's responsibility to monitor all gauges and warning devices while operating the vehicle.***

Improve Driving Habits

Your driving habits will have a significant influence on the amount of fuel you use. By consciously thinking about fuel economy and following these suggestions when you drive, you should be able to stretch your mileage:

- Avoid changes in speed as much as possible.

- Look ahead and anticipate changing traffic conditions. Sudden stops waste fuel.

- Avoid long periods of idling.

- Avoid fast acceleration.

- Do not drive with your foot resting on the brake pedal.

- Keep loads light and avoid carrying unneeded items.

- Keep tires inflated at the recommended pressure.

Slippery Surfaces

On slippery surfaces, avoid making quick movements with the steering wheel. Decrease your speed and allow for the extra stopping distance required by these conditions. Apply the brakes by pumping the pedal steadily and evenly to avoid wheel lockup and loss of vehicle control. Changes in speed should be made gradually.

WARNING: Do not use the cruise control on slippery roads.

WARNING: Do not race the engine at high RPM or spin the wheels. A tire could disintegrate with an explosive force which could result in death or injury to a passenger or bystander and damage your vehicle.

Flooded Areas

Avoid driving through flooded areas unless you are sure the water is no higher than the bottom of the wheel hubs. Proceed through the water slowly and allow an adequate stopping distance, since wet brakes do not grip well. After driving through water, gently apply the brakes several times while the vehicle is moving slowly to dry them.

What to Do If You Run Out of Fuel

If your vehicle runs out of fuel, stop the vehicle on a level location away from traffic. The engine may be restarted after you add at least 10 gallons of fuel to the fuel tank. If the vehicle is not level, up to 15 gallons of fuel may be required. Refer to the engine operator's manual to start the engine.

TOWING OR PUSHING THIS VEHICLE

If your vehicle is disabled, the drive line should be disconnected or the drive wheels lifted off the road before towing or pushing. The engine cannot be started by towing or pushing.

Attach towing chains to the frame of chassis. Refer to the coach manufacturer's manual for further towing instructions to prevent damage to the vehicle during towing.

WARNING: In all cases, when towing an object you should contact the local and or state authorities for the braking and other requirements concerning towed vehicles. The information on the vehicle data plate represents its capacity only and does not apply to actual vehicle towing requirements.

TOWING WITH THIS VEHICLE

Before towing an object with this vehicle, check the Gross Combination Weight Rating (GCWR) as specified by the coach manufacturer. The GCWR is the maximum amount of weight that can be transported by this vehicle. (The GCWR equals the GVWR of coach plus weight of object being towed.) To determine the maximum allowable weight of the vehicle to be towed, subtract the GVWR of your coach from its GCWR.

Use special precautionary procedures, safety equipment, and proper emergency warning lighting when towing. Refer to your coach manufacturer's manual for further instruction to prevent damage to this vehicle while towing.

Note: *Towing packages are available and are recommended when towing any vehicle or trailer, regardless of size or weight.*

MAJOR LUBRICATION/COOLANT FILL POINTS

GENERAL

Knowing the location of the major lubrication/coolant fill points beforehand will help you in performing preventive maintenance. Please locate and check (✓) the following items on the system layout diagram at the end of this chapter.

☐ Engine Oil Level Indicator

The dipstick and filler cap are located at the rearmost end of the engine at the rear of your motorhome. Refer to the engine chapter of this manual and the engine manual for oil type, capacity and change interval.

☐ Engine Filters

Oil Filter — Refer to the engine chapter of this manual and the engine manual for location, filter number and change interval.

Fuel Filter and Fuel/Water Separator — Refer to the engine chapter of this manual and the engine manual for location, filter numbers and change interval.

Coolant Filter — See engine chapter of this manual and engine manual for location, filter number and change interval.

☐ Transmission Fluid Level Indicator

The dipstick is located at the rearmost end of the engine at the rear of your motorhome. Refer to the transmission chapter of this manual for fluid type, capacity and change interval.

> ***Note:*** *Fluid is added through dipstick tube.*

☐ Transmission Filter

The fluid filter in the AT and MT series are remotely mounted on the frame near the drive shaft end of the transmission, while the filter in the MD series and all Hydra-matic transmissions (4L80-E and 3L80) are internal. Refer to the transmission chapter of this manual for filter number and change interval.

> ***Note:*** *Due to varying hose lengths with remote mounted filters, transmission fluid capacity is approximate. Adjust the capacity according to the reading on the dipstick.*

☐ Cooling System Radiator

Check periodically to make sure that there are no obstructions, such as leaves, snow, etc. between radiator and the grille. *(Not shown on diagram)*

☐ Cooling System Surge Tank

Check periodically to make sure the sight glass has a green tint. This indicates there is enough coolant in the system. If the sight glass is clear, there is not enough coolant in the system, and it must be filled and deaerated. Consult cooling system section of Chapter 3.

☐ Cooling System Recovery Bottle

> ***Note:*** *Make sure coolant level is between the add and full markings on the coolant recovery bottle at all times.*

☐ Brake System Air Tanks

Be sure to drain the moisture from each tank before starting off on a trip. Consult the maintenance and brake chapters of this manual.

☐ Brake System Air Dryer

Consult the brake chapter of this manual.

☐ Power Steering System Fluid Level

The dipstick is located in the lid of the fluid reservoir, which is mounted in the engine compartment. Consult diagrams at the end of this chapter for the general reservoir location and fluid type.

☐ Power Steering System Filter

The fluid filter is located inside the reservoir. Consult diagrams at the end of this chapter for filter number and change interval.

☐ Front Axle

Axles with oil-lubricated wheel bearings (example: Eaton 12F4) — Check oil level through the window in the end of the hub. Consult the maintenance and axle chapters of this manual for fluid type.

Axles with grease-lubricated wheel bearings (example: Dana I-60) — Consult the maintenance and axle chapters of this manual.

☐ Rear Axle

Consult the maintenance and axle chapters of this manual.

☐ Prop Shaft

Consult the diagrams at the end of this chapter.

☐ Air Cleaner

Check the air cleaner fresh air inlet periodically and make sure it is clear of obstructions. An optional air restriction indicator mounted near the air cleaner indicates when the filter element needs changing. Consult the maintenance and air cleaner sections of Chapter 3.

MAINTENANCE SUMMARY

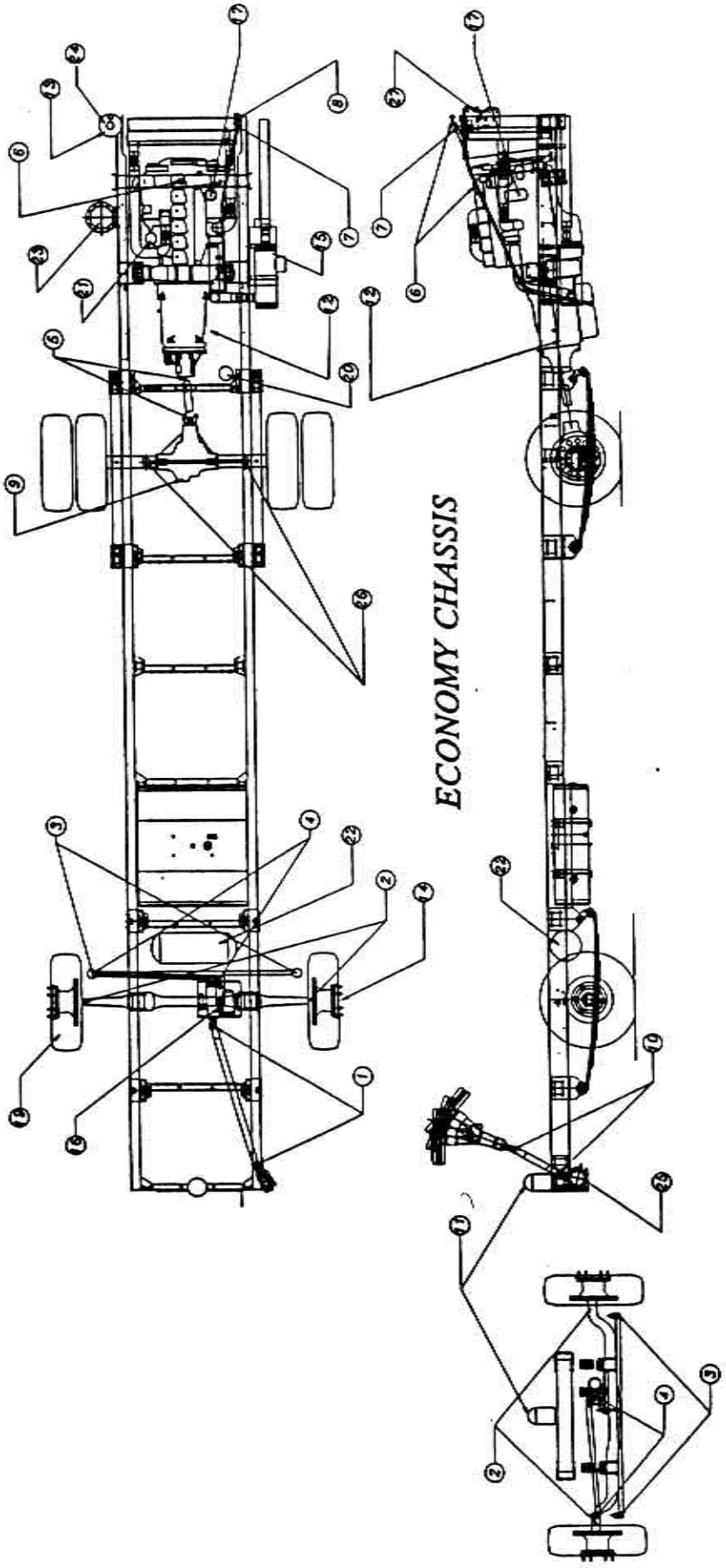
***CAUTION:** This is a summary only, please refer to the appropriate chapters in this manual for all aspects of chassis inspection, maintenance, and service.*

	A	B	C	D	E	F	G	H	I	J	K
ENGINE (Chapter 3 for details)											
Oil Change	●		●								
Filter (replace)	●		●								
Fuel Water Separator (drain water from separator)	●	●									
Check/Replace Fuel Strainer						●					
Check Oil Level		●									
Check Bolts		●									
Fuel Filter (replace)	●										
TRANSMISSION (Chapter 4 for details)											
External Filter (replace)	●										
Change Oil	●										
Check Oil Level		●									
Internal Sump and Gov. Filter	●										
COOLING SYSTEM (Chapter 3 for details)											
Flush								●			
Check Level		●									
Check Quality				●							
Filter, replace 6C engines only	●			●							
STEER AXLE (Chapter 6 for details)											
Check Oil Level		●									
Grease Fittings											●
POWER STEERING RESERVOIR (Chapter 6 for details)											
Replace Filter									●		
Fluid Level		●									
AIR CLEANER (Chapter 3 for details)											
Check Air Cleaner Indicator		●									
Replace Air Cleaner Filter or When Indicated as Dirty					●						
BRAKE SYSTEM (Chapter 5 for details)											
Drain Air Tanks		●								●	
Replace Air Drier Desiccant	●										
Check **Tires** and Pressure (Chapter 6)		●									
Walk around and look under the vehicle to check for any fluid leaks		●									

A - See manufacturers chart for specified intervals
B - Start of each trip
C - Every 3 months, or 5,000 miles
D - Every 6 months, or 10,000 miles
E - Every 9 months, or 15,000 miles
F - Every 12 months, or 20,000 miles
G - Every 15 months, or 25,000 miles
H - Every 30 months, or 40,000 miles
I - Every 48 months, or 65,000 miles
J - After 15 days or more of stroage, or non-use
K - See Spartan Service Manual for specific description

LAYOUT/LUBRICATION DIAGRAMS

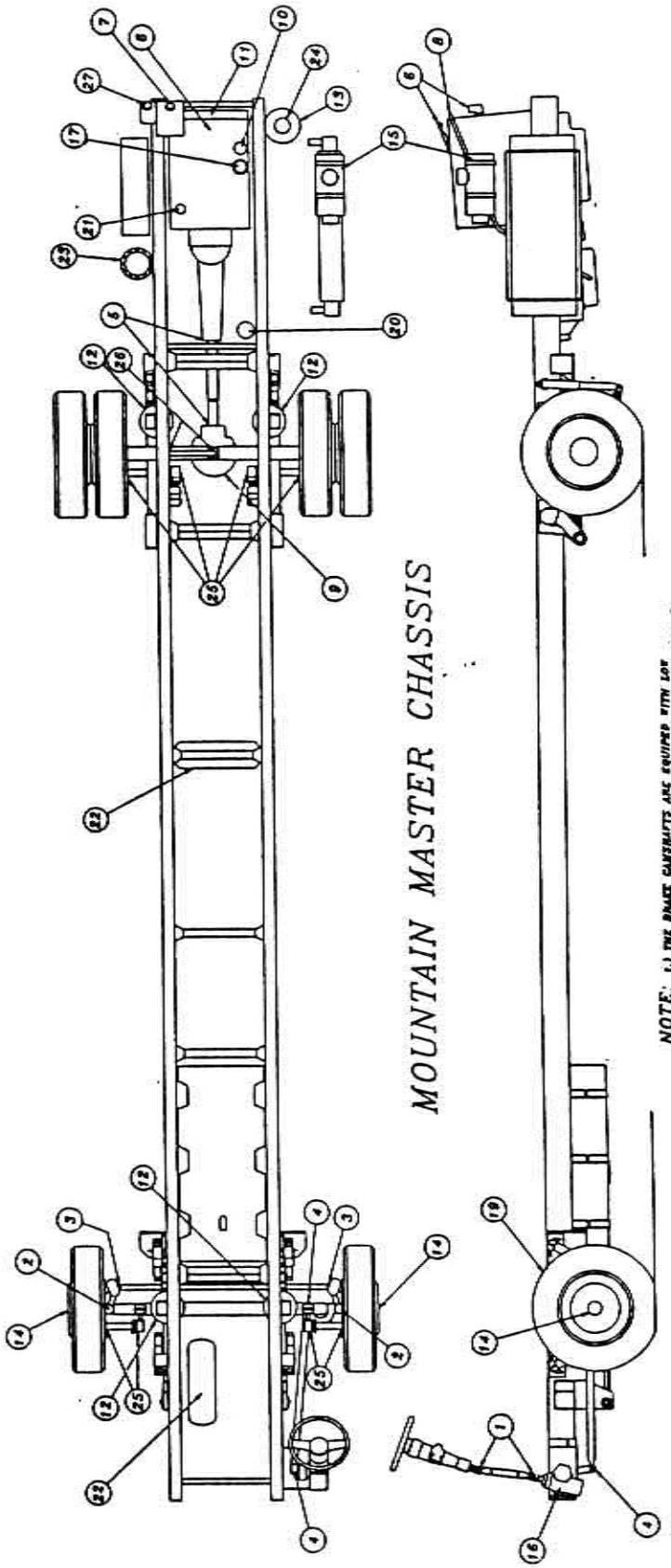
ECONOMY CHASSIS



NO.#	DESCRIPTION	DAILY	WEEKLY	EVERY 750 MI.	EVERY 1500 MI.	EVERY 2500 MI.	EVERY 5000 MI.	EVERY 7500 MI.	EVERY 12 MTHS.	EVERY 24 MTHS.	TYPE OF LUBE. FLUID OR FILTER
1	STEERING SLIP SHAFT U-JOINTS						LUBRICATE				GREASE - NLGI #2 OR EQUIV.
2	SPINDLE JOINTS - TOP & BOTTOM						LUBRICATE				GREASE - NLGI #2 OR EQUIV.
3	TIE ROD BALL JOINTS						LUBRICATE				GREASE - NLGI #2 OR EQUIV.
4	DRAG LINK BALL JOINTS						LUBRICATE				GREASE - NLGI #2 OR EQUIV.
5	PROP SHAFT U-JOINTS						LUBRICATE				GREASE - NLGI #2 OR EQUIV.
6	ENGINE OIL	CHECK LEVEL					CHANGE				SEE ENGINE MANUAL
7	COOLING SYSTEM FILL	CHECK LEVEL							CHANGE		50/50 ETHYLENE GLYCOL & WATER
8	TRANSMISSION FLUID	CHECK LEVEL							CHANGE		DEXTRON II
9	REAR AXLE LUBE						CHECK LEVEL		CHANGE		SEE AXLE MANUAL
10	STEERING SLIP SHAFT U-JOINTS - MTER BOX TO STRG. GEAR						LUBRICATE				GREASE - NLGI #2 OR EQUIV.
11	BRAKE FLUID RES. - SEE BODY MANU. FOR LOCATION		CHECK LEVEL								HYD. BRAKE FLUID - DOT #3
12	PARK BRAKE BELLCRANK						LUBRICATE				GREASE - NLGI #2 OR EQUIV.
13	POWER STRG. RESERVOR		CHECK LEVEL						CHANGE		DEXTRON II
14	WHEEL BEARINGS - FRONT						LUBRICATE				SEE AXLE MANUAL
15	AIR CLEANER		INSPECT			CLEAN	CLEAN	REPLACE ELEMENT			DRY TYPE ELEMENT

NO.#	DESCRIPTION	DAILY	WEEKLY	EVERY 750 MI.	EVERY 1500 MI.	EVERY 2500 MI.	EVERY 5000 MI.	EVERY 7500 MI.	EVERY 12 MTHS.	EVERY 24 MTHS.	TYPE OF LUBE. FLUID OR FILTER
16	POWER STEERING GEAR			INSPECT FOR LEAKS							
17	ENGINE OIL FILTER						CHANGE				SEE ENGINE MANUAL
18	BATTERIES	INSPECT									SEE BODY MANUAL FOR BATTERY LOCATION
19	TIRES	INSPECT									
20	TRANSMISSION OIL FILTER						CHANGE				SEE TRANMISSION MANUAL
21	ENGINE FUEL FILTER								CHANGE		SEE ENGINE MANUAL
22	AIR TANK		DRAIN MOISTURE								
23	AIR DRYER DESSICANT CARTRIDGE									CHANGE	
24	POWER STRG. RES. FILTER (INSIDE RESERVOIR)								CHANGE		
25	STEERING MTER BOX								CHK. LEVEL		MOTOR OIL
26	REAR TRACK BAR						LUBRICATE				GREASE - NLGI #2 OR EQUIV.
27	COOLANT RECOVERY BOTTLE	CHECK LEVEL									FILL AS NEEDED WITH 50/50 ETHYLENE GLYCOL/WATER MIX.

MOUNTAIN MASTER CHASSIS



NOTE: 1.) THE BRAKE CAMSHAFTS ARE EQUIPPED WITH LOW PRESSURE GREASE FITTINGS. STEWART-WARNER #1190-B. DO NOT REPLACE WITH STANDARD FITTING. THIS WILL RESULT IN PREMATURE REPLACEMENT OF BRAKE SEAL AND FILLING OF BRAKE DRUMS WITH LUBRICANT.
2.) VEHICLE CHASSIS PART LOCATIONS MAY VARY. IF THERE ARE ANY QUESTIONS ABOUT PART LOCATIONS, PLEASE CONTACT SPARTAN MOTORS

NO. #	DESCRIPTION	DAILY	WEEKLY	EVERY 750 MI.	EVERY 1500 MI.	EVERY 2500 MI.	EVERY 5000 MI.	EVERY 7500 MI.	EVERY 12 MTHS.	EVERY 24 MTHS.	TYPE OF LUBE. FLUID OR FILTER
1	STEERING SLIP SHAFT U-JOINTS						LUBRICATE				GREASE - NLGI #2 OR EQUIV.
2	SPINDLE JOINTS - TOP & BOTTOM						LUBRICATE				GREASE - NLGI #2 OR EQUIV.
3	TIE ROD BALL JOINTS						LUBRICATE				GREASE - NLGI #2 OR EQUIV.
4	DRAG LINK BALL JOINTS						LUBRICATE				GREASE - NLGI #2 OR EQUIV.
5	PROP SHAFT U-JOINTS						LUBRICATE				GREASE - NLGI #2 OR EQUIV.
6	ENGINE OIL	CHECK LEVEL					CHANGE				SEE ENGINE MANUAL
7	SURGE TANK - COOLING SYSTEM FILL	CHECK LEVEL							CHANGE		50/50 ETHYLENE GLYCOL & WATER
8	TRANSMISSION FLUID	CHECK LEVEL							CHANGE		DEXTRON II
9	REAR AXLE LUBE						CHECK LEVEL		CHANGE		SEE AXLE MANUAL
10	COOLANT FILTER						CHANGE				SEE ENGINE MANUAL
11	DRIVE BELT		INSPECT								CHANGE
12	AIR BAGS		INSPECT								
13	POWER STRG. RESEVOR		CHECK LEVEL						CHANGE		DEXTRON II
14	WHEEL BEARINGS - FRONT	CHECK LEVEL									BOW90 GEAR LUBE
15	AIR CLEANER		INSPECT			CLEAN	CLEAN	REPLACE ELEMENT			DRY TYPE ELEMENT

NO. #	DESCRIPTION	DAILY	WEEKLY	EVERY 750 MI.	EVERY 1500 MI.	EVERY 2500 MI.	EVERY 5000 MI.	EVERY 7500 MI.	EVERY 12 MTHS.	EVERY 24 MTHS.	TYPE OF LUBE. FLUID OR FILTER
16	POWER STEERING GEAR			INSPECT FOR LEAKS							
17	ENGINE OIL FILTER						CHANGE				SEE ENGINE MANUAL
18	BATTERIES	INSPECT									SEE BODY MANUAL FOR BATTERY LOCATION
19	TIRES	INSPECT									
20	TRANSMISSION OIL FILTER FOR AT & MT TRANS.						CHANGE				SEE TRANMISSION MANUAL
21	ENGINE FUEL FILTER								CHANGE		SEE ENGINE MANUAL
22	AIR TANKS		DRAIN MOISTURE								
23	AIR DRYER DESSICANT CARTRIDGE									CHANGE	
24	POWER STRG. RES. FILTER (INSIDE RES.)								CHANGE		
25	BRAKE CAM SHAFT & SLACK ADJUSTER						LUBRICATE				GREASE - NLGI #2 OR EQUIV.
26	REAR TRACK BAR						LUBRICATE				GREASE - NLGI #2 OR EQUIV
27	COOLANT RECOVERY BOTTLE	CHECK LEVEL									ADD COOLANT AS NEEDED

Warranty

spartan motors inc.

CUSTOM BUILT VEHICLES AND CHASSIS
p.o. box 440 1000 reynolds road charlotte, michigan 48813
phone (517) 543-6400 fax (517) 543-7729

IMPORTANT:
- Please include original invoice for work, labor, parts.
- All bills must be accompanied with this paperwork otherwise they will be rejected.
- Any work performed which exceeds the initial Spartan authorization cost must be approved by Spartan Motors.

OWNER'S NAME	
ADDRESS	
PURCHASE DATE	FAILURE DATE

CHASSIS VIN#	VEHICLE MILES	
BODY BUILDER		

SERVICE CENTER ADDRESS	
PHONE NO.	CONTACT

WARRANTY AUTHORIZATION

Authorization# _____
Hours Authorized _____
Hours Adjustment _____
Hours Billed _____
Travel: Authorized _____ Unauthorized _____

WORK PERFORMED	HOURS	PARTS REQUIRED	QTY.	PRICE
TOTAL HOURS		TOTAL AMT DUE		

White - Spartan Motors Service Warranty Dept. • Canary - Spartan • Pink - Spartan Quality Dept. • Goldenrod Service Center

FORM NO. 081289

spartan motors inc.

CUSTOM BUILT VEHICLES AND CHASSIS
p.o. box 440 1000 reynolds road charlotte, michigan 48813
phone (517) 543-6400 fax (517) 543-7729

IMPORTANT:

- Please include original invoice for work, labor, parts.
- All bills must be accompanied with this paperwork otherwise they will be rejected.
- Any work performed which exceeds the initial Spartan authorization cost must be approved by Spartan Motors.

OWNER'S NAME	
ADDRESS	
PURCHASE DATE	FAILURE DATE

CHASSIS VIN#	VEHICLE MILES	
BODY BUILDER		

SERVICE CENTER ADDRESS	
PHONE NO.	CONTACT

WARRANTY AUTHORIZATION

Authorization# _____
Hours Authorized _____
Hours Adjustment _____
Hours Billed _____
Travel: Authorized _____ Unauthorized _____

WORK PERFORMED	HOURS	PARTS REQUIRED	QTY.	PRICE
TOTAL HOURS		TOTAL AMT DUE		

White - Spartan Motors Service Warranty Dept. • Canary - Spartan • Pink - Spartan Quality Dept. • Goldenrod - Service Center

FORM NO. 081289

spartan motors inc.

CUSTOM BUILT VEHICLES AND CHASSIS
p.o. box 440 1000 reynolds road charlotte, michigan 48813
phone (517) 543 6400 fax (517) 543-7729

IMPORTANT:

- Please include original invoice for work, labor, parts.
- All bills must be accompanied with this paperwork otherwise they will be rejected.
- Any work performed which exceeds the initial Spartan authorization cost must be approved by Spartan Motors.

OWNER'S NAME	
ADDRESS	
PURCHASE DATE	FAILURE DATE

CHASSIS VIN#	VEHICLE MILES	
BODY BUILDER		

SERVICE CENTER ADDRESS	
PHONE NO.	CONTACT

WARRANTY AUTHORIZATION

Authorization# _____
Hours Authorized _____
Hours Adjustment _____
Hours Billed _____
Travel: Authorized _____ Unauthorized _____

WORK PERFORMED	HOURS	PARTS REQUIRED	QTY.	PRICE
TOTAL HOURS		TOTAL AMT DUE		

White - Spartan Motors Service Warranty Dept. • Canary - Spartan • Pink - Spartan Quality Dept. • Goldenrod - Service Center

FORM NO. 081289

Spartan motors inc.

CUSTOM BUILT VEHICLES AND CHASSIS

IMPORTANT!

PART DELIVERED	QTY	PRICE

WORK PERFORMED	HOURS	TOTAL HOURS

spartan motors inc.

CUSTOM BUILT VEHICLES AND CHASSIS
p.o. box 440 1000 reynolds road charlotte, michigan 48813
phone (517) 543-6400 fax (517) 543-7729

IMPORTANT:
- Please include original invoice for work, labor, parts.
- All bills must be accompanied with this paperwork otherwise they will be rejected.
- Any work performed which exceeds the initial Spartan authorization cost must be approved by Spartan Motors.

OWNER'S NAME	
ADDRESS	
PURCHASE DATE	FAILURE DATE

CHASSIS VIN#	VEHICLE MILES	
BODY BUILDER		

SERVICE CENTER ADDRESS	
PHONE NO.	CONTACT

WARRANTY AUTHORIZATION

Authorization# _____
Hours Authorized _____
Hours Adjustment _____
Hours Billed _____
Travel: Authorized _____ Unauthorized _____

WORK PERFORMED	HOURS	PARTS REQUIRED	QTY.	PRICE
TOTAL HOURS		TOTAL AMT DUE		

White - Spartan Motors Service Warranty Dept. • Canary - Spartan • Pink - Spartan Quality Dept. • Goldenrod - Service Center

FORM NO. 081289

spartan motors inc.

CUSTOM BUILT VEHICLES AND CHASSIS
p.o. box 440 1000 reynolds road charlotte, michigan 48813
phone (517) 543-6400 fax (517) 543-7729

IMPORTANT:
- Please include original invoice for work, labor, parts.
- All bills must be accompanied with this paperwork otherwise they will be rejected.
- Any work performed which exceeds the initial Spartan authorization must be approved by Spartan Motors.

OWNERS NAME

ADDRESS

PURCHASE DATE | FAILURE DATE

CHASSIS VIN | VEHICLE MILES

BODY BUILDER

SERVICE CENTER ADDRESS

PHONE NO. | CONTACT

WARRANTY AUTHORIZATION
Authorization# ______
Hours Authorized ______
Hours Adjustment ______
Hours Billed ______
Travel Authorized ______ Unauthorized ______

WORK PERFORMED	HOURS	PARTS REQUIRED	QTY.	PRICE
TOTAL HOURS		TOTAL AMT DUE		

White - Spartan Motors Service Warranty Dept • Canary - Spartan • Pink - Spartan Quality Dept • Goldenrod - Service Center

FORM NO. 081289

WARRANTY

TABLE OF CONTENTS

2

THIS WARRANTY WILL BE NULL AND VOID IF SPARTAN OWNER VEHICLE REGISTRATION FORM IS NOT SENT TO SPARTAN WITHIN THIRTY DAYS AFTER DATE OF PURCHASE.

CHASSIS LIMITED WARRANTY

CHAPTER 2

WARRANTY DETAILS

Spartan Motors, Inc., ("Spartan") warrants to the original purchaser of a vehicle equipped with a Spartan chassis ("chassis") that Spartan, through an authorized service center will repair or replace, at its option, any part covered by the warranty described below, if a defect in materials or workmanship appears in any such item within the applicable period warranty.

The warranty shall apply as follows:

Limited Chassis Warranty

Spartan Motors warranties its own workmanship for a period of **12 months or 24,000 miles** of operation, whichever comes first. The warranty period will begin on the date the vehicle is delivered to the original purchaser. **This warranty is separate from any other warranties that may be applicable on items included in the chassis that are warranted by their own "manufacturer", such as engine, transmission, axles, brakes, etc.**

> ***Note:*** *Warranty is not transferrable from one owner to another.*

- Any chassis or component part that has been altered or modified in ways not approved in writing by Spartan or by component manufacture, makes said warranty null and void.

Does not cover those items as set forth in "Component Manufacturer's Warranty Coverage".

Owner Responsibilities

Owner is responsible for the cost of lubricating oil, antifreeze, brake linings, filter elements, belts, hoses and other maintenance items replaced during warranty repairs, unless such items are not reusable due to the Warrantable Failure.
Owner is responsible for the operation and maintenance of the chassis as specified in the Spartan Operation and Maintenance Manuals.

Component Manufacturer's Warranty Coverage

The manufacturers of certain components including, but not limited to, the engine, transmission and axles offer a limited warranty on their associated components. These warranties are separate from the Spartan Warranty and are the only coverage for these specific components. In all cases the component manufacturer's warranty are separate from the Spartan Warranty. Component manufacturer warranties may exceed or be less than one (1) year or 24,000 miles.
Frame warranty is void if altered by welding, cutting, or splicing without expressed written consent, and approval to said modifications. And/or improper drilling of flanges.

Please see the manufacturer's warranty guide for description and details.

Items Not Covered

Spartan Motors is not responsible for the following:

- Premiums charged for overtime labor requested by the purchaser.
- Repairs or service work performed by unauthorized service outlet.
- Additions and accessions not performed by Spartan Motors and any problems which may occur as a result of these additions and accessions.
- Depreciation or damage caused by normal wear, lack of reasonable and proper maintenance, failure to follow operating instructions misuse, lack of proper protection during storage, accident, racing or other competitive activities, or usage of un-authorized parts.

- Normal maintenance and replacement of maintenance and wear items such as oil filters, coolants and conditioners, belts, hoses, clutch linings, and brake pads, shoes, discs and drums, etc.
- Loss of time, inconvenience or loss of vehicle use.
- Any towing charges or associated housing bills.
- Batteries and tires.
- Incidental or consequential damages.
- Expenses or costs in excess of warranty coverage.

Obtaining Warranty Service

To obtain service under the Spartan Motors Chassis Limited Warranty, the original retail purchaser must request, during the applicable warranty period, warranty service from an authorized chassis service outlet. To find the nearest authorized service outlet, the purchaser should immediately contact Spartan Motors Service/Warranty Administration (8:00 a.m. to 7:00 p.m., Eastern Standard Time, except weekends and holidays), **1-800-543-4334**.

Have ready your vehicle identification number, mileage, and date of purchase.

Important Note: <u>All warranty work must be authorized by Spartan Motors before repairs are made.</u>

No Authority to Modify

Spartan Motors does not authorize any person to make any representation or promise on its behalf, or to modify the terms or limitations of this warranty in any way.

THIS WARRANTY WILL BE NULL AND VOID IF SPARTAN OWNER VEHICLE REGISTRATION FORM IS NOT SENT TO SPARTAN WITHIN THIRTY DAYS AFTER DATE OF PURCHASE.

IMPORTANT WARRANTY INFORMATION

In the event of a Warranty related problem contact the following:

WARRANTY at Spartan Motors
(800) 543-4334

In the event of a Service related problem, as a result of service received from our factory Service Dept. contact:

SERVICE at Spartan Motors
(517) 543-6400, ext. 207

When contacting any of the above, please have your chassis Vehicle Identification Number (VIN) and mileage in hand.

To insure prompt payment on all Warranty Claims, please follow this procedure:

Important Warranty Information *(Continued)*

1. Be sure that the customer has sent in the Warranty Registration to Spartan Motors.
2. Call the Warranty Department prior to doing the repairs. We will be more than happy to assist you. If possible, please supply Spartan Motors with an estimate for all chassis repairs needed.
3. Spartan's Warranty Department will issue a Warranty Authorization Number to all Warranty Claims over the phone. **This W.A.# must be present on all claims submitted as Warranty.**
4. All bills should be itemized with parts and labor broken down per repair item.
5. Supply all information on top of Spartan's Warranty Claim Form.
6. Attach an original bill to Spartan's Claim Form.
7. In the event of an emergency, Spartan Motors may be contacted at 800-543-4334

between the hours of 8:00 am-7:00 pm, Eastern Standard time, or by calling (517) 543-6400 Ext. 339 between the hours of 8:00 am-4:30 pm Eastern Standard time.

a. NO CHARGE PARTS NOT TO BE RETURNED

Check your packing slip or invoice to determine if Spartan Motors requires the part to be shipped back. If this note "Warranty Order - No Charge", appears on the packing slip and invoice, please do not send the part back as this is a waste of shipping charges.

b. INVOICED PARTS TO BE RETURNED FOR CREDIT

For the parts Spartan Motors requires to be returned, this note will appear on both the packing slip and the invoice:

NOTE: WARRANTY ORDER, REPLACEMENT PARTS, CREDIT WILL BE ISSUED UPON RECEIPT OF DEFECTIVE PARTS AT SPARTAN MOTORS REF. S.O.# _____

TO ASSURE PROPER CREDIT, RETURNED PARTS MUST BE IDENTIFIED WITH THIS P.S.# _____

The new part will have a red tag attached to it. This tag must be removed and attached to the defective part returned for credit. Please properly describe the defect of the part on the red tag. Also, make sure you refer to the P/S No. on the packing slip or invoice number.

If this procedure is followed, we will be able to trace your order and issue credit promptly.

COMPONENT MANUFACTURERS' WARRANTY

AIR DRYER

Midland-Grau Heavy Duty Systems
10930 N. Pomona Ave.
Kansas City, MO 64153
Phone: (800) 643-4728

AXLES

Eaton Corporation
Axle & Brake Division
P.O. Box 4008
Kalamazoo, MI 49003
Phone: 616-342-3050
800-TCM-HELP

On-Highway Products
Rockwell International Corporation
2135 West Maple Road
Troy, MI 48084
Phone: 313-435-1899

Spicer Off-Highway Axle Division
Dana Corporation
P.O. Box 2229
Ft. Wayne, IN 46801-2229
Phone: 704-433-4600

BATTERY

Wonch Battery Co.
1521 Keystone Avenue
Lansing, MI 48911
Phone: 517-394-3600

BRAKES

Gunite Corporation
302 Peoples Avenue
Rockford, IL 61104-7092
Phone: 800-331-2413
(In IL) 800-323-6076

CRUISE CONTROL

Bendix Heavy Vehicle Systems Group
OEM Marketing Regional Office
20650 Civic Center Drive
P.O. Box 5029
Southfield, MI 48086-5029
Phone: 313-827-6460

Rostra Precision Controls, Inc. (Dana)
2519 Dana Drive
Laurinburg, NC 28352
Phone: 919-276-3412

Chevrolet Pontiac Canada Group
Engineering Building
Special OEM Products
30003 Van Dyke Avenue
Warren, MI 48090-9060

ENGINE

Cummins Engine Company, Inc.
P.O. Box 3005
Columbus, IN 47202
Phone: 800-343-7357

Chevrolet Pontiac Canada Group
Engineering Building
Special OEM Products
30003 Van Dyke Avenue
Warren, MI 48090-9060

EXHAUST/FILTRATION

Nelson Industries
Hwy. 51, West
P.O. Box 428
Stoughton, WI 53589
Phone: 608-873-4200

SHOCK ABSORBERS (BILSTEIN)

Power Brake & Spring Co., Inc.
3015 Western Avenue
South Bend, IN 46619
Phone: 219-289-1044

Trailmaster Inc.
649 E. Chicago Rd.
Coldwater, MI 49036
Phone: 1-800-221-1229

STEERING

TRW Ross Gear Division
800 Heath Street
Lafayette, IN 47902
Phone: 317-423-5377

SUSPENSION

Reyco Industries Inc.
P.O. Box 2268
Springfield, MO 65801
Phone: 800-227-3926

TIRES

The Goodyear Tire & Rubber Company
1144 E. Market Street
Akron, OH 44316
Phone: 800-962-4920

Michelin Tire Corporation
One Parkway South
Greenville, SC 29615
Phone: 800-847-8475

TRANSMISSION

Allison Transmission
Division of General Motors
Attn: Warranty Adm. (PF9)
P.O. Box 894
Indianapolis, IN 46209-9913
Phone: 317-242-6292

Chevrolet Pontiac Canada Group
Engineering Building
Special OEM Products
30003 Van Dyke Avenue
Warren, MI 48090-9060

WHEELS

Accuride Corp.
P.O. Box 40
Henderson, KY 42420
Phone: 800-826-5000

Forging Division
ALCOA
1600 Harvard Avenue
Cleveland, OH 44105
Phone: 800-242-9898

Engine

ENGINE

TABLE OF CONTENTS 3

ENGINE

C H A P T E R 3

ABOUT THIS CHAPTER

This chapter, along with the attached Cummins Operation and Maintenance Manual, contains information for correctly operating and maintaining your Cummins engine. The manual also includes important safety information, engine and systems specifications, troubleshooting guidelines, and a listing of Cummins Authorized Repair Locations and component manufacturers.

Note: *Keep your Cummins manual with your vehicle. If your RV is traded or sold, be sure to give the manual to the new owner.*

B-SERIES MAINTENANCE SCHEDULE

Daily or Refueling	Every 8,000 Km (5,000 Mi),250 Hours or 3 Months	Every 16,000 Km (10,000 Mi), 500 Hours or 6 Months	Every 32,000 Km (20,000 Mi) 1000 Hours or 12 Months	Every 64,000 Km (40,000 Mi), 2000 Hours or 2 Years
Check		Change/Replace		
•Oil Level	•Lube Oil[1]	•Lube Oil	•Lube Oil	•Lube Oil
•Coolant Level	•Lube Filter	•Lube Filter	•Lube Filter	•Lube Filter
•Fan-Inspection		•Fuel Filter	•Fuel Filter	•Fuel Filter
•Drive Belt-Inspection				•Antifreeze[2]
•Fuel Water Trap			Adjust	
			•Valve Lash[3] Clearance	•Valve Lash Clearance
			Check/Inspect	
	•Air Cleaner	•Air Cleaner	•Air Cleaner	•Air Cleaner
	•Intake System	•Intake System	•Intake System	•Intake System
		•Antifreeze	•Antifreeze	•Fan Hub
			•Fan Hub	•Belt Tensioner Bearing
			•Belt Tensioner Bearing	•Belt Tension
			•Belt Tension	•Damper

[1] Refer to the Oil Change interval chart given in Chapter 4 to find the specific oil change interval for your application.

[2] Must use a heavy duty antifreeze that meets the chemical composition of GM6038M. The change interval is 2 years or 200,000 miles (320,000 Km), whichever comes first.

[3] Initial valve lash clearance adjustment, subsequent adjustments to be performed at 40,000 mile intervals.

C-SERIES MAINTENANCE SCHEDULE

Daily or Refueling	Every 8,000 Km (5,000 Mi),250 Hours or 3 Months	Every 16,000 Km (10,000 Mi), 500 Hours or 6 Months	Every 32,000 Km (20,000 Mi) 1000 Hours or 12 Months	Every 64,000 Km (40,000 Mi), 2000 Hours or 2 Years
Check	Change/Replace			
•Oil Level	•Lube Oil[4]	•Lube Oil	•Lube Oil	•Lube Oil
•Coolant Level	•Lube Filter	•Lube Filter	•Lube Filter	•Lube Filter
•Fan-Inspection		•Fuel Filter	•Fuel Filter	•Fuel Filter
•Drive Belt-Inspection				•Antifreeze[5]
•Fuel Water Trap			Adjust	
			•Valve Lash Clearance[6]	•Valve Lash Clearance
			Check/Inspect	
	•Air Cleaner	•Air Cleaner	•Air Cleaner	•Air Cleaner
	•Intake System	•Intake System	•Intake System	•Intake System
		•Antifreeze	•Antifreeze	•Fan Hub
			•Fan Hub	•Belt Tensioner Bearing
			•Belt Tensioner Bearing	•Belt Tension
			•Belt Tension	•Damper

ENGINE: FILTERS, FLUIDS, AND CAPACITIES

Engine	Oil Filters	Recom'd Capacity	Oil Pan Capacity	Total Oil Capacity	Fuel Filters	Coolant Filters	Recom'd Coolant
Cummins	Fleetguard #	CE/SF	15 Quarts	17.3 Quarts	Fleetguard #'s		Low Sillicate
6BTA 5.9	LF 3349	15W-40			Dual Filter System FF 5052 FF 5038 Single Filter System FS 1226	———	50% Ethylene Glycol Antifreeze 50% Water
Cummins 6CTA 8.3 240 HP	Fleetguard #'s LF 734	CE/SF 15W-40	20 Quarts	23.7 Quarts	Fleetguard #'s Dual Filter System FF 5052 FF 5038	Fleetguard #'s Initial WF 2072 After That WF 2070	Low Silicate 50% Ethylene Glycol Antifreeze 50% Water
Cummins 6CTA 8.3 250 HP	Fleetguard #'s LF 3000	CE/SF 15W-40	20 Quarts	23.7 Quarts	Fleetguard #'s Dual Filter System FF 5052 FF 5038	Fleetguard #'s Initial WF 2072 After That WF 2070	Low Silicate 50% Ethylene Glycol Antifreeze 50% Water
Cummins 6CTA 8.3 300 HP	Fleetguard #'s LF 3000	CE/SF 15W-40	20 Quarts	23.7 Quarts	Fleetguard #'s Dual Filter System FF 5052 FF 5038	Fleetguard #'s Initial WF 2072 After That WF 2070	Low Silicate 50% Ethylene Glycol Antifreeze 50% Water

Note: *Refer to the date plate inside the coach for specific engine and transmission model numbers.*

[4] Refer to the Oil Change interval chart given in Chapter 4 to find the specific oil change interval for your application.

[5] Must use a heavy duty antifreeze that meets the chemical composition of GM6038M. The change interval is 2 years or 200,000 miles (320,000 Km), whichever occurs first.

[6] Initial valve lash clearance adjustment, subsequent adjustments to be performed at 40,000 mile intervals.

ENGINE FILTERS

Filters	Fleetguard No.
B 5.9	
Fuel Filter (water separator)	FS 1226
Oil Filter.	LF 3349
C8.3	
Fuel Filter - Primary (water Separator)	FS 1280
Seconday.	FF 5052
Oil Filter.	Lf 3000
Coolant Filter.	WF 2070

ENGINE BELTS

EC Model Chassis		
B5.9 160 Hp.	Main Drive Belt	A/C Compressor Belt
190 + 230 hp w/105 amp alternation	Dayco # 5080560	Dayco 17455
190 + 230 hp w/160 amp alternation	Dayco # 5080605	Dayco 17455

IC and MH Model Chassis		
	Main Drive Belt	A/C Compressor Belt
B 5.9 190 + 230 hp w/105 amp alternator	Dayco # 5080560	Dayco # 17455
190 + 230 hp w/160 amp alternator	Dayco # 5080605	Dayco # 17455
C 8.3 250 & 300 hp.	Dayco # 5080605	Dayco # 17465

***CAUTION:** When replacing belts be sure to look at the part number printed on old belt.*

ENGINE AIR CLEANER

Air Cleaner Asm.	Element No.	Remarks	Application
Nelson Industries Model 77003N	Nelson Industries 70469N	4" Inlet and Outlet	Cummins B 5.9 160,190 hp
Nelson Industries model 78515N	Nelson Industries 70470N	5" Inlet and Outlet	Cummins B 5.9 230 hp
Nelson Industries Model 78515N	Nelson Industries 70470N	5" Inlet and Outlet	Cummins C 8.3 250,300 hp

AIR CLEANER SERVICE

Avoid opening the air cleaner or disturbing the seals and element any more than necessary.

WHEN SHOULD AN AIR CLEANER NOT BE SERVICED? Do not replace the air cleaner when it is not restricted . . . even though it may **look** dirty. A moderate dust cake improves filtration efficiency and helps to filter out ultra-fine particles that plug the pores of the paper. It can actually extend the life of the filter element.

ELEMENT LIFE: Service intervals depend on environmental conditions in which the unit is operating.
Snow or exhaust smoke may plug an element in a very short time.

REPLACING THE ELEMENT: Gasket end seals and wing nut seals should be checked for compression set, loose bonding, or anything that would prevent an airtight seal.

The air cleaner housing sealing surfaces should be wiped clean and checked for dents or warpage that would prevent a good seal when reinstalling the element.

6.5L V-8 TURBO DIESEL MAINTENANCE SCHEDULE

Daily or Refueling	Every 5,000 Mi. (8,000 Km), 250 hrs or Three (3) Months	Every 10,000 Mi. (16,000 Km), 500 hrs or Six (6) Months	Every 20,000 Mi. (32,000 Km), 1000 hrs or Twelve (12) Months	Every 40,000 Mi. (64,000 Km), 2000 hrs or Two (2) Years
Check		Change or Replace		
Oil Level Coolant Level Fan-Inspection Drive Belt Inspection Fuel Water Trap	Lube Oil (1,3) Lube Filter	Lube Oil Lube Filter Fuel Filter	Lube Oil Lube Filter Fuel Filter Antifreeze (2)	Lube Oil Lube Filter Fuel Filter Antifreeze (2)
		Check or Inspect (Replace if neccessary)		
	Air Cleaner Intake System	Air Cleaner Intake System Antifreeze	Air Cleaner Intake System Fan Hub Belt Tensioner and Bearing Belt Tension Belts Crankcase Depr. Regulator Valve	Air Cleaner Intake System Fan Hub Belt Tensioner and Bearing Belt Tension Belts Crankcase Depr. Regulator Valve

1. Refer to the Oil Change interval chart given in Chapter 4 to find the specific oil change interval for your application.
2. Must use a heavy duty antifreeze that meets the chemical composition of GM 1899M specification. The change interval is 12 months (1 year) or every 40,000 miles (64,000 Km) maximun, whichever comes first.
3. Unless towing, then the required interval is 2,500 miles (4,000 Km), 250 hours or three(3) months.

ENGINE FILTERS

Filters	GM Part #'s
Fuel Filter/Water Seperator	10154635
Secondary Fuel Filter/Water Seperator	14075347
Oil Filter (AC Delco # PF-35)	6438384

ENGINE BELTS

EC-1000 Series	Main Drive W/AC	Main Drive WO/AC
General Motors Part#	14102104	22518599
Dayco Part #	5061010	5061020

CAUTION: When replacing belts be sure to look at the part number printed on the belt.

ENGINE AIR CLEANER

Air Cleaner Assm.	Element No.	Application
A/C Delco	A/C #A917C	6.5L V-8 190hp
	GM #25042562	6.5L V-8 190hp

Engine	Oil Filters	Recom'd Fluid	Recom'd Capacity	Fuel Filters	Recom'd Coolant
General Motors		CE/SE			Low Silicate
6.5L V–8	GM# 6438384 AC/Delco# PF–35	15W–40	7 Quarts	GM# 10154635 Secondary Filter: Stanadyne #80 Element	50% Ethylene Glycol Anti–freeze and 50% water

FILTER MINDER
(MH - Standard; EC & IC - Option)

(Not available for EC-1K Series)

CAUTION: Do not over-service — or under-service — the air cleaner!

The Filter Minder is an air restriction monitoring system that works much like a fuel gauge to progressively and constantly indicate how much air filter capacity has been used and how much element capacity remains. It measures the actual maximum restriction of the filter element when the engine is operating under full load and locks in the reading at that point, so that remaining element capacity can be read even after the engine is shut down.

PREVENTIVE MAINTENANCE INSPECTION

- If the yellow indicator has not reached the 25" line, note and record the indicated restriction. Compare it with the last reading and note the rate of change. An unusually rapid increase may indicate a temporary restriction caused by moisture or snow.
- Reset the Filter Minder by pushing on the bottom to determine that it is operating and that the fitting on the air cleaner is not plugged. The indicator will rise back to the actual restriction level and lock in on the next trip.
- Reset the Filter Minder at each service check. If it does not reset, check for plugged restriction tap fitting.

SERVICE

Avoid opening the air cleaner or disturbing the seals and element either until the Filter Minder reads 25" or at the engine manufacturer's restriction specification for service. Service the air cleaner BEFORE the yellow indicator reaches the red line.

WHEN SHOULD AN AIR CLEANER NOT BE SERVICED?

Do not replace the air cleaner when it is not restricted . . . even though it may **look** dirty. A moderate dust cake improves filtration efficiency and helps to filter out ultra-fine particles that plug the pores of the paper. It can actually extend the life of the filter element.

LOSS OF POWER

If the Filter Minder indicator is not at the red line and not obstructed, you will know that the element is not fully restricted and therefore not causing the loss of power. **Check the fuel filter.**

ELEMENT LIFE

Service intervals based on air cleaner restriction are not time or mileage predictable — it depends on environmental conditions in which the unit is operating. Snow or exhaust smoke may plug an element in a very short time.

NEW ELEMENTS

Initial restriction with new elements will vary with each air cleaner from as little as 2" to as much as 15". This value can be noted after new elements are installed and the engine is operating at full power.

WHEN REPLACING ELEMENTS

The air cleaner housing sealing surfaces should be wiped clean and checked for dents or warpage that would prevent a good seal when reinstalling the element.

SYSTEM CHECK

The Filter Minder can be reset at zero at each service interval to see that it returns to its present condition. If the Filter Minder is at the red line but the filter does not appear to be plugged, this may be due to a temporary condition, such as snow. The element should be thoroughly

checked for damage resulting from high vacuum with wet filter paper.

TURBOCHARGED ENGINES

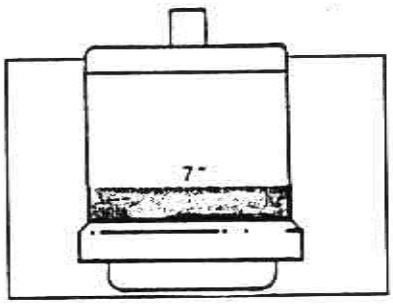
Air cleaner restriction can be accurately measured on turbocharged engines only when the engine is operating under full load either with a dynamometer or when passing another vehicle going uphill. This is because certain conditions, such as collapsing and restricting rubber elbows, may occur only at full load air flow.

***CAUTION:* Do not wash the Filter Minder gauge with engine degreaser solvents. These solvents may deteriorate the Lexan polycarbonate housing.**

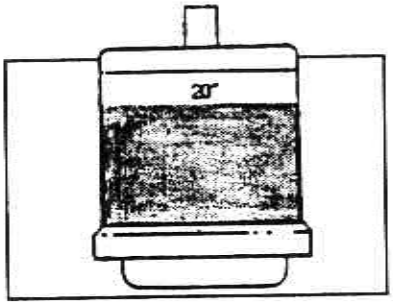
GENERAL INFORMATION

Restriction tap fittings often plug from moisture or engine vapors. They should not be located at a low point where moisture and oil can settle. Most engine degreasers are harmful to polycarbonate (Lexan) plastics that are used in restriction indicators and other clear plastic items such as head lamps, oil bowls, etc. Tysol Products, Chicago, Illinois, manufactures Tysol #196 cleaner which we have found harmless if water temperature does not exceed 160°F.

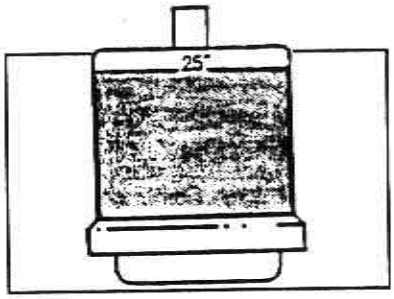
It is important to know the highest full load restriction that occurred during the vehicle operation in order to service the filter BEFORE blockage is indicated at the red line. After an element has reached its red-line value, only a little more contaminant is allowed before high fuel consumption and poor engine operation occurs.



Normal clean filter.
(Varies with each system design.)

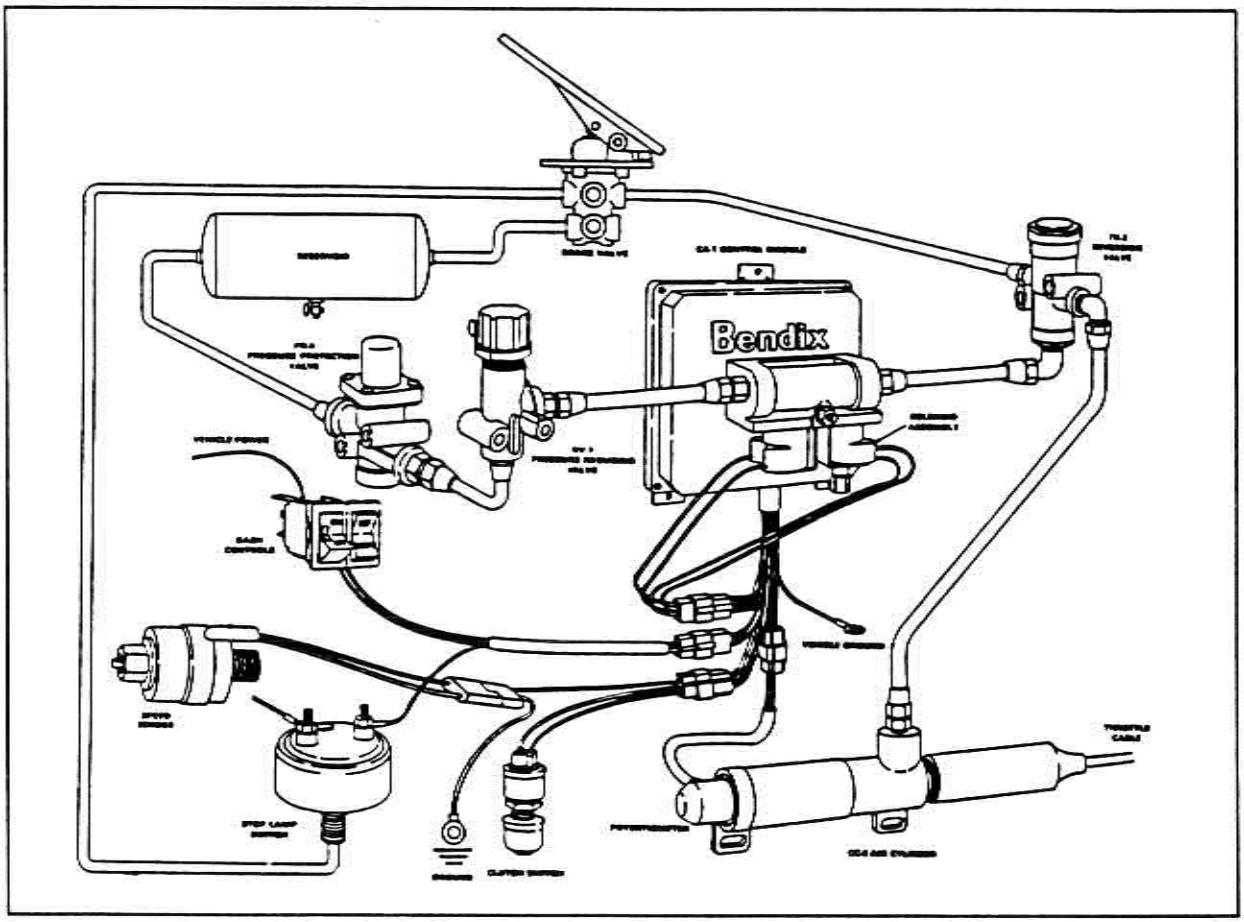


Filter approaching the end of its dirt holding capacity. (Fuel consumption increasing, but engine still runs well.)
SERVICE AT THIS POINT



Filter life used up. Engine is using more fuel with a slight loss in power. Additional contamination causes black smoke, low power and higher fuel consumption. CONTINUED OPERATION MAY DAMAGE ENGINE

BENDIX CRUISE CONTROL SYSTEM OPTION



DESCRIPTION

Bendix Cruise Control is a driver-controlled, automatic speed control system designed for use on heavy-duty highway vehicles. It can be used on most popular diesel engines and any type of standard or automatic transmission.

The system incorporates the following standard features:

Set/Resume - permits vehicle speed to be set or to resume a previously set speed after disengagement.

*Accelerate/Coast** - permits vehicle speed increase or decrease with control switches.

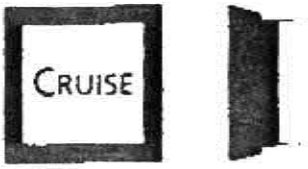
In addition, the following optional features are available:

Top Speed, Set Limit - prevents Cruise Control System use above a preset maximum vehicle speed.

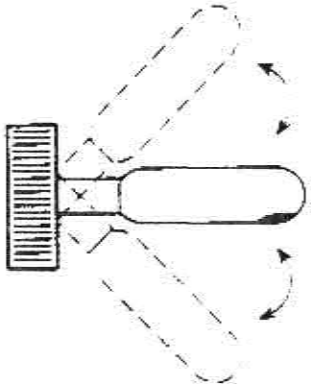
Throttle Control - provides control of the engine throttle position while the vehicle is stationary.

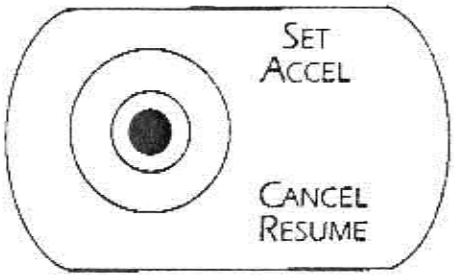
The Bendix Cruise Control System is available for either 12-volt or 24-volt electrical systems.

** Accelerate feature not available in early design models.*



MASTER ON/OFF SWITCH
IN = ON OUT = OFF
ILLUMINATED ONLY
WHEN CRUISE IS SET





ECO *cruise* ELECTRONIC SPEED CONTROL SYSTEM

Operating Instructions

Drive vehicle to desired speed, move toggle switch to **SET** release.

To ACCELERATE: hold toggle switch to **ACCEL** until desired speed is reached, release.

To DISENGAGE: move toggle switch to **CANCEL** release.

To RESUME previous cruise speed, move toggle switch to **RESUME,** release.

Depressing the brake or clutch (manual transmission) pedal will disengage the system, as will selecting NEUTRAL in automatic transmission (optional). The last cruise speed will remain in the memory and can be RESUMED by moving toggle switch to **RESUME.**

The system can also be disengaged by switching the master switch off. However, the last cruise speed will be lost from memory.

The system will not operate below 25 mph. However, the last cruise speed will remain in memory.

ECONOCRUISE

For further information please contact:
Econocruise 3744 Plaza Dr., #1A, Ann Arbor, MI 48108
(313) 930-0500 FAX (313) 930-0932

PREVENTIVE MAINTENANCE

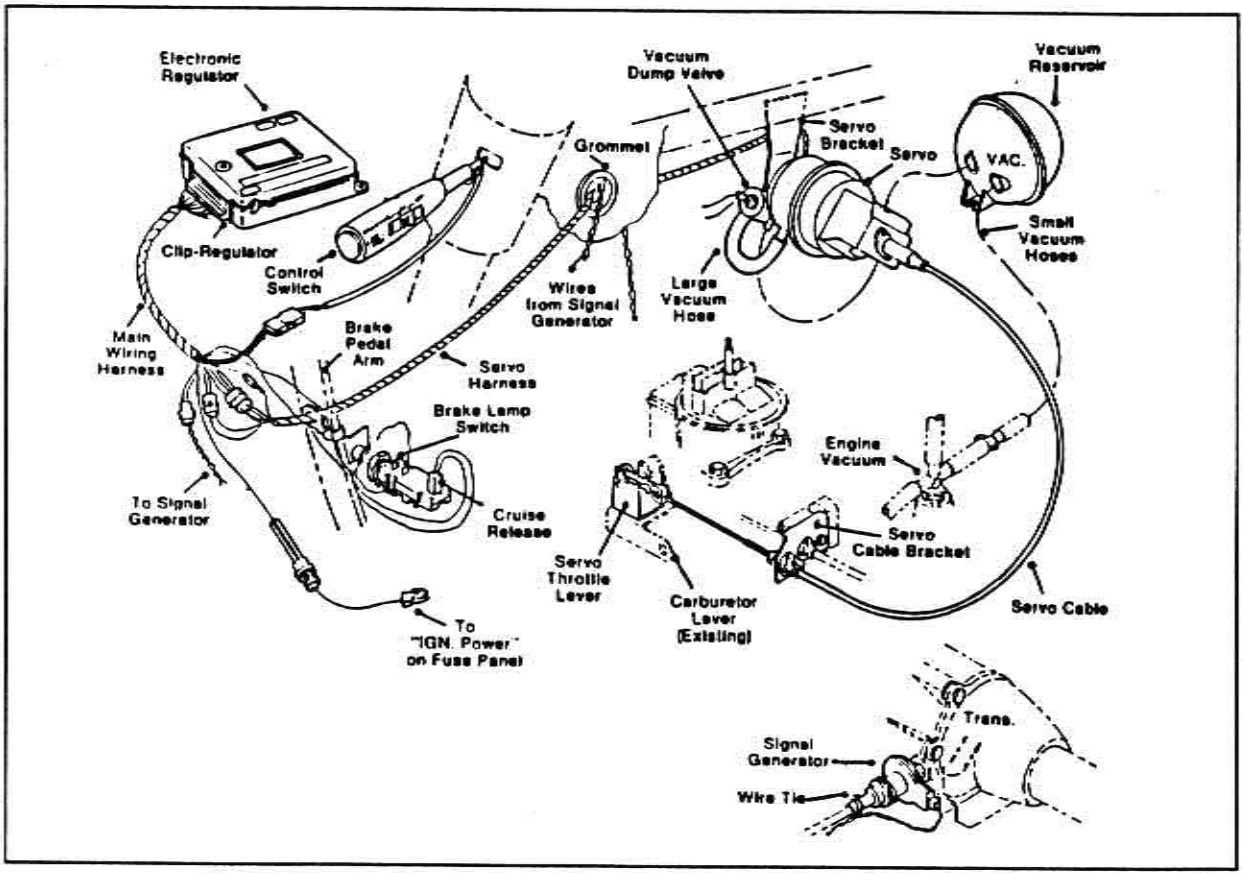
Every three months, 25,000 miles, or 900 operating hours:

1. Inspect the CC-5 Air Cylinder for secure mounting.
2. Remove accumulated grime from the outside of the CC-5 Air Cylinder, paying particular attention to the three body vents.
3. Remove accumulated grime from the exterior of the solenoid assembly.
4. Visually inspect the throttle cable and cable end for fraying or wear. Replace if necessary.
5. Inspect the throttle cable hardware for secure mounting.
6. Visually inspect the system wiring and connectors for deterioration or wear.
7. Perform the system operation and road test.

Every year, 100,000 miles or 3,600 operating hours, remove, repair or replace and test the following components:

1. TR-3 Inversion Valve (refer to Service Data Sheet SD-03-65).
2. RV-1 Reducing Valve (refer to Service Data Sheet SD-03-60).
3. PR-2 or PR-4 Pressure Protection Valve (refer to Service Data Sheet SD-03-55).
4. CC-5 Air Cylinder.
5. Solenoid assembly.

DANA'S (ROSTRA) ELECTRONIC CRUISE CONTROL SYSTEM (7-R SYSTEM) OPTION



SAFETY SWITCH

In the regulator box of your cruise-control system is a safety switch which will not let the system operate until your vehicle is moving above a pre-selected low speed. This "low speed switch" is set at the factory to close between 27 and 33 mph.

CONTROL SWITCH

The control switch is the switch you will use to operate all features of the system described in the following paragraphs. It is mounted on the turn signal lever as an integral unit.

CRUISE CONTROL OPERATION

Set Speed

Move the slide button on the control switch to the ON position. Accelerate the vehicle to your desired cruising speed (32 mph or higher). Holding that speed with your foot, press and release the SET/COAST button. Wait one second after release, then take your foot off the accelerator pedal.

You can increase your speed at any time with the accelerator pedal. When you release the pedal, the vehicle will return to the set speed.

Acceleration

To accelerate using the cruise control, hold the slide button in the RESUME/ACCEL position. Your vehicle will accelerate until you release the slide button, allowing the vehicle to slow to the set speed and remain there.

To make a higher speed your new set speed, release the slide button from the RESUME/ ACCEL position when you reach the higher speed you want, then quickly press and release the SET/COAST button.

Coast

Press and hold the SET/COAST button to erase the set speed from the regulator's memory and allow the vehicle to coast. To make a lower speed your new set speed, release the SET/ COAST button just before you reach the lower speed you want. Your new speed must be above 32 mph to allow the cruise control to function.

Disengagement

Depressing the brake or clutch pedal approximately one inch also gives you manual control of the vehicle speed. You can also disengage the cruise control by pushing the slide button to OFF, but this erases the set speed from the regulator's memory.

Resume

Disengaging the system with the brake does not erase the Set Speed from the regulator's memory, even if you come to a complete stop. To return to your chosen speed, accelerate to a speed above 32 mph, then move the slide button to the RESUME/ACCEL position and release it. The cruise control will take you back to your set speed and control there.

If the rate of acceleration is faster or slower than you like, drive with the accelerator to a speed close to the set speed, then slide the button to the RESUME/ACCEL position and release it.

When the regulator is adjusted correctly, the cruise control should hold your selected speed within 4 mph above or below, so long as grades do not exceed 7% — the maximum you will encounter on most interstate highways.

FINAL NOTES

Note: *Leaving the control switch on with the ignition switch off will not drain the battery.*

CAUTION: ***Do not use your cruise control on slippery roads, or in heavy traffic.***

Note: *Before leaving on a long trip, make a short road trip to see that all functions are working. If your cruise control does not function as described above, contact your dealer.*

If you have any questions concerning the operation of your cruise control, please contact your dealer or call 1-800-GET-DANA.

Cooling System (MH & IC model chassis)

Radiator Location - Driver's side of chassis beside engine.

Cooling fan - Hydrostatically driven and tapped into power steering system. The fluid in the power steering reservoir also lubricates the cooling fan.

Pressure Cap Location - On surge tank fill neck. 16PSI Stant R-30 or equivalent.

Coolant - 50/50 mixture of ethylene glycol and water.

Cooling System (EC model chassis)

Two different cooling systems are offered on this model. Be sure to determine which system is installed on your vehicle.

Cooling System #1
Radiator Location - On driver's side of chassis beside engine. Refer to the cooling system for the MH and IC model chassis described above for more information.

Cooling System #2
Radiator Location - Behind engine.
Cooling Fan - Belt Driven.
Pressure Cap Location - Located on radiator fill neck. 16PSI Stant R-30 or equivalent.

Exception: EC-1K chassis has a sealed radiator cap NAPA# 703-1400 and the 16PSI stant R-30 on the fill neck of the surge tank.

Coolant - 50/50 mixture of ethylene glycol and water

Fluid Level Check

WARNING: Extreme caution should be taken when removing surge tank cap or radiator cap. Coolant could be extremely hot and under pressure.

MH, IC and EC model chassis with radiator mounted on drivers side of chassis beside engine: Fluid level should be checked at both the surge tank and the recovery bottle. The surge tank fluid level can be viewed through the sight glass located on the fill neck end of the surge tank. The sight glass should always be greenish in color (indicating presence of fluid), regardless of whether the engine is warm or cold. If it is clear, fluid needs to be added. The recovery tank fluid level can be viewed through the tank itself. Level should be between the MAX and MIN marks on the tank.

EC model chassis with radiator mounted behind engine: Fluid level should be checked at both the radiator and the recovery bottle. The radiator fluid level can be checked by removing the radiator cap and looking into fill neck. Fluid should be visible above radiator core. The recovery tank fluid level can be viewed through the tank itself. Level should be between the MAX and MIN marks on the tank.

Changing Coolant

It is recommended that coolant be drained and replaced every 24 months.

Refill and Venting Procedure

When refilling the system, make sure all drain cocks are closed. Add coolant to the surge tank (MH & IC models and EC models with side mounted radiator) or the radiator (EC models with rear vented radiators). When surge tank or radiator is full, start and run the engine, and continue adding water until the system is completely full and completely vented of air. The engine thermostat must open before the system can vent itself. Once the system is full, replace the pressure cap and adjust the fluid level in the coolant recovery tank. Some engines are equipped with a vent fitting on the engine thermostat housing, which should be opened during the filling and venting process. Leave this vent open until all air has escaped from system, then close it.

Because most coach manufacturers increase the standard size of the cooling system by adding heater cores, and other modifications, contact your coach manufacturer for total cooling system capacity.

PACBRAKE AUXILIARY BRAKING DEVICE (Optional)

Pacbrake exhaust retarders are auxiliary braking devices for slowing down your vehicle. They both reduce the need to use the service brakes, thus reducing wear and tear on the service braking system.

The Pacbrake Retarder . . .

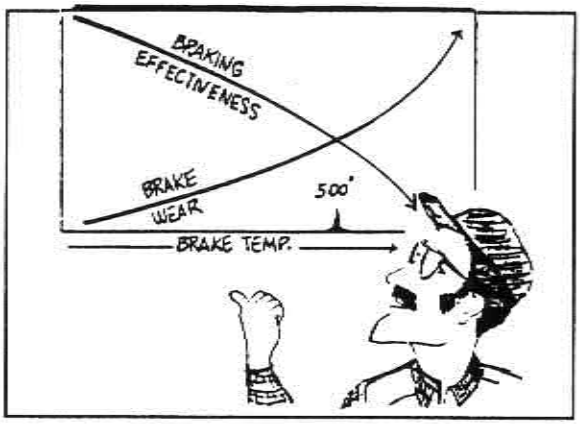
- **can** be used on downhill grades to maintain a steady controlled speed without having to use your service brakes.
- **can** be used to help slow down your vehicle for exit ramps, turns, etc., without having to use your service brakes.
- **cannot** stop your vehicle completely.
- **cannot** be used as a parking brake.

Why Use a Pacbrake Retarder?

- It gives you an added safety margin by saving your service brakes for stopping (especially in downhill operations).
- It can save you money by helping to decrease service brake wear.

Two things happen when service brakes get hot:

- BRAKE WEAR INCREASES — FAST!
- BRAKE EFFICIENCY DECREASES — FAST!



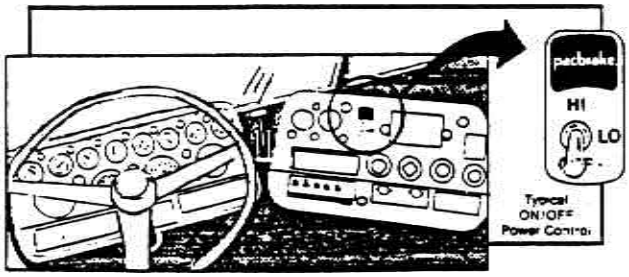
Remember: Extremely high braking system temperatures can build up quickly if you ride the brake, make a quick, hard stop, or have poorly adjusted brakes. When very hot, service brakes fade and you end up with a "runaway rig."

EXHAUST BRAKE

The exhaust brake retarder system is controlled by a master ON/OFF switch on the dash and a throttle switch located in the throttle system. This unit will function only when the master switch is ON and throttle is at or near idle.

Braking Horsepower

Systems work by using a valve to create back pressure in the engine's exhaust system. Retarding power can be up to 70 percent of the engine horsepower with the engine running at rated RPM.



DRIVING TIPS

For flat, dry road conditions, your retarder can be left on at all times. The retarder is very effective for speed control in town and on local hauls.

Use your retarder to slow the vehicle down when:

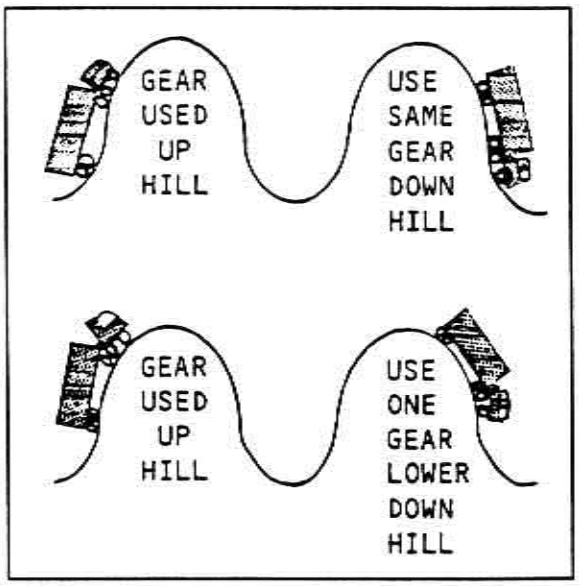
- preparing to turn onto a freeway exit ramp.
- approaching traffic lights.
- approaching stopped or slow traffic.

Use your service brakes only to bring the vehicle to a complete stop or for emergency stops.

Going Downhill

Before beginning the descent, select the gear that lets you go downhill at a constant, controlled speed with little or no use of service brakes. Use your retarder to provide the braking power.
The amount of downshifting needed depends on the type of retarder you have.

Remember: The longer or steeper the hill, the more important it is to use your retarder. Make maximum use of your retarder by downshifting and letting the retarder do the work.



Ice, Snow, or Rain

Using a **Pacbrake** retarder on wet or slippery roads (especially curves) may cause overbraking of the wheels and send you into a skid or jackknife. Using a retarder on slippery or wet roads can actually increase your stopping distance.

Remember:

- The first 10-15 minutes of a rainfall are the most dangerous, since road dirt and oil mix with the rain to create a slippery surface.
- Turn the retarder OFF on icy or snow-covered roads.
- In cold weather, turn the retarder OFF when approaching bridge decks, entry ramps, or exit ramps.
- REDUCE RETARDER POWER in rain or on wet roads. If you cannot reduce the retarder power, TURN THE RETARDER OFF.

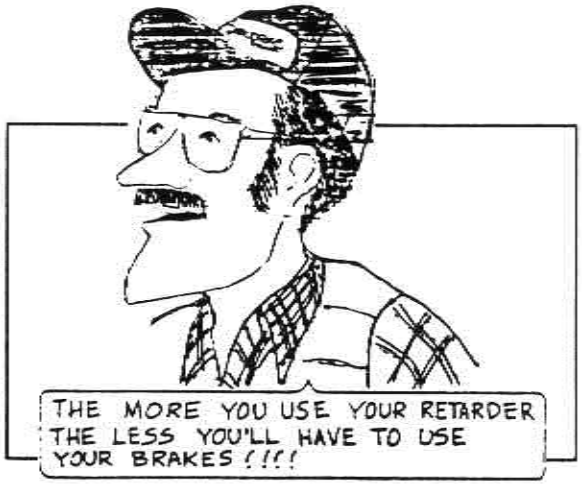
SMART USE OF YOUR RETARDER WILL SAVE YOUR SERVICE BRAKES

By keeping your service brakes cool, you:

- Ensure that your service brakes can make an emergency stop.
- Increase the life of your brake linings.
- Reduce brake drum wear and damage.

Therefore:

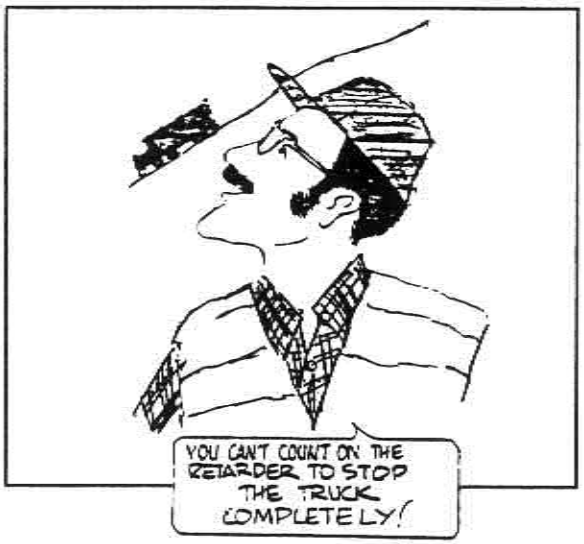
- Use your retarder to slow down — not your service brakes.
- Use your retarder to maintain a steady speed down hills — not your service brakes.
- Ideally, you should only use your service brakes to come to a complete stop, or for emergencies.



PACBRAKE RETARDERS ARE NOT A SUBSTITUTE FOR BRAKES

Do not neglect service brake maintenance and assume your retarder will do their job.

- A retarder will not compensate for poorly maintained service brakes.
- Inspect your brakes before each trip, including adjustment, lining condition, etc.



DRIVING TIPS SUMMARY

A Pacbrake retarder is only to be used to bring the vehicle down to a very slow speed with little or no use of the service brakes.

Use your retarder when:

- you want to slow down in preparation for a stop.
- you want to control your downhill speed.
- you want to keep your service brakes cool for possible maximum use later on.
- you want to save service brake linings.

Remember: Pacbrake retarders are more efficient at preventing an overspeed condition than correcting an overspeed condition.

Transmission

TRANSMISSION

TABLE OF CONTENTS 4

TRANSMISSION

CHAPTER 4

ABOUT THIS CHAPTER

This chapter contains operating tips and preventive maintenance on Allison Transmissions, Models AT-500, MT-600, and MD3060, and Hydra-matic transmission, Model 4L80-E, and 3L80. Please verify your transmission model on the vehicle identification plate before reading this chapter.

A BRIEF DESCRIPTION OF THE ALLISON AUTOMATIC & HYDRAMATIC

ALLISON AUTOMATICS & HYDRAMATIC described in this manual include a hydraulic torque converter, a planetary gear train, and a hydraulic control system which automatically changes gear ratios and supplies pressure to apply the clutches.

The torque converter multiplies engine torque during starts and acts as a hydraulic cushion between the engine and gearing. The clutches and gear sets provide multiple speeds forward and one speed reverse.

The torque converter lockup clutch, for maximum fuel economy, engages automatically after the load is rolling. Lockup clutch is not available on AT-500 Series transmissions.

TORQUE CONVERTER

The torque converter consists of three elements — pump, turbine, and stator. The pump is the input element and is driven by the engine. The turbine is the output element and is driven by oil from the pump, except when the lockup clutch is engaged. The stator is the reaction (torque multiplying) element.

The torque converter is continuously filled with oil. The pump, driven by the engine, directs the oil against the turbine vanes which causes the turbine to rotate. The turbine returns the oil through the stator which redirects the flow so that oil strikes the pump vanes in the same direction that the pump is rotating. As the pump turns faster in relation to the turbine, the velocity of the oil increases and so does the torque multiplication.

As the speed of the turbine approaches the speed of the pump, the oil flow starts striking the back sides of the stator vanes. This causes the stator to freewheel in the same direction as the pump and turbine. When this occurs, the torque multiplication stops and the converter functions as a fluid coupling.

LOCKUP CLUTCH [MT(B) 600]

The lockup clutch consists of three elements — piston, clutch plate, and backplate. The piston and backplate are driven by the engine. The clutch plate, located between the piston and backplate, is splined to the converter turbine.

The lockup clutch automatically engages after the load is rolling and the torque demand is low. Engagement of the lockup clutch mechanically connects the torque converter pump to the turbine and provides a direct drive from the engine to the transmission. The lockup clutch automatically releases at lower vehicle speeds. When the lockup clutch is not engaged, drive from the engine is transmitted hydraulically through the converter to the transmission gearing.

Because the converter lockup engagement and release is designed to fit the vehicle's vocation, there are many variations among transmission assemblies. Lockup speeds are determined by many factors. Among these are transmission-engine match, transmission-vehicle match, model year, throttle position, and calibration of the hydraulic system. Some models have lockup available in all ranges. Others have lockup

LOCKUP CLUTCH (Continued)

available in the upper ranges. Some models have modulated lockup, which provides better engine braking by delaying lockup disengagement during closed-throttle operation. For specific information on the lockup characteristics of your transmission, contact your dealer or distributor.

Lockup engagement, like range shifts, may be felt under some conditions. The driver who counts shifts should not confuse lockup with a gear change. A little driving experience with the ALLISON AUTOMATIC will enable the driver to distinguish between the two.

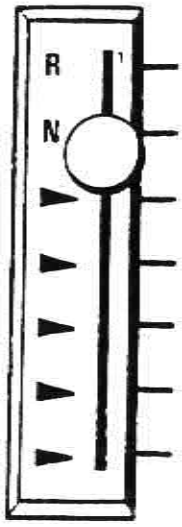
SHIFT SELECTORS

The best performance will be obtained by using the correct gear range for each driving condition. The following table illustrates shift patterns for the various models and indicates the page that explains the shift pattern for your vehicle.

When your vehicle is equipped with an ALLISON AUTOMATIC, it is not necessary to select the right moment to upshift or downshift during the changing road and traffic conditions.

The ALLISON AUTOMATIC does it for you. A knowledge of the gear ranges available at your range selector will make control of the vehicle and your job even easier.

ALLISON AUTOMATICS



AT-542 AT-545	MT(B)-643	MD-3060
Reverse	Reverse	
Neutral	Neutral	(SEE PAGES AT END OF CHAPTER)
1-4	1-4	
1-3	1-3	
1-2	1-2	
1	1	
—	—	

GEAR RANGE SELECTION — AT-542, AT-545; MT(B)-643	
!	***WARNING: Do not allow your vehicle to coast in neutral. This practice can result in severe transmission damage. Also no engine braking is available.***
R	Use this to back the vehicle. Completely stop the vehicle before shifting from a forward gear to reverse or from reverse to forward. The reverse warning signal is activated when the range selector is in this position. Reverse has only one gear. Reverse operation also provides the greatest tractive advantage.
N !	Use this position when you start the engine. If the engine starts in any other position, the neutral start switch is malfunctioning. Neutral position is also used during stationary operation of the power takeoff (if your vehicle is equipped with a PTO). ***WARNING: In the event it becomes necessary to leave the vehicle, even momentarily, while the engine is running, ensure that the parking brake and/or emergency brakes are set and properly engaged, and the wheels are chocked.*** ***Unexpected and possibly sudden vehicle movement may occur if these precautions are not taken.***
D	The vehicle will start in 1st gear, and as you depress the accelerator, the transmission will upshift to 2nd gear, 3rd gear, and 4th gear automatically. As the vehicle slows down, the transmission will downshift to the correct gear automatically.
3 **2**	Occasionally, the road, load, or traffic conditions will make it desirable to restrict the automatic shifting to a lower range. When conditions improve, return the range selector to the normal driving position. These positions also provide progressively greater engine braking power (the lower the gear range the greater the braking effect).
1	This is low gear — use this when pulling through mud and snow or driving up steep grades. This position also provides maximum engine braking power.
The transmission incorporates a hold feature to prohibit upshifting above the range selected during normal driving. For downhill operation, however, the transmission may upshift above the highest selected gear when the engine governed speed is exceeded and damaging engine overspeed is a possibility.	

DRIVING TIPS

Throttle Control

The position of the throttle influences the automatic shifting. At wide open throttle, the transmission will automatically upshift near the governed speed of the engine. At part throttle, shifts will occur at a lower engine speed. When modulated lockup is provided, closed-throttle operation delays the release of the lockup clutch to provide additional engine braking at lower vehicle speeds.

> ***WARNING: Never shift from (N) neutral to (D) drive or (R) reverse at engine speeds above idle. The vehicle will lurch forward or rearward and the transmission can be damaged.***

Downshift Inhibit Feature

The transmission hydraulic system will inhibit a shift into any range at a speed that will cause engine overspeed. Any lower forward range may be selected at any time, but the actual engagement will not occur until road speed is reduced — downshifting is progressive as road speed decreases. The inhibit effect will cause downshifts to occur at slightly higher speeds than normal automatic downshifts.

Operating in Cold Weather

Following are the minimum fluid temperatures at which the transmission may be safely operated in a forward or reverse range. When ambient temperature is below the minimum fluid temperature limit and the transmission is cold, preheat is required. If auxiliary heating equipment is not available, run the engine to preheat the fluid to the minimum temperature limit before operating in a forward or reverse range. Failure to observe the minimum fluid temperature limit before operating in a forward or reverse range, can result in transmission malfunction or reduced transmission life.

FLUID TYPE	MINIMUM FLUID TEMPERATURE
DEXRON®-II	-10°F (-23°C)
Type C-4 SAE 10W	10°F (-12°C)
Type C-4 SAE 30	32°F (0°C)
® DEXRON-II is a registered trademark of General Motors Corp.	

Using the Engine to Slow the Vehicle or Equipment

To use the engine as a braking force, shift the range selector to the next lower range. If the vehicle is exceeding the maximum speed for a lower gear, use the service brakes to slow the vehicle.

Using the Hydraulic Retarder

Hydraulic retarders are available on the MT 600 and HT 700 Series transmissions. The MT 600 retarder is installed on the rear of the transmission in place of the output housing. The HT 700 retarder is installed between the torque converter and the transmission gearing. The function of the retarder is to provide auxiliary retardation in all conditions.

The MT 600 Series output retarder is mounted on the rear of the transmission as an integral part of the transmission and provides your vehicle with an auxiliary retardation system to slow the vehicle. The unit combines both hydraulic and clutch pack

***Using the Hydraulic Retarder** (Continued)*
retardation capabilities. In many applications the output retarder is applied in conjunction with the service brakes.

Depending on vehicle retarder apply system used, partial retarder application is available when maximum application is not needed.

Observe the following cautions when driving a vehicle equipped with an input or output retarder.

- **Apply and operate the retarder with engine at closed throttle only.**

- **Do not use the retarder when road surfaces are slippery.** De-energize the system at the master control switch.

- **Observe transmission and engine temperature limits at all times.** Select the lowest possible transmission range to increase the cooling system capacity and total retardation available.

- In the event of **overheating, decrease vehicle speed to reduce retarder power absorption.**

- **Observe the retarder "alert light"** to ensure that the vehicle control system is functioning properly.

- **Do not operate the input or output retarder simultaneously with an engine exhaust brake.** Extreme torque loads can be produced in the range section, damaging the transmission.

EMERGENCY TOWING OR PUSHING OF THIS VEHICLE

CAUTION: Failure to disconnect the driveline or lift the driving wheels before pushing or towing the vehicle can cause serious transmission damage.

Before towing or pushing a disabled vehicle, the driveline should be disconnected or the drive wheels lifted off the road. The engine cannot be started by pushing or towing.

PARK POSITION

There is no "park" position in the Allison transmission shift pattern. Therefore, always put the selector in neutral and apply the parking brake to hold the vehicle when it is unattended.

Even though there is a park position on the EC-1000 Series shift selector, To properly park your vehicle you must do the following:

1. Come to a complete stop.

2. Put gear shift selector in (N) neutral.

3. apply park brake.

Warning: Never rely on the park (P) position to properly park your vehicle. Always use you park brake system.

DRIVING ON ICE OR SNOW

WARNING: Do not use the retarder when roads are slippery.

The ALLISON AUTOMATIC & HYDRA-MATIC Automatic transmissions continually provides proper balance between required power and good traction. The driver can have better control of his vehicle because of this smooth, constant flow of power through the drivetrain. When driving on ice or snow, any acceleration or deceleration should be made gradually.

ROCKING OUT

CAUTION: DO NOT make neutral-to-range or directional shift changes when engine rpm is above idle. Also, do not allow the transmission to overheat while rocking out.

If the vehicle is stuck in deep sand, snow, or mud, it may be possible to "rock" it out. Shift to drive (D) and apply steady, light throttle (never full throttle). When the vehicle has rocked forward as far as it will go, apply and hold the vehicle service brakes. Allow the engine to return to idle; then select reverse. Apply a steady, light throttle and allow the vehicle to rock in reverse as far as it will go. Again apply and hold the service brakes and allow the engine to return to idle. This procedure may be repeated in drive and reverse if each directional shift continues to move the vehicle a greater distance. Never make neutral-to-range or directional shift changes when the engine rpm is above idle.

TEMPERATURES

The transmission oil temperature is indicated in some vehicles by a gauge specifically designed for this purpose and in some vehicles by the engine coolant temperature indicator. Extended operations at low vehicle speeds with the engine at full throttle can cause excessively high oil

TEMPERATURES (Continued)

temperatures in the transmission. These temperatures may tend to overheat the engine cooling system as well as cause possible transmission damage.

> ***CAUTION: The engine should never be operated for more than 30 seconds at full throttle with the transmission in gear and the output stalled. Prolonged operation of this type will cause the transmission oil temperature to become excessively high and will result in severe overheat damage to the transmission.***

- If excessive temperature is indicated by the engine coolant temperature gage, stop the vehicle and determine the cause. If the cooling system appears to be functioning properly, the transmission is probably overheated. Shift to neutral and accelerate the engine to 1200-1500 rpm. This should reduce the sump temperature to operating level within a short time.

- Normal transmission operating temperature as measured at outlet of torque converter is 230-270°F. Maximum transmission-to-cooler oil temperature for AT, MT, and HT (non-retarder models) is 300°F. Retarder models allow a maximum of 330°F. If excessive temperature is indicated by the transmission oil temperature gage, stop the vehicle and shift to neutral. Accelerate the engine to 1200-1500 rpm and allow the temperature to return to normal (two or three minutes) before resuming operation.

- If the transmission overheats during normal operation, check the oil level in the transmission. (Refer to the oil check procedure as described in this chapter.)

- If high temperature in either the engine or transmission persists, stop the engine and have the overheating condition investigated by maintenance personnel.

PERIODIC INSPECTIONS

The Allison Automatic requires minimum maintenance. Careful attention to the oil level, selector linkage, throttle (modulator) linkage, and the electronic and hydraulic circuits are most important.

For easier inspection, the transmission should be kept clean. Make periodic checks for loose bolts and leaking oil lines. Check the condition of the electrical harnesses regularly. Check the engine cooling system occasionally for evidence of transmission oil which would indicate a faulty oil cooler. Report any abnormal condition to your maintenance personnel.

PREVENT MAJOR PROBLEMS

Minor problems can be kept from becoming major problems if you **notify maintenance personnel** when one of these conditions occur:

- Overheating
- Shifting feels odd
- Transmission leaks oil
- Unusual sounds
- CHECK TRANS light comes on frequently (MD Series)
- DO NOT SHIFT light comes on frequently (MD Series)

IMPORTANCE OF PROPER OIL LEVEL

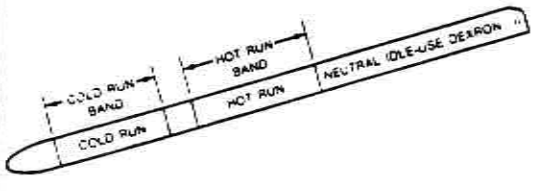
Because the transmission oil cools and lubricates transmission parts and transmits power, it is important that the proper oil level be maintained at all times. If the oil level is too low, the converter and clutches will not receive an adequate supply of oil. This can result in poor performance or transmission failure. If the level is too high, the oil will aerate, causing the transmission to overheat. Check the oil level at intervals specified in your vehicle service instructions, or more frequently, if operating conditions indicate.

OIL CHECK PROCEDURE

> ***WARNING: When checking the oil level, be sure that the parking brake and/or emergency brakes are set and properly engaged, and the wheels are blocked. Unexpected and possibly sudden vehicle movement may occur***

If these precautions are not taken.

Always clean around the end of the fill tube before removing the dipstick. Dirt or foreign matter must not be permitted to enter the oil system because it can cause valves to stick, cause undue wear of transmission parts, or clog passages. Check the oil level by one of the following procedures and report any abnormal oil level to your maintenance personnel.



Typical Dipstick Markings

Check for abnormal oil level, milky appearance or any trace of coolant in the oil.

COLD CHECK

Note: *The purpose of the cold check is to determine if the transmission has enough oil to be safely operated until a hot check can be made.*

- A cold oil check may be made when the sump temperature is 60-120°F (15-49°C).
- Run the engine for at least one minute. Shift to Drive and then Reverse to clear the oil system of air. Then shift to Neutral and allow the engine to idle (500-800 RPM).
- With the engine running at idle, wipe the dipstick clean and check the oil level. Any level within the COLD RUN (REF FILL) band is satisfactory for operating the vehicle. If the level is not within the COLD RUN (REF FILL) band, add or drain oil as necessary to bring the level to the middle of the COLD RUN (REF FILL) band.
- Perform a hot check at the first opportunity after normal operating temperature (160-200°F; 71-93°C) is reached.

HOT CHECK

Note: *The oil must be hot to ensure an accurate check. the oil level rises as temperature increases.*

- Operate the transmission in a drive range until normal operating temperature (160-200°F; 71-93°C) is reached.
- Park the vehicle on a level spot, shift to (N) neutral and apply the parking brake. Let the engine run at idle speed.
- Wipe the dipstick clean and check the oil level. The safe operating level is any level within the HOT RUN band on the dipstick.
- If not within this range, add or drain oil as necessary to bring the level to the middle of the HOT RUN band.

FLUID RECOMMENDATIONS

Hydraulic fluids used in the transmission are important influences on transmission reliability and durability. DEXRON®-II and type C-4 oils (Allison approved SAE 10W or SAE 30) are recommended. Type C-4 oil is the only fluid approved for use in off-highway applications. Use type C-4 SAE 30 in all applications where ambient temperature is consistently above 86°F (30°C).

Some DEXRON®-II fluids are also qualified as type C-4 oils and may be used in off-highway applications. However, a DEXRON®-II fluid which is not a qualified type C-4 oil must never be used in off-highway applications. Consult your local Allison dealer or distributor to determine if a DEXRON®-II fluid is also a qualified type C-4 oil.

Before using type C-4 oils, consult the vehicle manufacturer to ensure that materials used in tubes, hoses, external filters, seals, etc., are compatible with type C-4 oils. Also, consult your local Allison dealer or distributor to determine if the oil you have selected is an approved type C-4 oil.

Ford Motor Company specification fluids M2C33-F, M2C138-CJ, and M2C166H may be used and may be intermixed with DEXRON®-II fluid.

KEEPING OIL CLEAN

***CAUTION:** Containers that have been used for any anti-freeze solution should not be used for transmission oil.*

It is absolutely necessary that the oil put into the transmission be clean. The oil must be handled in clean containers, fillers, etc., to prevent foreign material entering the transmission.

OIL AND INTERNAL FILTER CHANGE

Change the oil and internal filter at the specified intervals. Consult the following oil and oil filter change chart for the proper change interval for your transmission. More frequent change intervals may be required depending on operating conditions. Local conditions, severity of operation, or duty cycle may dictate more or less frequent service intervals.

Hydra-Matic L80 Series Transmission

- The transmission should be at operating temperature to assist draining.
- Drain the oil by removing the drain plug from the oil pan. On earlier models, disconnect the oil fill tube from the oil pan.
- Remove the oil pan and filter. Discard the oil pan gasket, filter and filter pipe seal ring. Clean the oil pan.
- Remove, clean, and reinstall magnet in the bottom of the oil pan.
- Oil filter and gasket GM# 8678757, filter pipe seal GM# 8656613, and oil pan gasket GM# 8677743.
- Install the new filter and seal. Install the oil pan and gasket. Install the drain plug into the oil pan. Tighten the plug to 15-20 lb. ft. (20-27 N-m). Tighten the fill tube nut to 90-100 lb. ft. (122-135 N-m).
- If an external auxiliary filter is present, replace the filter element.
- Refill the transmission. (Refer to Filter & Oil chart for the fluid best suited for the vehicle.)
- Check the oil level as outlined in this chapter.

***Note:** The amount of transmission fluid shown in the following chart does not include the amount required to fill any external circuits.*

Allison AT Series Transmission

- The transmission should be at operating temperature to assist draining.
- Drain the oil by removing the drain plug from the oil pan. On earlier models, disconnect the oil fill tube from the oil pan.
- Remove the oil pan and filter. Discard the oil pan gasket, filter, and filter pipe seal ring. Clean the oil pan.
- Remove, clean, and reinstall the governor feed line screen in the control valve body.
- Oil filter and gasket kit (reference Parts Catalog SA 1235) contains the filter assembly, filter pipe seal ring, and oil pan gasket.
- Install the new filter and seal ring. Install the oil pan and gasket (refer to Service Manual SA 1241). Install the drain plug into the oil pan. Tighten the plug to 15-20 lb. ft. (20-27 N-m). Tighten the fill tube nut to 90-100 lb. ft. (122-135 N-m).
- If an external auxiliary filter is present, replace the filter element. If an Allison high-efficiency filter is present, refer to following page for replacement interval.
- Refill the transmission. (Refer to Filter & Oil chart for the fluid best suited for the vehicle.)
- Check the oil level as outlined in this chapter.

***Note:** The amount of transmission fluid shown in the following chart does not include the amount required to fill the external circuits.*

OIL PAN TYPE	QUANTITY
GM Hydra-matic L-80 Series Trans	7 U.S. qt. (6.6 liters)
Shallow oil pan 4.0 Inches (102mm)	9 U.S. qt. (8.5 liters)
Deep oil pan 5.3 Inches (135mm)	16 U.S. qt. (15 liters)

MT Series Transmission

- Remove the drain plug from the oil pan to drain the oil (remove the oil filler tube in some earlier models that have no drain plug). The transmission should be at operation temperature to assist draining.

- Remove the oil pan and filter. Discard the oil pan gasket, filter, and filter pipe seal ring. Clean the oil pan. **The seven-inch pan does not require pan removal.**

- Install a new governor feed filter at the rear of the transmission. Refer to Service Manual SA 1317 or SA 1546 for exact location.

- Install a new filter and seal ring. Install the oil pan and gasket. Connect the filter tube to the oil pan.

- Replace the external oil filter.

  Note: *The quantity of transmission fluid required to obtain the proper fluid level may vary according to the oil pan configuration and external cooler and filter system.*

- Approximate fill:
  - 4.3-inch pan, 12 U.S. quarts (11 liters)
  - 5.1-inch pan, 15 U.S. quarts (14 liters)
  - 7.0-inch pan, 17 U.S. quarts (16 liters)

- Check and adjust oil level as needed.

MD Series Transmission

- The transmission should be at the operating temperature 160-200°F (71-93°C) when the oil is drained. This will ensure quicker and better drainage.

- Remove the drain plug from the control module and allow the oil to drain. On Model MD 3070PT also remove drain plug from bottom of transfer case.

- To remove filters, remove twelve bolts, two filter covers, two O-rings, two square cut seals and two filters (refer to figure).

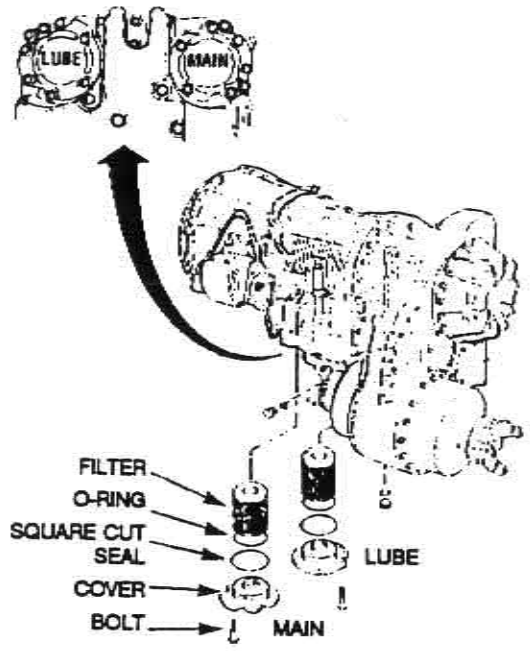
- To install filters, pre-lube and install the two O-rings, two square cut seals followed by the filters (lube O-ring on cover and in filter cartridge only) onto the filter covers. Index each filter/cover assembly to the holes in the channel plate/sump. Push cover assembly to seat seals (do not use bolts to draw cover to sump; this can damage cover/seal/sump). Install six bolts into each cover and tighten to 18-24 lb. ft. (25-32 N-m).

- The refill amount is less than the initial fill because some of the oil remains in the external circuits and transmission cavities.

- After refill, check the oil.

  Note: *The quantity of transmission fluid required to obtain the proper fluid level may vary according to the oil pan configuration and external cooler and filter system.*

TRANSMISSION TYPE	LITERS	QTS.
MD 3060/3560		
• Initial Fill	24.5	26
• Refill After Oil Change	18	19



Location of oil filter for service

OIL CONTAMINATION

Examine at Oil Change

At each oil change, examine the oil which is drained for evidence of dirt or engine coolant (water). A normal amount of condensation will emulsify in the oil during operation of the transmission. However, if there is evidence of coolant, check the cooler (heat exchanger) for leakage between the coolant and oil areas. Oil in the coolant side of the cooler (heat exchanger) is another sign of leakage. This, however, may indicate leakage from the engine oil system.

Metal Particles

CAUTION: ***If excessive metal contamination has occurred, replacement of the oil cooler and replacement of all bearings within the transmission is recommended.***

Metal particles in the oil (except for the minute particles normally trapped in the oil filter) indicate damage has occurred in the transmission. When these particles are found in the sump, the transmission must be disassembled and closely inspected to find the source. Metal contamination will require complete disassembly of the transmission and cleaning of all internal and external circuits, cooler, and all other areas where the particles could lodge.

Coolant Leakage

If engine coolant leaks into the transmission system, immediate action must be taken to prevent malfunction and possible serious damage. The transmission must be completely disassembled, inspected, and cleaned. All traces of the coolant, and varnish deposits resulting from coolant contamination must be removed. Clutch plates contaminated with ethylene glycol must be replaced.

Fluid Analysis

Transmission protection and fluid change intervals can be optimized by monitoring oxidation according to the tests and limits shown in this chapter. Consult your local telephone directory for oil analysis firms. Use one oil analysis firm. Results between firms cannot be accurately compared. Refer to SA 2055, Technicians' Guide for Automatic Transmission Fluid, for additional information.

TRANSMISSION: FILTERS AND OIL

Transmission	Internal Filters	Oil	Capacities	External Filters
Hydra-matic 4L80-E	GM Part# 8678757	Dexron II	13 Quarts	Not Applicable
Allison AT-542	Allison #29500365	Dexron or Dexron II	11 Quarts	AC #PF-897
Allison AT-545	Allison #6883044	Dexron or Dexron II	17.5 Quarts	AC #PF-897
Allison AT-643	Allison #6883044	Dexron or Dexron II	17.5 Quarts	AC #PF-897
Allison MD-3060	Allison #29505965	Dexron or Dexron II	26 Quarts Initial Fill 18 Quarts Refill After Oil Change	None

AUXILIARY FILTER

If a condition occurs that introduces debris into the oil system, a complete clean-up of the oil cooler and lines is recommended.

Because repeated cleaning and flushing may not remove all debris, installation of an auxiliary filter in the cooler-out line (between cooler and transmission) is recommended. This recommendation applies whether the transmission is overhauled or replaced by a new or rebuilt unit.

If any doubt exists about the clean-up of the oil cooler, replace the cooler.

The auxiliary filter should have at least a 40 micron filter element and a maximum filter pressure drop of 3 psi (21 kPa) at 4.5 gpm (17 liters/minute) at operating temperature, in neutral, and at 2400 rpm.

The following auxiliary filters are recommended for the Allison Transmission:

Filter Assembly	Filter Element
AC PM 13-16	PF 897

BREATHER

The breather is located at the top of the transmission housing. It serves to prevent pressure buildup within the transmission and must be kept clean and the passage open. The prevalence of dust and dirt will determine the frequency at which the breather requires cleaning. Use care when cleaning the transmission. Spraying steam, water, or cleaning solution directly at the breather can force the water or solution into the transmission.

EXTERNAL FILTER CHANGE

Most external oil filters should be changed after the first 5,000 miles and thereafter at the time the oil is changed. Consult the following oil and oil filter change chart for the proper change interval for your transmission.

EFFECT OF ALLISON HIGH EFFICIENCY EXTERNAL OIL FILTER ON OIL CHANGE INTERVAL

Oil need not be changed at the time of filter replacement unless the oil:

- has been used 12 months, or 25,000 miles,
- is visibly contaminated, or
- analysis shows it to be oxidized beyond the following limits.

FLUID OXIDATION MEASUREMENT LIMITS	
Measurement	**Limit**
Viscosity	+/-25% change from new fluid
Carbonyl absorbance	+0.3 A*/0.1mm change from new fluid
Total acid number	+3.0 change from new fluid
Solids	2% by volume maximum

*Note: A = Absorbance units

OIL AND OIL FILTER CHANGE CHART

Transmission	Oil Change Interval	Internal Sump and Gov. Filter	External Filter**
Hydra–matic L80 Series	25,000 Miles (40,000 km) or 12 months*	25,000 miles (40,000 km) or 12 Months*	Not Applicable
AT–500 Series (On–Highway)	25,000 Miles (40,000 km) or 12 months*	Shallow pan (4 inch), small filter, at each oil change interval. Deep pan (5 inch), small filter, at each oil change interval. Large filter, 25,000 miles (40,000 km) or 24 months*	After first 5,000 miles (8,000 km) and at normal oil change intervals thereafter.
AT–600 Series (On–Highway)	25,000 Miles (40,000 km) or 12 months*	25,000 miles (40,000 km) or 12 Months*	After first 5,000 miles (8,000 km) and at normal oil change intervals, thereafter.
MD–3060 Series (On–Highway)	After first 5,000 miles (8,000 km) thereafter, 25,000 miles (40,000 km) or 18 months*	At oil Change	None

* Whichever occurs first.

** An Allison high efficiency oil filter may be used until the change filter light indicates it is contaminated or until it has been in use for three years, whichever occurs first. No mileage restrictions apply.

OPERATING TIPS

CAUTION:

RANGE SELECTION: To prevent possible drivetrain damage, transmission should not be shifted from neutral to any forward or reverse range unless engine speed is below 900 rpm.
Vehicle should be stopped when moving from forward to reverse or reverse to forward.

TOWING: Before towing a disabled vehicle, disconnect driveline or pull axle shafts or tow with rear wheels suspended.

STARTING: Place selector in neutral. Note engine cannot be started by pushing or towing vehicle.

DOWN HILL BRAKING: Select position giving maximum speed desired for descending grade.

Selector Position	Range Coverage	Operating Conditions
R	Reverse	Backing vehicle
N	Neutral	Starting engine and stationary operation
D	1st converter thru 4th converter	Normal driving
3	1st converter thru 3rd converter	Suburban driving
2	1st converter thru 2nd converter	City (stop and go) driving
1	1st converter	Low speed operation

L80 SERIES OPERATING TIPS

OPERATING TIPS

CAUTION:

RANGE SELECTION: To prevent possible drivetrain damage, transmission should not be shifted from neutral to any forward or reverse range unless engine speed is below 900 rpm.
Vehicle should be stopped when moving from forward to reverse or reverse to forward.

TOWING: Before towing a disabled vehicle, disconnect driveline or pull axle shafts or tow with rear wheels suspended.

STARTING: Place selector in neutral. Note engine cannot be started by pushing or towing vehicle.

DOWN HILL BRAKING: Select position giving maximum speed desired for descending grade.

Selector Position	Range Coverage	Operating Conditions
R	Reverse	Backing vehicle
N	Neutral	Starting engine and stationary operation
OD	1st converter thru 4th converter	Normal driving
D	1st converter thru 3rd converter	Suburban driving
2	1st converter thru 2nd converter	City (stop and go) driving
1	1st converter	Low speed operation

OPERATING TIPS

CAUTION:

RANGE SELECTION: To prevent possible drivetrain damage, transmission should not be shifted from neutral to any forward or reverse range unless engine speed is below 900 rpm.
Vehicle should be stopped when moving from forward to reverse or reverse to forward.

TOWING: Before towing a disabled vehicle, disconnect driveline or pull axle shafts or tow with rear wheels suspended.

STARTING: Place selector in neutral. Note engine cannot be started by pushing or towing vehicle.

DOWN HILL BRAKING: Select position giving maximum speed desired for descending grade.

Selector Position	Range Coverage	Operating Conditions
R	Reverse	Backing vehicle
N	Neutral	Starting engine and stationary operation
D	1st converter thru 4th lockup	Normal driving
3	1st converter thru 3rd lockup	Suburban driving and additional engine braking
2	1st converter thru 2nd converter	City (stop and go) driving
1	1st converter	Low speed operation

OPERATING TIPS

The Electronic Control System is programmed to inform you if operating parameters have been exceeded and automatically take action to protect the operator, vehicle, and transmission. A diagnostic code will be registered when the **DO NOT SHIFT** light is on and also when other conditions are diagnosed which do not require the **DO NOT SHIFT** light to be on.

Every time the engine is started, the **DO NOT SHIFT** light comes on. It will go off after a few seconds. This momentary lighting is to show that the light circuit is working properly. If the light does not come on during engine start, service should be requested immediately.

DO NOT SHIFT

Illumination of this light, accompanied by eight seconds of short beeps from the shift selector, indicates that shifts are being restricted. The **SELECT** digit on the display will be blank. Operation may continue in order to reach service assistance. The ECU may not respond to shift selector requests since operating limitations are being placed on the transmission; i.e., upshifts and downshifts may be restricted. **Direction changes will not occur.** If the shift lever is moved while **DO NOT SHIFT** is indicated, a continuous alarm will be sounded. The alarm will stop when the lever is moved back to the previous position where **DO NOT SHIFT** was first indicated. For push button shift selectors, the ECU will not respond to operator requests. The ECU will cause the transmission to shift a safe gear and a **Hold-In-Range and disengage the lockup clutch.**

Hold-In-Range Feature If DO NOT SHIFT is Active

Gear Selected or Attained		Allowed Operating Range*	
MD-3060	R,N	N	Converter Lockup Disengaged
	1	3	
	2,3,4,5	4	
	6	5	

* Only in case of power loss or ECU shutdown. Some conditions cause the transmission to stay in the gear it was in. Direction changes do not occur.

RESET PROCEDURE TO CLEAR DO NOT SHIFT LIGHT AND RESTORE OPERATION

When the **DO NOT SHIFT** light comes on, a reset procedure can be performed to clear the system. If necessary, continue to operate the vehicle and have the transmission checked at the earliest opportunity.

LEVER SELECTOR

- Bring vehicle to stop at a safe location
- Apply parking brakes
- Push **Display Mode** button one time
- Press and hold the **Display Mode** button until a tone is heard. Then release the button and the transmission will return to the direction attained prior to clearing the active indicator. *(See Note)*

PUSH BUTTON SELECTOR

- Bring vehicle to a stop at a safe location
- Apply parking brakes
- Simultaneously press the **Up** and **Down** arrow buttons one time
- Press and hold the **Display Mode** button until a tone is heard. Then release the button and the transmission will return to the direction attained prior to clearing the active indicator. *(See Note)*

RESET PROCEDURE TO CLEAR DO NOT SHIFT LIGHT AND RESTORE OPERATION *(Continued)*

Note:
If the condition is temporary, the ***DO NOT SHIFT*** *light will not come back on and your vehicle will operate in a normal manner.*

If the condition is not temporary, the ***DO NOT SHIFT*** *light may come back on and the transmission may remain inhibited or operate in a normal manner until the condition is detected again. The type of operation permitted by the ECU will depend on the type of condition.*

Refer to Diagnosis.

ACCELERATOR CONTROL

The position of the accelerator pedal influences the timing at which automatic shifting occurs. When the pedal is fully depressed, upshifts will occur automatically at high engine speeds. A partially depressed position of the pedal will cause the upshifts to occur at lower engine speeds. An electronic signal tells the ECU how much the operator has depressed the pedal.

DOWNSHIFT OR REVERSE INHIBITOR FEATURE

Although there is no speed limitation on upshifting, there is on downshifting and shifts from Neutral into Drive or Reverse. If a downshift or neutral-to-range shift is selected when the engine speed or throttle position is too high, the ECU will prevent the shift from occurring until a lower speed is reached. If idle speed is too high, shifts to range are inhibited. A continuous "beep" tone is emitted if reverse is selected during forward movement or a neutral-to-range shift is selected at too high an engine speed.

USING THE ENGINE TO SLOW THE VEHICLE OR EQUIPMENT

To use the engine as a braking force, select the next lower gear. If the vehicle is exceeding the maximum speed for this gear, use the service brakes to slow the vehicle. When a lower speed is reached, the ECU will automatically downshift the transmission. Engine braking provides good speed control for going down grades. When the vehicle is heavily loaded, or the grade is steep, it may be desirable to preselect a lower gear prior to the grade.

GEAR PRESELECTION

Gear preselection means selection of a lower gear to match driving conditions you encounter or expect to encounter. Learning to take advantage of preselect will give you better control on slick or icy roads and on downgrades. Downshifting to lower gears increases engine braking. The selection of a lower gear often prevents cycling between a gear and the next higher gear on a series of short up-and-down hills.

COLD WEATHER STARTS

Most transmissions are programmed to restrict full operation until specific temperatures are reached. Refer to the following chart for temperature restrictions.

Sump Oil Temperature	DO NOT SHIFT light	Operation*
-32°C (-25°F) and below	ON	Neutral only
-31°C (-24°F) to -7°C (+19°F)	OFF	Neutral, First, Second, or Reverse
-7°C (20°F) and above	OFF	Full operation in all gears

** Transmissions used in emergency vehicles do not have programmed temperature restrictions.*

ROCKING OUT

WARNING: DO NOT make Neutral-to-Drive or directional shift changes when the engine rpm is above idle. If the wheels are stuck and not turning, do not apply full power for more than 30 seconds. Full power for more than 30 seconds under these conditions will cause the transmission to overheat. If the transmission overheats, shift to Neutral and operate the engine at 1200-1500 RPM until it cools (2-3 minutes).

If the vehicle is stuck in deep sand, snow, or mud, it may be possible to rock it out. Shift to Drive and apply steady, light throttle (never full throttle). When the vehicle has rocked forward as far as it will go, apply and hold the vehicle service brakes. Allow the engine to return to idle; then select Reverse. Release the brakes and apply a steady, light throttle and allow the vehicle to rock in Reverse as far as it will go. Again, apply and hold the service brakes and allow the engine to return to idle. This procedure may be repeated in Drive and Reverse if each directional shift continues to move the vehicle a greater distance. Never make Neutral-to-Drive or directional shift changes when the engine RPM is above idle.

HIGH OIL TEMPERATURE

If the sump oil temperature reaches 120°C (250°F) in non-emergency vehicle applications, the ECU will inhibit operation in the higher gears. In emergency vehicle applications, the ECU will not inhibit operation in higher gears.

If the transmission overheats during normal operations, check the oil level in the transmission. (Refer to the Oil Check Procedure as described in this chapter.)

CAUTION: The engine should never be operated for more than 30 seconds at full throttle with the transmission in gear and the output stalled. Prolonged operation of this type will cause the transmission oil temperature to become excessively high and will result in severe overheat damage to the transmission.

If the engine temperature gauge indicates a high temperature, the transmission is probably overheated. Stop the vehicle and check the cooling system. If it appears to be functioning properly, run the engine at 1200-1500 RPM with the transmission in Neutral. This should reduce the transmission and engine temperatures to normal operating levels in two or three minutes.

If the engine temperature indicates a high temperature, an engine problem is indicated. If high temperature in either the engine or transmission persists, stop the engine and have the overheating condition investigated by maintenance personnel.

PARKING BRAKE

Select Neutral and apply the parking brake to secure the vehicle when it is not attended. Always make sure the vehicle's parking brake system has been maintained as per the vehicle manufacturer's specifications.

EMERGENCY TOWING OR PUSHING OF THIS VEHICLE

CAUTION: Failure to disconnect the driveline or remove the axle shafts before pushing or towing can cause serious transmission damage.

The engine cannot be started by pushing or towing. Before pushing or towing of this vehicle, the driveline should be disconnected or the drive wheels should be lifted off the road. If the vehicle is a motor coach, remove the axle shafts from the drive wheels. Then cover the wheel openings to prevent loss of lubricant and entry of dust and dirt. An auxiliary air supply will usually be required to actuate the vehicle brake system.

SHIFT SELECTORS

The vehicle manufacturers may choose different types of shift selectors for their equipment. The shift selector in your Allison-equipped vehicle will be similar to one of those shown on this page.

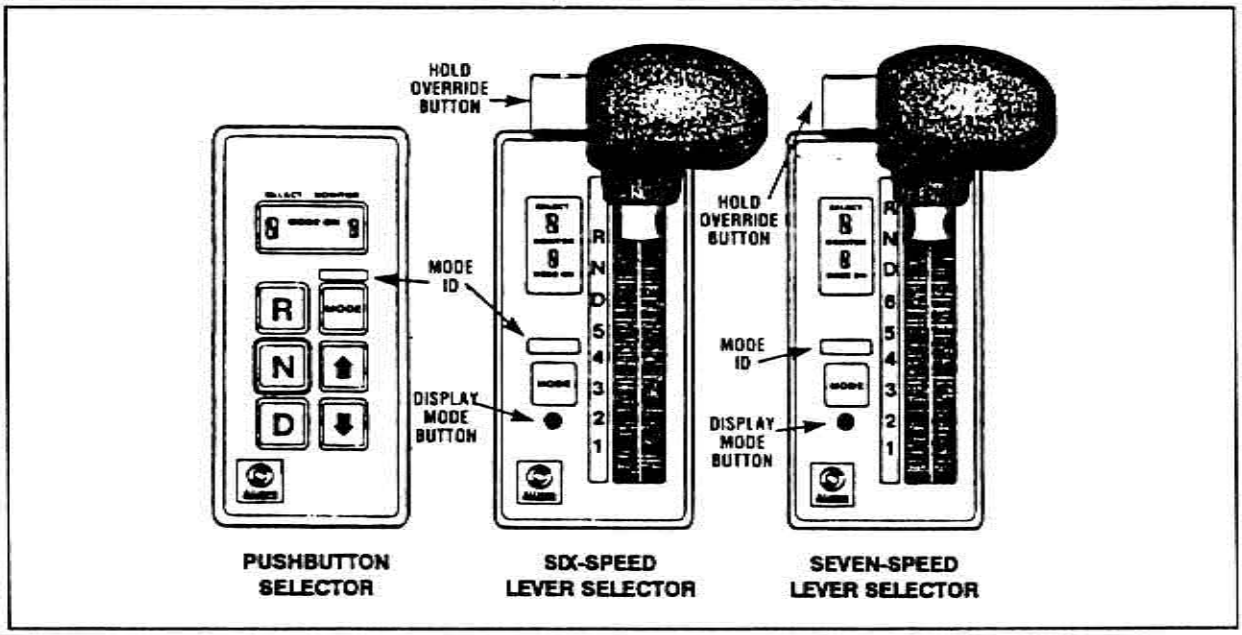
The push button shift selector has **R, N, D, ↑, ↓,** a **MODE** button, and a digital display. When a range button has been pressed, a tone will sound, the **SELECT** indicator displays the chosen operation (if the ECU determines the shift is acceptable), and the transmission will shift to the starting range as indicated on the **MONITOR** display. In **Drive**, selection of a specific gear can be accomplished by pressing the up or down Arrow buttons. Conditions resulting in the **DO NOT SHIFT** light located on the instrument panel will disable the pad and no tones will be heard.

The lever selector is an electro-mechanical control. The pattern of positions can vary according to the shift selector installed. Positions **(R, N,** and **D)** are selected by pressing a hold override button and choosing the desired gear. It is possible to move between forward drive positions without pressing the hold override button.

A **Mode** button (a dash mounted switch can be used) is located on lever and push button shift selectors to activate a second shift schedule or specialized function when desirable. The mode being utilized above the **Mode** button. The display will indicate **MODE ON** for most programmed functions.

A **Display Mode** button is included on the lever selector to allow access to diagnostic code information. The capability is included on the push button selector by pressing the up and down arrow buttons at the same time.

With an Allison MD-equipped vehicle it is not necessary to select the right moment to upshift or downshift during the changing road and traffic conditions. The Allison MD does it for you. However, knowledge of the gear ranges and when to select them will make vehicle control and your job even easier.



GEAR RANGE SELECTION — MD-3060 or MD-3560	
!	***WARNING: In the even the operator leaves the vehicle, even momentarily, while the engine is running, be sure that the transmission is in Neutral, parking brake and/or emergency brakes are set and properly engaged, and the wheels are chocked. Unexpected and possible sudden vehicle movement may occur if these precautions are not taken.***
R	The vehicle must be completely stopped before shifting from Forward to Reverse or from Reverse to Forward. The Select indicator will display R and the Monitor will display **R** when Reverse is attained.
N !	Use Neutral to start the engine, checking vehicle accessories, and for extended periods of engine idle operation. If the engine starts in any gar other than Neutral, the start circuit should be serviced immediately. Neutral is also used during stationary operation of the power takeoff (if your vehicle is equipped with a PTO). The Select indicator will display **Neutral** and the Monitor will display **Neutral.** ***WARNING: Do not allow your vehicle to coast in Neutral. This practice can result in transmission damage. Also, no engine braking is available in Neutral.***
D	The vehicle will attain first gear when **D** is selected, and as the speed increases, the transmission will automatically upshift through each gear. As the vehicle slows down, the transmission will automatically downshift. The Select indicator will display the highest gear available and the Monitor will display the current operating gear.
5 **4** **3** **2**	Occasionally, the road conditions, load or traffic conditions will make it desirable to restrict the automatic shifting to a lower gear. These positions also provide progressively greater engine braking for going down grades (the lower the gear, the greater the braking effect). The pushbutton selector utilizes arrow buttons. Push the **Up** or **Down** arrow to the desired gear. The Select indicator will display your choice and the Monitor will display the selected gear when it is attained.
1	Use this gear when pulling through mud and deep snow, when maneuvering in tight spaces, or while driving up or down grades. Low gear provides the vehicle with its maximum driving power and maximum engine braking power.
The transmission incorporates a hold feature to prohibit upshifting above the gear selected during normal driving. For downhill operation, however, the transmission may upshift above the highest selected gear when the engine governed speed is exceeded and damaging engine overspeed is a possibility.	

GEAR RANGE SELECTION - 4L8-E HYDRA-MATIC	
! P	***WARNING: Never rely on the "park" position to properly park your vehicle, always use your park brake system. In the event the operator leaves the vehicle,even momentarily, while the engine is running, be sure that the transmission is in Neutral, parking brake and/or emergency brakes are set and properly engaged, and the wheels are chocked. Unexpected and possible sudden vehicle movement may occur if these precautions are not taken.***
R	The vehicle must be completely stopped before shifting from Forward to Reverse or from Reverse to Forward.
N	Use Neutral to start the engine, checking vehicle accessories, and for extended periods of engine idle operation. If the engine starts in any gar other than Neutral, the start circuit should be serviced immediately.
!	***WARNING: Do not allow your vehicle to coast in Neutral. This practice can result in transmission damage. Also, no engine braking is available in Neutral.***
OD	The vehicle will attain first gear, and as the speed increases, the transmission will automatically upshift through each gear. As the vehicle slows down, the transmission will automatically downshift.
D 2	Occasionally, the road conditions, load or traffic conditions will make it desirable to restrict the automatic shifting to a lower gear. These positions also provide progressively greater engine braking for going down grades (the lower the gear, the greater the braking effect).
1	Use this gear when pulling through mud and deep snow, when maneuvering in tight spaces, or while driving up or down grades. Low gear provides the vehicle with its maximum driving power and maximum engine braking power.

The transmission incorporates a hold feature to prohibit upshifting above the gear selected during normal driving. For downhill operation, however, the transmission may upshift above the highest selected gear when the engine governed speed is exceeded and damaging engine overspeed is a possibility.

Brakes

" W A R N I N G "

CHASSIS EQUIPPED WITH MANUAL SLACK ADJUSTERS ON THE BRAKES MUST BE PERIODICALLY INSPECTED AND PROPERLY ADJUSTED. SERVICE INTERVALS WILL VARY DEPENDING ON THE BRAKE LINING AND DRIVERS BRAKING HABITS. FAILURE TO INSPECT REGULARLY AND PERFORM THE REQUIRED ADJUSTMENTS WILL RESULT IN LOSS OF BRAKING EFFECTIVENESS!!

BRAKES

TABLE OF CONTENTS

5

BRAKES

CHAPTER 5

ABOUT THIS CHAPTER

This chapter presents very important information on your Spartan chassis brake system. Take the time to read the "Quick Review" on this page which explains the principles of air brake systems. This will help you to understand the maintenance requirements. Read the highlights of the other paragraphs as well. Above all, check with your Spartan chassis dealer if you have further questions.

A QUICK REVIEW DUAL AIR BRAKE SYSTEM

The dual air brake system consists of an air compressor attached to the engine, storage tanks to hold the compressed air, a governor, pressure cylinders or diaphragm chambers at each wheel, suitable control valves and the necessary piping and connections.

Air Compressor

The air compressor pumps air into the air storage tanks (reservoirs). The air compressor is engine-driven and cooled by the engine cooling system. It may have its own oil supply or be lubricated by engine oil. If the compressor has its own oil supply, check the oil level before driving.

Governor

The governor controls how frequently and long the air compressor pumps air into the air storage tanks. When air tank pressure rises to the "cut-out" level (around 125 pounds per-square-inch, or "psi"), the governor stops the compressor. The governor allows the compressor to start pumping again when the tank pressure falls to the "cut-in" pressure (around 100 psi).

Air Storage Tanks

The air storage tanks hold enough compressed air to allow the brakes to be used several times, even if the compressor stops working.

DUAL-SYSTEM BRAKES (All Models)

Your Spartan chassis is equipped with a brake system that, depending on the chassis model, is either...

- totally air-operated
  OR
- air over hydraulic (EC 2000) or a

- hydraulic boost system over hydraulic brake (EC IK)

Both air driven feature independently operated braking systems for the front and rear wheels. System #1 operates the rear brakes, while system #2 operates the front brakes and serves as a backup in case of a failure in system #1. The two systems are operated simultaneously by the driver, using a single control.

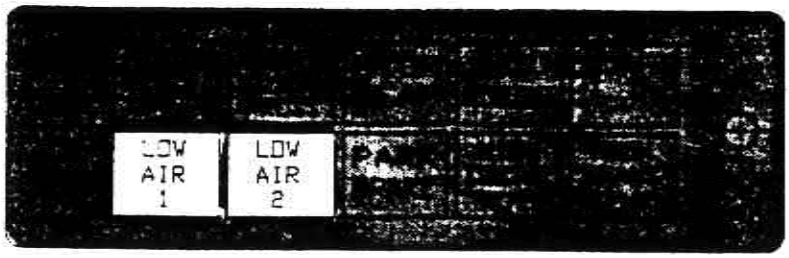
AIR-OPERATED BRAKES (MH & IC CHASSIS)

The dual-system brakes on the MH & IC model chassis are air-operated, using compressed air supplied by the engine-driven air compressor to apply the service brakes on the front and rear axles.

> ***Note:*** *Before driving, allow time for the air compressor to build up enough air to turn off the warning lamps for both systems #1 and #2. Both lamps must be off.*
>
> *Note: Air consumption while applying air brakes varies by the amount of pressure applied to the brake pedal. Even though the air gauges will indicate 100-120 PSI, the pressure applied to the brakes is considerably less. For instance, 15 PSI applied thru the brake pedal to the brakes will be felt as gentle braking, 25 PSI will be felt as "HARD" braking, while 40 PSI will lock them up.*

AIR DRYER

The air dryer has three main functions. It cools, filters, and dries the systems air. The air dryer has a filter that needs to be change once every (2) two years, and is serviceable from either end.



Low Air Warning Indicator

AIR BOOST (EC-2000 CHASSIS)

The EC-2000 Series chassis uses an air-boosted hydraulic brake system. Compressed air from an engine-driven air compressor boosts the hydraulic service brakes on the front and rear axles.

HYDRAULICALLY-OPERATED BRAKES

The EC-1K Series uses a hydraulic boost brake system. Pressurized fluid from the power steering pump boost the hydraulic service brakes on the front and rear axles. Pressure is available only when the engine is running.

BRAKE SUBSYSTEMS

All Spartan air, air/hydraulic brake systems feature three subsystems: service brakes, parking brakes, and emergency brakes.

Note: The parking brake and the emergency brake use the same spring force to the brakes.

Service Brakes (Brake Pedal)

The **service brake** system applies and releases the brakes when you use the brake pedal during normal driving. The service brakes are applied by depressing the brake pedal (also called foot valve or treadle valve). Pushing the pedal down harder applies more air or hydraulic pressure; releasing the pedal reduced the air pressure and releases the brakes. Air brake operation consumes compressed air and reduces tank air pressure, which is replenished by the engine-driven air compressor.

Service Brake Test. Wait for normal air or hydraulic pressure to build, release the parking brake, move the vehicle forward slowly (about 5 mph) and apply the brakes firmly using the brake pedal. Note if the vehicle "pulls" to one side, any unusual feeling, or delayed stopping action could indicate that the brakes need adjusting.

Parking Brake (Spring Brakes)

The **parking brake** system applies and releases the parking brakes, using the parking brake control (illustration below). **The parking brakes on all Spartan chassis except EC-1K are applied by pulling out the diamond-shaped, yellow, push-pull control knob. To release the brakes, push the knob in. Use the parking brakes whenever the vehicle is parked. To apply the parking brake on the EC-1K, move the lever to the release position.**

Parking Brake Push-Pull Control Knob

The parking brakes are spring-applied but are controlled by air or hydraulic pressure. When the parking brakes are applied, air or hydraulic pressure is released, allowing springs to apply braking force. When the parking brakes are released, air or hydraulic pressure will hold them in that position, thus preventing the springs from applying the brakes. The parking brakes cannot be released unless there is a minimum of 60 psi in system #1 of the brake system; or in the hydraulic system of the EC-1K, unless the engine is running.

On the MH & IC model chassis, the parking brake assembly is attached to the rear axle. On the EC model chassis, the parking brake mounts on the rear of the transmission.

Parking Brake Test. Stop the vehicle, put the parking brake on, and gently accelerate against it in a low gear to assure that the parking brake will hold.

Emergency Brakes

The **emergency brake** system uses the parking brake spring systems to stop the vehicle in the event of a brake system failure. In case of air loss so severe that the air pressure in brake system #1 drops to 60 psi, the parking brakes (spring brakes) begin to apply, thus becoming the emergency brakes.

In the event of hydraulic pressure loss, due to either a failure or a leak, the park brake needs to be applies, thus becomming the emergency brake.

WARNING: Because the front brakes do not work when the emergency brakes are applied, stopping distances are greater than normal when using the emergency brakes.

WARNING: If the spring brakes are fully applied on slippery road surfaces, the rear tires may lose traction, causing possible loss of control.

AIR BRAKE ADJUSTMENT (MH & IC CHASSIS)

The tests made earlier on the service and parking brakes may disclose problems that you should correct before using the brakes on the highway.

In addition, if air consumption while braking has increased, or you feel that stopping power is diminished, do have your brakes checked for adjustment.

Most truck repair facilities are familiar with air brakes and can inspect and adjust your brakes, or we can inform you of the nearest Authorized Spartan Service Center.

It is recommended that you have brake adjustment checked each time you have the chassis lubricated.

BRAKE ADJUSTMENT **(EC CHASSIS)**
The EC model chassis is equipped with self-adjusting, hydraulically operated brakes; thus, no adjustments are necessary.

DRAINING AIR TANK

Compressed air usually accumulates water and compressor oil in the tank bottom. This is bad for the brake system because the water can freeze and cause brake failure, while the oil tends to collect and remain in the bottom of the air tank. Each tank is equipped with a manual drain valve. (Dual-compartment tanks have a drain valve on each tank compartment.) **To drain the tanks, rotate the knob on the drain valves until air escapes. Allow air to escape until all traces of moisture are gone before closing valves.**

Air tanks should be drained at the start of each trip and then weekly when the coach is in use.

AIR SUPPLY PRESSURE GAUGES

All Spartan chassis have an air pressure gauge for monitoring the air pressure in each half of the dual air system.

Low Air Pressure Warning. A low air pressure warning signal is required by law on vehicles with brake systems using compressed air. Separate warning lamps are provided for brake systems #1 and #2. The appropriate lamp lights up when air pressure in that part of the system drops to 60 psi. A warning buzzer attached to system #1 comes on when air pressure in that system drops to 60 psi.

Air Brake Stoplight Switch. The vehicle's rear brake lamps are activated by pressure gauges in the air system.

In the event you have purchased an EC-1K chassis, the vehicle's rear brake lamps are activated by mechanical switches on the back side of the brake pedal housing.

Low-Pressure Warning Buzzer. A warning buzzer, connected to brake system #1 only, comes on when the air pressure drops to 60 psi. If this happens while driving, you should stop right away and safely park the vehicle. If one air system is very low on pressure, either the front or rear brakes will not operate fully. This means it will take you longer to stop. Carefully bring the vehicle to a stop and have the air brake system repaired.

PREVENTIVE MAINTENANCE (MH & IC Chassis)

BRAKE AIR SYSTEM CHECK

This check should be performed weekly or at intervals, preferably when the air tanks are drained of accumulated water. This test will assure proper functioning of the check valves in the system and proper performance of the dual air system. When applying the brake pedal, hold it fully depressed and listen for air leaks.

Note: Your vehicle must be parked on a level surface. Install wheel blocks or cribbing on the front and rear of all four tires, and set the parking brake valve in the OFF position.

1. Start the engine and allow both air systems to build to 110 psi. Note that system #1 should build to 90 psi before system #2 starts to charge.

2. Drain the air from the #2 air system; the #1 air system may be allowed to drain to 95 psi. After the air is drained from system #2 the rear brakes should still function while the brake pedal is depressed. The parking brake valve must be in OFF position while performing this test.

3. Start the engine and recharge both systems to 100 psi.

4. Drain the air from system #1. Note that system #2 holds 110 psi. Both the front and rear brakes should function when the brake pedal is depressed. Again, make sure the parking brake is in the OFF position.

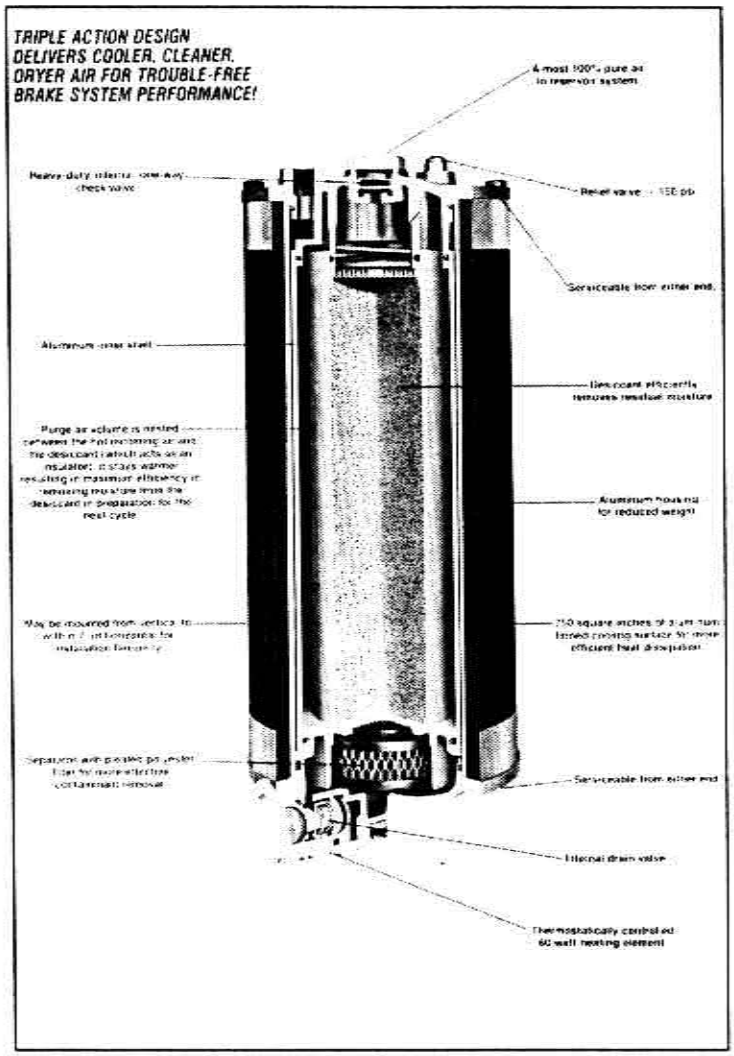
The tank diagram (at the end of this chapter) explains the tank locations for systems #1 and #2.

If the MH or IC model is not equipped with automatic slack adjusters, visually inspect brake functioning by observing slack adjuster travel. EC model chassis have front and rear disc brakes, therefore they automatically adjust themselves with normal use.

> ***Note:*** *On the MH & IC chassis, the parking brake system is integrated with the rear service brakes. These must be adjusted properly for effective holding power.*

If the brakes do not function as described in the brake check, call Spartan Motors immediately.

MIDLAND N4245H AIR DRYER PREVENTIVE MAINTENANCE



DESCRIPTION

The function of the Midland N4245H Air Dryer (see photos) is to collect and remove air system contaminants in solid, liquid, and vapor form before they enter the brake system. It supplies clean, dry air to the components of the brake system, increasing the life of the system and reducing maintenance costs.

PREVENTIVE MAINTENANCE

Every 900 operating hours or 25,000 miles or every three (3) months:

1. Check for moisture in the air brake system by opening reservoirs, drain cocks, or valves and checking for water. If moisture is present, the desiccant may require replacement; however, the following condition can also cause water accumulation and should be considered before replacing the desiccant:

   a. An outside air source has been used to charge the system. This air did not pass through the drying bed.

   b. In areas where more than a 30-degree range of temperature occurs in one day, small amounts of water can accumulate in the air brake system due to condensation. Under these conditions, the presence of small amounts of moisture is normal and should not be considered as an indication that the dryer is not performing properly.

PREVENTIVE MAINTENANCE *(Continued)*

Note also that a small amount of oil in the system may be normal and should not, in itself, be considered a reason to replace the desiccant; oil-stained desiccant can function adequately.

2. Check mounting bolts for tightness; re-torque to 270-385 inch-lbs.

Note: *The desiccant change interval may vary from vehicle to vehicle. Although typical desiccant cartridge life is three years, many will perform adequately for a longer period of time. In order to take maximum advantage of desiccant life and assure that replacement occurs only when necessary, it is important that Operation and Leakage Tests be performed.*

PREVENTIVE MAINTENANCE (MH & IC Chassis)

Due to the importance of a well-maintained brake system, Eaton recommends that the inspections and maintenance listed below be performed by commercial vehicle operators at the intervals suggested.

Since driver technique and vehicle use affect the rate of brake component wear, it may be appropriate to increase the frequency of the following inspections to fit individual needs based upon past experience.

LUBRICATION

Type

For camshaft bushings, use the same grease specified for chassis lubrication. DO NOT OVER LUBRICATE.

All other components should use high-temperature, waterproof grease conforming to #1 grade NLGI specifications.

Intervals

Pressure-lubricate camshaft bushings at maximum interval of 6 months.

> ***Note:*** *The camshaft lube fittings are a special low pressure type. DO NOT REPLACE WITH A STANDARD TYPE, AS GREASE COULD BE FORCED INTO THE BRAKE DRUM AND ON THE BRAKES.*

Special Instructions

When servicing brakes or replacing components, lubricate the roller and anchor pin recesses of each shoe, using grease specified above.

> ***WARNING: Do not lubricate the cam head surface or related parts that contact cam head surface. For efficient operation, the cam head surface must remain free of oil, grease, and other contaminants.***

Manual Slack Adjuster Lubrication

Pressure lubricate at maximum 6 month intervals.

PERIOD INSPECTIONS

The component inspections discussed below are general in nature; more detailed component inspections are normally done at the time of an overhaul.

General Visual Inspection

A thorough visual inspection for brake wear, loose fasteners, broken parts and/or obvious damage should be made each time the brake is serviced or the wheel drum has been removed.

Lining Inspection

A visual check of brake lining thickness and condition should be made each time the vehicle is serviced in the maintenance shop. Remove inspection plug from dust shield to inspect lining thickness.

Brake Operation Check

A complete operation check of the braking system should be made following the instructions below after any brake service.

Brake Overhaul

A complete brake overhaul should be accomplished at every brake reline. Consult your Authorized Spartan Service Center.

PREVENTIVE MAINTENANCE (MH & IC Chassis)

DANGER: AVOID CREATING DUST. DUST IS A POSSIBLE CANCER AND LUNG DISEASE HAZARD.

1. Eaton does not offer asbestos linings. The possibly detrimental, long-term effects of non-asbestos fibers have not been determined. Therefore, the following precautions should be used when handling these materials.

2. The Occupational Safety and Health Administration of the United Stated Department of Labor (OSHA) has set the maximum allowable exposure level for airborne asbestos at 0.2 fibers of asbestos per cubic centimeter of air (0.2f/cc) as an eight-hour time-weighted average. This guideline should also be followed for non-asbestos fibers.

   Eaton recommends that personnel performing brake work take the following steps to minimize exposure to airborne brake lining particles. OSHA-APPROVED RESPIRATORS SHOULD BE WORN AT ALL TIMES DURING BRAKE SERVICING.

3. Proper procedures to reduce exposure include segregation of areas where brake work is done, and use of enclosed cells with filtered vacuums and/or a well-ventilated area.

4. COMPRESSED AIR OR DRY BRUSHING SHOULD NEVER BE USED FOR CLEANING BRAKE ASSEMBLIES.

5. OSHA regulations on exposure levels, testing, disposal of waste, and methods of reducing exposure (including use of respirators and exhaust systems) are set forth in Code 29 of Federal Regulations §1910.1001. These regulations should be observed.

6. Workers should wash before eating, drinking, or smoking; shower after working; and never wear clothes home. Work clothes should be vacuumed and laundered without shaking.

PERIODIC SERVICE. Due to the importance of a well-maintained brake system, Eaton recommends that the inspections and maintenance listed be performed at the intervals suggested.

Since driver technique and vehicle use affect the rate of brake component wear, it may be appropriate to increase the frequency of the following inspections to fit individual needs based upon past experience.

RECOMMENDED PREVENTIVE MAINTENANCE

Every three months or 25,000 miles

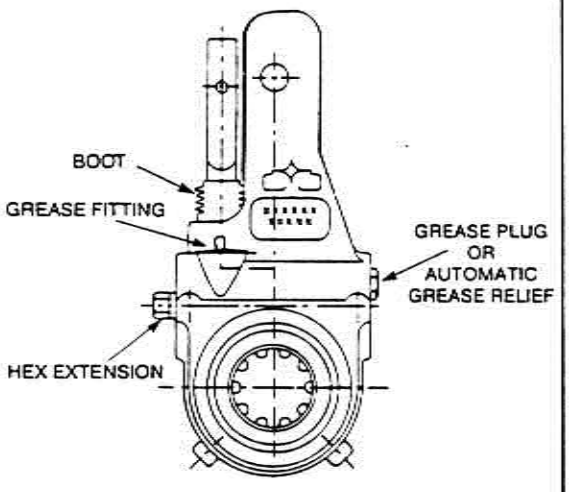
1. Check the condition of the foundation brakes, including drums, shoes and linings, cams, rollers, bearings, etc.

2. Check for structural damage of the automatic slack adjuster housing and condition of the boot for cuts, tears, etc. Replace if necessary.

3. After allowing brake drum to cool to room temperature, check for correct chamber stroke.

Every six months or 50,000 miles

The Gunite automatic slack adjusters are factory lubricated and extensively sealed to protect against dirt, water, salt and other corrosive elements. Nevertheless, periodic lubrication is recommended.



Lubrication Points

1. Grease the automatic slack adjuster.

   a. The styles of grease plugs or reliefs vary according to models. Determine which you have by comparing it to the photos below.

GREASE PLUG | STYLE A GREASE RELIEF | STYLE B GREASE RELIEF

   b. If your model has a grease plug, remove it from cap opposite hex extension.

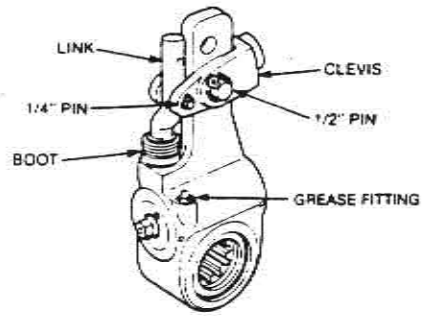
   Note: *Failure to remove grease plug could result in boot and/or seal damage.*

   c. A grease fitting is provided to allow fresh lubrication during normal chassis servicing. With a conventional grease gun and an approved grease, fill the inside of the slack until grease flows from the grease plug hole or automatic grease relief opening.

   d. **Lubriplate Aero** is an approved grease and is used in the manufacture of Gunite automatic slack adjusters. It is recommended for use in temperatures as low as -40°F. Texaco Multifak EP-2 and Mobil Grease #77 are also approved greases, but are not recommended for use in temperatures below -20°F.

   e. Install the grease plug if your model has one, and tighten to 70-90 in.-lbs. torque.

2. Test adjuster function.



Location of Clevis Pins and Boot

Never operate the vehicle with the small 1/4" pin or large 1/2" pin missing from the clevis. The automatic slack adjuster *will not* maintain proper brake adjustment with either pin missing.

Steering/Tires/ Wheels/Axles/ Suspension

STEERING/TIRES/WHEELS/ AXLES/SUSPENSION

TABLE OF CONTENTS

6

STEERING/TIRES/WHEELS/ AXLES/SUSPENSION

CHAPTER 6

ABOUT THIS CHAPTER

Prior to using information in this chapter, (1) please confirm models of steering and axle assemblies on your vehicle's identification plate, and **(2) find lubrication points in Maintenance Summary in Chapter 1.**

This chapter presents preventive maintenance instructions for the following Spartan chassis assemblies:

- Steering
- Tires
- Wheels
- Axles
- Suspension

STEERING (TRW Ross)

TRW-Ross Bulletin #TAS-103, limits operator preventive care to a check of the power steering fluid level, and lubrication of steering linkage.

> ***Note:*** *Wear, looseness or binding of any of the moving parts of the steering and suspension systems will affect vehicle alignment. Accurate alignment cannot be achieved as long as such conditions go uncorrected.* ***Consult your Spartan Service Center for detailed diagnosis of front suspension and steering system problems (such as hard steering, poor directional stability, excessive play in system, and other problems).***

Power Steering System (TRW Ross)

Check the fluid level in the power steering fluid reservoir weekly when coach is in use. This requires the removal of the engine access cover. Add DEXRON® II automatic transmission fluid as necessary to bring level into proper range on the dipstick located in lid of reservoir.

On MH, IC and EC-2000 (with side mounted radiator) model chassis the engine cooling fan is driven by the power steering system.

Power Steering System (Saginaw)

Check the fluid level in the power steering fluid reservoir weekly when coach is in use. This requires the removal of the engine access cover. Add Automtive grade power steering fluid as necessary to bring level into proper range on the dipstick located in lid of reservoir.

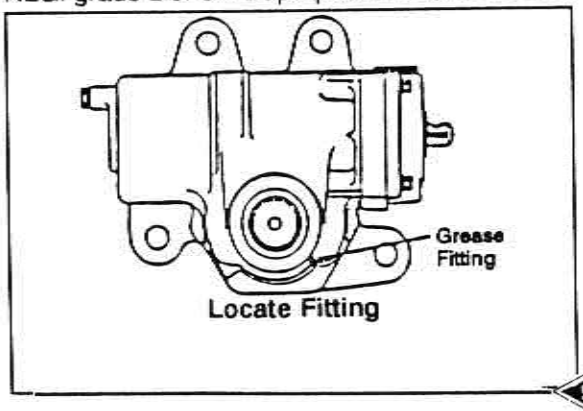
Steering Linkage

The steering linkage (tie rods) and suspension should be lubricated, using a lithium soap multi-purpose grease that meets specification, at every oil change. Seals should be checked for damage.

LUBRICATION OF TAS GEARS (MH Model Chassis)

TAS steering gears must be lubricated at the output shaft dirt and water seal to maintain a grease barrier. The grease barrier will maximize seal performance and gear service life by restricting corrosive elements from entering the bearing and high pressure seal area.

This fitting should be greased twice a year using NLGI grade 2 or 3 multipurpose EP chassis lube:

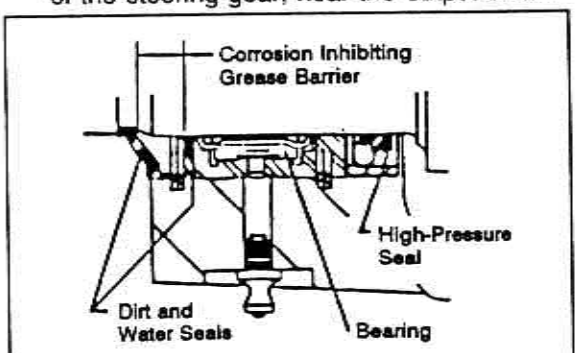


Locate Fitting

- Before winter to provide a good grease barrier.
- After winter to replenish the barrier and force out any contaminated grease.

GREASING PROCEDURE:

1. Locate the grease fitting on the trunnion side of the steering gear, near the output shaft.



Lubricate Manually

2. ***CAUTION:*** ***Do not use an automatic or power grease gun on this fitting, because the rate of flow is too high. This high flow rate could force grease inside the high pressure seal, which could contaminate the hydraulic system and also promote seal leakage.***

   Use a hand-type grease gun to force grease through the fitting until you can see it past the external dirt and water seal.

FLUID FILTERS

Filters are located inside fluid reservoir. Access is gained by removing reservoir lid.

MH, IC, and EC-2000 (with side mounted radiator) model chassis: Nelson Industries Part No. 84220A.

EC-2000 model chassis with rear mounted radiator: Nelson Industries Part No. 83213A.

EC-1K model chassis with rear mounted radiator: GM Part No.

TIRES

The factory-installed radial tires on your vehicle are designed to provide the best all-around performance for normal vehicle operation, when inflated as recommended in the tire inflation chart, page 6-5. The tires have the load carrying capacity to operate satisfactorily at all normal highway speeds.

SNOW TIRES

If the vehicle is expected to encounter muddy or snowy driving conditions, it is recommended that rear driving wheels be equipped with mud and snow type tires.

If you equip your vehicle with mud and snow tires, they should be of the same size, load range, and construction as original equipment tires.

TIRE WARRANTY

Tires are warranted by the tire manufacturers as covered in Chapter 2.

TIRE CARE

Tires should be checked regularly for proper inflation pressure, wear, and damage. The following information will assist you in properly caring for your tires.

Inflation Pressure

Tire inflation pressures listed on the tire inflation chart have been selected to provide the best tire life, riding comfort and handling stability for the specified load weight on the axle.

The use of improper tire inflation pressures can adversely affect tire life and vehicle performance. Too little air pressure can result in excessive tire heat, abnormal tire wear, adverse vehicle handling and reduced fuel economy. Too much air pressure can result in abnormal tire wear, adverse vehicle ride and handling, and increased susceptibility to damage by road impacts.

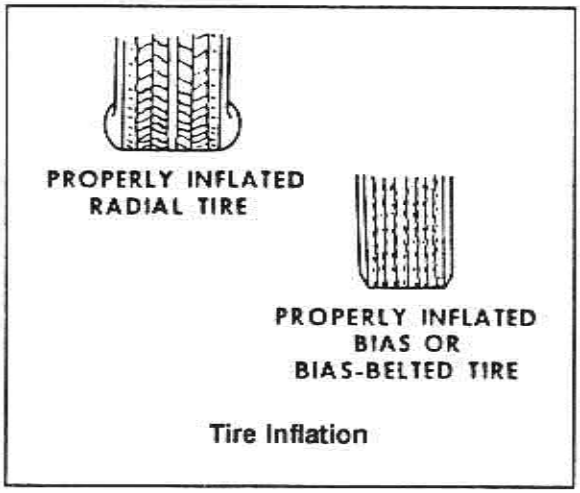
Tire pressure should be checked at least once a month (and preferably more often), before long trips or when heavily loaded. The following points should be observed when checking and setting tire pressures.

1. Cold tire pressure ratings are applicable when a vehicle has been inoperative for 3 hours or more, or driven less than one mile.

2. Tire inflation pressure may increase as much as 6 psi when hot (after vehicle has been driven 10 miles or at speeds of more than 60 mph). Do not "bleed" or reduce pressures when tires are hot from driving.

3. Always use a tire pressure gauge when checking tire pressure.

   Note: *Radial tires may have the appearance of being under-inflated when at recommended cold inflation pressure. Refer to figure below for view of properly inflated radial tire.*



Tire Inflation

Tire Damage & Repair

Tires with cuts, splits or cracks deep enough to expose the fabric should be removed from service. Bulges usually indicate internal damage, and the tire should be removed. Tires with questionable damage should be removed from the wheel and examined by an expert.

If an air loss occurs while driving, do not attempt to drive on the deflated tire more than is necessary to stop safely. Driving even a short distance can damage a tire beyond repair.

Temporary repairs, such as "blowout" patches or any repair made from the outside of the tires should not be made except in emergencies. "Stop-gap" devices such as plugs and aerosol-type sealants are good for not more than 100 miles of driving at speeds not over 50 mph. A permanent vulcanized repair, plug or patch applied from inside the tire should be made as soon as possible. Also, the installation of an inner tube in a damaged tubeless tire is not a recommended repair procedure.

Tire Replacement

CAUTION: Do not mix different construction types of tires on the vehicle such as radial, bias, and bias-belted tires, because vehicle handling may be seriously affected.

Use of any other size, load range or other construction type of tires may seriously affect load carrying capacity, ride, handling, speedometer/odometer calibration, vehicle ground clearance, and tire clearance to the body and chassis. If replacing only a single tire, it should be paired on the same axle with the least worn tire of the vehicle.

The following also should be considered when replacing tires:

- To achieve best all-around vehicle performance, bias-ply and bias-ply steel belted tires should not be mixed on the same vehicle.
- It is recommended that new tires be installed in pairs opposite each other (preferably the front wheels).
- When replacing only one tire, it should be paired with the tire having the least wear to equalize braking traction.

Tire Traction

A decrease in driving, cornering, and braking traction occurs when water, snow, ice, gravel, or other material is on the road surface. Driving practices and vehicle speed should be adjusted to the road conditions.

When driving on wet or slushy roads, it is possible for a wedge of water to build up between the tire and road surface. This phenomenon, known as hydroplaning, may cause partial or complete loss of traction, which adversely affects vehicle control and stopping ability. To reduce the possibility of traction loss, the following precautions should be observed:

1. Slow down during rain storms or when roads are slushy.
2. Slow down if road has standing water or puddles.
3. Replace tires when tread wear indicators are visible.
4. Keep tires properly inflated.

TIRE INFLATION PROCESS

1. Replace valve stem.
2. Individually weigh front and rear axles to determine weight on each axle and adjust tire pressure accordingly.
3. Adjust air pressure in accordance with the air pressure chart.

TIRE INFLATION TABLE

Inflation Pressure P.S.I.

Tire Size	Weight Lbs.	60	65	70	75	80	85	90	95	100	105	110
235/80R22.5 LR "F" MICHELIN	Frt. Axle	7,190	7,630	8,070	8,555	9,085	9,350					
	Rear Axle	13,585	14,375	15,260	16,140	17,110	17,640					
255/70R22.5 LR "G" MICHELIN	Frt. Axle	6,175	6,590	7,000	7,410	7,820	8,235	8,645	9,055	9,470	9,880	
	Rear Axle	11,469	12,205	12,950	13,695	14,440	15,180	15,930	16,670	17,415	18,160	
255/80R22.5 LR "F" MICHELIN	Frt. Axle				8,260	8,820	9,480	9,920	10,400			
	Rear Axle				15,260	16,320	17,280	18,300	19,240			
8R 19.5 LR "E" GOODYEAR	Frt Axle		4,820	5,080	5,360	5,600	5,860	6,120	6,340			
	Rear Axle		9,400	9,840	10,280	10,720	11,121					
8R 19.5 LR "F" GOODYEAR	Frt. Axle		4,820	5,080	5,360	5,600	5,860	6,120	6,340	6,560	6,800	7,000
	Rear Axle		9,400	9,840	10,280	10,720	11,121	11,520	11,920	12,280		
8R 19.5 LF "F" MICHELIN	Frt. Axle	5,035	5,365	5,600	5,950	6,340	6,650	7,000				
	Rear Axle	9,770	10,390	10,800	11,475	12,200	12,825	13,500				

NOTE: For longest tread life and best ride, load coach as it would be in normal use, weigh front and rear axles, and adjust tire pressure per above table.

REPLACEMENT WHEELS

Note: *Be sure "RADIAL" is stamped on the rim.*

Wheels must be replaced if they become bent, are heavily rusted, if the lug nuts won't stay tight, or if they leak air. Straightening bent wheels or using inner tubes in leaking wheels are not recommended repair procedures.

When replacing wheels for any reason, care should be taken to insure that the wheels are equivalent to the originals in load capacity, diameter, rim width, and offset. Correct replacement wheels can be obtained from your authorized Spartan Motors dealer.

Use of any other size or type of wheel may adversely affect wheel and wheel bearing life, brake cooling and stopping ability, head lamp aim, speedometer-odometer accuracy, bumper height, vehicle ground clearance and tire clearance to the body and chassis.

The installation of used wheels is also not recommended; if they have been run overloaded or under other severe operating conditions for extended periods, the wheel's life may have been greatly shortened.

INSPECTION OF STEEL DISC WHEELS

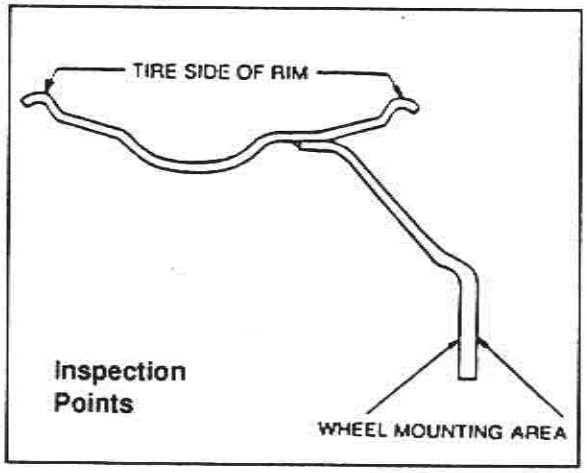
During tire inspections or periodic vehicle maintenance:

1. Check all metal surfaces thoroughly, including both sides of the wheels and areas between duals. Watch for excessive rust or corrosion buildup; cracks in metal; bent or broken flanges or components; loose, missing or damaged nuts; and bent or stripped studs. (See illustration below)

   CAUTION: Excessively corroded or cracked rims are dangerous, particularly during the removal of the assembly. Deflate tire (both tires of a dual assembly) before removing the wheel. Insert a wire through the valve to assure debris has not prevented deflation.

2. Replace an assembly that is damaged or has damaged components.

3. Look for rust streaks, which are an indication of loose nuts or improper nut fit. After tightening the nuts to the proper recommended torque level or replacing them, remove the rust streaks.



4. Replace broken studs and each unbroken stud next to the broken stud.

5. Determine the cause of the damage before installing another wheel.

6. Inflate tires to only the recommended air pressure, being sure not to exceed the wheel's maximum inflation rating.

STEEL DISC WHEEL INSTALLATION

STUD-PILOTED MOUNTING

Wheels with the stud-piloted mounting system are called stud mount wheels. Stud mount wheels are designed to be centered by the nuts on the studs. The seating action of the chamfered nuts in the chamfered bolt holes centers the wheels (3-figure illustration on following page).

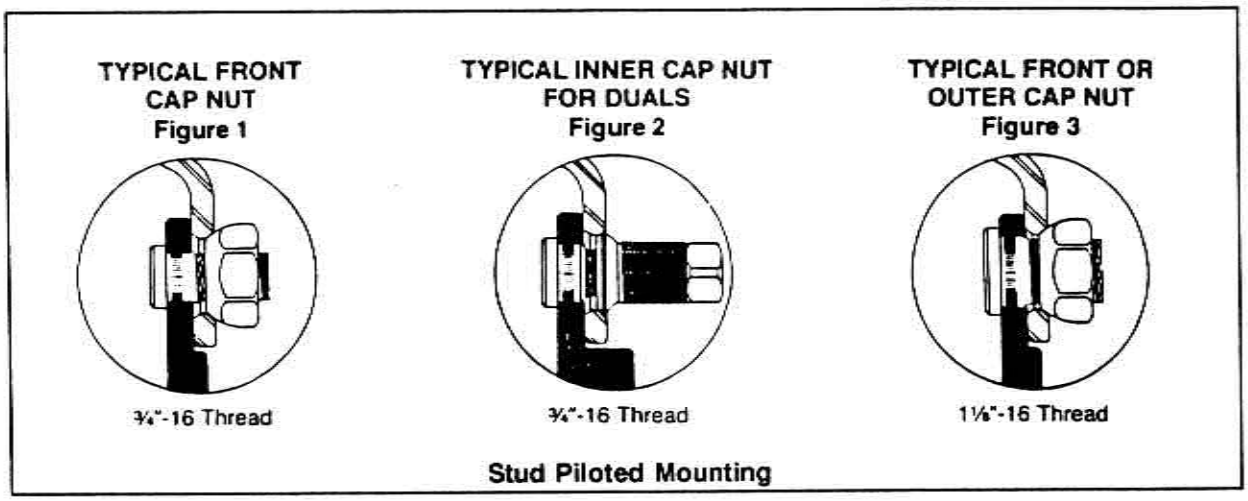
10-Hole, 11¼" Bolt Circle DCN and 6-Hole, 8¾" Bolt Circle DCN Mounting:

1. Inflate tire prior to installing on vehicle (see "Tire Inflation Table", page 6-5).

2. Inspect parts before installing:

   - Check all parts for damage, including rims/wheels. Ensure that studs, nuts and mounting faces of hub drum and wheels are flat, clean and free from grease. Clean hub surface with wire brush if scale is present. Install wheels only on hubs or drums that have the proper backup diameter (see SAE J694).

   - Replace any damaged parts. Do not bend, weld, heat or braze components. Do not use tubes to stop rim air leakage.



Stud Piloted Mounting

STUD-PILOTED MOUNTING *(Continued)*

WARNING: Not all nuts and studs can be used with all types of wheels. The use of improper nuts and studs can cause nut loosening, stud failure, or premature wheel failure, which could cause an accident or injury.

- Use correct nuts. Inspect nuts to ensure they function properly and are not worn.

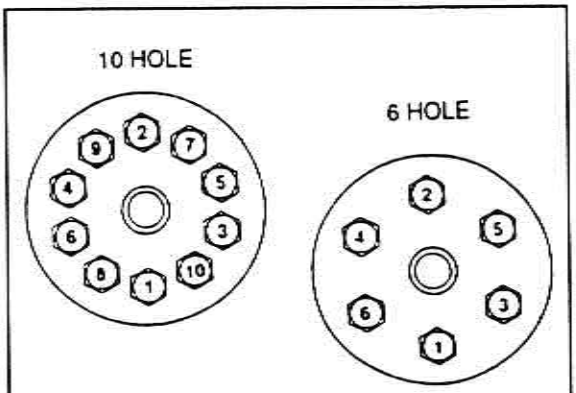
3. Install wheel on vehicle.

   a. Front Wheels

      Slide front wheel over studs, being careful not to damage the stud threads. Snug up nuts in the sequence shown in illustrations for 6- and 10-hole wheels. Do not tighten the nuts fully until all have been seated. This procedure will permit the uniform seating of nuts and ensure the even, face-to-face contact of wheels, hub, and drum. Tighten nuts to 450-500 ft.-lbs. (dry) using the same criss-cross sequence.

   b. Dual Rear Wheels

      - Slide the inner dual wheel over studs, being careful not to damage the stud threads. Snug up the inner cap nuts in sequence shown in illustration for 6- and 10-hole wheels. Do not tighten the nuts fully until all have been seated. This procedure will permit the uniform seating of nuts and ensure the even, face-to-face contact of wheels, hub, and drum. Tighten to 450-500 ft.-lbs. (dry) using the same criss-cross pattern.

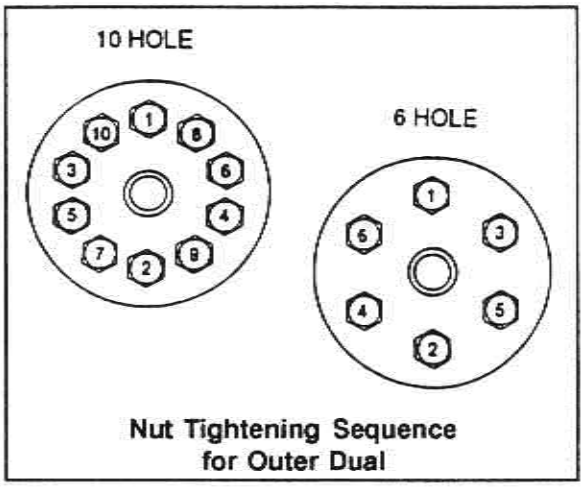


Nut Tightening Sequence for Front or Inner Dual

- Align the hand holes to allow access to the air valves.

***STUD-PILOTED MOUNTING** (Continued)*

- Slide the outer dual wheel over the inner cap nuts and repeat the entire procedure, using the nut tightening sequence in illustration. Tighten the outer cap nut to 450-500 ft.-lbs.



Nut Tightening Sequence for Outer Dual

4. Torque nuts properly

   WARNING: Nuts must be kept tight by retorquing on a routine basis and using the proper nut torque and tightening sequence. Loose nuts could result in loose wheels or premature wheel failure. This can result in an accident or injury.

   a. Be sure to tighten wheel nuts to the recommended nut torque. Do not over-tighten. Do not lubricate the nuts or studs.

   b. After the first 50-100 miles of operation, recheck the torque level and re-tighten nuts to the proper torque level. When inner cap nuts are re-tightened be sure to loosen the outer cap nuts first, tighten inner cap nuts and re-tighten outer cap nuts to proper torque level.

   c. Maintain nut torque at the recommended level through planned, periodic checks.

   d. If air wrenches are used, they must be periodically calibrated for proper torque output. Use a torque wrench to check the air wrench output and adjust the line pressure to give correct torque.

INSPECTIONS ON VEHICLE

As owner, you are probably the most frequent inspector of your motor home equipment. You will probably be the first to spot any signs of potential trouble with your wheels.

Pay particular attention to front-end assemblies. Examine all exposed areas, frequently. Clean wheels and look for cracks or other damage. Damaged wheels must be replaced. For example replace wheels that are bent, cracked, heavily corroded, or leak air.

AVOID ABUSE

Abuse can shorten the life of a wheel. Lack of care in changing a tire, heavy pounding of the wheel rim, overloading or hitting curbs at high speed or a sharp angle can damage wheels.

Elongated stud holes or dirt streaks radiating from stud holes indicate loose cap nuts.

ALUMINUM WHEELS

GENERAL

Following the easy owner care and routine service procedures outlined in this manual will help protect your wheels. Alcoa Forged Wheels deliver optimum performance and lasting good looks mile after mile, season after season.

OFF VEHICLE INSPECTION

Inspect the wheel and other hardware for safe operation. Like tires and other vehicle components that work hard, wheels will eventually wear out. It isn't always possible to predict exactly when the useful life of a wheel will end. But generally, an older wheel should be examined more frequently for obvious signs that it should be removed from service.

HIDDEN DAMAGE

Some forms of wheel damage can be hidden beneath the tire, so whenever a tire is removed, thoroughly examine the complete wheel. Remove all grease and road dirt. Use a wire brush or steel wool to remove rubber from the bead seats.

BALANCERS AND SEALERS

Liquid balancers and sealers can cause corrosion. Using any additive in the air chamber that causes corrosion will void the warranty and can cause premature wheel failure.

INSPECTIONS ON VEHICLE

As the owner, you are probably the most frequent inspector of your motor home equipment. You will likely be the first to spot any signs of potential trouble with your wheels.

Pay particular attention to front-end assemblies. Examine all exposed areas frequently. Clean wheels and look for cracks or other damage. Damaged wheels such as those that are bent, cracked, heavily corroded, or leak air, must be replaced.

AVOID ABUSE

Abuse can shorten the life of a wheel. Lack of care in changing a tire, heavy pounding of the wheel rim, overloading or hitting curbs at high speed or a sharp angle can damage wheels.

Elongated stud holes or dirt streaks radiating from stud holes indicate loose cap nuts.

CLEANING AND MAINTENANCE AGAINST CORROSION

CAUTION: Wheels sometimes contain sharp or jagged edges, capable of cutting one's hand. To avoid contact with sharp edges, it is strongly recommended that rubber gloves be worn when washing or polishing your wheels.

1. Keep your Alcoa Forged Wheels looking great with simple care. Wash the wheels with steam or high-pressure water from a hose and a mild soap. Do not use household detergents. Most automotive supply shops carry suitable mild car wash soaps.

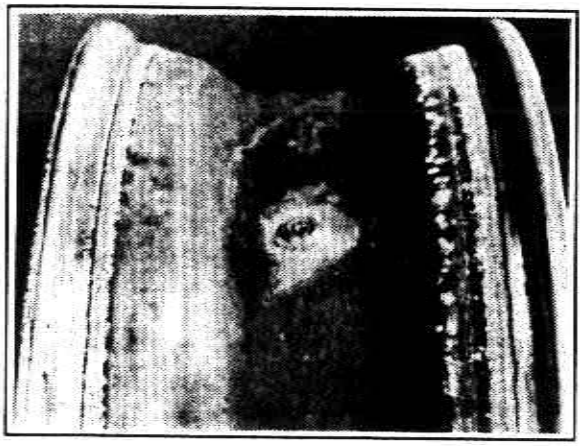
2. You can brighten the wheels, even after years of use, with readily-available buffing compounds. Follow the buffing instructions that come with the compound.

3. When tires are removed, the entire wheel must be cleaned and inspected. Remove any soil or oxidation products from the tire side of the rim with a wire brush. Heavily-corroded parts, including studs or cap nuts, must be replaced.

4. Due to aluminum's natural resistance to corrosion, Alcoa forged aluminum disc wheels do not need to be painted for most operating conditions. However, certain environments can lead to corrosion. Some of these are: livestock hauling; salt; chloride compounds used for snow removal; and highly alkaline materials. And if the air used

CLEANING AND MAINTENANCE AGAINST CORROSION *(Continued)*

to fill tubeless tires, or the tire itself, is not dry, the areas of the wheel under the tire can corrode severely.



Bead seat and valve stem corrosion often are caused by entrapped moisture which contains corrosive elements. Mild corrosion should be removed thoroughly by wire brush and the rim should be protected with a coat of Freylube or equivalent. Remove any severely corroded wheel from service.

CLEANING ALUMINUM WHEELS, HUB CAPS AND NUT COVERS

Alcoa wheel manufacturers recommend the following: Busch maintenance kit from: Busch Industries, P.O. Box 7407, Charlotte, NC 28217, phone (704) 588-2067, or Mothers cleaners and buffing compounds. After regular washing, the wheels can be waxed with a generous amount of automotive wax.

Important: Waxing should be done every 3 to 6 months.

INSPECTION

Thorough, Frequent Inspection

Examine wheels, both on and off the vehicle, at frequent intervals for safe operation.

As an aid in determining the period of time a wheel has been in service, it is recommended the owner stamp an "in service" date onto the wheel at the time he or she receives it. See section entitled: "Owner/In-Service Identification", page 6-13 for recommended stamping locations.

Beginning in 1977, all Alcoa wheels have been stamped with the month and year of manufacture. Wheels produced prior to 1977 carry a manufacturing date code. To decode the date, refer to the key and example on page 6-14 of this manual.

Pay particular attention to front-end assemblies. Examine all exposed areas frequently. Clean wheels and look for cracks or other damage.

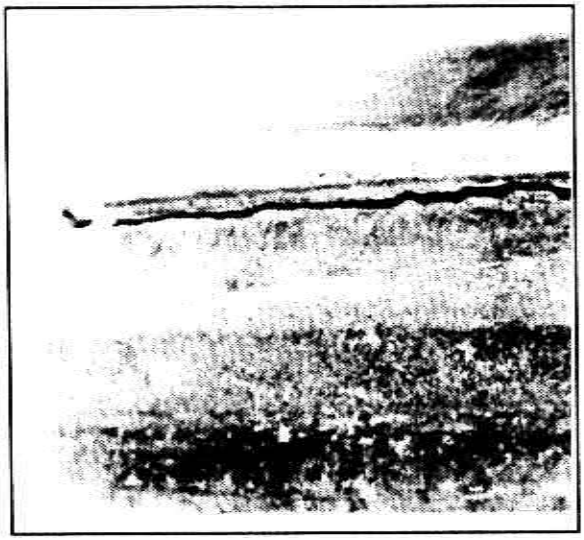
During tire changes, thoroughly examine the entire wheel. Pay particular attention to the surfaces of the rim contour and, on tube-type wheels, the gutter area normally concealed by the side rings.

Be sure that the best wheels are on the front.

Gutter Area

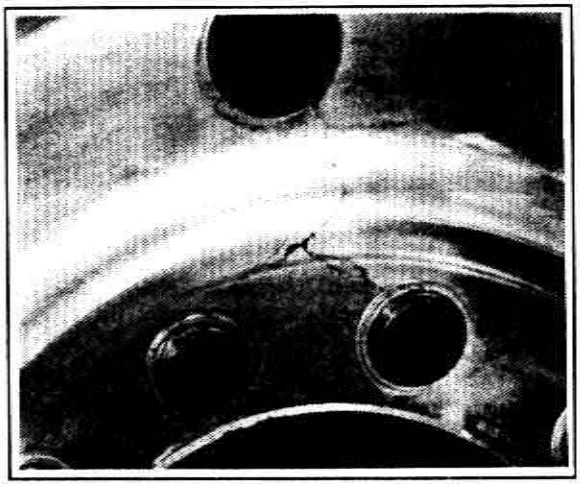
Projections on the side wall of the wheel gutter area can cause even seating of the side and lock ring and chipping of the gutter. Such projections must be removed. Remove wheel from service - if damaged.

***Gutter Area** (Continued)*

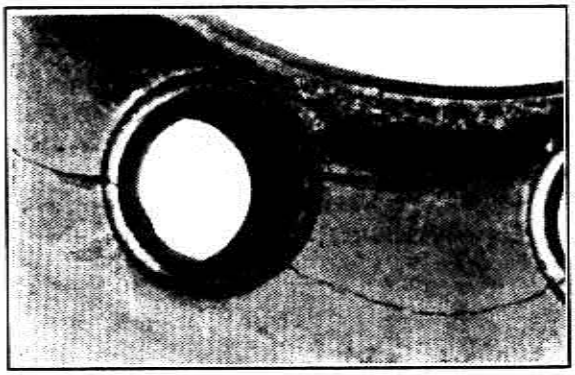


Be alert for cracking in bottom of the gutter flange. Occasionally, circumferential cracks may appear in the bottom of the gutter area. This area should be thoroughly cleaned and carefully inspected after a tire is removed from the wheel. Also check the side underneath gutter flange for circumferential cracks. Gutter flange cracks can ultimately lead to the separation of the rim area from the disc. Immediately remove from service a wheel that exhibits any cracks.

Mounting Area



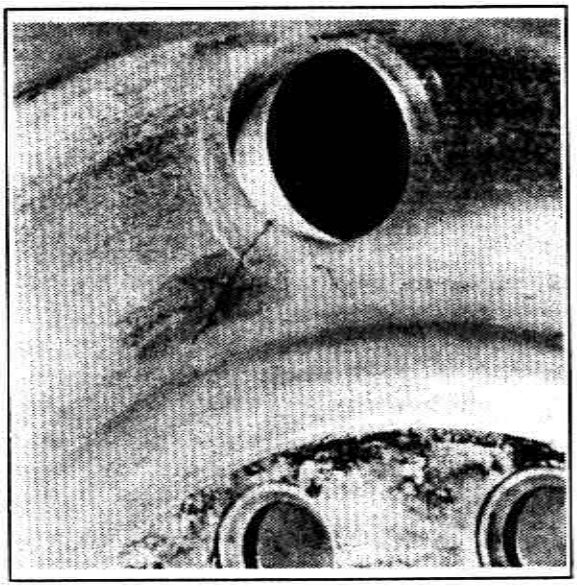
Stud hole crack. Usually caused by improper torquing or excessive loading. Remove wheel from service.



Stud hole cracks emanating from stud hole on hub/drum side of wheel. Causes are: undersized diameter of wheel support surface, support surface not flat, wheel mounting surface not flat or incorrect attachment parts and insufficient torque. Remove wheel from service.

Support surface should be flat and at least 13-3/16" in diameter, 13-1/2" preferred.

Disc Area



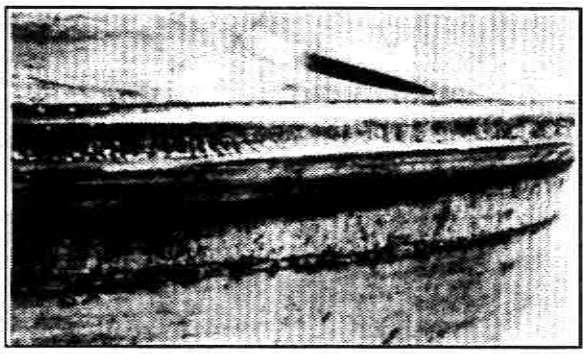
Hand hole crack. Inspect both sides of disc area for hand hole crack. Wheel should be removed from service.

Rim Area

Valve hole crack. Check the entire rim area for nicks, gouges and cracks. Loss of air may be caused by cracks in areas around the valve stem hole. Wheel should be removed from service.

Rim Flange Wear

Irregular wear on the surface of the rim flange caused by the chafer area of the tire working on the surface of the rim flange. Remove from service when rim flange wear is excessive.



CARE AND MAINTENANCE

Keep Cap Nuts Tight

Wheel cap nuts must be kept tight. When checking the cap nuts on dual disc wheels utilizing the stud-located ball seat mounting system, loosen the outer nut before attempting to tighten the inner nut. Try all cap nuts for proper torque after the first use or any removal. Inspect wheels and check wheel nuts during service stops.

The proper torque for ball seat cap nuts is 450 to 500 ft.-lbs. (dry) using same tightening sequence mentioned in steel wheel section.

> ***WARNING:*** ***Nuts must be kept tight by retorquing nuts on a routine basis and using proper nut torque and tightening sequence. Loose nuts could result in loose wheels or premature wheel failure. This can result in an accident or injury.***

Be sure to tighten wheel nuts to the recommended nut torque. Do not over-tighten. Do not lubricate the nuts or studs.

After the first 50-100 miles of operation, recheck the torque level and re-tighten nuts to the proper torque level. When inner cap nuts are re-tightened be sure to loosen the outer cap nuts first, tighten inner cap nuts and re-tighten outer cap nuts to proper torque level.

Owner/In-Service Identification

Some fleets wish to specially identify wheels as to OWNERSHIP and IN-SERVICE dates. Alcoa recommends that fleets and owner-operators adopt the practice of permanently stamping wheels with the date they are first placed into service.

1. Use "Lo-Stress" stamps or equivalent.

2. Location of stamped areas on outside disc should be in a space outward from a line between hand hole centers and a minimum of one inch from the periphery of any hand hole.

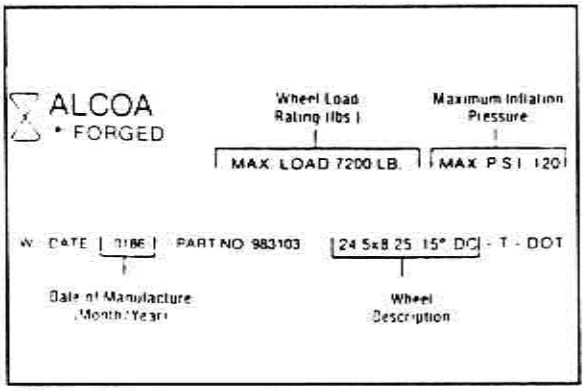
3. Location of stamped identification on inside of wheel should be as close to the factory identification stamping as possible.

IDENTIFICATION

ALCOA WHEEL IDENTIFICATION

Since 1977, all Alcoa forged aluminum disc wheels have been identified with a stamped marking like the one below.

On all wheels except the 16-inch, the Alcoa identification symbol [ ] also appears on the outside of the disc near the hand hole in line with the valve location.

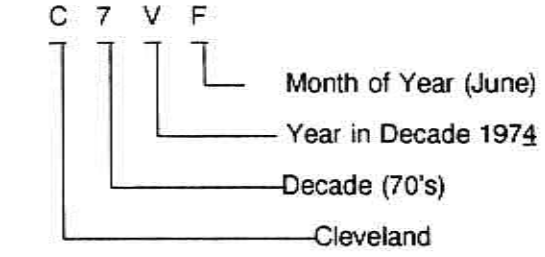


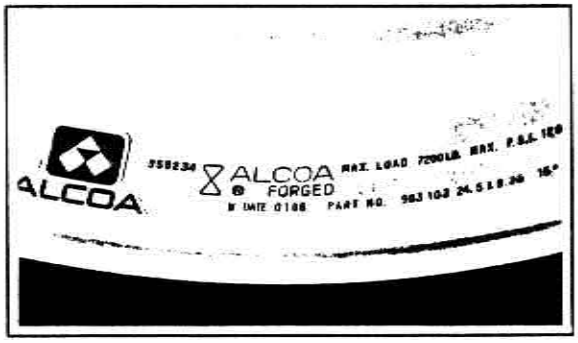
PREVIOUS IDENTIFICATION DATE CODE SYSTEM

Prior to 1977 the date on a wheel was manufactured appeared in code. To decode a wheel date, use the following chart as shown in the example.

C7VF = Cleveland, 1974, June

Code	
Q = 9	A = January
R = 8	B = February
S = 7	C = March
T = 6	D = April
U = 5	E = May
V = 4	F = June
W = 3	G = July
X = 2	H = August
Y = 1	I = September
Z = 0	J = October
	K = November
	L = December





These identifications are your assurance of a genuine Alcoa Forged Aluminum Disc Wheel.

GENERAL AXLE INFORMATION

IMPORTANT SAFETY NOTICE

Should an axle assembly require component parts replacement, it is recommended that original equipment replacement parts be used. They may be obtained through your local service dealer or other original equipment manufacturer parts supplier.

> ***CAUTION:*** ***The use of non-original equipment replacement parts is not recommended, as their use may cause unit failure and/or affect vehicle safety.***

Proper service and repair is important to the safe, reliable operation of all motor vehicles or driving axles, whether they be front or rear. The service procedures recommended and described in this service manual are effective methods for performing service operations. Some of these service operations require the use of tools specially designed for the purpose. The special tool should be used when and as recommended.

> ***CAUTION:*** ***Extreme care should be exercised when working on components utilizing snap rings or spring-loaded retention devices. For personal safety, it is recommended that industrial strength safety goggles or glasses be worn whenever repair work is being done on any vehicle or vehicle components.***

It is impossible to know, evaluate and advise the service trade of all conceivable ways in which service might be done or of the possible hazardous consequences of each way.

Accordingly, anyone who uses a service procedure or tool which is not recommended must first assure that neither personal safety nor vehicle safety will be jeopardized by the selected service methods.

WARNING: Some vehicle manufacturers may require the assembly of brake components on Dana axles that utilize materials containing asbestos fibers.

BREATHING ASBESTOS DUST MAY BE HAZARDOUS TO YOUR HEALTH AND MAY CAUSE SERIOUS RESPIRATORY OR OTHER BODILY HARM.

Follow O.S.H.A. standards for proper protective devices to be used when working with asbestos materials.

SILICONE RUBBER SEALANT (RTV) AND LUBRICATING GREASE AND OILS:

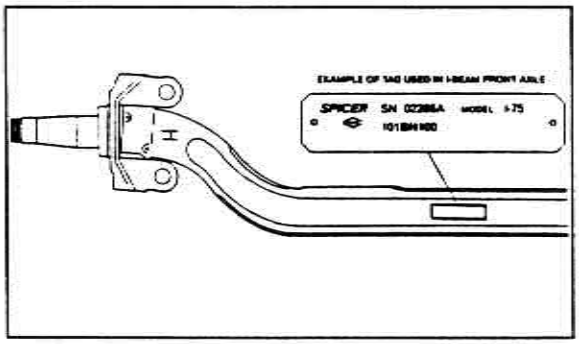
Silicone rubber sealant is used as a gasket material on Dana axles, as well as various lubricants for lubricating purposes. Before using any of these materials, one should become familiar with and follow all safety precautions as recommended by the product manufacturer/supplier. All personnel involved with these materials should follow good industrial hygiene practices (e.g. before eating, hands and face should be thoroughly washed. Eating, drinking and smoking should be prohibited in areas where there is potential for significant exposure to these materials).

When discarding any of the materials, observe all local, state, and federal laws and regulations for proper disposal procedures.

IDENTIFICATION

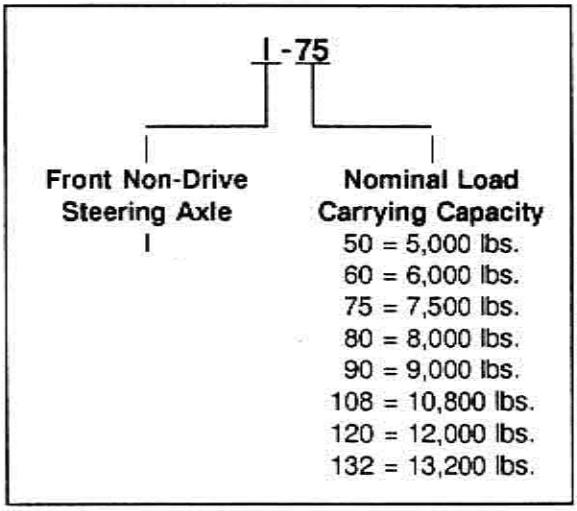
The Spicer front non-drive steering axles are identified with a tag located between the spring pads, on the front side of the center beam section.

The axle tag contains the serial number, the model number, and the assembly number.



SPICER HEAVY MODEL NUMBERING SYSTEM

The Spicer model numbering system provides pertinent information about the axle for easy identification. Example:

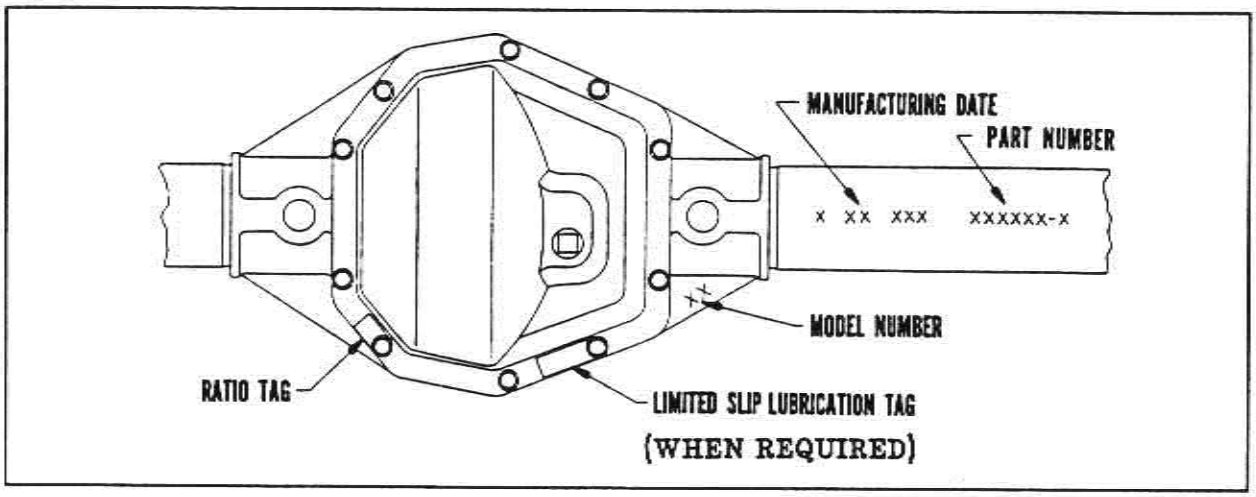


SPICER RECOMMENDED PREVENTIVE MAINTENANCE SCHEDULE

INTERVAL	COMPONENT	PROCEDURE
Break-In After completing 100 hours or 4,000 miles of operation	Wheel Bearings (All Models) Wheel Bearings (Oil) King Pins* Tie Rod Ends	Adjust Check level daily during break-in. Lubricate with NLGI-1 or NLGI-2 (EP-1 or EP-2) Grease
10,000 miles or every 5 months (whichever comes first)	King Pins* Tie Rod Ends	Lubricate with NLGI-1 or NLGI-2 (EP-1 or EP-2) Grease
32,000 miles or annually (whichever comes first)	Wheel Bearings (Grease)	Repack with NLGI-1 or NLGI-2 (EP-1 or EP-2) Grease
96,000 miles or annually (whichever comes first)	Wheel Bearings (Oil)	Change lubricant GL-5 Gear Lubricant

* Raise front axle wheels off the floor, prior to lubrication of king pins. This allows sufficient grease to circulate through king pin bushings and thrust bearings.

MODEL 80 IDENTIFICATION (EC Model Chassis)



Spicer axles are identified with a manufacturing date and complete part numbers stamped on the right-hand tube. The part number may also appear on a metal tag attached to the cover plate by the cover screws, depending upon the requirements of the vehicle manufacturer.

The part number, consisting of six digits reading from left to right, is the basic number for identifying the particular axle assembly. The seventh digit following the dash will identify ratio, differential, and end yoke options used in the assembly. The next group of numbers is the manufacturing date of the axle and is interpreted as follows: the first number is the month, the second number is the day of the month, the third number is the year, the fourth is the line that built the axle, and the letter is the shift.

Note: *It is recommended that when referring to the axle, the complete part number and build date be obtained. To do this, it may be necessary to wipe or scrape off dirt, etc., from the axle housing.*

If the axle is unique in design so that the unit cannot be identified in the standard manner as described above, refer to the vehicle manufacturer's service and/or parts manual for proper identification.

VEHICLE STORAGE OR PROLONGED INOPERATION

If the vehicle is not recently operated on a regular daily basis, it is recommended that it be operated at least once every two weeks. The vehicle should be moved far enough to cause the drivetrain components to make several complete revolutions. This procedure will help assure that all internal components receive adequate amounts of lubrication to help reduce component deterioration caused by an undesirable environment (e.g. high humidity).

SPICER (Model 80) DIFFERENTIAL LUBRICATION SPECIFICATIONS

It is not our intent to recommend any particular brand or make of lubricant for the Spicer hypoid axle. However, an S.A.E. 80W-90 multi-purpose gear lubricant meeting Mil. Spec. L-2105-C, and suitable for A.P.I. (American Petroleum Institute) Service Classification GL-5, is suggested as a minimum requirement.

Important: Motor vehicles are operated under various requirements, conditions, and environments. This manual specifies the minimum requirements that the lubricants should meet. However, it is recommended that the lubricants specified by the vehicle manufacturer be used. They may provide additional lubricating characteristics which may be required for your vehicle's operation. Contact your local service dealer or refer to your owner's manual for obtaining the proper lubricant specification.

AXLE LUBRICANT CHANGE SCHEDULE

The following schedule is a suggested lubricant change schedule. Lubricant in your vehicle may require more frequent changes depending upon the environment in which it is operated in. Contact your local service dealer or refer to your owner's manual for obtaining the proper lubricant change schedule for your vehicle.

Drain lubricant at first oil change and refill with specified lubricant. FOR NORMAL HIGHWAY USE, change lubricant every 100,000 miles or 24 months, whichever comes first. FOR OFF-HIGHWAY, SANDY, DUSTY, OR WET CONDITIONS, change lubricant every 25,000 miles or 6 months, whichever comes first.

Lubricant may be drained by removing the carrier cover plate. This also allows for visual inspection of the internal components. Follow the service procedure in the manual for reassembly of the cover plate.

WHEEL BEARING LUBRICATION

Wheel bearings are lubricated by packing them with grease. For grease packing it is recommended that a N.L.G.I. (National Lubricating Grease Institute) No. 2 lithium EP grease suitable for automotive wheel bearings be used. Contact your local vehicle service dealer for proper lubricant specification, and maintenance schedule.

GENERAL INSPECTION

Perform a thorough visual inspection for proper assembly, broken parts, looseness each time vehicle is lubricated. Make certain spring to axle beam mounting nuts and steering connection fasteners are secure.

WHEEL ALIGNMENT

If excessive steering effort, vehicle wander or uneven and excessive tire wear is evident, then check wheel alignment.

SUBMERSION OR DEEP WATER FORDING

If the vehicle is exposed to water deep enough to cover the hubs, it is recommended that the wheel ends be disassembled and inspected for water damage and/or contamination.

In the event the carrier housing should become sub-merged in water, particularly if over the breather, it is recommended that the hypoid gear lubricant be drained and internal parts be inspected for water damage and/or contamination.

Clean, examine, and replace damaged parts if necessary, prior to assembling the housing cover and refilling with the specified hypoid lubricant.

> ***Note:*** *If the hubs are exposed to deep water, it is possible that the water could enter the carrier at the point the axle shaft enters the tube in the wheel end. This could also necessitate the draining of the hypoid lubricant as described above.*
>
> *It is recommended that whenever bearings are removed, they be replaced with the new ones, regardless of mileage.*

RECOMMENDED LUBRICATION PRACTICES (EC Model Chassis)

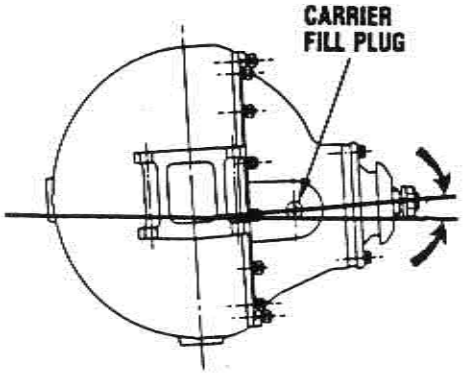
NEW AND RECONDITIONED AXLE SERVICE

Drain and flush the factory-fill axle lubricant of a new or reconditioned axle after the first 1,000 miles (1,600 km) but never later than 3,000 miles (4,800 km). Drain the lubricant (while the unit is still warm) from the carrier/housing, and, if a drain plug is employed, from the inter-axle differential assembly of the forward carrier of tandem axles. Flush axle with clean GL-5 axle lubricant of the same viscosity as used in service. **Do not** flush axles with solvent such as kerosene.

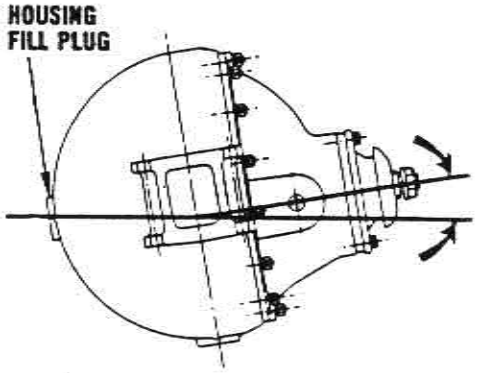
IMPORTANT: The design of certain Rockwell forward/rear tandem axle carriers such as the LHD, QHD, TDD, UDD and FDD models include separate cast housings to enclose their respective inter-axle differential assemblies. Baffles and dams are incorporated in these cast housings to maintain a reservoir of lubricant but may also trap wear particles and debris. Therefore, it is important to always purge the lubricant that is retained in these inter-axle differential assemblies whenever the axle lubricant is changed, initially, at scheduled intervals, or at overhauls. For this purpose these types of carriers employ separate oil drain and fill holes located in either the inter-axle differential cover or the inter-axle differential housing.

Also, change the oil filter of drive units employing a pump forced lubrication system. Initially the filter should be changed at the same time as the oil, or 1000-3000 miles (1600-4800 km).

Fill axles to bottom of level hole (in carrier or housing) with specified lubricant with the vehicle on level ground. If the axle employs an inter-axle differential of the type that can be directly filled through a top filler plug hole, pour an additional 2 U.S. pints (0.946 liters) of the same lubricant into the inter-axle differential housing.



**PINION ANGLE LESS THAN 7°
FILL TO CARRIER FILL PLUG HOLE**



**PINION ANGLE MORE THAN 7°
FILL TO HOUSING FILL PLUG HOLE**

Proper Lubricant Levels

IMPORTANT: The angle of the drive pinion, as mounted under the vehicle, will determine which oil fill/level plug hole should be used.

NEW AND RECONDITIONED AXLE SERVICE *(Continued)*

Except for "Top Mounted" or pinion inverted type carriers, use the following information to locate the fill/level hole.

Measure the drive pinion angle — if angle is less than 7° (above horizontal) use the hole located in the side of carrier. If the angle is more than 7° (above horizontal) use the hole located in the axle housing bowl. Note: Some axle models may have only one lube fill hole which is located in the housing bowl. With these models use this lube filler hole for all pinion angles. On axles employing "Top Mounted" or pinion inverted type carriers, the fill/level hole is always located in the axle housing bowl. Some axle models have a small tapped and plugged hole located near, but below the housing lubricant level hole. This smaller hole has been provided for the use of a lubricant temperature indicator only and **must not be used as a fill or level hole.**

After filling the axle with lubricant drive the vehicle, unloaded, for one (1) or two (2) miles (1.6 to 3.2 km) at speeds not to exceed 25 miles per hour (40 kph) to thoroughly circulate the lubricant throughout the axle and carrier assemblies.

REGULAR AXLE SERVICE

Follow "New and Reconditioned Axle" procedures except for initial 1000-3000 mile (1600-4800 km) drain and flush instructions. Change lubricant at recommended intervals.

LUBRICANT CAPACITIES OF ROCKWELL COMPONENTS

(Single Axles - Reference Only)

MODEL	CAPACITY U.S. Pints	CAPACITY Liters
F-106	13	6.0

LUBE AND INTERVAL CHART

(Max. Lubrication Change Intervals)

	RECOMMENDED ‡ STANDARD LUBES	CLASS "A" ON HIGHWAY ONLY
DRIVE UNITS (Differentials)*	0-76-A, 0-76-B	100,000 miles/ 12 months**

‡ Lubricants listed are recommended for average temperatures and operating conditions. Check the manual for optional lubricants.

* Drain factory fill axle lube from new or reconditioned axles after first 1000 to 3000 miles of operation. Replace oil filter, if employed, every time the oil is changed.

** Whichever comes first

GENERAL RECOMMENDATIONS (MH & IC Model Chassis)

The following procedures are consistent with industry practice and are recommended as general guidelines for periodic service. Use the manufacturer's instructions as a Intermediate primary guide.

AXLE IDENTIFICATION

The Model and Part Numbers are stamped on a plate that is attached to the front of the axle beam. The Serial Number is stamped in the beam. The Serial Number is used by Eaton for control purposes. The Model Number describes the axle specifications. *If difficulty is experienced* in parts replacement identification, furnish Model No. and Serial No. only. (See illustration below)

GENERAL INSPECTION

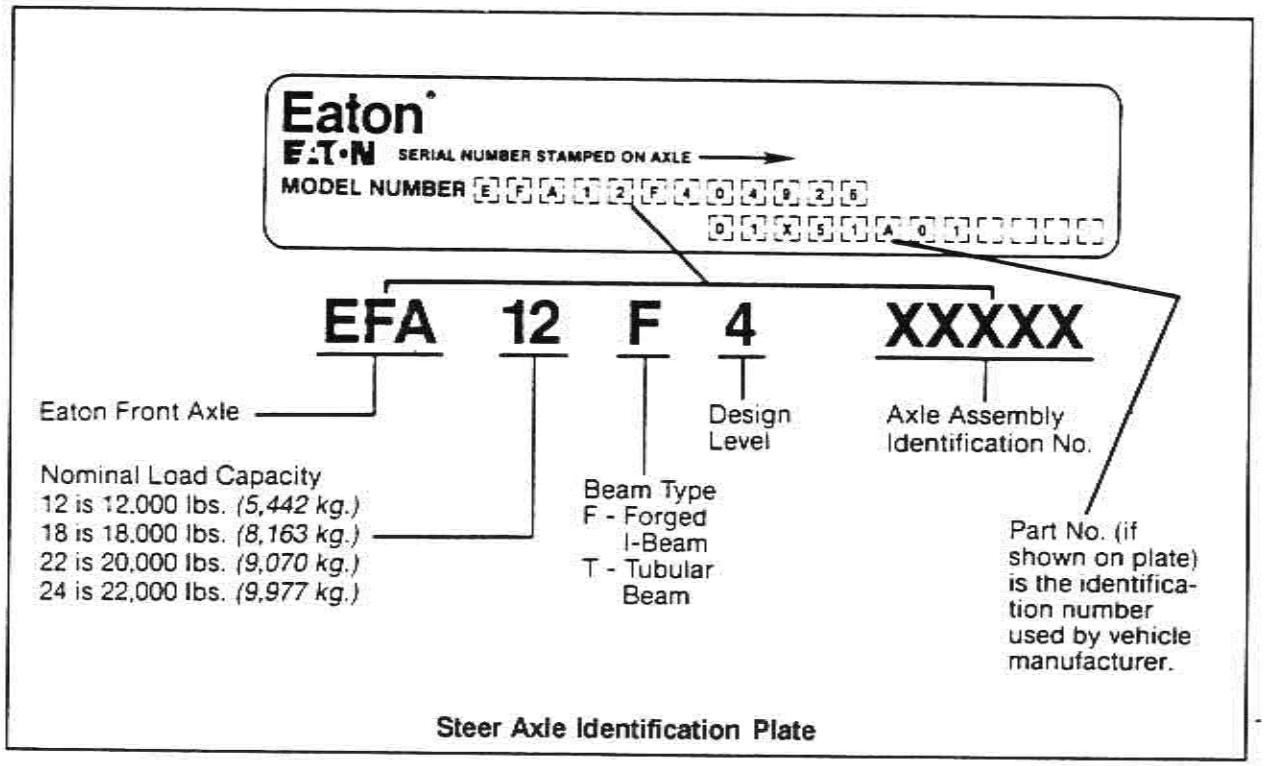
Perform a thorough visual inspection for proper assembly, broken parts, and looseness each time the vehicle is lubricated. Make certain spring to axle beam mounting nuts and steering connection fasteners are secure.

WHEEL ALIGNMENT

If excessive steering effort, vehicle wander or uneven and excessive tire wear is evident, then check wheel alignment.

STEERING AXLE STOPS

Steering stops are pre-set at the factory and should not be adjusted. Adjustment or removal can result in damage to chassis and body components.



Steer Axle Identification Plate

TIE ROD ENDS

Inspect each time axle is lubricated. Check for seal damage, worn ball sockets or loose fasteners.

LUBRICATION

Pressure-Fitting Grease

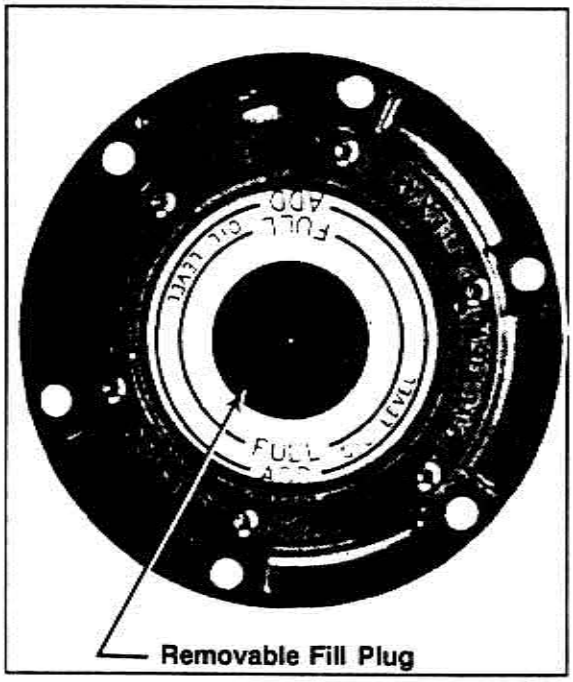
Heavy-duty, multipurpose lithium base (#2 grade). Do not mix with sodium base grease.

Knuckle Pins, Thrust Bearings, Tie Rod Ends

Pressure lubricate every 25,000 miles (40,000 km) or 6 months. Use grease specified above. Knuckles or tie rod ends without grease fittings are permanently lubricated.

Wheel Bearings

Fill hub with 80W90 Gear Lube to full line, as shown in illustration, by removing plug in center of hub.

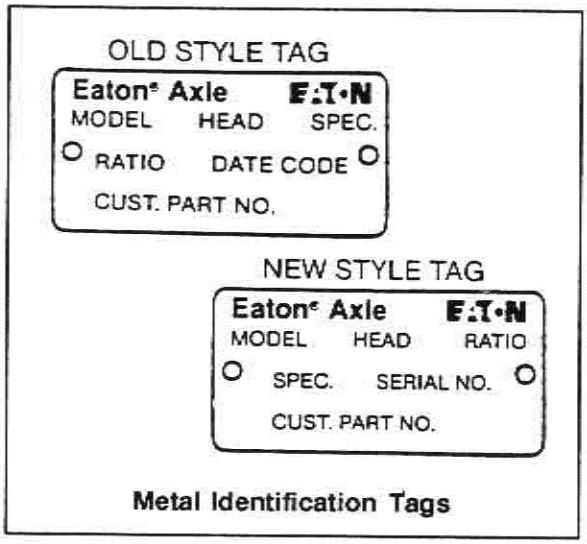


REAR AXLE IDENTIFICATION (MH & IC Model Chassis)

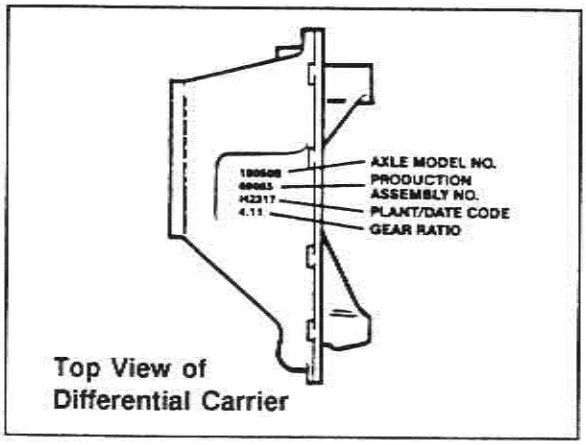
Axle and differential carrier identification is either stamped on the carrier itself or on a metal tag affixed to the carrier. Location on the carrier is the same.

19 050 S

- **19** — Ground Load Capacity (x1000) (Lbs.)
- **050** — GCW (x1000) (Lbs.)
- **S** — Gearing
  - S - Single Reduction
  - T - 2-Speed
  - P - Planetary Double Reduction
  - D - Wheel Differential Lock



Metal Identification Tags

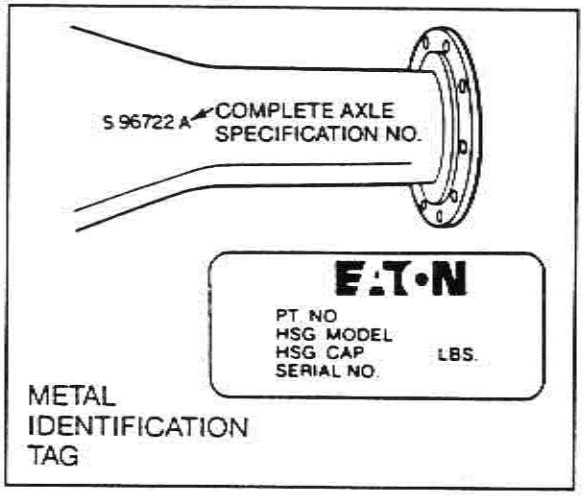


Top View of Differential Carrier

AXLE SPECIFICATION NUMBER

The complete axle is identified by the specification number stamped on the rear right-hand side of the axle housing. This number identifies all component parts of the axle built by Eaton, including special OEM requirements such as yoke or flange.

In addition, some axle housings may include a metal identification tag (see illustration). This tag identifies the housings only. It does not identify the differential carrier assembly components.



METAL IDENTIFICATION TAG

LUBRICATION

Proper lubrication is vital for optimal drive axle service life. The importance of the following procedures cannot be overstated.

Eaton recommends petroleum-based and synthetic-based gear lubricants meeting military specifications MIL-L-2105C/D for use in drive axles. 80W-140 or 85W-140 are recommended for severe service.

Eaton Roadranger™ synthetic gear lubricants meet or exceed these requirements and are available in 75W-90 and 80W-140.

Oil additives are NOT APPROVED for use in Eaton axles.

Axle gear lubrication should be selected on the basis of the ambient temperature range in which the vehicle normally operates.

> ***Note:*** *Do not mix lubricants of different grades. Different brands of same grade lubrication meeting MIL-L-2105-C may be mixed.*

Ambient Temperature Range	Proper Grade
-40°F to -15°F (-40°C to -26°C)	75W
-15°F to 100°F (-26°C to 38°C)	80W-90
-15°F and above (-26°C and above)	80W-140
10°F and above (-12°C and above)	85W-140

Lube Level

Lubricant should be filled to a level even with the bottom of the filler hole. A level close enough to be seen or touched is not sufficient.

> ***Note:*** *Check and clean the housing breather vent at each lubrication level check.*

Lube Change Intervals

Change lubricant according to the schedule shown, following the steps below.

New or rebuilt axle . . . . . 5,000 miles
On-highway use . . . . . 100,000 miles
More severe use . . . . . 40,000 miles
Low mileage . . . . . annually

> ***CAUTION: The initial lube change within 5,000 miles is critical. This will remove fine particles of wear material generated during break-in and prevent accelerated wear of gearing and bearings.***

Changing Axle Lube

DRAINING: Drain into suitable container with lube at normal operating temperature. Inspect drain plug for excessive metal particle accumulation symptomatic of extreme wear. Clean and replace plug after draining.

> ***Note:*** *After the initial lube change, the entire unit should be inspected if excessive particle accumulation is observed.*

FILLING: Remove filler hole plug and fill housing with approved lubricant until level with bottom of filler hole.

Lube Capacities
DO NOT OVERFILL AXLES

NOTE: Capacities do not apply to housings not designed by Eaton.

Axle Model	Pints	(Liters)
15040	21.0	(9.9)
19050, 19055	25.0	(11.8)
21065, 22065	33.5	(15.8)
23070, 23085	40.0	(18.9)
23105, 26105, 30105	44.0	(21)

Axles installed at angles exceeding 6° or operated regularly on grades exceeding 12% may require standpipes to allow proper fill levels. For specific information, contact Axle & Brake Engineering Department.

AIR SUSPENSION SYSTEM (MH Model Chassis)

Some Spartan Motors chassis are equipped with air suspensions to give a smooth ride and proper height, regardless of changes in weight loading in the coach.

HEIGHT CONTROL VALVES - GENERAL

The height control valves of the air suspension system are set to provide the proper distance between axle and frame that will prevent "bottoming out" on bumps. This setting is maintained via the height control valves by putting air in the air springs with additional load on board, or removing air in the air springs with removal of load from the coach.

HEIGHT CONTROL SETTING

This setting of the height control valves should never be changed in an attempt to improve ride. Other factors such as tire inflation pressure, shock absorbers, etc. will affect ride more often.

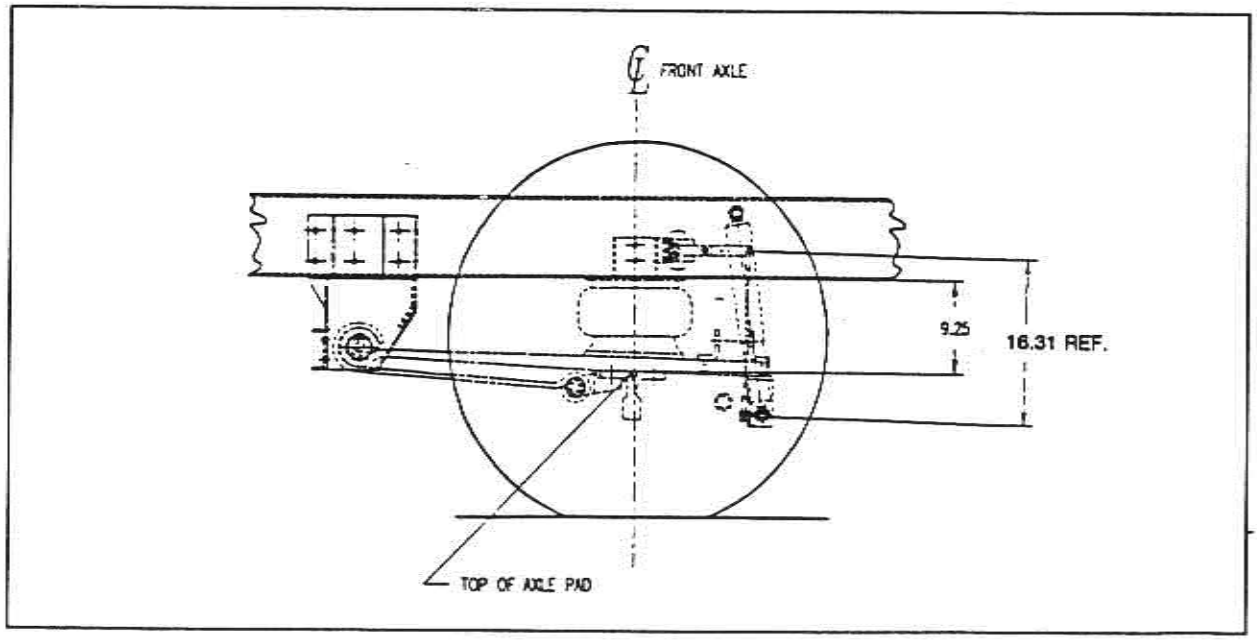
The proper heights of the frame are given in illustrations on pages 6-25 and 6-26 of the front and rear suspension height control valve adjusting procedure. If the coach is leaning, the dimensions given will help determine whether to lower the high side or raise the low side to achieve a level coach.

FRONT SUSPENSION HEIGHT CONTROL VALVE ADJUSTING PROCEDURE

If the front of the unit appears to be too high or low or leans to one side, it may be necessary to adjust the ride height of the front and/or rear suspension(s).

To adjust the ride height of the front suspension, follow this procedure.

1. Start the engine and build air system pressure to maximum.
2. Make sure tires are properly inflated according to the Tire Inflation Table (page 6-5).



***FRONT SUSPENSION HEIGHT CONTROL VALVE ADJUSTING PROCEDURE** (Continued)*

3. Park the unit on a smooth and level surface, place shift control in neutral, set parking brake, and shut off engine.

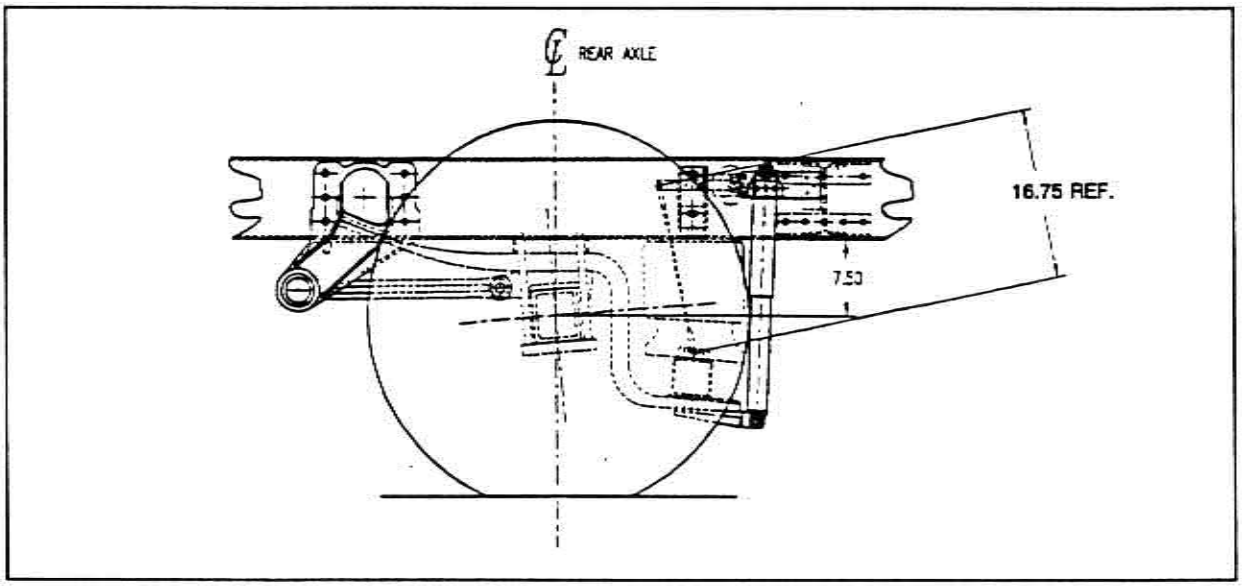
4. Measure the distance between top of axle pad and bottom of frame rail and compare measurement with dimensions in illustration on page 6-25.

5. If measurements agree with illustrations, no adjustment is necessary. If measurements disagree, continue with next step of adjustment procedure.

6. Disconnect rod between height control valve control arm and axle or suspension (see illustrations on page 6-25 and 6-27).

7. If chassis is too low, rotate height control valve control arm upward. This will allow more air to enter the air spring(s), causing the chassis to rise. Once the proper height dimension is attained, return the height control valve control arm to the horizontal (center) position. If chassis is too high, rotate leveling valve control arm downward. This will allow air to exhaust from the air spring(s), causing the chassis to drop. Once the proper height dimension is attained, return the height control valve control arm to the horizontal (center) position.

8. Adjust length of rod by loosening hose clamps and sliding rubber rod ends to make rod length match the distance between the height control valve and the bracket on the axle or suspension. Reinstall rod and tighten hose clamps. If suspension is equipped with two height control valves, repeat this procedure for the other valve.



REAR SUSPENSION HEIGHT CONTROL VALVE ADJUSTING PROCEDURE

If the rear of the unit appears to be too high or low or leans to one side, it may be necessary to adjust the ride height of the front and/or rear suspension(s).

To adjust the ride height of the rear suspension follow this procedure.

1. Start the engine and build air system pressure to maximum.

2. Make sure tires are properly inflated per the Tire Inflation Table (page 6-5).

3. Park the unit on a smooth and level surface, place shift control in neutral, set parking brake, and shut off engine.

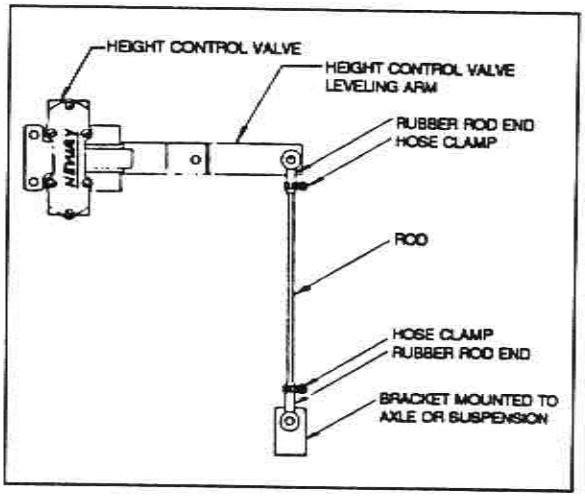
4. Measure the distance between horizontal centerline of axle housing and bottom of frame rails and compare measurement with dimensions in illustration on page 6-26.

5. If measurements agree with illustration, no adjustment is necessary. If measurements disagree continue with next step of adjustment procedure.

6. Disconnect rod between height control valve control arm and axle or suspension (see illustrations on page 6-26 and 6-27).

7. If chassis is too low, rotate height control valve control arm upward. This will allow more air to enter the air spring(s), causing the chassis to rise. Once the proper height dimension is attained, return the height control valve control arm to the horizontal (center) position. If chassis is too high, rotate height control valve control arm downward. This will allow air to exhaust from the air spring(s), causing the chassis to drop. Once the proper height dimension is attained, return the height control valve control arm to the horizontal (center) position.

8. Adjust length of rod by loosening hose clamps and sliding rubber rod ends to make rod length match the distance between the height control valve and the bracket on the axle or suspension. Reinstall rod and tighten hose clamps. If suspension is equipped with two height control valves, repeat this procedure for the other valve.



REYCO MODEL 102AR TRACTOR SUSPENSION

MAINTENANCE RECOMMENDATIONS (MH Model Chassis)

The Reyco 102AR Tractor Suspension, by design, requires a minimum of maintenance and a maximum of trouble-free service. However, suspensions in "over-the-road operations" require periodic checks to assure continued trouble-free performance. We recommend inspections be conducted after delivery (pre-service), after the first 1,000-1,500 miles and at 180-day intervals thereafter. The 1,000 mile check is especially important to make sure no loosening of components is evident.

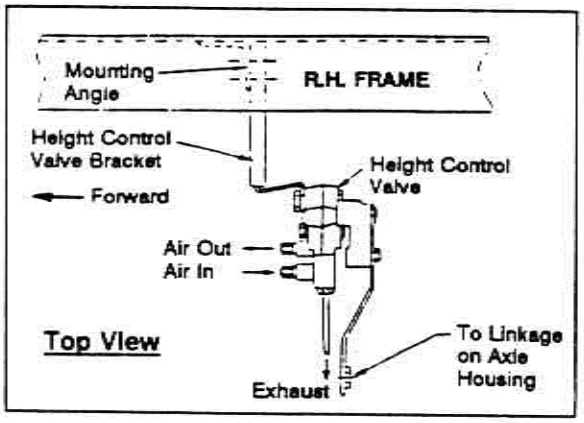
1. If hanger mounting bolts are used, they should be checked for tightness.

2. Check U-bolt nuts to assure that 450 ft.-lbs. of torque is maintained.

3. Check shock absorber mounting bolts to assure that 200 ft.-lbs. torque is maintained.

4. a. Check the 1/4 inch nuts in the height control valve linkage to assure that 6 ft.-lbs. torque is maintained. Adjust height control valve lever arm to maintain "ride height."

   b. Ensure air lines are clear of moving parts and the height control rod is at least 1.5" from air spring. (Air should be added to the air spring when lever is moved upward.)



5. Check air spring mounting bolts to assure the following torques are maintained:

   a. Top mounting nuts (½ & ¾ inch) 50 ft.-lbs.

   b. Bottom mounting bolts (½ inch) 50 ft.-lbs.

   c. Lower bracket-to-beam nuts (¾ inch) 400 ft.-lbs.

6. Check the 1 inch torque arm nuts at hanger and split bushing axle seat end to assure 160-200 ft.-lbs. torque is maintained. Standard 7/8 inch nut at axle seat requires 400 ft.-lbs.

7. Check ¾" torque arm clamp nuts to assure that 175-200 ft.-lbs. torque is maintained. Insure the clamp is directed away from the spring to prevent possible interference during operation.

8. Check ½" beam retainer bolt in hanger to assure that 75 ft.-lbs. torque is maintained.

9. Check suspension alignment. Suspension alignment should also be checked when any one of the following conditions prevail:

   a. Discovery of a loose suspension fastener, if relative motion has occurred at any fastened joint, or evidence of wearing of spring beam in hanger sides.

   b. Discovery of elongated holes in a suspension component.

   c. When bushings have been replaced.

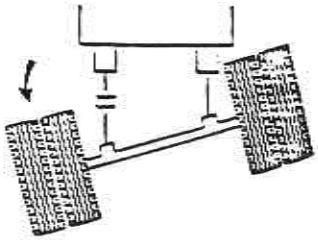
   d. Excessive or abnormal tire wear.

10. Check to ensure track bars are centering the spring beams in suspension hangers.

11. To ensure an accurate torque reading, the torque wrench must provide correct measurements. Check the wrench periodically. Also, the nut and bolt should be clean (free of any dirt, grit, rust, etc.).

AIR SUSPENSION REQUIREMENTS

WARNING: Loose suspension fasteners and worn parts may cause vehicle instability. Tighten fasteners to requirements stated.



Note: *After approximately 1,000 miles, and periodically thereafter, check suspension fasteners. Torque requirements are as follows:*

U-bolt nuts	450-475 ft.-lbs.
Torque arm bolt nuts	
(1-piece bushing type)	350-400 ft.-lbs.
(2-piece bushing type)	160-200 ft.-lbs.
Torque arm clamp bolt nuts	125-150 ft.-lbs.
Air spring mounting bolts	
(top and bottom)	50 ft.-lbs.
Cross beam-to-trailing	
beam nuts	400-425 ft.-lbs.
Shock absorber mounting	
bolt nuts	200-225 ft.-lbs.
Trailing beam retainer bolts	75-80 ft.-lbs.
Height control valve linkage nuts	6 ft.-lbs.

These settings must be maintained at all times.

Proper ride height must be maintained.

Electrical & Instrumentation

ELECTRICAL & INSTRUMENTATION

TABLE OF CONTENTS 7

ELECTRICAL & INSTRUMENTATION

CHAPTER 7

SPARTAN MOTORS SUPPLIED VDO GAUGES

Illumination Bulb - VDO Part No. 600 802

Gauges monitor the following functions: fuel level, battery voltage, engine oil pressure, engine coolant temperature, vehicle road speed, engine RPM, brake system #1 air pressure, and brake system #2 air pressure.

Optional gauges: transmission temperature and engine hour meter.

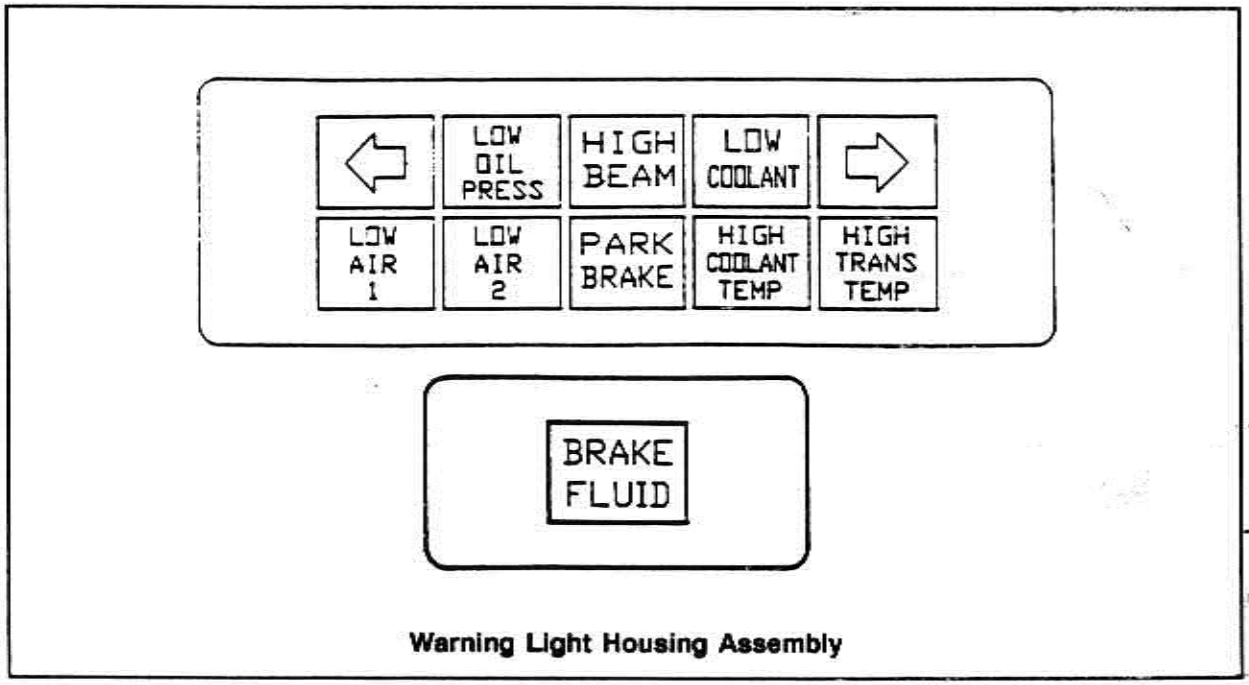
SPARTAN MOTORS SUPPLIED WARNING AND INDICATOR LAMPS

Warning lamps monitor the following functions: engine low oil pressure, engine high coolant temperature, brake system #1 low air pressure, brake system #2 low air pressure, transmission high temperature, and low brake fluid (EC model chassis only). (All warning lamps bulbs - #74.) Indicator lamps indicate the following functions: left and right turn signal, headlamp hi-beam, and parking brake application. (All indicator lamp bulbs - #74.)

> ***Note:*** *Not all coach manufacturers use Spartan Motors gauges, warning lamps, and indicator lamps, therefore your bulb numbers may be different. If you are not sure if these components in your coach were supplied by Spartan or the coach manufacturer please call Spartan Motors.*

WARNING BUZZER

Warning buzzer monitors the following functions: engine low oil pressure, engine high coolant temperature, brake system #1 low air pressure, transmission high temperature, and low brake fluid (EC model chassis only).



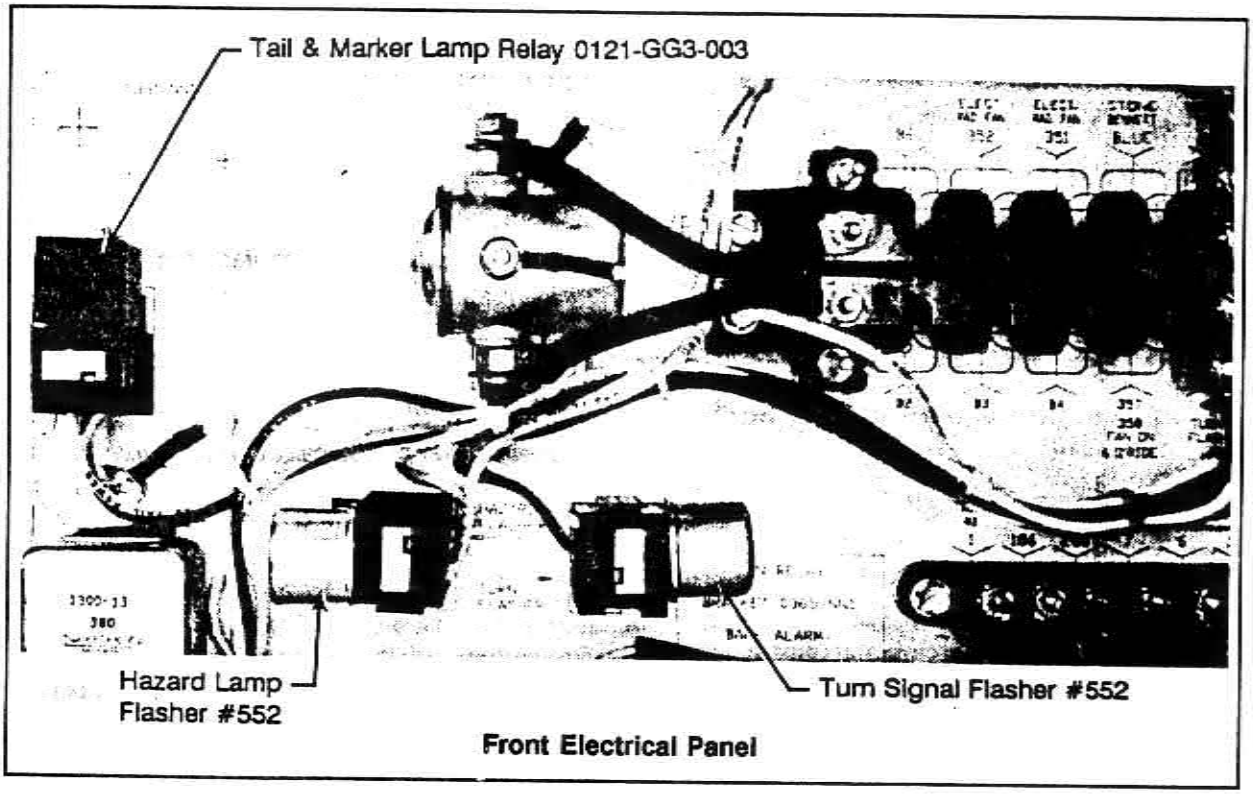
Warning Light Housing Assembly

FRONT ELECTRICAL PANEL

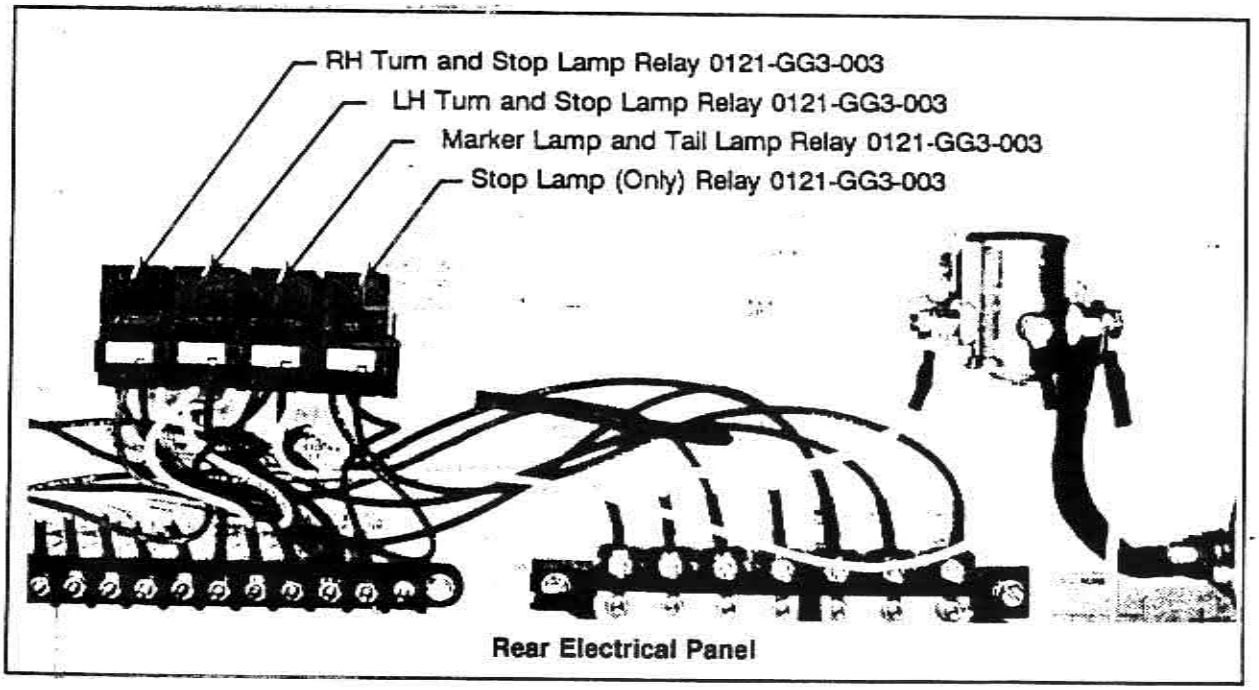
This panel is mounted at the front of the coach and contains a few components that may eventually need replacing. See figure below.

REAR ELECTRICAL PANEL (MH Model Chassis Only)

This panel is mounted in the rear of the coach in the vicinity of the engine compartment. There are a few components on this panel that may eventually need replacing. See figure below.



Front Electrical Panel



Rear Electrical Panel

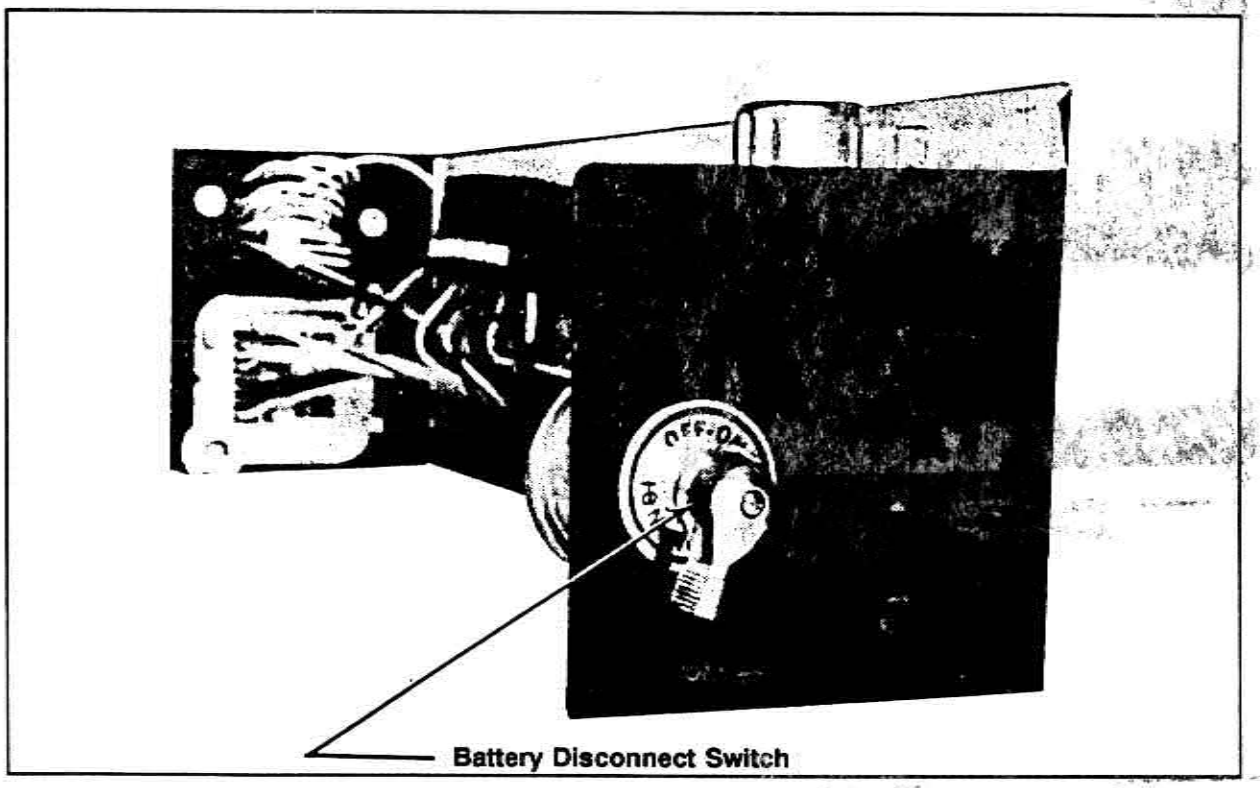
CIRCUIT BREAKERS

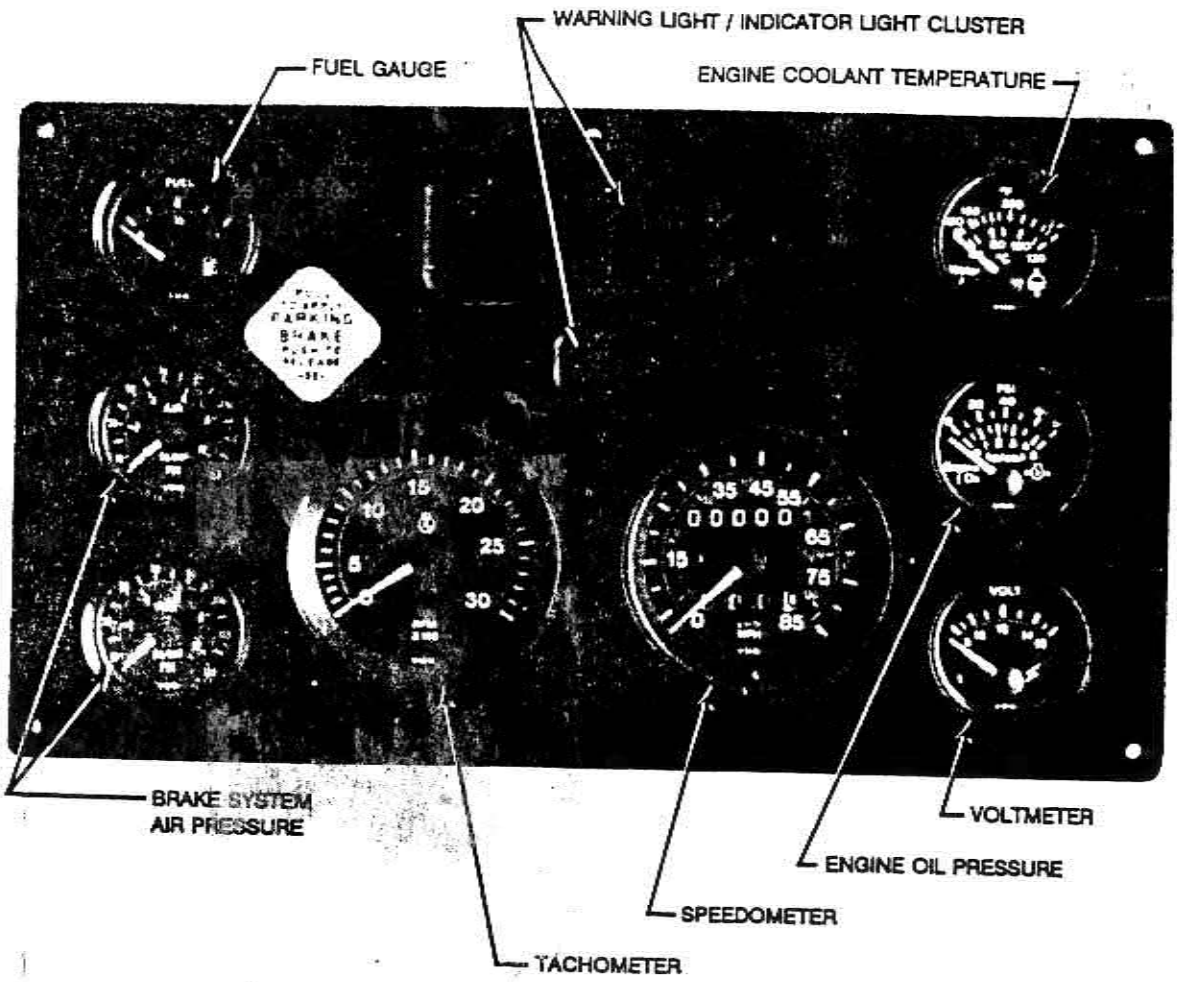
WARNING: Do not replace headlamp breaker with an automatic reset type breaker because once that type of breaker opens the headlamps would remain off until the circuit is repaired.

All chassis related circuits except the headlamp circuit are protected by automatic reset circuit breakers. At the occurrence of a short circuit or overload these breakers open and remain open until the short or overload is removed. The headlamp circuit is protected by a fryer type circuit breaker. At the occurrence of a short circuit or overload this breaker opens but then resets almost immediately. Since the problem with the circuit still exists the breaker opens again and then resets again. This on and off cycling will continue until the circuit is repaired. By using this kind of a breaker the headlamps are off for only a minute period of time at a time.

BATTERY DISCONNECT SWITCH (MH Model Chassis Only)

If this switch is in the OFF position the chassis electrical system is dead. See figure below.





Instrument Panel