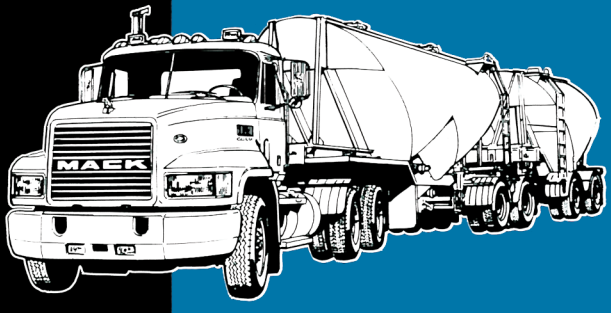
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Mack

TS49405

MAINTENANCE AND LUBRICATION

FOR MACK® DIESEL POWERED TRUCKS

CALIFORNIA PROPOSITION 65 WARNING

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects and other reproductive harm.

CALIFORNIA PROPOSITION 65 WARNING

Battery posts, terminals and other related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and other reproductive harm.

Batteries also contain other chemicals known to the State of California to cause cancer.

Wash hands after handling.

SERVICE BULLETIN

NUMBER: SB211022
DATE: 07/22/05
MODEL: ASET™ AI, AMI

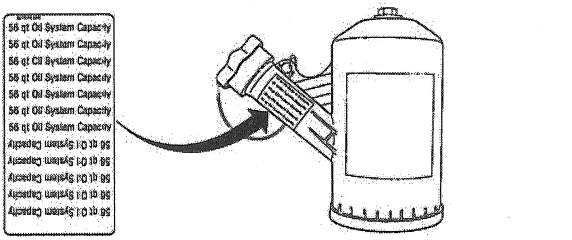
(Not applicable to Mack Trucks Australia)
(Supersedes SB211022 dated 1/18/05)

52-Quart Oil Pan — ASET™ AI and AMI Engines

REV Effective December 2004 for ASET™ AMI-370 and AI-427 engines and July 2005 for ASET™ AI-400 engines, the 52-quart oil pan became the standard oil pan for these engines used in CV and CT model chassis. Fifty two-quart oil pans will also be an available option for other ASET™ AI and AMI engine models used in CV and CT models. Engines having the 52-quart oil pan have a total oil system capacity of 56 quarts. Oil pan and oil system capacities for ASET™ AI and AMI engines are as follows:

Oil Pan Capacity	Total Oil System Capacity
Engines having 52 qt (49 L) oil pan	56 qt (53 L)
Engines having 36 qt (34 L) oil pan	40 qt (38 L)
Engines having 28 qt (27 L) oil pan (CV all wheel drive models only)	32 qt (30L) without Luber-Finer® remote-mounted oil filter 36 qt (34 L) with Luber-Finer® remote-mounted oil filter

To identify engines having the 52-quart (49 L) oil pan/56-quart (53 L) system capacity, and to ensure that the proper amount of oil is added to these engines at each oil change, a yellow sticker noting the increased oil capacity is affixed to the Centrimax® filter oil fill spout.



285837a

Figure 1 — 52-Quart Oil Pan Identification Sticker

On engines having two oil fill spouts, a sticker is applied to both spouts.

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SERVICE BULLETIN

NUMBER: SB-210-036
DATE: 2/10/05
MODEL: ASET™ AC

(Does not apply to Mack Trucks Australia)

Revised Oil Change Intervals — ASET™ AC-460P and AC-460E Engines

Modern diesel engines generate higher levels of combustion soot into the engine lubricating oil than previous engines. To keep engine wear to a minimum, it is extremely important that engine oil and filters be changed at regular intervals, before soot levels exceed the MACK specification of 5% maximum, and that oils meeting MACK specification EO-N Premium Plus 03 High-Performance Diesel Engine Oil be used along with MACK-approved oil filters.

Oil analysis programs are highly recommended for monitoring overall condition of the oil and for determining levels of soot. Oil testing laboratories, however, use a variety of methods to determine soot levels, with many of these methods being very inaccurate. The only two soot measurement methods approved by Mack Trucks, Inc. are the TGA (thermogravimetric analysis) and LEM (Light Extinction Measurement) methods, as these two methods provide the most accurate results. The MaxiGuard/2 Oil analysis program available through Mack Trucks, Inc., uses the LEM method to provide a cost effective and accurate method of measuring soot, which is essential for a beneficial oil monitoring program.

Mack Trucks, Inc. has reviewed the oil analysis reports for a significant number of ASET™ engines and has determined that it is necessary to revise the specified oil and filter change interval for all ASET™ AC-460P and AC-460E engines. These new change intervals are as follows:

Highway Chassis — ASET™ AC-460P and AC-460E — Engine Oil, Oil Filters (including the Centri-Max® ULTRA Centrifugal Rotor), Fuel Filters and Coolant Conditioning	
Miles/Kilometers	**Time**
15,000 miles/24 000 kilometers	400 hours

NOTE

Oil and filter changes must be performed within the above mileage or hour limits, **whichever occurs first.**

When chassis are used in high mileage/high hour operations, such as pump-off or similar types of operations where the engine idles for long periods of time, oil change intervals must be based on hours of engine operation, not accumulated chassis mileage.

Perform oil analysis regularly and modify the intervals as required if reports indicate soot levels exceed the 5% maximum specification.

NOTE

Oil analysis is a useful tool for monitoring oil condition and determining whether or not shorter drain intervals are necessary. However, oil analysis can never be used to extend drain intervals beyond those which are specified by Mack Trucks, Inc.

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SERVICE BULLETIN

Number: SB210039
Date: 10/19/05
Model: ASET™ AI, AMI

(Does not apply to Mack Trucks Australia)

Oil Change Intervals for Chassis Equipped with ASET™ AI or AMI Engines

Modern diesel engines generate higher levels of combustion soot into the engine lubricating oil than previous engines. To keep engine wear to a minimum, it is extremely important that engine oil and filters be changed at regular intervals, before soot levels exceed the MACK specification of 5% maximum, and that oils meeting MACK specification EO-N Premium Plus 03 High-Performance Diesel Engine Oil be used along with MACK-approved oil filters.

Oil analysis programs are highly recommended for monitoring overall condition of the oil and for determining levels of soot. Oil testing laboratories, however, use a variety of methods to determine soot levels, and some of these methods can be very inaccurate. The only two soot measurement methods approved by Mack Trucks, Inc. are the TGA (thermogravimetric analysis) and LEM (Light Extinction Measurement) methods, as these two methods provide consistently accurate results. The MaxiGuard/2 Oil analysis program available through Mack Trucks, Inc., uses the LEM method to provide a cost effective and accurate method of measuring soot, which is essential for a beneficial oil monitoring program.

Mack Trucks, Inc. has reviewed the oil analysis reports for a significant number of ASET™ engines and has determined that it is necessary to revise the specified oil and filter change interval for all ASET™ AI-350 engines when used with an Allison automatic transmission. Chassis/engine/transmission combinations requiring the Extra Severe Service oil change intervals are outlined below:

Vocational Chassis — ASET™ AI and AMI Engines — Extra Severe Service Interval	
Time*	Distance*
250 Hours	8,000 Miles/13 000 Kilometers

* Whichever occurs first

- LE models WITH an ASET™ AI-350 engine and an Allison automatic transmission
- All MR models WITH an ASET™ AI or AMI engine and a manual transmission, or an ASET™ AI-350 engine in combination with an Allison automatic transmission
- CV and CT models WITH an ASET™ AI-350 engine (having the standard 36 qt. oil pan) in combination with an Allison automatic transmission

NOTE

The oil drain interval for CV and CT model chassis equipped with an ASET™ AI-350 engine and an Allison automatic transmission can be extended to 300 hours, 10,000 miles (16 000 km) only IF the engine has the optional 52 qt. oil pan. (The 52 qt. oil pan will not fit on MR or LE model chassis.)

- CV All-Wheel Drive models with an ASET™ AI or AMI engine WITHOUT the Luber-Finer® remote-mounted oil filter

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Chassis/engine/transmission combinations that can use the Severe Service oil change intervals are outlined below:

Vocational Chassis — ASET™ AI and AMI Engines — Severe Service Interval	
Time*	Distance*
300 Hours	10,000 Miles/16 000 Kilometers

* Whichever occurs first

The Severe Service intervals apply to the following conditions:

- LE models EXCEPT chassis equipped with an ASET™ AI-350 engine and an Allison automatic transmission
- MR models with either an ASET™ AI-300A or AI-375 engine in combination with an Allison automatic transmission
- All CV and CT models EXCEPT chassis equipped with an ASET™ AI-350 engine (having the standard 36 qt. oil pan) in combination with an Allison automatic transmission

NOTE

The oil drain interval for CV and CT model chassis equipped with an ASET™ AI-350 engine and an Allison automatic transmission can be extended to 300 hours, 10,000 miles (16 000 km) only IF the engine has the optional 52 qt. oil pan. (The 52 qt. oil pan will not fit on MR or LE model chassis.)

- CV All-Wheel Drive models with either an ASET™ AI or AMI engine WITH the Luber-Finer® remote-mounted oil filter

NOTE

DO NOT exceed the above mileage or hour limits.

Perform oil analysis regularly and reduce the intervals as required if analysis reports indicate soot levels exceed the 5% maximum specification.

NOTE

Oil analysis is a useful tool for monitoring oil condition and determining whether or not shorter drain intervals are necessary. However, oil analysis can never be used to extend drain intervals beyond those which are specified by Mack Trucks, Inc.

TS49405 MAINTENANCE AND LUBRICATION FOR MACK® DIESEL POWERED TRUCKS

(ASET™ AC, AI AND AMI ENGINES)

Operation, maintenance, lubrication and emissions information applicable to MACK chassis powered by Natural Gas (NG) engines will be found in a separate manual designated as TS857.

The information supplied in this manual is not all-inclusive, and cannot take into account all unique situations.

The engine oil/filter and gear oil change intervals outlined in this manual pertain to components manufactured by Mack Trucks, Inc. For information concerning engine oil/filter and gear oil change intervals for vendor components, refer to the specific vendor component service literature.

The information, specifications and illustrations in this publication are based on information that was current at the time of publication, and are subject to change without prior notification.

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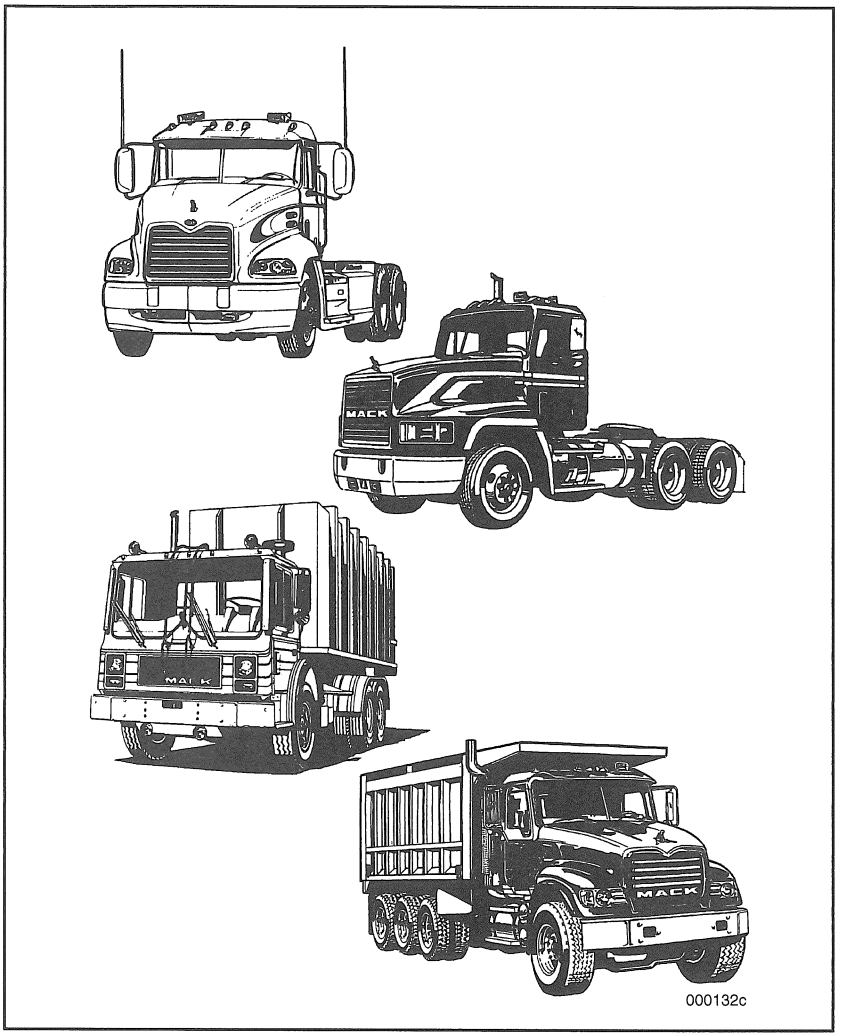


Figure 1 — Mack Truck Applications

INTRODUCTION

Preventive maintenance is vital to the life of your new MACK truck. This manual explains the proper preventive maintenance and lubrication procedures which should be used on all MACK Class 8 chassis.

The MACK Preventive Maintenance and Lubrication program outlined in this manual is designed to ensure a long and productive life from your truck. The program is divided into four maintenance schedules, each addressing items which require periodic inspections to ensure efficient, reliable and trouble-free operation. To allow flexibility in developing a maintenance routine suitable to your operating requirements, maintenance intervals in this manual are arranged in miles/kilometers, hours or days of operation. Maintenance instructions, specifications and capacities are outlined for quick and easy reference. The service manager at your MACK distributor will be happy to assist in customizing a maintenance program tailored to your operating requirements.

Following the MACK Preventive Maintenance Program is highly recommended to all operators of MACK vehicles because it is the key to lower operating costs both in time and money. The bottom line to a well-run maintenance program is less downtime and increased profitability.

SAFETY INFORMATION

MACK cannot anticipate every possible occurrence which may involve a potential hazard. An accident can be avoided by recognizing potentially hazardous situations before an accident occurs. Correctly performed service procedures are critical to technician safety and the consequent safe, reliable operation of the vehicle.

Do not perform any service procedures or lubrications until this manual has been read and understood.

Some service procedures may require the use of special tools designed for a specific purpose. These tools must be used in the manner described in the instructions. Anyone using a procedure or tool not recommended in this manual must realize he is jeopardizing his safety and the safe operation of the vehicle. Individuals deviating from the instructions set forth in this manual assume all risks of personal injury or damage to equipment.

MAKE SAFETY FIRST . . .

. . . AND MAKE IT LAST

ADVISORY LABELS

Cautionary *signal words* (Danger-Warning-Caution) may appear in various locations throughout this manual. Information accented by one of these signal words must be observed to minimize the risk of personal injury to service personnel, or the possibility of improper service methods which may damage the vehicle or cause it to be unsafe. Additional Notes and Service Hints are used to emphasize areas of procedural importance and provide suggestions for ease of repair. The following definitions indicate the use of these advisory labels as they appear throughout the manual:

⚠ DANGER

Activities associated with* Danger *indicate that death or serious personal injury may result from failing to heed the advisory. Serious personal injury may be equated to career-ending injury.

⚠ WARNING

Activities associated with *Warning* indicate that personal injury may result from failing to heed the advisory. In this case, personal injury is not equated to career-ending injury, but results in possible change in quality of life.

⚠ CAUTION

Activities associated with ***Caution*** *indicate that product damage may result from failing to heed the advisory. Caution is not used for personal injury.*

NOTE

A procedure, practice, or condition that is essential to emphasize.

SERVICE HINT

A helpful suggestion that will make it quicker and/or easier to perform a procedure, while possibly reducing service cost.



Figure 2 — ASE Certification

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VEHICLE BREAK-IN

To get the most from your new MACK truck, and to ensure many years of reliable, trouble-free operation, the following "break-in" procedures are recommended.

During first 3000 miles (5000 km)

- ✓ After the first 125 miles (200 km), retorque the wheel nuts using an accurately calibrated torque wrench. Recheck this torque again after 500 miles (800 km).
- ✓ Check engine oil and coolant level frequently.
- ✓ Check brake and clutch adjustment per recommended schedules and adjust as needed.
- ✓ Observe instruments often and shut down as soon as possible at first sign of any abnormal readings.
- ✓ Check for leaks, loose fasteners, unusual noises, etc., and correct as necessary.
- ✓ Check spring clip torque (U-bolts). (Reyco suspensions: also check equalizer nut torque.)
- ✓ At the end of the first 1000 miles (1610 km) of service, check the U-bolt torque on all MACK air suspensions (including MAXAIR™ 40/40A and MAXLITE™ 20–40).

At the end of first 3000 miles (5000 km) or before 4000 miles (6500 km) or 3 to 4 months (whichever comes first)

- ✓ Retorque spring clips (U-bolts). (Reyco suspensions: Retorque spring clips and equalizer nuts.)

At the first A inspection interval

- ✓ Check front and rear axle alignment and adjust if out of specification.
- ✓ Check steering knuckle to axle beam clearance on MACK FA(W) front axles.

Initial Valve Adjustment

Valves must be initially adjusted at the following intervals:

- Highway Usage — ASET™ AC Engines — First B inspection
- Vocational Usage — ASET™ AI and AMI Engines — First B inspection, or no later than first C inspection

Although your new truck has been quality built, inspected, lubricated and final adjustments performed at the MACK Trucks Assembly Plant, an occasional air, oil or coolant leak may develop. Quick action to correct these minor items will prevent a major repair later. Take your truck to the nearest MACK service center as soon as any abnormal condition becomes evident.

NOTE

Refer to table on page 13, table on page 15, table on page 18 and table on page 20 for the recommended lubrication change intervals applicable to the following items:

- Gear oils — transmission, rear axle carrier(s), front drive axle carrier, transfer case, flywheel PTO
- Engine oil, oil filters, fuel filters

It is important that lubricants, coolants, diesel fuel, etc., meeting proper specifications be used in your MACK chassis. (Refer to SPECIFICATIONS AND CAPACITIES.)

When checking oil levels, the vehicle must be parked on level ground, and the units at normal operating temperature. Components must be filled to the correct level. DO NOT OVERFILL.

The oil and filter change intervals in this manual pertain to components manufactured by Mack Trucks, Inc. For information concerning oil and oil filter change intervals for vendor components, refer to the specific vendor component service literature.

DAILY INSPECTION

Driver's Daily Inspection

Before beginning the day's operation, make a "walk around" inspection of your truck. The following checklist provides an aid in making a thorough inspection and ensures no item will be overlooked. Make sure any problem is corrected before using the vehicle.

⚠ DANGER

To avoid serious injury, DO NOT step on fuel tanks, battery boxes, frame, etc. Step only on areas where adequate slip resistance surfaces and handholds are provided.

GENERAL APPEARANCE

- ☑ Check the overall condition of the vehicle. Look for signs of leaking fuel, oil or coolant.
- ☑ Check to see if the chassis is leaning (flat tires, broken springs, etc.).
- ☑ Review the previous chassis inspection sheets. Make sure any reported defects were corrected.

RAISE THE HOOD/TILT THE CAB

- ☑ Check the windshield washer reservoir. Add washer solvent if necessary.

Radiator

- ☑ Check the coolant level and add a mixture between 40%–60% of antifreeze/quality water, if necessary.
- ☑ Check for coolant leaks.
- ☑ Check the condition of radiator and heater hoses.
- ☑ Clean debris from grille area.

Engine

- ☑ Check crankcase oil level and add recommended engine oil, if necessary.
- ☑ Check condition of all engine drive belts.
- ☑ Check for oil, fuel and air leaks.
- ☑ Check engine and chassis wiring harnesses for frayed or broken wires.

Steering System

- ☑ Check power steering fluid level and add recommended fluid, if necessary.
- ☑ Check security of steering gear, pitman arm and drag link.
- ☑ Check steering shaft U-joints for tightness, cracks and damage.

CLOSE HOOD/LOWER CAB; SECURE LATCHES

Cab Exterior

- ☑ Check condition of wheels and tires. Inspect each tire for cuts, leaks, punctures, bulges, abnormal wear and tire match.
- ☑ Check rims for damage and wheel nut tightness. Rust streaks around wheel nut ball seats are an indication of looseness.
- ☑ Check tire pressure while tires are cold.
- ☑ Check oil level of oil-lubricated front wheel bearings. Add oil, if necessary.
- ☑ Check brake system components.
- ☑ Check electrolyte level in battery and add distilled water, if necessary. If the battery is a maintenance-free type, check state of charge indicator. Check the battery cables for condition, chafing and proper routing.
- ☑ Check condition of fuel tanks and fuel hoses, connectors and pipes.

- ☑ *Inspect air intake for secure mounting, leaks, or damage. Replace air cleaner element if indicator locks in the red zone or dash-mounted gauge indicates maximum inlet restriction of 20 inches (510 mm) [MACK] or 25 inches (635 mm) [Cummins] of water for applicable engine (see table on page 123).* **Gaseous Emission Control Maintenance.**
- ☑ Clean headlamps, exterior windows and mirrors. Check windshield and mirrors for cracks. Check operation of all lamps and inspect lenses. Repair any non-operating lamps and replace any broken lenses.

CLIMB INTO CAB

Cab Interior

- ☑ Clean interior windows and dash gauges.
- ☑ Check seatbelts for security and damage.
- ☑ Secure any loose items found in the cab.
- ☑ Check emergency equipment and warning devices.
- ☑ Adjust driver's seat and sideview mirrors.
- ☑ Check clutch pedal free-play.

Start the Engine

- ☑ Listen for any unusual noises.
- ☑ Make sure the alarms shut off when oil pressure, air pressure, etc., reach normal operating range.
- ☑ Check operation of horns (both air and electric), windshield wipers and washers, heater and defroster, back-up alarm, and, if so equipped, heated mirrors.
- ☑ Check operation of service brakes.
- ☑ Check application of parking brakes.

☑ Observe instruments and verify readings.

— **Air pressure gauge** — Low air buzzer should shut off at 70 ± 5 psi (483 ± 34 kPa). Operating range is 105 psi (724 kPa) minimum to 135 psi (931 kPa) maximum.

— **Engine oil pressure gauge — ASET™ AC, AI and AMI Engines:** 10 to 35 psi (69 to 241 kPa) at idle, 30 to 84 psi (207 to 579 kPa) at governed speed.

— **Engine oil temperature gauge (if equipped) — ASET™ AC, AI and AMI Engines:** 215°F to 270°F (102°C to 132°C).

NOTE

Engine oil pressures and temperatures are for MACK ASET™ diesel engines only. Consult specific engine operating manual if equipped with an engine other than MACK.

— **Voltmeter** — With switch ON and engine OFF, indicates condition of battery. With engine running, indicates condition of charging system.

— **Coolant temperature gauge** — Normal operating temperature for a MACK engine is between 170°F and 225°F (77°C and 107°C).

END OF THE DAY

☑ Apply parking brakes, block tires and completely drain air system.

☑ Drain water from fuel separator, if equipped.

☑ Check for fuel, oil and coolant leaks.

PREVENTIVE MAINTENANCE PROGRAM

MACK Preventive Maintenance and Lubrication Program

Your MACK chassis was designed and built with performance, durability and productivity in mind. The MACK Preventive Maintenance and Lubrication program was developed to maintain your chassis and keep it running the way it was designed to run. Preventive maintenance, not breakdown maintenance, is the key to many years of trouble-free operation.

The MACK Preventive Maintenance and Lubrication program consists of mechanical inspections, lubrication and oil, filter and coolant conditioner change intervals designed to maintain vehicle efficiency and prevent mechanical failure.

Developing your maintenance program is not all that complicated, simply choose the maintenance category that best fits your highway or vocational operation.

NOTE

The following maintenance categories and interval charts are the standard maintenance and lubrication intervals for a MACK chassis.

For ease of planning, maintenance and lubrication schedules are based on mileage/kilometers or days/hours of operation. The service manager at your MACK dealer will be happy to assist in tailoring a maintenance program for your particular operating requirements.

NOTE

It is extremely important that engine oil be changed at the specified oil change intervals as outlined in the charts found on pages 13 through 20.

To gain maximum benefit from the MACK Preventive Maintenance Program, Mack Trucks, Inc. recommends the following:

1. **Oil and fuel filters must meet MACK specifications and should be changed within specified intervals.**
2. **MACK specification EO-N PREMIUM PLUS '03 diesel engine oil is mandatory for ASET™ AC, AI and AMI engines.**
3. **MACK specification Grade 2D diesel fuel must be used.**
4. **MACK factory specifications must be maintained.**

NOTE

Certain chassis vocations may require more frequent service intervals. When developing a maintenance program, review chassis operating conditions and adjust the service intervals as required. At each maintenance and lubrication interval, look at the condition of chassis lubrication points, condition of components, etc., and adjust your service intervals accordingly.

A lubricant analysis program performed by a reputable laboratory is the most effective method of determining lubricant change intervals. Mack Trucks, Inc., supports the Maxigard/2 Oil Analysis Program which is conducted by Analysts, Inc. Test kits are available through MACK Parts System. Part Nos. for the various test kits are as follows:

- **4549-PMXAB** — Tests spectrochemical, LEM (to determine soot levels), fuel dilution and viscosity, uses a plastic bellows-type container for collecting the oil sample
- **4549-PMXAJ** — Tests spectrochemical, LEM (to determine soot levels), fuel dilution and viscosity, uses a jar for collecting the oil sample
- **4549-PMXBB** — Tests spectrochemical, LEM (to determine soot levels), fuel dilution, viscosity and neutralization (known as TBN), uses a plastic bellows-type container for collecting the oil sample
- **4549-PMXBJ** — Tests spectrochemical, LEM (to determine soot levels), fuel dilution, viscosity and neutralization (known as TBN), uses a jar for collecting the oil sample

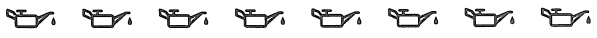
For additional information, contact Analysts, Inc. at 1-800-655-4473, or visit their website at **www.analystsinc.com**.

Alter the maintenance program to meet your needs, but never exceed MACK-recommended intervals.

Highway Chassis — ASET™ Engines Excluding AC-460P and AC-460E

- Chassis equipped with ASET™ AC engines (excluding AC-460P and AC-460E engines) used in highway operations.

Includes Changing Engine Oil, Oil and Fuel Filters, and Coolant Conditioning.

MAINTENANCE AND LUBRICATION								
Mileage (in Thousands)	25	50	75	100	125	150	175	200
Kilometers (in Thousands)	40	81	121	161	201	241	282	322
Maintenance Schedule (Note 2)**	A	B	A	C	A	B	A	D
Chassis Lubrication (Note 1)**	L	L	L	L	L	L	L	L
Gear Oil Change (Note 3)**	2 years/250,000 miles/402 300 km							
CHANGE ENGINE OIL, OIL AND FUEL FILTERS, COOLANT CONDITIONING.								
Mileage* (in Thousands)	25	50	75	100	125	150	175	200
Kilometers* (in Thousands)	40	81	121	161	201	241	282	322
Engine Hours*	600	1200	1800	2400	3000	3600	4200	4800
Oil & Filter Change								
Coolant Conditioning***	•	•	•	•	•	•	•	•

* Whichever occurs first.

** Refer to Notes 1 through 3 in "NOTES TABLE" on page 22.

*** Refer to "Coolant Conditioning" on page 104 for information concerning coolant conditioning.

NOTE

When chassis are used in high mileage/hour operations such as pump-off or similar types of operations where the engine idles for long periods of time, oil change intervals must be based on hours of engine operation rather than accumulated chassis mileage.

NOTE

Certain chassis vocations may require more frequent service intervals. When developing a maintenance program, review chassis operating conditions and adjust the service intervals as required. At each maintenance and lubrication interval, look at the condition of chassis lubrication points, condition of components, etc., and adjust your service intervals accordingly. Using a lubricant analysis program performed by a reputable laboratory is the most effective method of determining lubricant change intervals. Alter the maintenance program to meet your needs, but never exceed MACK recommended intervals.

NOTE

It is extremely important that engine oil be changed at the specified oil change intervals as outlined in the charts found on the preceding page.

Highway Chassis — ASET™ Engines AC-460P and AC-460E

- Chassis equipped with ASET™ AC-460P or AC-460E engines used in highway operations.

Includes Changing Engine Oil, Oil and Fuel Filters, and Coolant Conditioning.

MAINTENANCE AND LUBRICATION								
Mileage (in Thousands)	20	40	60	80	100	120	140	160
Kilometers (in Thousands)	32	64	97	129	161	193	225	258
Maintenance Schedule (Note 2)**	A	B	A	C	A	B	A	D
Chassis Lubrication (Note 1)**	L	L	L	L	L	L	L	L
Gear Oil Change (Note 3)**	2 years/250,000 miles/402 300 km							
CHANGE ENGINE OIL, OIL AND FUEL FILTERS, COOLANT CONDITIONING.								
Mileage (in Thousands)*	20	40	60	80	100	120	140	160
Kilometers (in Thousands)*	32	64	97	129	161	193	225	258
Engine Hours*	500	1000	1500	2000	2500	3000	3500	4000
Oil & Filter Change								
Coolant Conditioning***	•	•	•	•	•	•	•	•

* Whichever comes first.

** Refer to Notes 1 through 3 in "NOTES TABLE" on page 22.

*** Refer to "Coolant Conditioning" on page 104 for information concerning coolant conditioning.

NOTE

When chassis are used in high mileage/hour operations such as pump-off or similar types of operations where the engine idles for long periods of time, oil change intervals must be based on hours of engine operation rather than accumulated chassis mileage.

NOTE

Certain chassis vocations may require more frequent service intervals. When developing a maintenance program, review chassis operating conditions and adjust the service intervals as required. At each maintenance and lubrication interval, look at the condition of chassis lubrication points, condition of components, etc., and adjust your service intervals accordingly. Using a lubricant analysis program performed by a reputable laboratory is the most effective method of determining lubricant change intervals. Alter the maintenance program to meet your needs, but never exceed MACK recommended intervals.

NOTE

It is extremely important that engine oil be changed at the specified oil change intervals as outlined in the charts found on the preceding page.

Vocational Chassis — Severe Service — ASET™ AI and AMI Engines

- All models equipped with ASET™ AI and AMI engines excluding MR models equipped with manual transmissions and DM models regardless of transmission type.
- CV All-Wheel drive models equipped with ASET™ AI and AMI engines and the Luber-Finer® remote-mounted oil filter.

Includes Changing Engine Oil, Oil and Fuel Filters, and Coolant Conditioning.

VOCATIONAL CHASSIS — SEVERE SERVICE INTERVAL

MAINTENANCE AND LUBRICATION								
Mileage (in thousands)	5	10	15	20	25	30	35	40
Kilometers (in thousands)	8	16	24	32	40	48	56	64
Days of Usage*	45	90	135	180	225	270	315	360
Hours of Operation*	150	300	450	600	750	900	1050	1200
Maintenance Schedule (Note 2)**	A	B	A	C	A	B	A	D
Chassis Lubrication (Note 1)**	L	L	L	L	L	L	L	L
Gear Oil Change (Note 3)**	1 year/1200 hours/40,000 miles (64 000 km)							
CHANGE ENGINE OIL, OIL AND FUEL FILTERS, COOLANT CONDITIONING.								
Mileage (in thousands)	5	10	15	20	25	30	35	40
Kilometers (in thousands)	8	16	24	32	40	48	56	64
Days of Usage*	45	90	135	180	225	270	315	360
Hours of Operation*	150	300	450	600	750	900	1050	1200
Oil and Filter Change***								
Coolant Conditioning****		•		•		•		•

* Whichever comes first.

** Refer to Notes 1 through 3 in "NOTES TABLE" on page 22.

*** Oil and filter change is mandatory every 90 days or 300 hours, whichever occurs first.

**** Refer to "Coolant Conditioning" on page 104 for information concerning coolant conditioning.

Vocational Chassis — Extra Severe Service — ASET™ AI and AMI Engines

- MR models equipped with ASET™ AI and AMI engines and a manual transmission.
- DM models equipped with ASET™ AI and AMI engines regardless of transmission type.

NOTE

MR models equipped with manual transmissions, and all DM models regardless of transmission type use the CentriMax® PLUS centrifugal oil filter. Space constraints on these models do not allow use of the CentriMax® ULTRA PLUS.

- CV All-Wheel drive models equipped with ASET™ AI and AMI engines without the Luber-Finer® remote-mounted oil filter.

Includes Changing Engine Oil, Oil and Fuel Filters, and Coolant Conditioning.

VOCATIONAL CHASSIS — EXTRA SEVERE SERVICE INTERVALS

MAINTENANCE AND LUBRICATION								
Mileage (in thousands)	4	8	12	16	20	24	28	32
Kilometers (in thousands)	6	13	19	26	32	39	45	52
Days of Usage*	45	90	135	180	225	270	315	360
Hours of Operation*	125	250	375	500	625	750	875	1000
Maintenance Schedule (Note 2)**	A	B	A	C	A	B	A	D
Chassis Lubrication (Note 1)**	L	L	L	L	L	L	L	L
Gear Oil Change (Note 3)**	1 year/1200 hours/40,000 miles (64 000 km)							
CHANGE ENGINE OIL, OIL AND FUEL FILTERS, COOLANT CONDITIONING.								
Mileage (in thousands)	4	8	12	16	20	24	28	32
Kilometers (in thousands)	6	13	19	26	32	39	45	52
Days of Usage*	45	90	135	180	225	270	315	360
Hours of Operation*	125	250	375	500	625	750	875	1000
Oil and Filter Change***								
Coolant Conditioning****		•		•		•		•

* Whichever comes first.

** Refer to Notes 1 through 3 in "NOTES TABLE" on page 22.

*** Oil and filter change is mandatory every 90 days or 250 hours, whichever occurs first.

**** Refer to "Coolant Conditioning" on page 104 for information concerning coolant conditioning.

NOTE

Certain chassis vocations may require more frequent service intervals. When developing a maintenance program, review chassis operating conditions and adjust the service intervals as required. At each maintenance and lubrication interval, look at the condition of chassis lubrication points, condition of components, etc., and adjust your service intervals accordingly. Using a lubricant analysis program performed by a reputable laboratory is the most effective method of determining lubricant change intervals. Alter the maintenance program to meet your needs, but never exceed MACK recommended intervals.

NOTE

It is extremely important that engine oil be changed at the specified oil change intervals as outlined in the charts found on the preceding page.

NOTES TABLE

Note 1: Recommended Eaton Clutch Release Bearing and Spicer Life™ driveshaft lubrication intervals:

Clutch Release Bearing (Eaton Easy-Pedal, and Solo™ Clutches with Greaseable Release Bearings, and ArvinMeritor™ Clutches)

- Lubricate at each chassis lubrication interval as follows:
  - — Highway Chassis with ASET™ Engines Excluding AC-460P and AC-460E: 25,000 miles (40 000 km) or 600 hours
  - — Highway Chassis with ASET™ AC-460P and AC-460E Engines: 20,000 miles (39 000 km) or 475 hours
  - — Vocational Chassis — Severe Service: 300 hours, 90 days or 10,000 miles (16 000 km), whichever occurs first
  - — Vocational Chassis — Extra Severe Service: 250 hours or 60 days, whichever occurs first

Spicer Life™ SPL-170 and SPL-250 Driveshaft — U-Joint Lubrication

- Highway Chassis: Every 100,000 miles (161 000 km) or 6 months*
- Vocational Chassis:
  - — Severe Service: 20,000 miles (32 000 km) or 180 days*
  - — Extra Severe Service: 375 hours or 90 days*

* Whichever occurs first.

Spicer Life™ SPL-170XL and SPL-250XL Driveshaft — U-Joint Lubrication

Spicer Life™ XL series driveshafts are equipped with "extended-lubrication" U-joints. These U-joints are easily identified by the blue plastic cover in the center of the U-joint cross where the grease fitting is usually located. The XL U-joints must be lubricated initially at the following intervals:

- Highway Chassis: 350,000 miles (560 000 km) or 3 years*
- Vocational Chassis (includes city driving and on/off highway: 100,000 miles (161 000 km) or 1 year*

* Whichever occurs first.

Following the initial lubrication outlined above, Spicer Life™ XL series U-joints must be lubricated at the following intervals:

- Highway Chassis: 100,000 miles (161 000 km) or 6 months*
- Vocational Chassis:
  - — Severe Service: 20,000 miles (32 000 km) or 180 days*
  - — Extra Severe Service: 375 hours or 90 days*

* Whichever occurs first.

NOTE

The slip-joints used with Spicer Life™ driveshafts are "Lubed for Life," and protected by a bellows. Lubrication of these slip-joints is not required and the bellows must not be disturbed.

ArvinMeritor™ RPL20 and RPL25 Permalube™ Series Driveshafts
The U-joints and slip joints on the RPL20 and RPL25 series driveshafts are permanently lubricated and sealed. Lubrication at regular intervals is not required during the life of the driveshaft.

ArvinMeritor™ 92N Permalube™ Wing-Style Driveshafts
The U-joints used on the 92N Permalube™ Wing-Style Driveshafts are permanently lubricated and sealed. Lubrication at regular intervals is not required during the life of the driveshaft. The slip joints, however, must be lubricated at each specified chassis lubrication interval. Refer to the preventive maintenance schedules found on pages 13, 15, 18 and 20.

Note 2: Effective with engine serial No. series 2A and later, valve lash must initially be checked and adjusted (if necessary) at the following intervals:

- Highway Chassis: First B inspection
- Vocational Chassis: First B inspection, or no later than first C inspection

After the initial adjustment, valve lash must be checked and adjusted (if necessary) at 150,000 miles (241 000 km) or 4500 hours, whichever occurs first.

Note 3: An extended service drain interval of 500,000 miles (804 600 km) or 3 years, whichever occurs first, for Highway type operations is permissible for MACK geared drivetrain components IF MACK-specific GO-J PLUS Gear Lubricant is used. For Vocational operations, an extended drain interval of 80,000 miles (128 800 km), 1 year or 1,200 hours, whichever occurs first, is permissible if GO-J PLUS Gear Lubricant is used. An SAE 40 or 50 grade transmission oil, TO-A PLUS, is also available for use in all MACK transmissions. Extended drain intervals for transmissions using TO-A PLUS are 500,000 miles (804 600 km) or 3 years, whichever occurs first, for Highway operations, and 80,000 miles (128 800 km), 1 year or 1,200 hours, whichever occurs first, for Vocational operations.

NOTE

If a MACK axle and/or transmission were initially filled with GO-J PLUS gear lubricant and later "topped-off" with greater than 1-1/2 quarts of GO-J specification gear lubricant, the drain interval is reduced to the GO-J limits (2 years or 250,000 miles [402 300 km]).

For chassis equipped with Eaton® Fuller® transmissions and Eaton® drive axles, Eaton-specified extended drain interval lubricants (E250 and E500) are available. E250 has a 250,000-mile (400 000 km) drain interval requirement and E500 has a 500,000-mile (800 000 km) drain interval requirement whether these lubricants were "factory filled" or "service filled." For a list of Eaton-approved extended drain interval lubricants, contact an Eaton® service representative, or visit the Eaton website at www.eaton.com.

Note that transmission and drive axle lubricants for Eaton components are different. Be sure the proper lubricant is being used in the component.

"Service fill" is defined as anytime a component is drained and re-filled with lubricant. This applies whether an approved extended drain interval lubricant is drained and the component is refilled with an approved extended drain interval lubricant, or a petroleum-based lubricant is drained and the component is refilled with an extended drain interval lubricant. "Factory fill" is defined as when the component is filled with lubricant at the assembly plant.

If an Eaton® Fuller® transmission or Eaton drive axle is "factory filled" with a petroleum-based lubricant, and it is desired to change to an approved extended drain interval lubricant, it is recommended that this be done within the first 5,000 miles (8 000 km) of service. If this cannot be done, it is important that seals be checked for leaks, and they be replaced if they are leaking. Seal performance can be jeopardized if an approved extended drain lubricant is used as a "service fill" for a component that has been "factory filled" with a petroleum-base lubricant.

INTERVAL CHART SYMBOLS

 denotes a mandatory oil and filter change at specified interval

♦ denotes mandatory addition of SCA packets or coolant conditioner change at specified interval

NOTE

Oil changes, filter changes and chassis lubrication intervals listed in this publication are specifically for chassis equipped with MACK components. For oil and filter change information concerning vendor components (transmissions, axles, etc.), consult the specific vendor component service literature.

Preventive Maintenance Inspection Instructions

The MACK Preventive Maintenance Program is arranged in easy-to-follow steps. Inspections are arranged in A, B, C, D order:

"A" is a light inspection.

"B" is a more detailed check.

"C" is a more extensive inspection and adjustment.

"D" is a comprehensive inspection and adjustment.

"L" is a chassis lubrication.

Perform a road test before each inspection to determine the road worthiness of the vehicle and isolate any specific problems.

Preventive maintenance inspection worksheets A, B, C and D are available through your MACK dealer, and provide a convenient means of keeping track of the maintenance procedures.

NOTE

Form No. TS491 A & B covers schedules A and B.
Form No. TS491 C & D covers schedules C and D.

Order a supply now so you will have them when needed.

For specific questions concerning service, maintenance and lubrication procedures not covered in this manual, or for components not manufactured by Mack Trucks, Inc., refer to the appropriate section of the operator's manual, service manual or vendor service publications, or consult your MACK dealer.

After performing the operations as listed and noting any adjustments, repairs and replacements on the applicable inspection form, the completed form should be signed by the technician and foreman (or inspector) and filed in the chassis folder.

NOISE EMISSION CONTROL

Noise Emission Information

Specific maintenance procedures performed at regularly scheduled intervals are necessary for maintaining noise emissions within acceptable limits throughout the life of the vehicle. This manual includes written instructions pertaining to maintenance items which are required to maintain the efficiency of the noise emission control systems.

Explanations of maintenance items for noise emission-related components are outlined in "CHASSIS INSPECTION" on page 37, along with schedules at which each item must be serviced. Noise emission-related maintenance items are noted as such for easy reference. The Preventive Maintenance Schedule charts outline the MACK recommended time or mileage intervals between service schedules.

Mack Trucks, Inc. recommends that copies of all work orders, invoices and other pertinent information relating to vehicle maintenance be kept on file for later reference. A service log can be found at the end of this manual that provides a convenient place for maintaining a record of service work performed on the chassis. Service records, along with this manual, should be passed along to subsequent owners of the vehicle.

The following information concerning noise emission control systems requirements is provided to familiarize the ultimate purchaser of this vehicle with his responsibilities as the owner, as well as the responsibilities of Mack Trucks, Inc. as the manufacturer.

Noise Emission Control Systems

United States Environmental Protection Agency (EPA) regulations require that vehicle manufacturers provide written instructions for the proper maintenance, use and repair of the vehicle to the ultimate purchaser to provide reasonable assurance of the elimination or minimization of noise emission degradation throughout the life of the vehicle. This manual covers items of maintenance which are necessary to maintain noise emission control efficiency.

Tampering with Noise Control Systems is Prohibited

Among those acts presumed to constitute tampering are those acts listed below:

- Removal, or rendering inoperative, of any exhaust components, including mufflers, heavy or double-wall exhaust tubing, flexible tubing or exhaust pipe clamping.
- Removal, or rendering inoperative, of the temperature-modulated cooling fan system.
- Removal of the cooling fan shroud.
- Removal, or rendering inoperative, of the air cleaner or air intake in-line silencer.
- Removal of the sound deadening material from the hood or cab tunnel.
- Removal, or rendering inoperative, of the engine speed governor so as to allow engine speed to exceed the manufacturer's specifications.
- Removal of splash shields located inside the wheel housings.
- Removal of engine block shields.
- Removal of engine crankcase shields or insulation.
- Removal of insulated rocker arm covers.
- Removal of transmission noise shields.

Vehicle Identification Number (VIN) and Model Year Designation

U.S. and Canadian motor-vehicle safety standards require that each chassis manufactured by Mack Trucks, Inc. be identified by a 17-character Vehicle Identification Number (VIN). The VIN can be found at several locations on the chassis. Refer to the Operator's Handbook for exact locations.

The 10th digit of the Vehicle Identification Number identifies the chassis model year. Listed below is a sample VIN with the model year designation highlighted, along with a chart explaining the model year code.

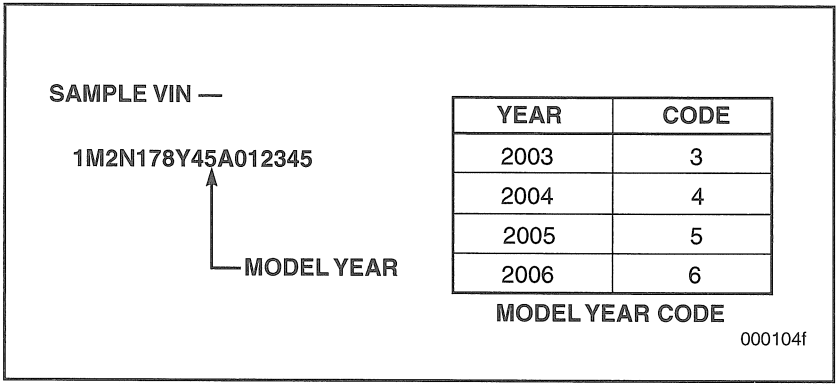


Figure 3 — Sample VIN and Model Year Code

ROAD TEST

Before proceeding with the chassis inspections, a road test should be performed to determine the road worthiness of the vehicle and to isolate any specific problems.

ENGINE:

	Inspection Schedule
Check operation of engine alarm(s) and shutdown system. The alarms should operate when the key switch is turned ON, before the engine is started, and should shut off when oil pressure, air pressure, etc., reach operating range. The electronic malfunction lamp should turn off approximately two seconds after the engine starts. If the alarms fail to function in this test or other malfunctions are noted, repair as necessary.	A, B, C, D
Check the operation of the starter drive mechanism (positive action, no unusual noises).	A, B, C, D
Check for rough idling, misfiring, bearing noises, piston slap and knock.	A, B, C, D
Check for unusual exhaust. Note the color and intensity of the smoke.	A, B, C, D
Record oil pressure psi (kPa) at idle and governed speeds (engine at operating temperature).	A, B, C, D
Check voltmeter and record maximum voltage reading.	A, B, C, D
Check and record engine coolant temperature in degrees F° (C°) after engine has achieved operating temperature.	A, B, C, D
If the engine is equipped with an engine oil temperature gauge, check and record the oil temperature in degrees F° (C°) after the engine has achieved operating temperature.	A, B, C, D

ENGINE: *(continued)*	Inspection Schedule
Check tachometer operation throughout engine speed range. Note any unsteady pointer operation.	A, B, C, D
Check speedometer operation while driving vehicle. Note accuracy and any unsteady pointer operation.	A, B, C, D
Check operation of exhaust pyrometer.	A, B, C, D
AIR COMPRESSOR:	
Check for proper operation. Build-up time of air pressure from 85 to 100 psi (586 to 690 kPa) should not exceed 25 seconds with engine running at maximum governed no-load speed. Rapidly cycle brake treadle valve until reservoir pressure drops below 105 psi (724 kPa). Note and record pressure at which governor cuts in.	A, B, C, D
Governor should cutout when reservoir pressure reaches 125–135 psi (862–931 kPa). Note and record pressure at which the governor cuts out. Check operation of low air pressure indicators, both low air pressure indicator light and audible low-air buzzer.	A, B, C, D

CLUTCH:

	Inspection Schedule
Check clutch pedal free travel. Do not allow less than 1/2 inch of free travel. Adjust to specifications, if necessary. *(See "CLUTCH ADJUSTMENT" on page 253.)*	A, B, C, D
Check clutch release when chassis is stopped and the engine is running at low idle. Verify proper clutch brake operation. Increased pedal effort should be felt approximately 1/2 to 1 inch (12.5–25 mm) from end of clutch pedal travel when pedal is depressed fully.	A, B, C, D

STEERING:

Check for *bind* in steering — *Bind* may be caused by inadequate lubrication or worn steering or steering axle components.	A, B, C, D
Check for excessive *free play* in steering — *Free play* may be caused by excessive steering gear backlash or loose steering linkage.	A, B, C, D
Check for *wander* — *Wander* may be caused by insufficient or unequal caster, camber, inadequate lubrication or excessively worn steering or axle components.	A, B, C, D
Check for *shimmy* in steering — *Shimmy* may be caused by unbalanced or out-of-round tires, wheels or brake drums, looseness in steering system, unequal front tire pressure (especially with radial tires).	A, B, C, D
Check operation of power steering pump for lack of, or erratic, power assist.	A, B, C, D

BRAKES:

	Inspection Schedule
Check for unusual noise during brake operation. Squeal may be caused by glazed lining or lining which is worn to rivets. Chatter may be caused by worn parts.	A, B, C, D
Check for pull. Pull may be caused by grease on the linings, worn brake linings and brake drums, misadjustment or malfunctioning self-adjusters.	A, B, C, D
Check for drag. Drag may be caused by misadjustment, broken return springs, loose wheel bearings or by malfunctioning brake camshafts.	A, B, C, D

PARKING BRAKES:

Check application and holding ability of spring brakes. Make sure the warning light indicates spring brake application. Release and reapply the spring brakes.	A, B, C, D

HEATER/DEFROSTER:

Check operation: Proper fan speed control. No excessive noises. Proper temperature output.	A, B, C, D

AIR CONDITIONER:

	Inspection Schedule
Check operation. Proper fan speed control. No excessive noises. Proper temperature output.	A, B, C, D

TRANSMISSION/AUX TRANS./TRANSFER CASE/FLYWHEEL PTO:

Shifting should take place quickly and quietly. If hang-up or clashing occurs, repair or adjustment is necessary.	A, B, C, D
Check lever operation noting any difficult movement or binding which would indicate the need to check the linkage. Check for indications of restricted motion in the linkage which could result in partial gear engagement and transmission damage.	A, B, C, D
Check for bearing and gear noises, or excessive vibration at various road speeds.	A, B, C, D

CARRIER:

	Inspection Schedule
Check for noise or vibration under drive and coast conditions.	A, B, C, D

PROPELLER SHAFT:

Check for noise or vibration at various road speeds.	A, B, C, D

ENGINE BRAKE:

Turn the engine brake switch on. Marked deceleration should be noted when the foot is removed from the accelerator pedal.	A, B, C, D

⚠ DANGER

Testing the engine brake when the vehicle is lightly loaded, particularly when operating on wet or slippery roads, requires extreme caution. Using an engine brake under these conditions may cause the vehicle to skid.

CHASSIS INSPECTION

CAB:

	Inspection Schedule
Inspect condition of mirrors and cab glass.	A, B, C, D
Check operation of horns (air and electric).	A, B, C, D
Clean the floor mats and clean any debris from around the treadle valve.	A, B, C, D
Observe operation of windshield wipers, making sure they operate in each speed. Check condition and travel of blades.	A, B, C, D
Check operation of windshield washers. Make sure the washer reservoir is filled with fluid.	A, B, C, D
Check operation and condition of back-up lights, tail lights, brake lights, turn signals, hazard warning flasher, marker lights, headlights (adjust high and low beams, if necessary) and instrument panel lights.	A, B, C, D
Lubricate the treadle valve and make sure it is securely mounted.	B, C, D
Check the engine cover for cracks or broken-out sections. ***Noise Emission Control Maintenance.***	B, C, D
Check condition and operation of seats and seatbelts, doors and latches, hood and latches.	C, D

CAB: *(continued)*	Inspection Schedule
Check condition of steel/fiberglass body panels, bumpers and steps. Check torque of chassis fairing fasteners. Two different types of M8 x 1.25 fasteners are used on the fairings, torque values are as follows: • Pan head Torx® drive, M8 x 1.25 — 48 lb-in (5.4 N•m) • Flanged hex head capscrew, M8 x 1.25 — 96 lb-in (10.9 N•m)	C, D

NOTE

The above torque values are for applications where the head of the fastener contacts the fiberglass fairing. The M8 x 1.25 Torx® drive pan head screw is also used in certain locations where the head of the screw contacts a metal bracket. In those applications, the pan head screw is tightened to 19 lb-ft (25.8 N•m).

Check the condition of the cab mounting. Inspect and adjust cab rear mounting (air-suspended cabs) as required. On LE and MR models, check the anti-vibration pads on the cab mount V-brackets for wear. Replace any pads that are worn or missing. Also check alignment of the cab mount V-blocks and adjust as required. (Refer to table on page 245.)	C, D
Check the condition of the sound-absorbing material that is affixed to the hood and/or cab. Check for tears and for suitable attachment. Excessive dirt can be removed with a mild soap and water solution. ***Noise Emission Control Maintenance.***	C, D

CAB: *(continued)*	Inspection Schedule
Check the splash shields that are located inside the wheel housings. Look for tears or broken-out sections. ***Noise Emission Control Maintenance.***	C, D
Check operation of window regulators.	C, D
V-MAC:	
Check for any faults which may be logged into the V-MAC system. Refer to the V-MAC® Operator's Manual or the V-MAC® Service Manual for complete troubleshooting procedures and fault diagnosis.	A, B, C, D
TILT CAB:	
Check cab tilt pump reservoir fluid level. Add fluid, if necessary. (See "LUBRICANT SPECIFICATIONS" on page 333.)	B, C, D
Check operation and condition of tilt mechanism, latches, safety prop, hinges and brackets.	B, C, D

BATTERY:

	Inspection Schedule
If equipped with low maintenance-type battery with removable plastic caps, check that the electrolyte level is a minimum of 3/8 inch (9.5 mm) above plates. Add distilled or good drinking water (no mineral water), if necessary. On maintenance-free batteries with flush-type cover, check state-of-charge indicator.	A, B, C, D
Clean battery terminals with solution of baking soda or household ammonia. Flush with clear water and dry. Tighten terminals. Coat terminals with light film of non-metallic grease.	B, C, D
Check condition and routing of the battery cables. Make sure there is no possibility of chafing and/or shorting.	B, C, D
Test the electrolyte with a hydrometer: 1.250–1.280 battery OK — less than 1.250, remove battery and recharge. Check with high discharge rate cell tester.	C, D
Remove batteries. Clean top and case. Make sure case is not cracked. Clean, paint and tighten battery hold-down arrangement.	C, D

STARTER:

	Inspection Schedule
Check tightness of the nuts that secure the cables to both the starter solenoid and the starter motor. Torque specifications are as follows: • 1/2 x 13 — 270 lb-in (26 N•m) • #10-32 — 23 lb-in (2.6 N•m)	C, D

⚠ CAUTION

Disconnect the batteries by disconnecting the negative battery first, then the positive cable before checking the tightness of the starter and starter solenoid cable nuts.

AIR STARTER:

Clean the strainer which is in line to the control valve.	C, D
Check air starting system for leakage (should not exceed 2 psi [14 kPa] per hour from 130 psi [897 kPa]).	C, D
Remove safety valve and test; should open at 150 psi (1034 kPa). Check pressure regulator; should open at 95 psi (655 kPa).	C, D
Check operation of control valve. Check operation of check valve by reducing main air reservoir pressure.	C, D
Check air starter reservoir mounting.	C, D

AIR SYSTEM:

	Inspection Schedule
Inspect the air system for leaks by fully pressurizing the system, releasing the parking brakes and observing any pressure drop as indicated by the dashboard air pressure gauge. Pressure drop should be less than 2 psi per minute for a truck, or less than 3 psi per minute for a tractor and trailer combination. Make a full treadle application and again check for leaks by observing the air pressure gauge. Pressure drop should not exceed 3 psi per minute for a truck, or 4 psi per minute for a tractor and trailer combination.	A, B, C, D
With air reservoirs fully charged, drain reservoirs slowly and completely. Spring brakes should apply automatically when air pressure decreases to 40 psi (276 kPa).	A, B, C, D
Check alcohol evaporator reservoir level. Add fluid, if necessary. (Use only 188 proof methanol alcohol.) Check that the connections are tight.	A, B, C, D
Check air dryer for proper operation. Consult the air dryer manufacturer's service literature for recommended service intervals and procedures.	B, C, D
Check the condition of all brake hoses. Check for interference and/or chafing.	B, C, D
Check mounting of air reservoirs.	C, D
Perform dual circuit brake test. (Refer to "Dual Circuit Brake System Function Test" on page 238.)	C, D
Change the VTG control valve oil coalescing air filter (ASET™ AC engines). Refer to page 130.	B, C, D

Service air system components:

⚠ WARNING

To prevent possible injury, chock wheels and drain air brake system completely before performing any maintenance on air brake system components.

	Inspection Schedule
Governor	
Check governor cut-in/cutout operation and test for excessive leakage. Replace, if necessary.	**A, B, C, D**
Low Pressure Indicator **Double Check Valve and Stoplamp Switch**	
Check lamps and electrical connections.	**B, C, D**
Check operation and test for excessive leakage. Replace if necessary.	**B, C, D**
Trailer Supply Valve **Tractor Parking Brake Control Valve** **Parking Control Valve** **Trailer Control Valve**	
Check operation of valves and test for excessive leakage. Replace, if necessary.	**B, C, D**

Check Valve **Double Check Valve**	**Inspection Schedule**
Check operation of valves and test for excessive leakage. Replace, if necessary.	**B, C, D**

Treadle Valve **Quick Release Valve** **Ratio Valve** **Pressure Protection Valve** **Tractor Protection Valve** **Spring Brake Control Valve** **Relay Valve**	
Check operation of valves and test for excessive leakage. Replace, if necessary.	**B, C, D**

COOLING SYSTEM:

	Inspection Schedule
Check the cooling system for leaks.	A, B, C, D
Check the coolant level in the radiator, recovery tank or surge tank. Refer to "COOLING SYSTEM" on page 93 for information. Add coolant, if necessary. Mack Trucks, Inc. recommends a coolant mixture between 40% – 60% of antifreeze/ quality water. Do not exceed a 60% concentration of antifreeze.	A, B, C, D

NOTE

At each oil and filter change interval, test the coolant and add supplemental coolant additive (SCA) packets or change the coolant conditioner as required. Refer to "Coolant Conditioning" on page 104 for detailed information.

Check inside the radiator for corrosion. (See "Cooling System Corrosion" on page 112.)	A, B, C, D
Check and record degree of antifreeze protection. Add antifreeze to obtain required protection level for anticipated ambient temperatures.	C, D
Check condition of hoses and clamps. Check for leaks and tighten all hose clamps. ***Gaseous Emission Control Maintenance.***	A, B, C, D
Inspect radiator cap gasket. Pressure-test cap. All MACK ASET™ AC engines use a 16-lb. pressure cap, and ASET™ AI engines use a 10-lb. pressure cap.	C, D
Using compressed air delivered from the rear of the radiator, clean the core fins and tubes. ***Gaseous Emission Control Maintenance.***	C, D

COOLING SYSTEM: *(continued)*	Inspection Schedule
Clean any debris that may have accumulated between the radiator core, charge air cooler core and the air conditioner condenser core.	C, D
Check condition and security of the radiator mounts.	C, D
Inspect the cooling fan shroud for tears or broken-out sections. Also check for proper alignment between the fan and the shroud. ***Noise Emission Control Maintenance.***	C, D
Inspect the electronically controlled viscous fan drive for leakage, and make sure it is securely mounted. With the engine stopped (cold engine) turn the fan by hand to ensure the drive is not seized. Inspect the air-controlled fan clutch (if so equipped) for proper operation. Check the fan for bent, cracked or broken blades and replace as necessary. ***Noise Emission Control Maintenance.***	C, D
ALTERNATOR:	
Make sure alternator is securely mounted. Tighten the alternator mounting hardware to the following specifications: • Alternator top mounting bolt — 60–70 lb-ft (81–95 N•m) • Alternator lower mounting bolt — 60–70 lb-ft (81–95 N•m) • Alternator mounting bracket-to-block — 61–68 lb-ft (82–92 N•m)	B, C, D
Inspect alternator connections.	C, D

EXTERNAL REGULATOR:

	Inspection Schedule
Check mounting and connections.	C, D

BELTS:

Check condition of all drive belts. Replace any frayed, cracked, worn or oil-soaked belts.	A, B, C, D
If the engine is not equipped with an automatic tensioner, use a tension gauge to check and adjust belt tension. Refer to "ADJUSTMENT" on page 78.	A, B, C, D

NOTE

On engines equipped with an automatic belt tensioner, belt tension cannot be checked. If the belt is loose, check the condition of the automatic belt tensioner and replace as necessary.

Using a straight edge, check the alignment of all belt pulleys.	B, C, D
Check condition of the automatic belt tensioner. (Refer to "Automatic Belt Tensioner Maintenance" on page 89.)	D

ENGINE:

	Inspection Schedule
Check engine oil level. Add oil, if necessary. (See "LUBRICANT SPECIFICATIONS" on page 333.)	A, B, C, D
Inspect engine for any leakage of fuel, oil, coolant, air or exhaust. Correct as required.	A, B, C, D

NOTE

Information outlining fuel injection nozzle maintenance, fuel filter changes and engine oil and oil filter changes is given in the SPECIFIC MAINTENANCE section of this manual.

EGR System — A, B, C, D

- **Wire Harnesses/Connectors** — *Inspect protective coatings on wire harnesses and connectors, especially heat resistant coverings (reflective and/or insulated). Make sure all protective coverings are returned to their original positions if disturbed. Repair or replace defective parts as required.* ***Gaseous Emission Control Maintenance.***
- **EGR Tubes and Hoses** — *Inspect connecting tubes and hoses for signs of leakage or chafing. Replace and/or repair defective parts as required.* ***Gaseous Emission Control Maintenance.***

Check viscous-type vibration dampers for dents and leakage.	C, D
Inspect front and rear engine mount insulators for deterioration. If metal members come in contact, replace insulator.	C, D
Remove, clean and reinstall the crankcase breather filter element. Check the breather hose for obstructions. ***Gaseous Emission Control Maintenance.***	D

AIR CLEANER:

	Inspection Schedule
Replace the element with a MACK-approved element according to MACK recommendations when the indicator locks in the red zone, or the gauge indicates 20 or 25 inches of water for applicable engine. Refer to "AIR CLEANER MAINTENANCE" on page 123 for a listing of inlet restriction per engine model. Reset indicator after element change. The air filter element should be replaced yearly, even if maximum restriction has not been reached. ***Gaseous Emission Control Maintenance.***	**A, B, C, D**

ENGINE AIR INDUCTION SYSTEM:

Inspect condition of all hoses, pipes, ducts, tubing, elbow connections and inline intake silencers. Check for alignment, leakage, engagement and possible interference. Replace any items having cracks or holes. ***Noise & Gaseous Emission Control Maintenance.***	**A, B, C, D**
Inspect all clamps, brackets and fasteners. Torque all hose clamps. (See "HOSE CLAMP TORQUES" on page 120.) ***Noise Emission Control Maintenance.***	**A, B, C, D**
Check all turbocharger connections for tightness and leaks. Repair as necessary.	**A, B, C, D**

NOTE

Additional turbocharger maintenance procedures are given under "TURBOCHARGERS" on page 127.

Change the variable turbine geometry (VTG) turbocharger control valve air filter. Refer to "Variable Turbine Geometry (VTG) Turbocharger Control Valve Air Filter" on page 130.	**B, C, D**

CHASSIS-MOUNTED CHARGE AIR COOLERS:

	Inspection Schedule
Check all air ducts and gasket connections. Torque hose clamps to specifications. Refer to "HOSE CLAMP TORQUES" on page 120. ***Gaseous Emission Control Maintenance.***	**A, B, C, D**
Check charge air cooler core fins for external damage, debris or salt corrosion. Use a firm bristle brush to remove corrosion, and compressed air to clean debris from the core. ***Gaseous Emission Control Maintenance.***	**C, D**
Check for cracks in the welds that join the side tanks to the core, and check the mounting brackets for security and condition. Torque mounts to 30 lb-ft (41 N•m). **Gaseous Emission Control Maintenance.**	**C, D**

FUEL SYSTEM:

Check nozzle lines for leaks and clamps for tightness. Be sure lines do not rub.	**C, D**

NOTE

Additional injection nozzle maintenance procedures are given in "Fuel Injector Nozzle Maintenance" on page 142.

FUEL TANKS:

	Inspection Schedule
Check filler cap and gasket for proper sealing.	B, C, D
Check for plugged or obstructed fuel tank vents.	C, D
Inspect the fuel tank mounting and fuel line clamps.	C, D

NOTE

The fuel tank caps on all MACK diesel powered chassis are vented. Should the cap be lost or damaged in any way, it must be replaced with a MACK approved vented cap only. Using any other type of cap may result in fuel tank damage and/or poor engine performance.

CXN and CHN model chassis have vented fuel tanks and do not use vented fuel tank caps.

Do not fill the fuel tanks to more than 95% of liquid capacity.

EXHAUST SYSTEM:

	Inspection Schedule
Inspect the muffler for leaks at the seams, and the inlet and outlet connections. Also check for holes in the muffler body. Replace as necessary. ***Noise Emission Control Maintenance.***	A, B, C, D
Inspect the exhaust system tubing for holes, including all flexible pipes, and check for exhaust gas leakage at all connections. Replace as necessary. ***Noise Emission Control Maintenance.***	A, B, C, D
On MR and LE models, inspect the muffler rain water drain tube (if equipped) to ensure the tube is clear of obstructions. ***Noise Emission Control Maintenance.***	A, B, C, D
Check for gasket leakage at the exhaust manifold and at the turbocharger connections. ***Noise Emission Control Maintenance.***	A, B, C, D
Inspect the condition of all exhaust system clamps. Tighten or replace as required. ***Noise Emission Control Maintenance.***	B, C, D
Check the condition of all exhaust system supports and brackets. Repair or replace as necessary. ***Noise Emission Control Maintenance.***	B, C, D

CLUTCH:

	Inspection Schedule
Inspect linkage for wear.	C, D
Check clutch pedal free travel. DO NOT allow less than 1/2 inch (12.7 mm) of free travel. If not within specifications, adjust as necessary. (See "CLUTCH ADJUSTMENT" on page 253.)	C, D

NOTE

Refer to "ADJUSTMENT PROCEDURE" on page 265 for additional lubrication guidelines applicable to clutch release bearing lubrication and bearing pads.

STEERING GEAR:

Perform a static shake test to check for wear and/or looseness in the steering linkage (steering shaft U-joints and yokes, drag link ends and cross steer tube ends). Refer to "FRONT AXLE STATIC SHAKE TEST" on page 190.	A, B, C, D
Inspect the condition of the steering gear mounting brackets, and check the tightness of all the fasteners. Inspect the steering gear for leaks.	A, B, C, D
Check the torque of the steering shaft pinch bolts. Replace any corroded pinch bolts or nuts.	C, D

POWER STEERING:

	Inspection Schedule
Check for leakage in the hoses, pump, steering gear and reservoir.	A, B, C, D
Check fluid level in reservoir and add fluid, if necessary.	A, B, C, D
Check relief stop settings.	C, D
Change power steering fluid and filter. Refer to "Power Steering Oil Change" on page 165 for more information.	D

Axle Alignment:

NOTE

For information concerning factors that influence tire wear, tire rotation, driving habits, tire loading, tire inspection, tire selection and inflation pressures, refer to "Factors That Influence Tire Wear" on page 232.

NOTE

At the first A inspection interval, front and rear axle alignment must be checked and adjusted if out of specification. Thereafter, front axle alignment should be checked and adjusted at each C and D interval, and rear axle alignment should be checked and adjusted at each D interval.

STEERING AXLE ALIGNMENT:

	Inspection Schedule
Under normal use, toe may change and occasional adjustment is recommended to optimize tire wear and handling. Check toe and adjust if out of specification. If driver reports indicate need, or irregular tire wear is present, check caster and adjust if out of specification.	C, D

REAR AXLE(S) ALIGNMENT:

If the vehicle is equipped with one of the following adjustable rear suspensions, MACK AL, AL II, MaxAir™ 40/40A, MaxLite™ 20–40, ST, Chalmers, Hendrickson Bar Pin, Neway or Reyco, check axle alignment and adjust as required.	D

NOTE

If the vehicle is equipped with one of the following non-adjustable suspensions, MACK SS, SW or Hendrickson straight pin, tires should be monitored for signs of irregular wear. Tire rotation is recommended to optimize tire life and achieve even wear. The suspension should be monitored for signs of component wear.

Before checking axle alignment on non-adjustable suspensions, a thorough inspection of all components that require maintenance must be performed. Any component in need of replacement or maintenance must be repaired prior to performing an axle alignment. Refer to the *Frame, Axle and Suspension Service and Total Vehicle Alignment*, 14-103, for proper repair/replacement of suspension components.

FRONT DRIVE AXLE:

	Inspection Schedule
Check carrier lube level. Add oil, if necessary.	C, D

FRONT AXLE AND SUSPENSION:

Perform a static shake test to check for broken spring leaves, particularly in the area of the spring leaf wrapper. Refer to "FRONT AXLE STATIC SHAKE TEST" on page 190.	A, B, C, D
Check for broken spring leaves.	A, B, C, D
Check for wheel seal leaks.	A, B, C, D
Check oil-lubricated wheel bearing lube level. Add oil, if necessary.	A, B, C, D

NOTE

Chassis with front driving axles may have oil- or grease-lubricated front wheel bearings. Consult the specific axle manufacturer's service literature for service procedures and lubrication recommendations.

Check for wear in the kingpins, bushings and bearings by jacking up the front axle and moving the wheel in and out at the top and bottom.	C, D

NOTE

On MACK front axles only, check steering knuckle to front axle beam clearance, and adjust if necessary at the first A inspection interval. Thereafter, this check must be performed at each C and D inspection.

FRONT AXLE AND SUSPENSION: *(continued)*	Inspection Schedule
Check steering knuckle to front axle beam clearance and adjust, if necessary.	C, D
Inspect condition of front axle beam and tie rod ends.	C, D
Inspect steering knuckles for cracks. Pay particular attention to the areas of the steering lever boss, cross steering tube boss and the lower king pin boss. Refer to "STEERING KNUCKLE INSPECTION" on page 191 for procedures.	C, D
Inspect shock absorbers for control, binding or leaks; insulators and mountings for wear, deterioration or breakage.	C, D
Check for broken center bolts, shifted axle, loose or damaged rebound bumper, spring clips, shackles, spring cap or hanger brackets.	C, D
Torque spring clips (U-bolts). (See "SPRING CLIP (U-BOLT) TORQUE" on page 194.)	C, D
Remove all wheels.	D
Clean and inspect wheel bearings.	D

NOTE

For chassis equipped with unitized wheel hubs, the hubs are sealed and lubricated for life. Do not disassemble and attempt to repair a unitized wheel hub. Refer to the specific manufacturer's service literature for detailed information.

Repack grease-type wheel bearings.	D
Inspect condition of brake lining/disc pads.	D
Measure and record brake lining thickness.	D

FRONT AXLE AND SUSPENSION: *(continued)*	Inspection Schedule
Inspect, measure and record drum/rotor wear in inches (mm). Compare measurement with dimension cast into the drum/rotor.	D
Inspect brake spiders, mounting bolts and/or disc calipers.	D
Inspect brake shoes.	D
Inspect brake cams and bushings (cam brakes).	D
Replace wheel bearing lube seals.	D
Reinstall wheels and adjust bearings.	D
Fill oil-type wheel bearings to specified level. (See "LUBRICANT SPECIFICATIONS" on page 333.)	D

⚠ WARNING

It is extremely important to use a retaining method when working on all spring brake chambers. The spring is under heavy compression and can expand rapidly with great force and cause injury.

Check brake air chambers for leakage. Make several brake applications and observe that push rods respond quickly and with no indications of binding. Refer to the *Air and Brake System Service Manual*, 16-104, for more detailed maintenance information.	A, B, C, D
Measure push rod travel. Stroke should be as short as possible without allowing the brakes to drag. Adjust manual slack adjusters as necessary. Automatic slack adjusters should not require periodic adjustments. Refer to the *Air and Brake System Service Manual*, 16-104, for more detailed information.	A, B, C, D

TRANSMISSION/AUX. TRANS. TRANSFER CASE/FLYWHEEL PTO:

	Inspection Schedule
Inspect for leaks at seals, covers and plugs.	A, B, C, D
Check lube level. Add oil, if necessary. (See "Gear Oils" on page 335 for recommended lubricants and capacities. For lubricant change procedures, refer to "Transmissions" on page 171.)	A, B, C, D
Check condition and tightness of all mounts.	A, B, C, D
Inspect all linkages for wear, binding and full engagement in all gears.	C, D
Inspect and clean breathers.	C, D
Change air filter on air-shifted transmissions.	C, D
Service select air valve on air-shifted transmissions.	C, D
Service air shift cover on air-shifted transmissions.	C, D
Service range shift valve on T300 series transmissions.	C, D

PROPELLER SHAFTS:

Check tightness of the universal joints. Check for leaks.	A, B, C, D
Inspect yokes or flanges for tightness.	A, B, C, D
Inspect splines for wear or seizure. Arrows at splined joints must be in alignment with each other to avoid vibration.	C, D

CENTER BEARING:

	Inspection Schedule
Inspect bearing for wear. Check for loose hanger bolts, deteriorated or worn insulator or cracked support.	A, B, C, D

REAR AXLE AND SUSPENSION:

Check for broken spring leaves.	A, B, C, D
Check for wheel seal leaks.	A, B, C, D
Check shock absorbers for leakage and damage. Replace if the shock absorber body is damaged, if the dust tube or end mounts are cracked or if leaking is evident. Also, check the upper and lower bushings for wear, deterioration or deformation and replace as necessary.	A, B, C, D
Check condition of spring and trunnion insulators.	B, C, D
Inspect axle housing(s) for leakage or cracks.	C, D
Remove and clean all magnetic plugs in carrier and power divider. Clean magnetic strips and oil trough.	C, D
Check torque rods for damage. Check torque rod ball joints for wear or deterioration. Check rubber-bushed torque rods for unequal rubber exposure, cracked or ruptured rubber bushings, off-center pins or expanded mounting pin holes.	C, D
Check for broken center bolts, and loose or damaged rebound clips, cap retainers, shackles and brackets.	C, D

REAR AXLE AND SUSPENSION: *(continued)*	Inspection Schedule
Torque spring clips (U-bolts) (spring and walking beam suspensions).	C, D

NOTE

On chassis equipped with Reyco suspensions, check and adjust torque of the spring clips (U-bolts), equalizer nuts, torque arm bolts (at the hangers and axle seats), and torque arm tube clamp nuts at each B, C, and D inspection interval.

ALL MACK AIR SUSPENSIONS — In addition to the other suspension items outlined in this section, the following items must be performed on MACK air suspensions.

Check U-bolt locknut torque.	A, B, C, D
Check main support member fastener torque: AL — Support member to air spring lower mounting bracket. AL II — Support member to cross channel section. MaxLite™ 20–40 — Support member to crossbeam.	A, B, C, D
Check air springs for cracks, gouges, distortion, bulges and/or chafing and replace as necessary. If an air spring requires replacement, inspect other areas of the suspension for potential problems.	C, D
Check air suspension air lines for leaks.	C, D
Check torque of other fasteners as outlined on table on page 200.	D
Check functionality of height-control valve. Measure and adjust ride height as necessary.	D
Remove all wheels.	D

REAR AXLE AND SUSPENSION: *(continued)*	Inspection Schedule
Clean and inspect wheel bearings.	D

NOTE

For chassis equipped with unitized wheel hubs, the hubs are sealed and lubricated for life. Do not disassemble and attempt to repair a unitized wheel hub. Refer to the specific manufacturer's service literature for detailed information.

Repack grease-type wheel bearings.	D
Inspect condition of brake lining/disc pads.	D
Measure and record brake lining thickness.	D
Inspect, measure and record drum/rotor wear in inches (mm). Compare measurements with dimension cast into the drum or rotor.	D
Inspect condition of brake spiders, mounting bolts and disc calipers.	D
Inspect condition of brake shoes. Check lining for flaking, etc.	D
Inspect brake cams and bushings (cam brakes).	D
Replace wheel bearing seals.	D

REAR AXLE AND SUSPENSION: *(continued)*	Inspection Schedule
Fill rear axle to specified level. (See "LUBRICANT SPECIFICATIONS" on page 333.)	D

⚠ WARNING

It is extremely important to use a retaining method when working on all spring brake chambers. The spring is under heavy compression and can expand rapidly with great force and cause injury.

Check brake air chambers for leakage. Make several brake applications and observe that push rods respond quickly and with no indications of binding. Refer to the *Air and Brake System Service Manual*, 16-104, for more detailed maintenance information.	A, B, C, D
Measure push rod travel. Stroke should be as short as possible without allowing the brakes to drag. Adjust manual slack adjusters as necessary. Automatic slack adjusters should not require periodic adjustments. Refer to the *Air and Brake System Service Manual*, 16-104, for more detailed information.	A, B, C, D

CARRIER/CARRIERS:	
Inspect for leaks.	A, B, C, D
Check carrier(s) lube level. Add required gear oil, if necessary.	A, B, C, D
Check carrier mounting. Check and re-torque hidden capscrews (refer to "CARRIER CAPSCREW TORQUE" on page 192).	C, D
Remove and clean carrier breather.	D

TIRES:

	Inspection Schedule
Check condition of tires and proper tire match.	A, B, C, D
Check tread depth, wear pattern and correct inflation pressure (while tires are cold).	A, B, C, D
Report any case of uneven or unusual tire wear. Remove and replace any damaged tires.	A, B, C, D
Check for proper function of central tire inflation system (if equipped).	A, B, C, D

WHEELS/RIMS:

Check condition of wheels, rims, wheel studs and nuts. Replace if damaged.	A, B, C, D
Torque wheel nuts (rim lug nuts on spoke wheels; wheel lug nuts [inner and outer when applicable] on disc wheels).	A, B, C, D
Torque chain clearance spacers if the chassis is so equipped. See "Chain Clearance Spacers" on page 230.	A, B, C, D

REAR AXLE FLANGE:

Torque axle flange nuts to specifications.	A, B, C, D

FRAME:

Clean frame and crossmembers.	C, D
Inspect side rails, crossmembers and brackets for looseness, cracks or fretting.	C, D
Inspect spring brackets and crossmember Huck bolts or bolts.	C, D

TRAILER CORD:

	Inspection Schedule
Inspect condition of the trailer cord. Look for chafing, missing or loose clamps, bad routing or loose connections.	A, B, C, D

TRAILER HOSES:

Check that the trailer hoses do not rub against the cab, frame or any other chassis components. Reroute or clamp as required. Inspect glad hands for defects that may affect sealing.	A, B, C, D

FIFTH WHEEL:

Check fifth wheel mounting, brackets, latching device, body mounts, sills, fastener and sliding mechanism for cracks or fretting. Torque mounting bolts. Instructions vary according to make, follow manufacturer's instructions.	A, B, C, D

PTO/HOIST:

Check reservoir fluid level. Add oil, if necessary. Refer to manufacturer's service literature for lubricant specifications.	A, B, C, D
Check operation of controls, PTO and hoist.	A, B, C, D
Inspect condition of mountings, hinges, brackets, linkages and hydraulic units.	B, C, D
On chassis equipped with a flywheel PTO having an optional safety fuse clutch, torque driveshaft nut to 100–110 lb-ft (136–149 N•m).	C, D

SAFETY EQUIPMENT:

	Inspection Schedule
Check pressure on fire extinguisher gauge. Dial should indicate pressure in OK zone.	A, B, C, D
On chassis in interstate commerce, check for ICC kit containing flags, reflectors, fuses, etc.	A, B, C, D

FLAPS:

Check condition and mounting of flaps. Replace, if necessary.	A, B, C, D

SPECIFIC MAINTENANCE

FOR COMPONENTS NOT MANUFACTURED

BY MACK TRUCKS

CONSULT VENDOR SERVICE PUBLICATIONS

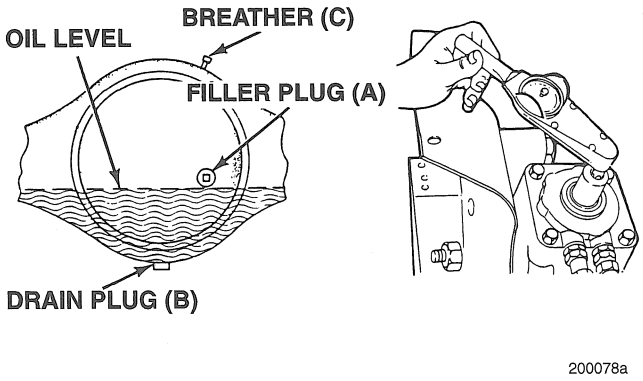


Figure 4 — Specific Maintenance

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FASTENER SIZES, TYPES AND GRADES

Fastener Sizes and Types

The first and most important fact that the technician must know about a fastener is whether it is a U.S. (Inch System) or a metric thread. Next is the size of the fastener, which is usually determined by the diameter of the shank, the length of the fastener, which is usually measured from the bottom of the head to the end of the thread, and the pitch of the threads.

The pitch of U.S. (Inch System) fasteners is measured by determining the number of threads per inch. The two pitches commonly used in vehicles are coarse threads, officially called Unified National Coarse (UNC), and fine threads, officially called Unified National Fine (UNF).

The pitch of metric fasteners is measured by determining the number of threads per millimeter. For example, a bolt with 0.8 pitch would have 125 threads in a 100 millimeter section (100 mm divided by 125 threads equals 0.8), and a bolt with 1.0 pitch would have 100 threads in a 100 millimeter section. Pitch may be measured directly using a ruler and counting the threads. Also, thread pitch gauges are available for both U.S. and metric threads, which makes it easy to check the pitch of a fastener.

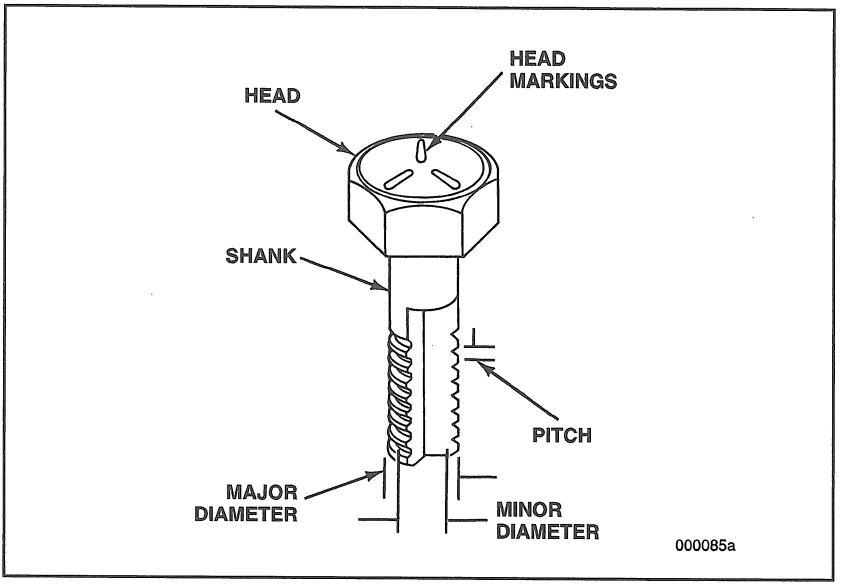


Figure 5 — Fastener Identification

Fastener Grades

A fastener must be strong enough to do the intended job. U.S. and metric systems both separate their fasteners into grades according to strength and quality. In the U.S. system, slash marks are used on bolt heads to indicate grade. SAE Grade 1 and 2 use no slash marks. These "hardware grades" are used only in the least demanding applications. SAE Grade 5 uses three slash marks on the head. These are most commonly used for vehicle applications. SAE Grade 8 uses six slash marks on the head. These high strength bolts are used where conditions require very high torque.

Locknuts are also divided into grades called A, B and C. Grade A locknuts are intended for use with SAE Grade 1 and 2 bolts, and the nuts are not marked for identification. Grade B locknuts are intended for use with SAE Grade 5 bolts and are marked either with the letter "B" or three equally spaced symbols (dot, line, letter or other character). Grade C locknuts are intended for use with SAE Grade 8 bolts and are marked with either the letter "C" or six equally spaced symbols (dot, line, letter or other character). Another marking alternative is having notches cut circumferentially into each of the six corners of the locknut at approximately mid-height, one row of notches for Grade B and two rows for Grade C.

Metric threaded fasteners are also separated into grades according to strength and quality. Bolts commonly used in vehicles are metric Class 8.8, metric Class 9.8, and metric Class 10.9. These metric bolts are identified by the class number stamped on the head of the bolt. Metric nuts commonly used are Class 9 and Class 10. The metric nuts also have the class number stamped on them for easy identification.

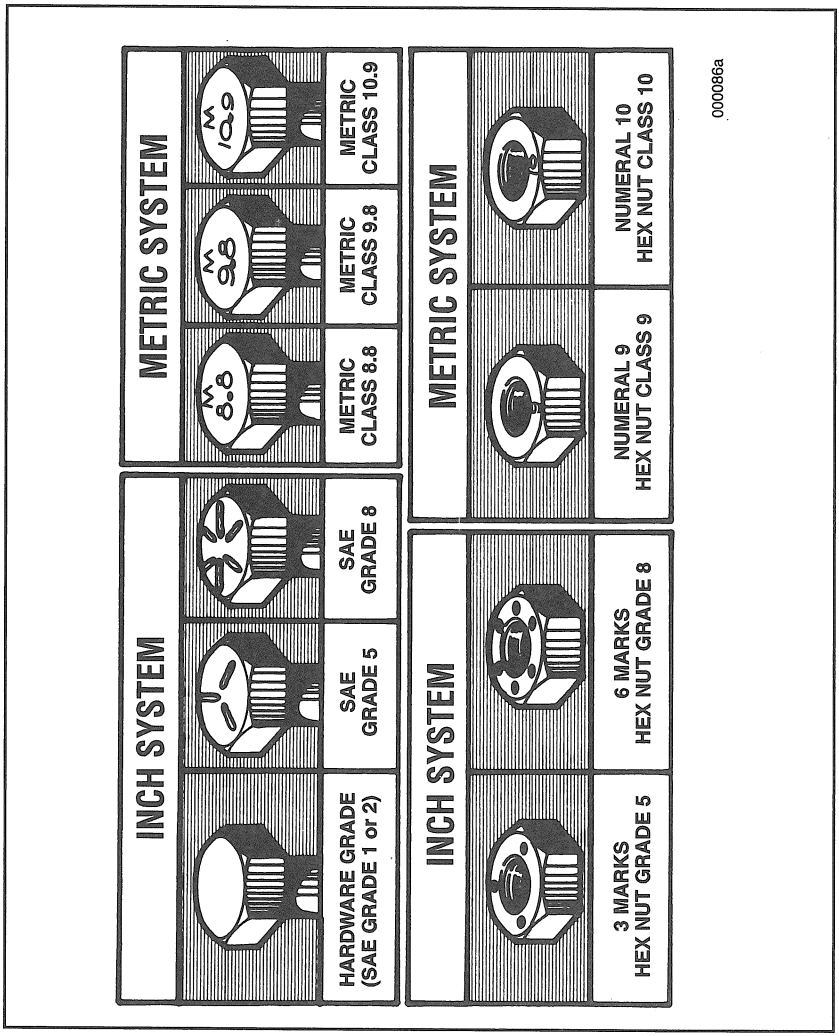


Figure 6 — Fastener Grades

⚠ WARNING

Potential external/internal thread mismatch conditions may occur with certain metric thread/ inch thread fastener combinations, and with fastener combinations involving incompatible metric fastener systems. A given thread mismatch can result in thread stripping and/or assembly weakness leading to potential service failure, thereby rendering a vehicle non-operational and/or unsafe for operation.

The specific external/internal thread combinations from which such problems can result are identified and set forth below as thread combinations which must not be utilized in service.

Incompatible Metric vs. Metric Fastener Systems

Potential external/internal thread mismatch can result from use of fasteners from incompatible metric fastener systems. The resulting condition of faulty thread engagement typically produces thread stripping and/or assembly weakness leading to possible service failure.

Domestically procured MACK models may use metric fasteners derived from differing metric fastener systems. It is therefore imperative to identify and use only those fasteners designated for use with the respective vehicle being serviced. Refer to fastener information provided in the applicable vehicle service manual.

Inch Thread vs. Metric Thread Fastener Combinations Contributing to Thread Stripping

The following combinations of inch and metric screws and nuts (or tapped holes) can be given a finger start (at least two full turns), but will strip if fully assembled.

INCH THREAD VS. METRIC THREAD FASTENER COMBINATIONS CONTRIBUTING TO THREAD STRIPPING

INCH SCREWS		METRIC NUTS	
4-40		M3 x 0.5	
5/16-18		M8 x 1.25	
*5/16-24		M8 x 1.25	
3/8-16		*M10 x 1.25	
*3/8-24	M10 x 1.5	*M10 x 1.25	*M10 x 1.0
7/16-14		*M12 x 1.25	
*7/16-20		M12 x 1.75	*M12 x 1.5
*1/2-20		M14 x 2	
*5/8-18		*M16 x 1.5	
*7/8-14		M24 x 3	
*1-12		M27 x 3	
METRIC SCREWS		**INCH NUTS**	
M3 x 0.5		5-40	
M6 x 1.0		1/4-20	
M6 x 1.0		*1/4-28	
*M8 x 1.0		*5/16-24	
M10 x 1.5		7/16-14	
*M10 x 1.25		7/16-14	
*M10 x 1.0		7/16-14	
M12 x 1.75		1/2-13	
M12 x 1.75		*1/2-20	
*M12 x 1.5		1/2-13	
*M12 x 1.5		*1/2-20	
*M12 x 1.25		1/2-13	
M14 x 2		9/16-12	
*M14 x 1.5		*9/16-18	
*M16 x 1.5		*5/8-18	
*M24 x 2		1-8	

* Fine Thread

Inch Thread vs. Metric Thread Fastener Combinations Contributing to Assembly Weakness

The following combinations of inch and metric screws and nuts (or tapped holes) can be fully assembled, but the resultant assembly will be 25% to 60% weaker than required. Service failure of the assembly is probable.

INCH THREAD VS. METRIC THREAD FASTENER COMBINATIONS CONTRIBUTING TO ASSEMBLY WEAKNESS

INCH SCREWS	METRIC NUTS
*4-48	M3 x 0.5
5-40	M3.5 x 0.6
6-40	M3.5 x 0.6
*8-36	M4 x 0.7
*10-32	M5 x 0.8
12-24	M6 x 1.0
*1/4-28	M7 x 1.0
3/8-16	M10 x 1.5
7/16-14	M12 x 1.75
1/2-13	M14 x 2
3/4-10	M20 x 2.5
*3/4-16	*M20 x 1.5
7/8-9	M24 x 3

METRIC SCREWS	INCH NUTS
M3 x 0.5	*5-44
M3.5 x 0.6	*6-40
M4 x 0.7	8-32
M4 x 0.7	*8-36
M5 x 0.8	*10-32
M5 x 0.8	12-24
M5 x 0.8	*12-28
*M12 x 1.25	*1/2-20
M18 x 2.5	3/4-10
*M18 x 1.5	*3/4-16
M24 x 3	1-8
M24 x 2	*1-12

* Fine Thread

DRIVE BELTS

V-Belts

Standard V-belts are used for the air conditioner compressor drive on certain ASET™ AI and AMI engines. Maintenance, installation and adjustment procedures for standard V-belts are as follows:

MAINTENANCE

- Check the belt tension when performing preventive maintenance inspections A, B, C and D. If tension is less than 75 lbs. (33 daN), increase to 110–120 lbs. (49–53 daN).

If belts squeak or squeal, clean with hydraulic brake fluid or an approved cleaning fluid. Replace belts that are severely worn or frayed.

INSTALLATION

1. To install the belt, loosen the air conditioner compressor mounting bolts and rotate the compressor toward the engine, then place the belt over the pulleys without force. Do not pry a belt over a pulley.
2. Check pulley alignment. Misalignment of pulleys should not exceed 1/16 inch (1.6 mm) for each foot of distance between pulley centers.
3. Check belt riding depth. Belts should not bottom in the pulley groove or protrude in excess of 3/32 inches (2.4 mm) above the top edge of the groove.
4. Check the pulleys. Pulley grooves should be clean and free of debris. Sharp edges on the pulley groove will produce excessive wear and premature failure of a V-belt. Especially with machined pulleys, care should be taken to ensure that a radius of at least 1/16 inch (1.6 mm) is obtained at the outer edges of the groove.
5. After positioning the belt over the pulleys, rotate the air conditioner compressor away from the engine until the proper amount of belt tension is obtained, then tighten the air conditioner compressor mounting bolts.

ADJUSTMENT

NOTE

When installing new belts, initially tighten between 130–150 lbs. (58–67 daN) gauge reading.

1. For consistent measurements, use belt tension gauge BT-3373-F to check the belt tension.

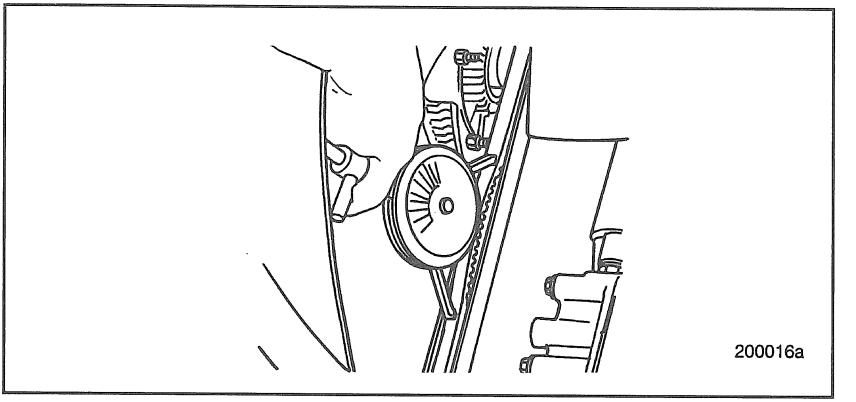


Figure 7 — Checking Belt Tension

2. Check at the center of longest span, and chalk-mark the point checked.
3. Run the engine approximately 5 to 10 minutes, allow the belts to cool, then recheck belt tension at the same point. If belt tension is less than 100 lbs. (45 daN), tighten to approximately 110–120 lbs. (49–53 daN).
   - For belts already in service, retension to 110–120 lbs. (49–53 daN) when tension drops below 75 lbs. (33 daN).

Poly V-Belts

Poly V-belts and automatic belt tensioners are used on certain ASET™ AI, AMI and all AC engines for both the main drive and accessory drive belts. Condition of the automatic belt tensioners should be checked as outlined in this manual, at each A, B, C and D inspection intervals. Additionally, condition of the belts must also be checked and replaced as required when the maintenance inspections are performed. Refer to the following belt replacement criteria.

NOTE

If belts squeak or squeal, clean with hydraulic brake fluid or an approved cleaning fluid. Replace belts that are severely worn or frayed.

RIB CRACKING

An in-service poly V-belt will go through several phases of cracking during its life. After an extended time in service, minor rib cracks may appear, usually one or two cracks per inch. This cracking is normal.

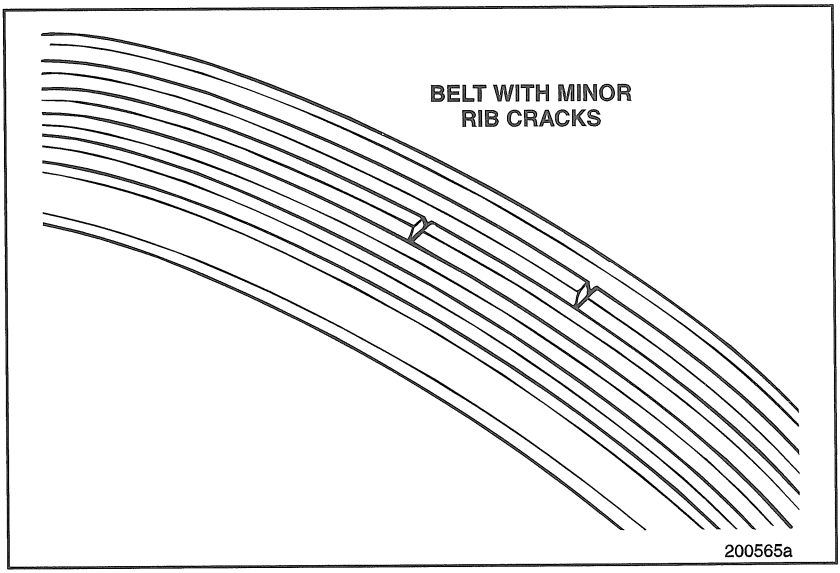


Figure 8 — Belt with Minor Rib Cracks

Belts should not be replaced unless the ribs exhibit severe multiple cracking as shown below. Multiple cracking will lead to rib chunking.

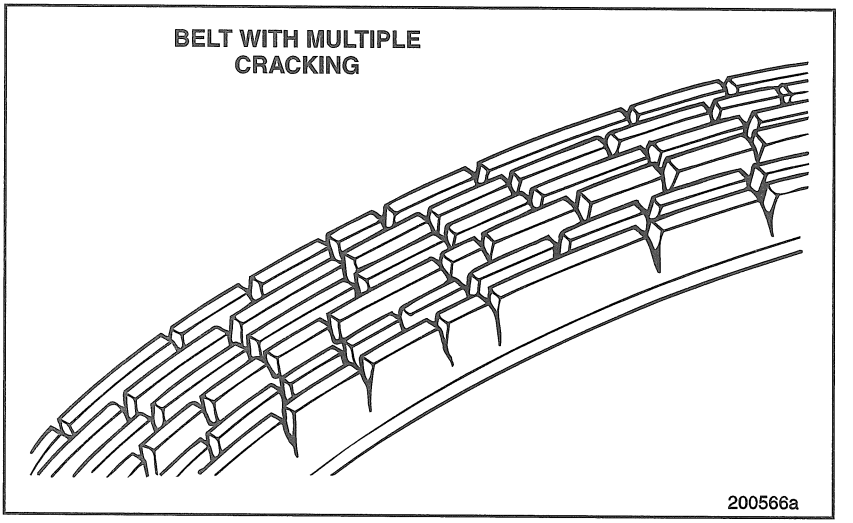


Figure 9 — Belt with Multiple Cracking

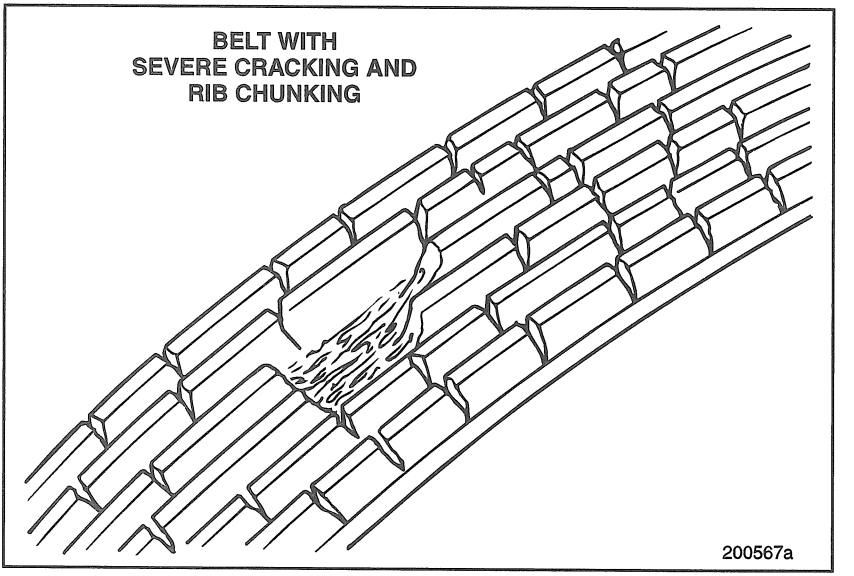


Figure 10 — Belt with Severe Cracking and Rib Chunking

RIB SIDEWALL GLAZING

When the belt ribs appear to have a shiny surface that is hard and brittle, it is usually an indication of belt slippage. This is attributed to inadequate tension and/or extreme temperature. Both these conditions will lead to severe cracking and belt failure, often with little advance warning. If this occurs, locate the cause and correct before installing a new belt.

BELT WEAR

Accelerated wear on any part of the belt (fabric backing, tensile cord or rib rubber) is a concern and should be investigated for cause, and corrected before installing a new belt.

Possible Causes of Accelerated Belt Wear

- Drive Misalignment — Belt performance will be adversely affected when misalignment exceeds 1/16 inch for every 12 inches of belt span.
- Belt Length — Must be correct.
- Environmental Conditions — Temperature, exposure to engine fluids, etc.
- Abrasive Materials — Small stones, metal shavings, etc.

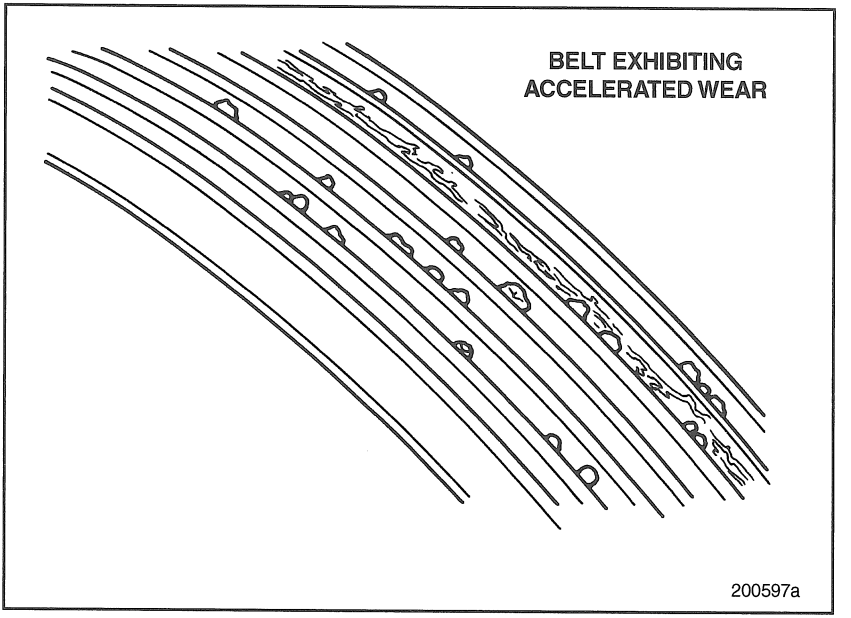


Figure 11 — Belt Exhibiting Accelerated Wear

FOREIGN OBJECTS

Any object protruding in the path of the belt drive and contacting the belt will cause damage and eventual failure. Locate the object before installing a new belt. (See Figure 12.)

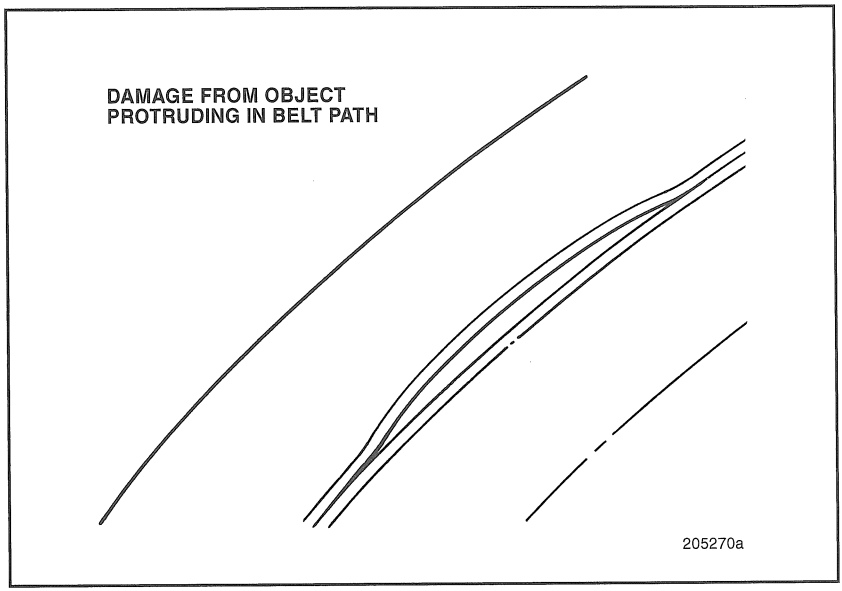


Figure 12 — Damage from Object Protruding in Belt Path

NOISE, VIBRATION AND HARSHNESS (NVH)

Poly V-belt drive systems were designed to prevent Noise, Vibration and Harshness (NVH) problems. Field problems, however, which may be related to NVH causes occasionally occur.

Possible Causes

Insufficient belt tension may create a high-pitched howl (squeal) or rasping sound during engine acceleration or deceleration.

Misalignment may cause a chirping noise, especially at, or near, idle speed. Rigid bracketing of accessories is a must for reasonably vibration-free belt spans. Some span vibration is to be expected during the range of engine speed and accessory loading.

⚠ WARNING

Failure to follow recommended application information and recommended procedures for installation, care maintenance and storage of belts may result in failure to perform properly and may result in damage to property and serious bodily injury. Make sure the belt selected for any application is recommended for that service.

Installation

To install a poly V-belt, swing the automatic tensioner to the full sprung position (fully toward the install stop), then place the belt over the pulleys. Slowly return the automatic tensioner back to its original position. Do not allow the tensioner to snap against the stops. For proper belt routing, refer to the following belt routing diagrams. Before installing the new belt, ensure that the pulley grooves are clean and free of debris.

Drive Belt Routing — ASET™ AC engines in CX and CH models, and ASET™ AI and AMI engines with new-style water pump in CV models with engines greater than 300 horsepower, and RB models, all with air conditioning.

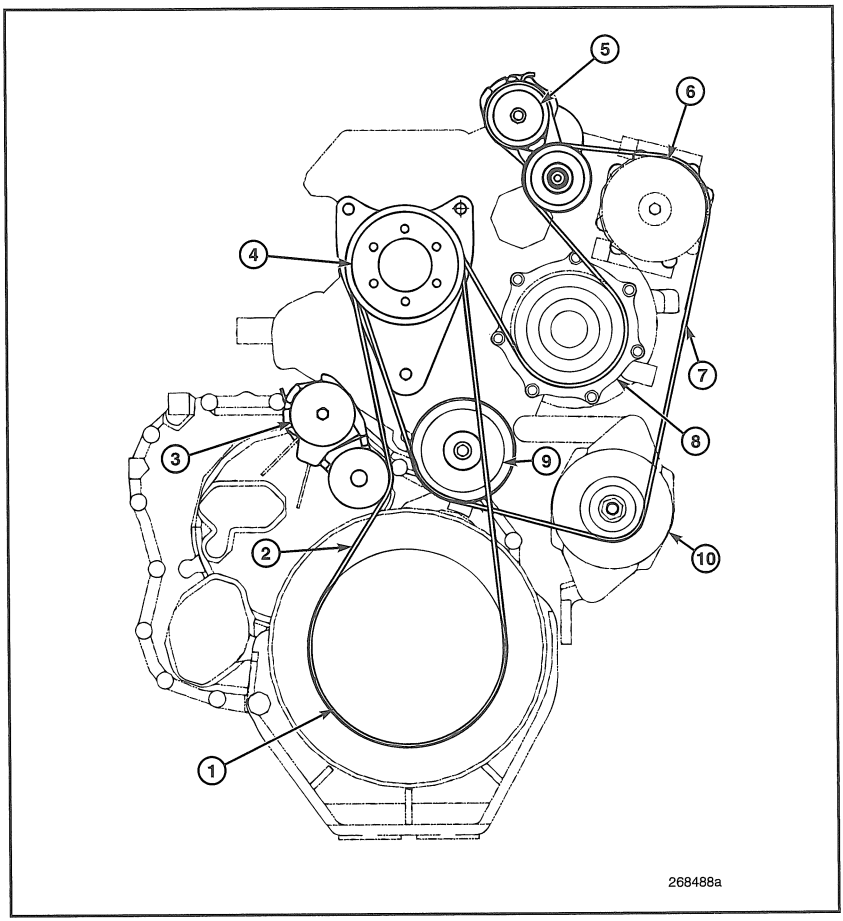


Figure 13 — Drive Belt Routing

1. Crankshaft Pulley	6. Air Conditioning Compressor
2. 10-Rib Poly V-Belt	7. 6-Rib Poly V-Belt
3. Automatic Tensioner	8. Water Pump
4. Fan Drive Hub	9. Idler Pulley
5. Automatic Tensioner	10. Alternator

Drive Belt Routing — ASET™ AC engines in CX and CH models, and ASET™ AI and AMI engines with new-style water pump in CV models with engines greater than 300 horsepower, and RB models, all without air conditioning.

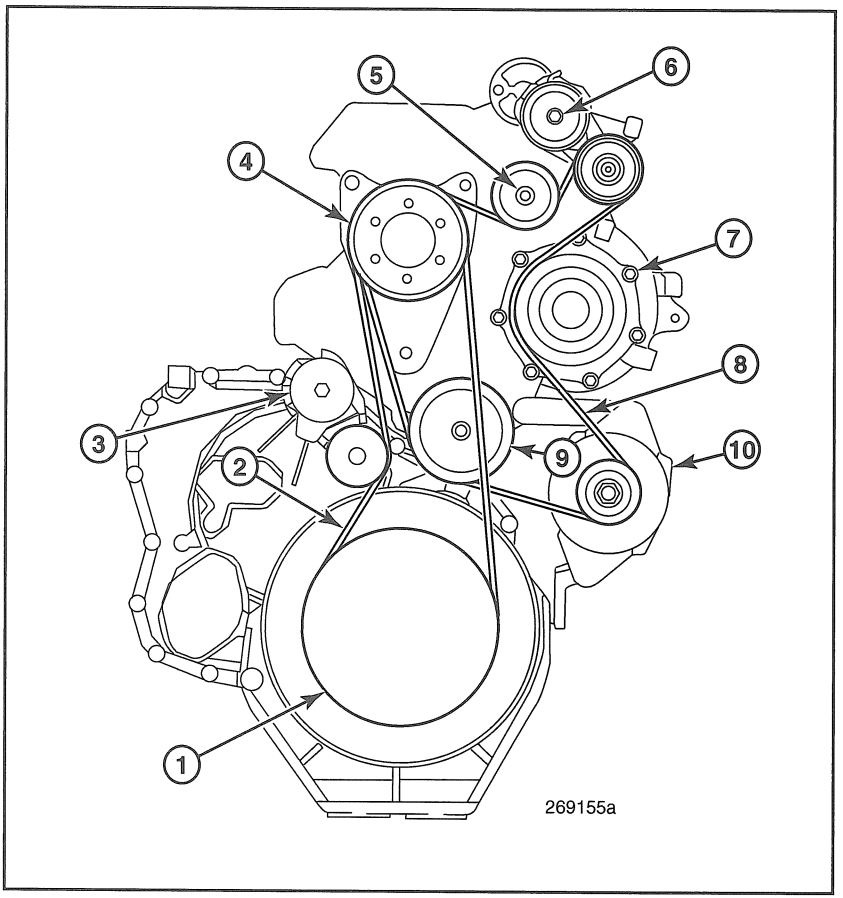


Figure 14 — Drive Belt Routing

1. Crankshaft Pulley	6. Automatic Tensioner
2. 10-Rib Poly V-Belt	7. Water Pump
3. Automatic Tensioner	8. 6-Rib Poly V-Belt
4. Fan Drive Pulley	9. Idler Pulley
5. Idler Pulley	10. Alternator

Drive Belt Routing — ASET™ AI and AMI engines with new-style water pump in MR and LE models with or without air conditioning.

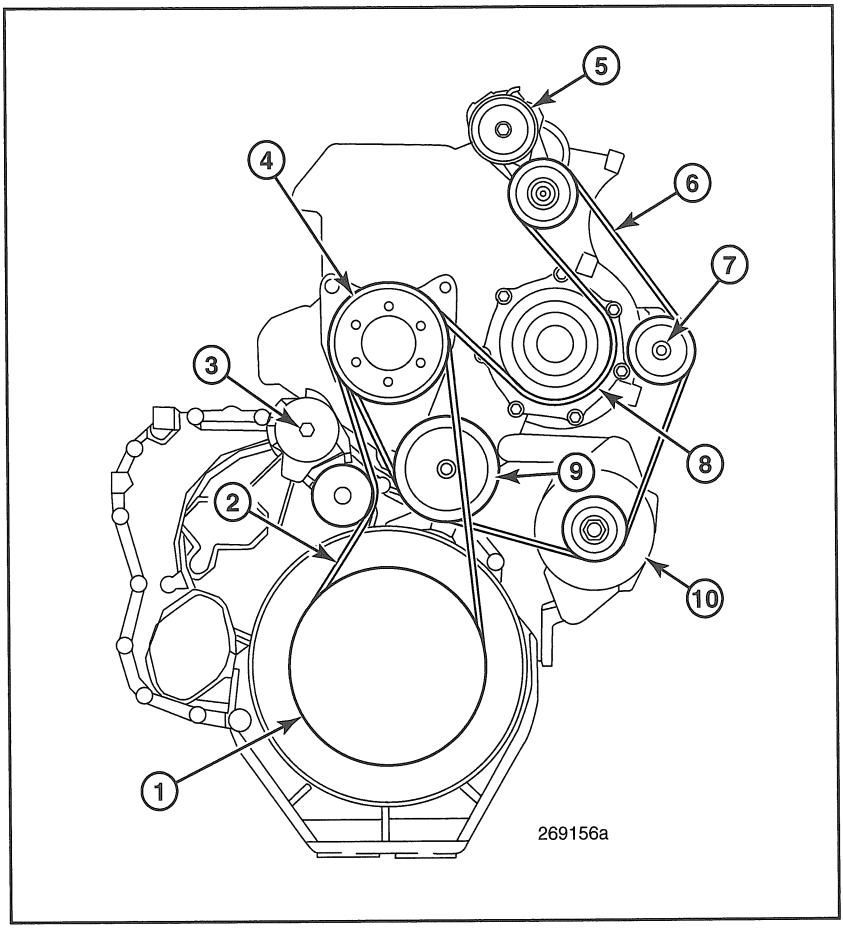


Figure 15 — Drive Belt Routing

1. Crankshaft Pulley	6. 6-Rib Poly V-Belt
2. 10-Rib Poly V-Belt	7. Idler Pulley
3. Automatic Tensioner	8. Water Pump
4. Fan Drive Pulley	9. Idler Pulley
5. Automatic Tensioner	10. Alternator

Drive Belt Routing — ASET™ AI and AMI engines in CV models with engines 300 horsepower and less, DM and DMM models, with or without air conditioning.

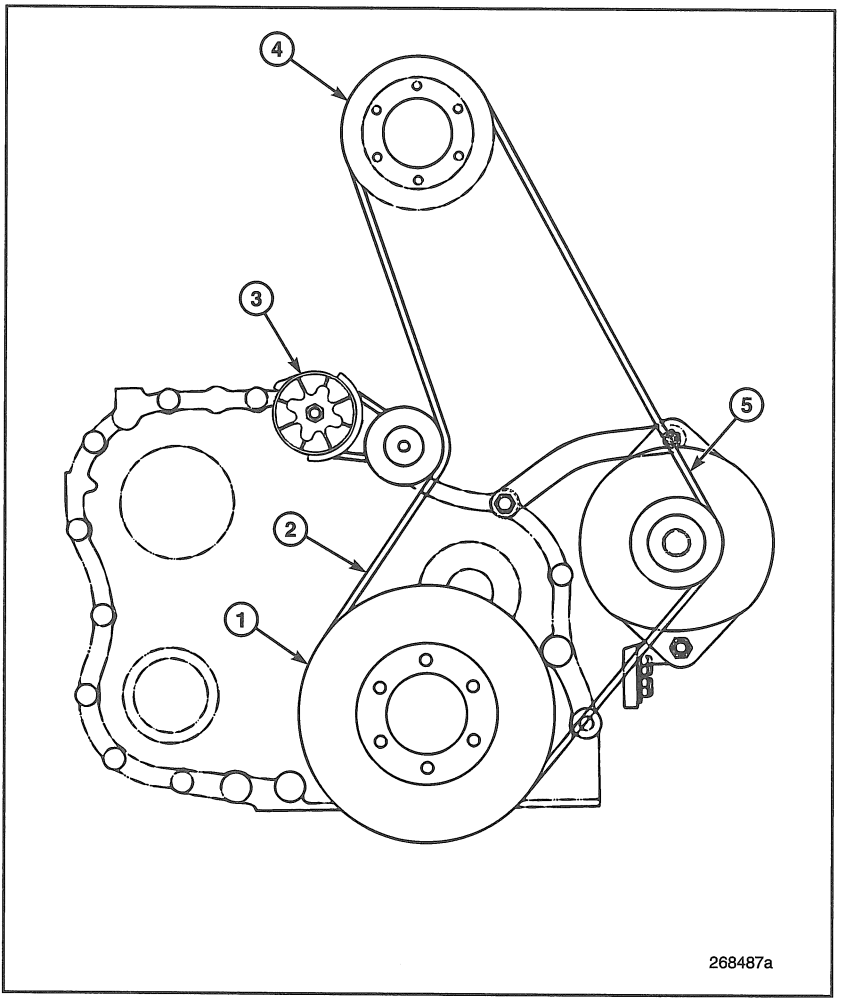


Figure 16 — Drive Belt Routing

1. Crankshaft Pulley 2. 10-Rib Poly V-Belt 3. Automatic Tensioner	4. Water Pump 5. Alternator

Automatic Belt Tensioner Maintenance

The automatic belt tensioner is designed to maintain proper belt tension throughout the life of the tensioner. The belt tensioner cannot be adjusted or repaired. At each D inspection interval or once per year, whichever occurs first, check the following:

- With the belt on the drive, check the following:
  - — Check to see if the tensioner is resting against the install stop or the free-arm stop. If the tensioner is resting against either stop, the tensioner must be replaced.

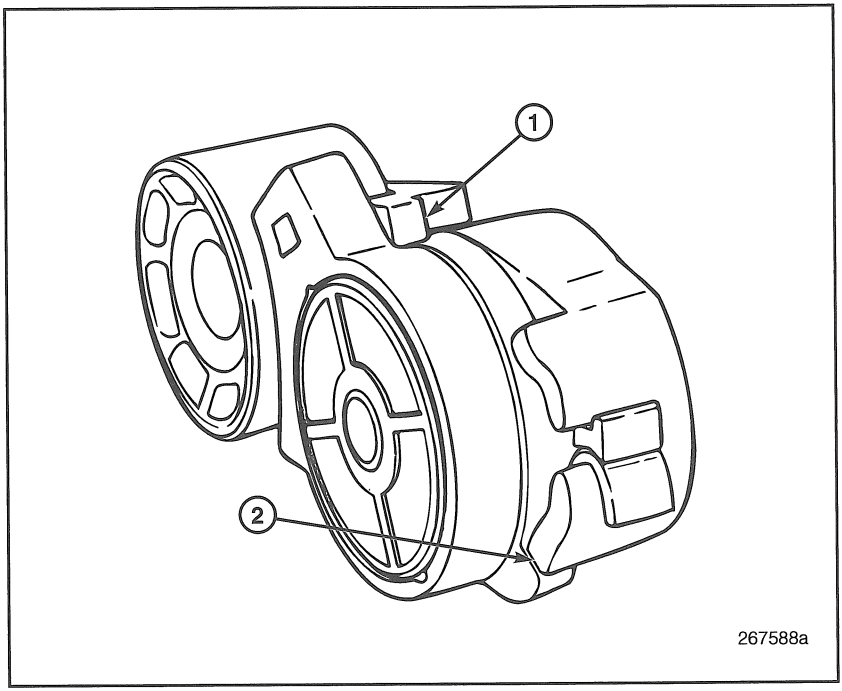


Figure 17 — Tensioner Install Stop and Free-Arm Stop (Main Drive Belt Tensioner Shown)

1. Install Stop	2. Free-Arm Stop

— On main drive belt tensioners, check belt tracking. If the belt is tracking all the way to one side of the tensioner pulley, the tensioner must be replaced. Belt tracking can be determined by looking at the witness mark (the shiny area on the pulley where the belt rides) on the pulley. If the witness mark is considerably wider than the belt, replace the tensioner.

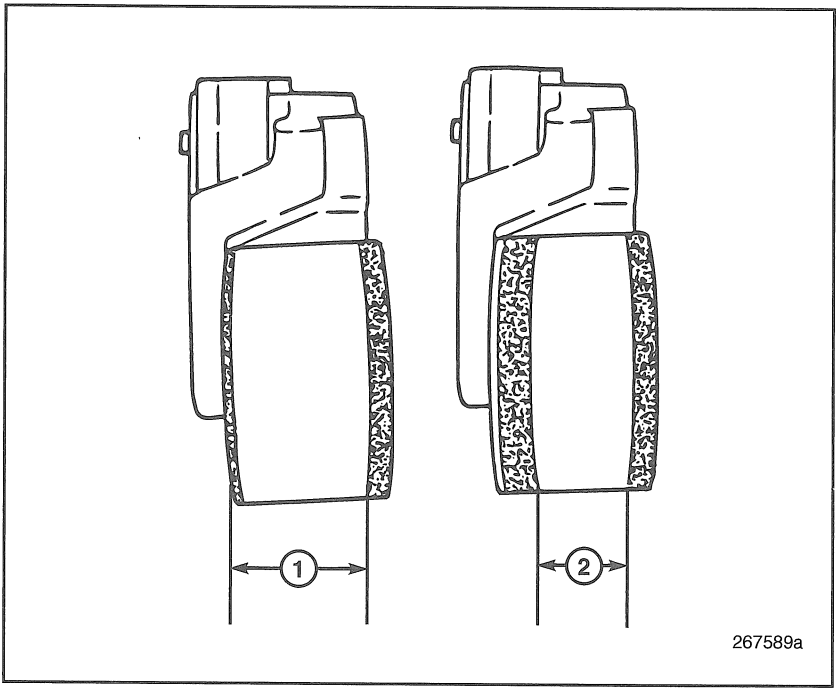


Figure 18 — Main Drive Belt Tensioner Belt Tracking Witness Mark

1. Wide Witness Mark, Wider than Belt Width	2. Narrow Witness Mark, Same as Belt Width

- Remove the belt by using a 3/8 inch breaker bar to pull the tensioner back to the install stop. Slowly return the tensioner to the free-arm stop.
- With the belt removed, use the breaker bar to slowly pull the tensioner from the free-arm stop to the install stop and then slowly releasing it back to the free-arm stop. Any excessive roughness or hesitancy noticed while performing this check indicates that the tensioner must be replaced.
- Check for metal-to-metal contact as follows:
  - — Check for contact between the arm and the spring case. Replace if metal-to-metal contact is seen.

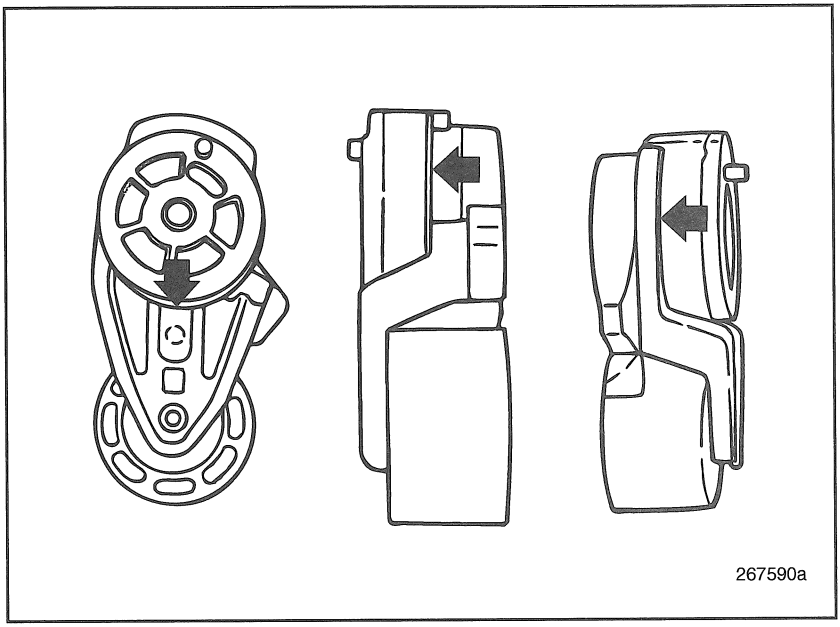


Figure 19 — Checking for Contact Between Arm and Spring Case

— Check for metal-to-metal contact between the arm and the end cap. Replace if contact is seen.

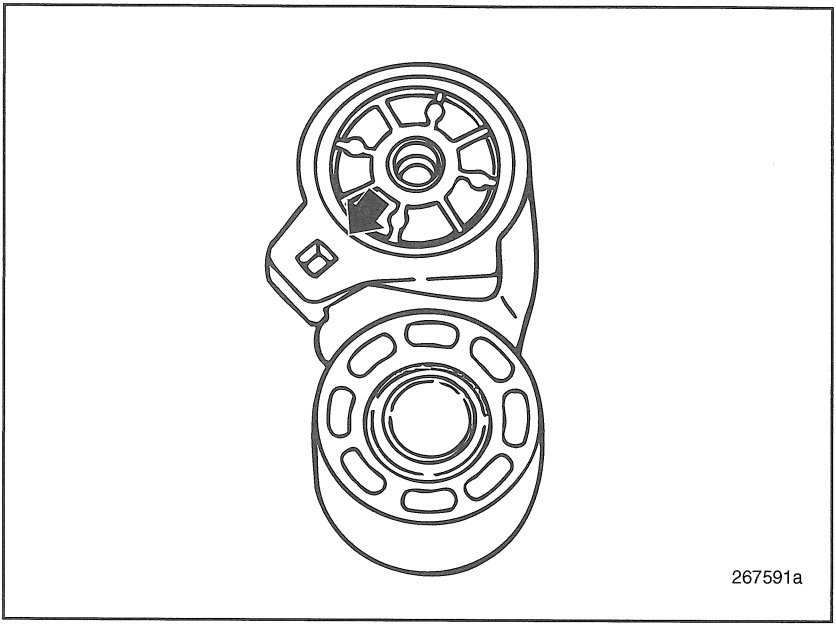


Figure 20 — Checking for Contact Between Arm and End Cap

- Check for cracks in the tensioner body or for broken stops on the spring case. If either is seen, replace the tensioner.
- Reinstall the belt making sure that the belt is properly seated in the grooves of ALL pulleys.

⚠ CAUTION

If an automatic belt tensioner must be replaced, make sure that the proper tensioner is used. Tensioner spring tension varies by engine and chassis model. Do not substitute one tensioner part number for another, as drive belt failure can result.

COOLING SYSTEM

The cooling system plays an important role in overall engine performance by keeping the engine within the normal operating temperature range — hot enough for efficient combustion, and cool enough to prevent engine damage caused by overheating. Good preventive maintenance practices, along with monitoring cooling system performance, go a long way in preventing engine damage that could result from cooling system problems. The maintenance items and tests outlined in this section should be performed at the intervals specified to ensure optimum performance from the cooling system.

Surge Tank/Radiator Pressure Cap

At every C and D inspection, check the condition of the surge tank/radiator cap gasket. Also, pressure-test the cap using a suitable cooling system and radiator cap tester. Radiator cap pressure specifications are as follows:

- **ASET™ AI and AMI Engines** — 10-lb. pressure cap
- **ASET™ AC Engines** — 16-lb. pressure cap
- **Cummins ISX Engines** — 15-lb. pressure cap
- **Cummins ISC Engines** — 10-lb. pressure cap
- **Cummins ISL Engines** — 10-lb. pressure cap

Thermostat

Check thermostat operation, particularly during cold weather, to make sure the thermostat closes fully, does not allow any leakage and does not open too soon. Also, the thermostat seal should be checked for leakage. A faulty thermostat and/or coolant leaking past the thermostat can cause engine overcooling and insufficient cab heat.

Coolant Mixture

The coolant mixture should be tested as outlined in table on page 101, to ensure that the coolant is maintained at the proper level of protection. A proper coolant mixture, which is essential to the cooling system, contains the following:

- **Quality Water** — Water meeting the minimum acceptable specifications listed in the following table, must be used in the cooling system.

Property	Limit	ASTM Test Method
Chloride (Cl), gr/gal (ppm)	2.4 (40) max.	D512b, D512d, D4327
Sulfate (SO4), gr/gal (ppm)	5.9 (100) max.	D516b, D516d, D4327
Total Hardness, gr/gal (ppm)	10 (170) max.	D1126b
Total Solids, gr/gal (ppm)	20 (340)	D1293

Water tests can be performed by any reputable testing laboratory. If water meeting the above specifications is not available, use de-ionized or distilled water rather than ordinary tap water to minimize the adverse effects of minerals in the water.

- **Antifreeze** — Heavy-duty diesel engine ethylene glycol- or propylene glycol-based coolant must be used in the cooling system. The standard factory-fill coolant is a 40/60 mixture of ethylene glycol-based coolant/quality water. Refer to "ANTIFREEZE SPECIFICATIONS" on page 350 for antifreeze specifications.

⚠ CAUTION

Heavy-duty coolant is required, regardless if the coolant being used is ethylene glycol, propylene glycol or organic acid technology (OAT). DO NOT use high-silicate automotive types of coolant, as these coolants are not compatible with the supplemental coolant additives used in heavy-duty coolants. Use of high-silicate automotive types of coolant can cause radiator plugging, resulting in engine damage.

- **Supplemental Coolant Additives (SCAs)** — Supplemental Coolant Additives are chemicals added to the coolant mixture that maintain nitrite and pH levels within a specific range. SCAs protect against corrosion, pitting and cavitation erosion.

STANDARD FACTORY-FILL COOLANT

The standard factory-fill coolant is a fuchsia (pinkish/purple), pre-charged ethylene glycol-based product. A pre-charged coolant is one that contains an initial charge of SCAs so that the nitrite concentration is quickly brought up to the proper level. However, the SCA package depletes over time, making it necessary to add additional SCAs during the life of the coolant.

OPTIONAL COOLANTS

Optional MACK-approved coolants are also available at the factory. These optional coolants include propylene glycol-based and extended-life coolants. **It is the vehicle owner's responsibility to know the type of coolant used in the cooling system and understand the manufacturer's recommended service procedures.**

NOTE

Texaco Extended-Life coolants are approved for use in MACK diesel engines.

NOTE

Fuchsia-colored coolants are NOT extended-life coolants.

TRADITIONAL COOLANTS VS. EXTENDED-LIFE COOLANTS

Traditional coolants are ethylene or propylene glycol-based coolants that require the periodic addition of SCAs during the life of the coolant so that the level of protection is maintained.

The extended-life coolant currently approved for use in MACK engines is an ethylene glycol-based coolant that uses Organic Acid Technology (OAT) to protect against corrosion, cavitation erosion and pitting. Organic acid coolants use a combination of carboxylate inhibitors in place of the traditional SCA package. These inhibitors deplete much more slowly than the SCA package used in traditional coolants, eliminating the need for routine testing of the coolant. Extended-life coolants require an annual check for contamination only.

⚠ CAUTION

Do not add SCAs to extended-life coolants. Do not use extended-life coolants in engines equipped with a coolant conditioner.

Cooling System Top-Off

Always use MACK-approved coolants when topping-off the cooling system. Always top-off with a coolant meeting the same specifications as the coolant already in the system.

NOTE

The color of the standard factory-fill coolant is fuchsia (a pinkish/purple shade) or some variation of this color depending upon the mix. This standard factory-fill coolant is compatible with all other MACK-approved traditional ethylene glycol-based coolants.

The color of Texaco and ROTELLA™ Extended-Life coolants is red. The color of traditional propylene glycol is green.

Fuchsia-colored coolants are NOT extended-life coolants.

Currently, there are no industry standards for coolant color, so the color of a coolant is not an accurate indication of the type of coolant. Always be sure of the type of coolant used in the cooling system before topping-off.

TRADITIONAL ETHYLENE-GLYCOL AND PROPYLENE-GLYCOL COOLANTS

Because of the difference in freeze points between ethylene glycol and propylene glycol, these two types of coolants should not be mixed. Cooling systems filled with ethylene glycol should be topped-off with ethylene glycol. Cooling systems filled with propylene glycol should be topped off with propylene glycol.

EXTENDED-LIFE COOLANTS

Although the currently approved extended-life coolants are compatible with traditional coolants, mixing the two is NOT recommended, as the extended-life capabilities will be compromised. If an extended-life coolant is not available, the cooling system may be topped-off with a traditional antifreeze or quality water. If water is used, freeze protection must be checked and adjusted as soon as possible. If traditional coolant is used, a mixture no greater than 15% traditional coolant to 85% extended-life coolant is permissible. Mixtures containing greater than 15% traditional coolant will shorten the service interval. In this case, the cooling system should either be drained, flushed and refilled with fresh extended-life coolant, or the coolant should be treated as a traditional coolant, and traditional coolant maintenance practices (testing nitrite level and adding SCAs as required) should be followed.

Coolant Change Intervals

⚠ DANGER

Coolant is toxic. Keep coolant out of reach of children and pets.

Handling and disposing of used coolant is subject to federal, state and local regulations. Always dispose of used coolant in an environmentally safe manner, such as at an authorized waste disposal facility. When in doubt, contact the local authorities of the Environmental Protection Agency (EPA) for guidance as to proper handling and disposing of used antifreeze.

⚠ WARNING

Avoid prolonged or repeated skin contact with used antifreeze, as such contact can result in skin disorders or other bodily injury. Always wash thoroughly after contact with used antifreeze.

TRADITIONAL ETHYLENE-GLYCOL AND PROPYLENE-GLYCOL COOLANTS

The change interval outlined in the following table is for traditional ethylene glycol- or propylene glycol-based coolants:

All Operating Conditions		
Miles (Kilometers)*	**Hours***	**Years***
200,000 (320 000)	3000	2

* Whichever occurs first.

EXTENDED-LIFE COOLANTS

Standard Extended-Life Coolant Change Interval

The change interval outlined in the following table is the standard change interval for Texaco or ROTELLA™ Extended-Life coolants:

All Operating Conditions		
Miles (Kilometers)*	**Hours***	**Years***
400,000 (644 000)	6000	4

* Whichever occurs first.

Optional Extended-Life Coolant Change Interval

The standard extended-life coolant change interval can be lengthened significantly by using a coolant extender. The extender replenishes the corrosion inhibitors in the coolant. When extender is used, extended-life coolant can be changed at the intervals outlined in the following table:

Extended-Life Coolant Change Interval When Using Extender		
All Operating Conditions		
Miles (Kilometers)*	Hours*	Years*
600,000 (966 000)	12,000	6

* Whichever occurs first.

Intervals for Adding Extender

To take advantage of the optional extended-life coolant change interval, coolant extender must be added at the intervals outlined in the following table:

All Operating Conditions		
Miles (Kilometers)*	Hours*	Years*
300,000 (483 000)	6000	3

* Whichever occurs first.

The following table outlines the amount of extender necessary, according to cooling system capacity:

Chassis Model	Engine Model	Coolant Capacity in Quarts (Liters)	Quantity of Extender
CX600 Series	ASET™ AC	33 (31)	1 quart
CXN Series	ASET™ AC	36 (34)	1 quart
CV500/700 Series	ASET™ AI, AMI Cummins ISL	33 (31) 25 (24)	1 quart 0.5 quart
CH600 Series	ASET™ AC	38 (36)	1 quart
CHN Series	ASET™ AC	36 (34)	1 quart
CT112 (AB)	ASET™ AI, AMI	34 (32)	1 quart
CL700 Series	Cummins ISX and Signature 600	62 (59)	1.5 quarts
LE600 Series	ASET™ AI, AMI Cummins ISC	38 (36) 31.5 (30)	1 quart 1 quart
MR600 Series	ASET™ AI, AMI	40 (38)	1 quart
RB600 Series	ASET™ AI, AMI	33 (31)	1 quart
DM600 Series	ASET™ AI, AMI	33 (31)	1 quart

NOTE

Capacities listed above may vary due to hoses and size of radiator, as well as accessory cooling equipment.

Coolant Tests

The coolant mixture must be properly maintained to provide maximum freeze protection, along with protection against corrosion, cavitation erosion and pitting. The following coolant tests should be performed to ensure that the coolant is providing maximum protection.

FREEZE PROTECTION

Coolant freeze protection should be checked twice per year, at each C and D inspection interval. A mixture between 40%–60% of antifreeze and quality water is required.

NOTE

Ethylene-glycol or propylene-glycol concentrations greater than 60% are not recommended. With mixtures above 60%, cooling performance degrades.

A refractometer should be used to measure freeze protection. A refractometer that measures both ethylene-glycol and propylene-glycol concentrations is available from SPX Kent-Moore. Tool part No. J 23688 measures ethylene/propylene-glycol concentration in degrees Fahrenheit and tool part No. J 26568 measures ethylene/propylene-glycol concentration in degrees Centigrade.

NITRITE LEVEL

To ensure that the coolant is properly maintained (neither overcharged, nor undercharged), coolant nitrite level must be checked at each oil change interval, prior to adding SCA packets or changing the coolant conditioner. Test strips (part No. 7046-3001M) are available through your MACK dealer. Nitrite level should be maintained between 1200 to 4000 ppm.

⚠ CAUTION

The coolant should be checked with a test strip prior to adding antifreeze/quality water solution to the cooling system and before adding SCA packets or changing the coolant conditioner. Low concentrations of SCAs will result in cavitation erosion, pitting and eventual engine failure. High concentrations of SCAs will lead to sludge build-up and overheating.

NOTE

Testing coolant nitrite level is not required with Texaco or ROTELLA™ Extended-Life coolants.

COOLANT pH LEVEL

Coolant pH level is a measure of coolant corrosiveness. For best results, pH should be maintained between 8.5–10.5 for traditional coolants, and between 7.0–10.0 for extended-life coolants. The coolant pH level should be tested at each oil change interval. If coolant pH is outside these ranges, the cooling system must be drained and refilled with fresh coolant. Coolant pH above the specified range attacks aluminum, copper and other non-ferrous materials in the cooling system. Coolants with pH below the specified range may attack ferrous materials. A coolant pH electronic tester (tool part No. J 41660) is available from SPX Kent-Moore. Additionally, test strip part No. 7046-3001M can be used to check coolant pH levels. These strips are available from your MACK dealer.

ORGANIC ACID CONCENTRATION (EXTENDED-LIFE COOLANTS)

To ensure that the extended-life coolant has not been contaminated with traditional coolant, the coolant mixture should be tested every 100,000 miles (161 000 km), 2000 hours or once per year (D inspection interval), whichever occurs first. Test strips are available for this purpose. The test is a pass/fail type that indicates whether or not the coolant is contaminated. If the test indicates contamination, the cooling system should be drained, flushed and refilled with fresh extended-life coolant. The test strips can be ordered directly from Chevron Texaco by calling 800-822-5823. Order part No. CPS 900546, Extended-Life Coolant dilution test kit.

NOTE

Do not use the nitrite test strips used for testing the nitrite level of traditional coolants to test extended-life coolants.

Coolant Conditioning

The coolant mixture in a wet sleeve diesel engine must be properly maintained to provide maximum engine block and cylinder sleeve protection. Engine coolant must contain a proper mixture of quality water, recommended antifreeze and supplemental coolant additives so that maximum freeze and boil point protection, and protection against cavitation erosion is provided.

Coolant is maintained by adding SCAs at each regularly scheduled oil change interval. Two different methods of adding SCAs are available. The standard method is by adding SCA packets directly into the cooling system. With this method, an envelope containing two dissolvable plastic packets of SCA in powder form is included with the filter service kit. These dissolvable plastic packets are added directly into the cooling system through either the coolant surge tank or directly into the radiator.

NOTE

Be sure to add the packets to the surge tank, not to the coolant recovery bottle.

The optional method is a spin-on coolant conditioner. The spin-on coolant conditioner contains the SCA package inside the canister, so that a fresh charge of SCAs is added to the cooling system each time the coolant conditioner is changed.

Regardless of the method used to add SCAs to the cooling system, the end result is the same; the proper level of SCAs is added, to protect both engine and cooling system.

NOTE

A coolant conditioner canister (part No. 25MF443) which contains a filter but no supplemental coolant additives is available through the MACK Parts System. This canister is used when a coolant filter is desired, but the cooling system is either filled with extended-life coolant, or SCA packets are added to the cooling system at the prescribed intervals.

NOTE

Do not use extended-life coolants in engines equipped with a coolant conditioner. Do not add SCA packets to extended-life coolants. Testing coolant nitrite level is not required with extended-life coolants.

ADDING SCA PACKETS

SCAs are supplied in envelopes containing two dissolvable plastic packets. This method of adding SCAs to the cooling system allows the coolant nitrite level to be optimized. SCA packets should be added to the cooling system according to the following criteria:

- 0–1,200 ppm — add two packets
- 1,200–2,400 ppm — add one packet
- Greater than 2,400 ppm — do not add packets

NOTE

When adding the SCA packets into the plastic surge tank, it may be necessary to use a suction pump (or similar type of device) to remove some coolant to provide room for the packets. Add the excess coolant into the recovery bottle.

NOTE

For chassis equipped with Cummins engines, refer to the Cummins Engine Operation and Maintenance Manual for information concerning coolant conditioning.

⚠ WARNING

Do NOT open the envelope containing the plastic SCA packets until ready to use. Do NOT open the plastic SCA packets. Place the entire sealed plastic packet into the cooling system.

⚠ WARNING

Avoid injury. Shut the engine off and allow the cooling system to cool before removing the pressure cap. Turn the cap to the first stop, but do not depress. Allow any residual pressure to dissipate. After pressure completely dissipates, press the cap downward and continue turning to remove.

Add the SCA packets to the cooling system as follows:

- On CX, CV, CH, CXN, CHN, RD6, RB and DM models equipped with MACK engines, add the SCA packets into the surge tank. The surge tank is the pressurized top tank of the surge tank/ recovery bottle arrangement. (The recovery bottle does not have a pressure cap. Refer to the following illustration.)

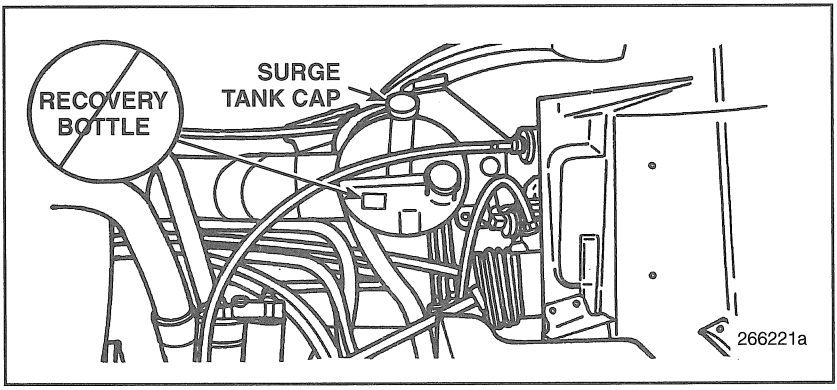


Figure 21 — Surge Tank/Recovery Bottle Arrangement

NOTE

For chassis equipped with Cummins engines, refer to the Cummins Engine Operation and Maintenance Manual for information concerning coolant conditioning.

- CL models are equipped with Cummins engines. For information concerning coolant conditioning, refer to the Cummins Engine Operation and Maintenance Manual supplied with your vehicle.

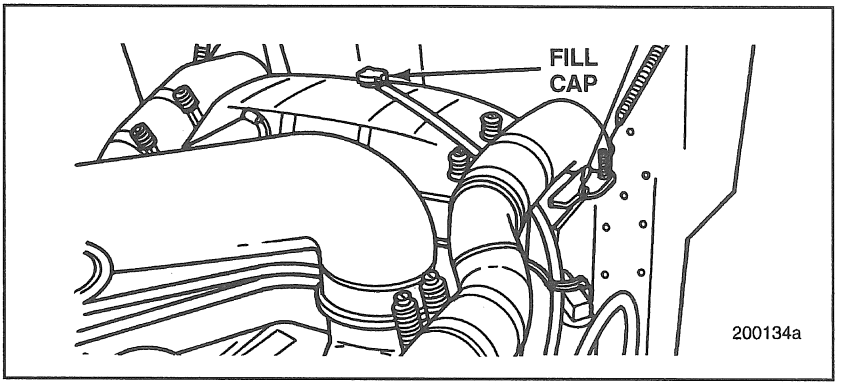


Figure 22 — Radiator Fill Cap — CL Models

- On LE and MR models equipped with MACK engines, add the SCA packets into the pressurized surge tank which is located behind the cab on the left-hand side of the chassis, mounted above the air cleaner. (Refer to the following illustration.)

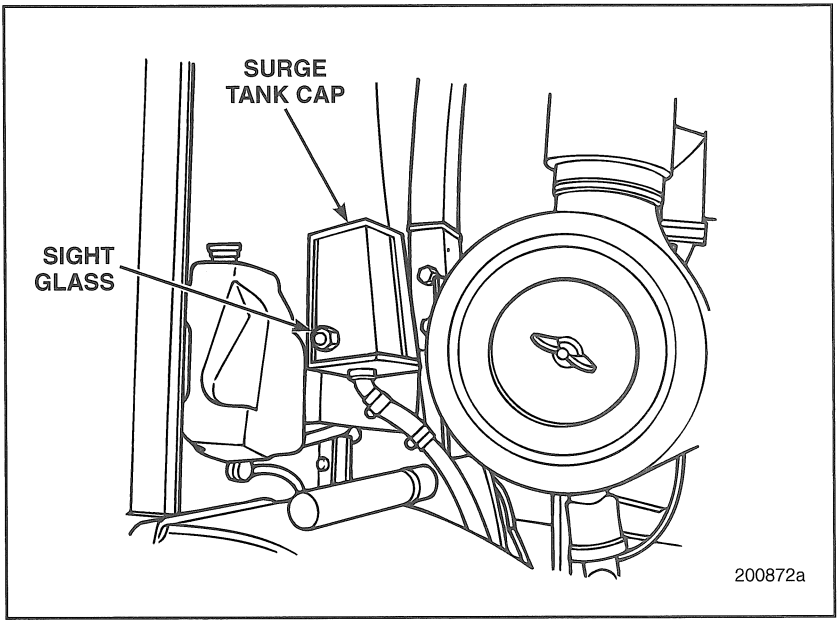


Figure 23 — LE and MR Model Surge Tank

NOTE

For chassis equipped with Cummins engines, refer to the Cummins Engine Operation and Maintenance Manual for information concerning coolant conditioning.

COOLANT CONDITIONER REPLACEMENT (OPTIONAL)

The location of the optional coolant conditioner on the ASET™ AC engine is at the back of the water pump housing at the lower left side of the engine. For the ASET™ AI and AMI engines, it is located on the thermostat housing at the front of the coolant manifold. The replacement procedure is the same for both engines.

⚠ WARNING

Avoid injury. Shut the engine off and allow the cooling system to cool before removing the pressure cap. Turn the cap to the first stop, but do not depress. Allow any residual pressure to dissipate. After pressure completely dissipates, press the cap downward and continue turning to remove.



COOLANT
CONDITIONER

201045a

Figure 24 — Coolant Conditioner

The conditioner element on ASET™ AI, AMI and AC engines is replaced as follows:

1. Relieve coolant system pressure by removing the radiator cap. Refer to Warning above.
2. Place a suitable container below the coolant filter area to catch any spilled coolant.
3. Using a suitable filter wrench (J 29927, or equivalent), remove the coolant conditioner filter element and discard.
4. Clean the coolant conditioner mounting surface.
5. Apply a light film of engine oil to the sealing gasket of the **new** coolant conditioner element.
6. Install the filter element on the coolant conditioner base assembly. Tighten the filter element 1/2 to 3/4 turn after the gasket contacts the base.
7. Reinstall the radiator cap. Start the engine and check for leaks.
8. Replenish the cooling system with the proper type and mixture of coolant.

Cooling System Corrosion

At each A, B, C and D inspection interval, check inside the radiator for signs of corrosion which may be present around the radiator tube ends. A limited view inside the radiator may be gained by removing the upper radiator hose, after first draining enough coolant from the system to bring the level below the top radiator tank. On radiators that have a radiator cap, it is only necessary to remove the cap to look inside the radiator. If corrosion is present, add one gallon (3.8 liters) of Penray® 2001 On-Line Cooling System Cleaner to the cooling system and operate the vehicle for approximately 25,000 miles (40 000 km). After 25,000 miles (40 000 km), drain and flush the cooling system. Refill the system with fresh coolant, then add SCA packets. DO NOT add additional inhibitors. If the engine is equipped with a spin-on coolant conditioner, replace with a MACK coolant conditioner rather than adding the SCA packets.

Fan Arrangement Safety Precautions

⚠ WARNING

Keep clear of fan when engine is running. Fan may start to rotate at high speed without warning.

⚠ WARNING

Misuse, misapplication or modification of radiator cooling fans can result in serious personal injury and property damage. Basic safety precautions, including the following, should always be followed.

1. DO NOT operate the engine with a defective fan drive, or with a fan which has been bent, mutilated, modified or damaged. Continued operation could result in serious failure resulting in injury or property damage.

2. If there is evidence of fan drive malfunction or exterior damage to the drive or fan, remove and replace both items. Field repair involving disassembly of an air sensing viscous fan drive or an electronically modulated fan drive can be dangerous and is not recommended. Contact your nearest MACK distributor.
3. Replace the fan if there appears to be any indication of damage to the fan.
4. Never attempt to restrict fan blade rotation during engine operation. Serious personal injury, property damage or damage to the fan drive could result.
5. DO NOT operate the engine if the fan strikes against any engine component while in operation.
6. Never operate an air sensing viscous fan with a fully closed winterfront. The winterfront center panel must be kept fully open. Do not use cardboard or other similar improvised restrictions.
7. Have the fan and fan drive inspected by a qualified mechanic if it has been exposed to excessively high temperatures (about 250°F [121°C]), and it contains any plastic or rubber components.
8. DO NOT rebalance the fan. If balancing is necessary, contact your nearest MACK dealer.
9. Perform all required maintenance on the fan drive assembly.
10. Ensure that all bolts attaching the fan to the drive are tightened to the specified torque.
11. Install the fan only on an engine that has been approved for such a fan. (Check the engine manufacturer's part list.) Likewise, install a subassembly to which the fan is attached only if approved or specified for use on the engine.
12. DO NOT modify or substitute any parts of the engine unless in accordance with the engine manufacturer's instructions. Take special care not to make modifications that increase the operating speed of the fan.

COLD WEATHER OPERATION

Cold weather operations place added demands on a diesel engine. Heavy-duty diesel engines are designed to operate at optimum efficiency when running loaded at, or very near, normal operating temperature where efficient combustion takes place. When operating unloaded, lightly loaded (stop-and-go operations, PTO operations or periods of extended engine idling), or in cold weather conditions, normal operating temperature may not be achieved or maintained. As a result, carbon and/or varnish build-up on the valves may occur, engine oil may become contaminated with combustion by-products and "slobbering" from the exhaust may become evident. In severe instances, heavy deposits of varnish can cause sticking valves which can result in bent valves, bent push rods or similar types of valve train component failure.

When starting a cold engine, or if the vehicle has been parked and the engine coolant has fallen well below normal operating temperature, a fast idle speed of approximately 1200 rpm should be maintained for a quicker engine warm-up.

NOTE

If the vehicle is kept outside during cold temperatures, and cold weather start-up and warm-up to normal operating temperature is difficult, a cylinder block heater is recommended.

During cold weather operations, it is important that coolant system maintenance be performed regularly, and that thermostat operation be checked to make sure it closes fully, does not allow any leakage and does not open too soon. The thermostat seal should also be checked for leakage. Coolant leaking past the thermostat will cause over-cooling.

Cold Weather Accessories

Cold weather operations place an added demand on a diesel engine. The following chart outlines the various accessories available that are designed to maximize engine reliability when operating in cold weather.

Component	CV	CX	CH	CL	RB	DM	MR	LE
Dual-Inlet Air Cleaner	X	X	X	X	NA	NA	NA	NA
Inside/ Outside Air	X	X	X	X	X	X	NA	NA
Engine Heater	X	X	X	X	X	X	X	X
Fuel Heater	X	X	X	X	X	X	X	X
Winterfront	X (1)	X	X	X (1)	X	X	X (1)	NA

(1) On chassis equipped with a Cummins engine, an area of approximately 120 sq. in. (775 cm^2) of the winterfront must be kept opened.

WINTERFRONTS

Winterfronts are a major benefit in maintaining the minimum required engine coolant temperature when the ambient temperature drops below freezing. The winterfront reduces the amount of cold "ram" air through the grille, which can overcool the engine and not allow minimum engine coolant temperature to be achieved and maintained.

If the engine is operated below minimum operating temperature, valve varnishing from incomplete combustion by-products (incompletely burned/unburned fuel and oil) can result. Valve varnishing can cause the valves to stick in the valve guides and may cause bent push rods when the engine is restarted after a shutdown.

If a winterfront is used, a MACK-approved pyrometer MUST also be installed and closely monitored while the engine is in operation. DO NOT exceed the temperature limit shown on the pyrometer. If exhaust temperature becomes too high, open the winterfront, downshift or reduce engine power.

⚠ CAUTION

Use only a MACK-approved winterfront designed for the specific chassis. Restricted airflow through the charge air cooler can cause higher exhaust temperatures, power loss, excessive fan usage, reduced fuel economy and possible engine damage. The use of any other type of device, such as a radiator cover, cardboard or similar material, is not approved by Mack Trucks, Inc.

The MACK-approved winterfront employs a closure panel(s) which may be secured in either the fully opened or fully closed position. When ambient temperatures are within 20°F (–7°C) to 10°F (–23°C) range, the panel(s) must be kept opened. For operation in colder temperatures, –10°F (–23°C) to –40°F (–40°C), the panel(s) should be closed to completely cover the grille.

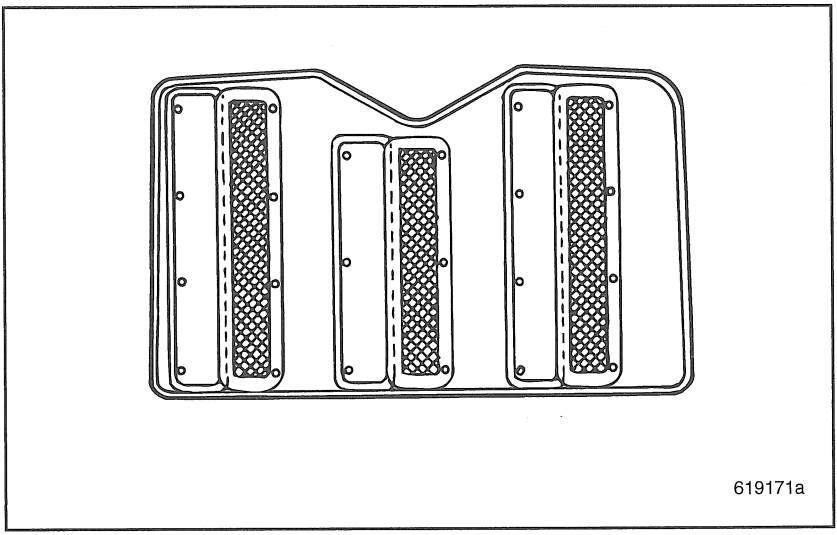


Figure 25 — Winterfront

NOTE

Winterfront shown in illustration above is for the CX model chassis. Winterfronts for other chassis will look different.

NOTE

On chassis equipped with a Cummins engine, the center panel must be kept opened, regardless of ambient air temperature.

ENGINE ENCLOSURE/BELLY TARP

A belly tarp is a canvas enclosure that is installed along the bottom of the engine and helps retain heat within the engine compartment. Belly tarps are generally used at colder ambient temperatures when a winterfront alone is not sufficient and may be fabricated from a piece of canvas of sufficient size to completely cover the underside of the engine compartment. The canvas tarp is then secured to the chassis with rubber straps, or "Bungie Cords." Make sure that the tarp does not obstruct the engine breather, interfere with any linkages or contact any part of the exhaust system.

DUAL-INLET AIR CLEANER

A dual-inlet air cleaner (part No. 2MD4138M) for CX, CV, CH and CL model vehicles is available from your local MACK dealer. This type of air cleaner has a second air inlet located above the turbocharger/ exhaust pipe to provide a means of heating the intake air during cold weather operations. The air inlet is covered with a manually operated sliding door. When operating in cold weather, loosen the four wing nuts that secure the door, then slide the door to the opened position. Secure the sliding door in the opened position by tightening the wing nuts. Refer to the chart at the end of this section for the suggested temperature ranges as to when the air cleaner sliding door should be closed, and when it should be opened.

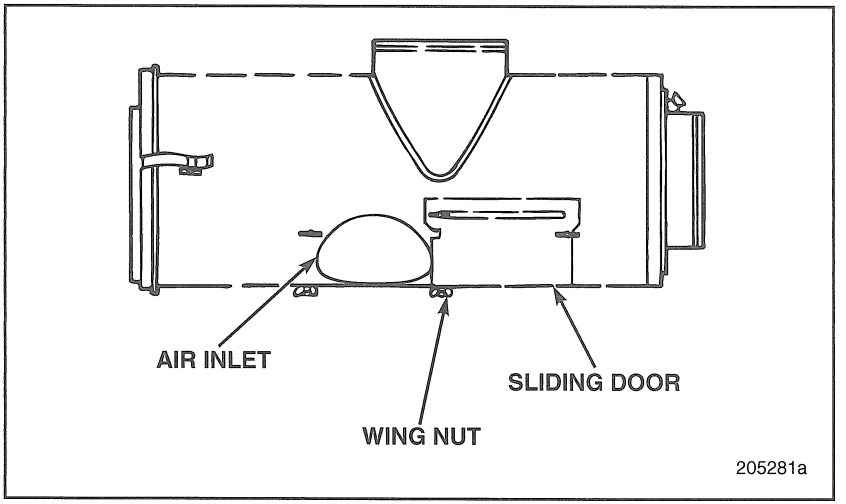


Figure 26 — Dual-Inlet Air Cleaner

COLD-WEATHER ACCESSORY USAGE

Refer to the following chart for the suggested temperature ranges when the various cold-weather accessories should be used.

<table>
<tr><th>Expected Coldest Temperature</th><th>MACK-Approved Winterfront</th><th>Belly Tarp</th><th>Inside/Outside Air Dual-Inlet Air Cleaner</th></tr>
<tr><td>40°F (5°C)</td><td>Prohibited</td><td>Prohibited</td><td rowspan="2">Available</td></tr>
<tr><td>32°F (0°C)</td><td rowspan="4">Suggested (Center Panel(s) Fully Opened)</td><td rowspan="3">Available</td></tr>
<tr><td>20°F (–7°C)</td><td rowspan="2">Suggested (Opened)</td></tr>
<tr><td>10°F (–12°C)</td></tr>
<tr><td>0°F (–18°C)</td><td rowspan="2">Suggested</td><td rowspan="5">Recommended (Opened)</td></tr>
<tr><td>–10°F (–23°C)</td><td rowspan="4">Recommended (Center Panel(s) Fully Closed)*</td></tr>
<tr><td>–20°F (–29°C)</td><td rowspan="3">Recommended</td></tr>
<tr><td>–30°F (–35°C)</td></tr>
<tr><td>–40°F (–40°C)</td></tr>
</table>

* On chassis equipped with Cummins engines, the winterfront center panel must be kept open regardless of ambient temperature.

HOSE CLAMP TORQUES

System	Lb-in (N•m)
Coolant System	27.5 (3.1)
Oil Return System	27.5 (3.1)
EGR System (ASET™ AC)	110 (13)
Air Inlet System:	
Pressurized hoses*	
• Spring-loaded T-bolt hose clamps	75 (8.5)
Non-pressurized hoses**	
• Standard hose clamps	37.5 (4.2)
• Spring-loaded T-bolt hose clamps	50 (5.7)
• High-torque heavy-duty worm clamps	80 (42.9)

* Includes all clamps installed between the turbocharger outlet and the inlet manifold, charge air cooler and inlet manifold connecting hose.

** Includes all hoses between the air cleaner and the turbocharger inlet.

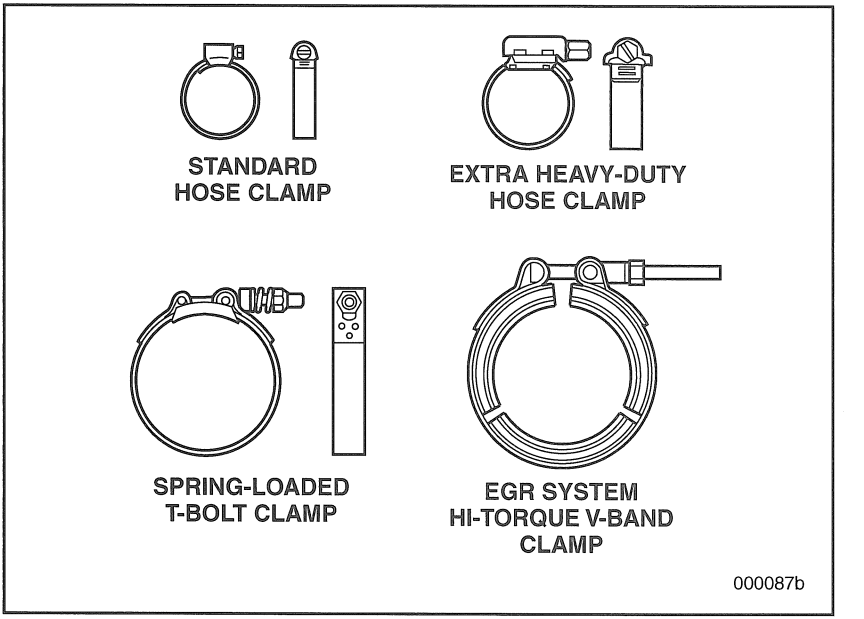


Figure 27 — Hose Clamp Types

AIR CONDITIONER MAINTENANCE

Periodic Inspections

To ensure proper air conditioner operation, the following procedures should be performed at each A, B, C and D inspection interval.

1. Inspect evaporator core (and heater core if a combination unit) for obstructions, and use compressed air to remove any debris that may be found.

> **⚠ CAUTION**
>
> *Use care to prevent damaging the blower wheel blades.*

2. Inspect condenser unit and remove any debris with compressed air. Tighten any loose fasteners.
3. Inspect the compressor. Check for loose or broken wires, and tighten nuts and bolts on compressor mounting bracket and clutch.
4. Check compressor drive belt tension and adjust, if necessary. (Refer to "DRIVE BELTS" on page 77.)
5. Inspect refrigerant hoses for abrasion or wear, and check all connections for leaks.
6. Check condensation drain hose leading from the evaporator and make sure it is not kinked or otherwise restricted.
7. Start the engine, turn the air conditioner ON and listen for any unusual noise coming from the compressor. The compressor clutch should rotate when the thermostatic switch is turned ON, and should not rotate when the switch is turned OFF.
8. Check the receiver/dryer service indicator. The normal color of the service indicator is blue. Replace the receiver/dryer when the service indicator color changes to pink. Refer to the service instruction label found on the receiver/dryer.
9. Determine if system is fully charged. Refer to Air Conditioning Service literature for proper procedures.

10. Check for proper blower speed control.
11. Determine satisfactory air conditioner performance by measuring the air temperature at the vent nearest to the evaporator. Acceptable air temperature at this location is a thermometer reading below 40°F (4.4°C) with ambient air temperature around 70°F (21°C).

NOTE

For specific information concerning air conditioning maintenance and service procedures, refer to the manufacturer's service manual.

⚠ CAUTION

Beginning with the 1994 model year, air conditioning systems in certain MACK model chassis were factory-filled with the new environmentally safe refrigerant R134a. This refrigerant is not a direct replacement for R12 refrigerant and must only be used in systems designed for its use. DO NOT use R134a in a system already charged with, or designed to use, R12. Conversely, DO NOT use R12 in a system already charged with, or designed to use, R134a.

AIR CLEANER MAINTENANCE

The air cleaner prevents dust, dirt and other harmful contaminants from entering the engine through the air intake system. Maximum engine protection can only be achieved through regularly scheduled maintenance practices that include periodic air intake system inspections and air filter element changes.

The most efficient method of determining air filter element change intervals is by regularly checking the air filter restriction gauge, which may either be mounted directly to the air cleaner canister, on the air cleaner outlet tube in the case of LE or MR model chassis or inside the cab. The restriction gauge measures the amount of restriction in the air filter element. Some chassis may have a dash-mounted dial-type restriction gauge which measures filter restriction in inches/mm of water.

Change the air filter element in accordance with the procedures as outlined, when the restriction gauge red signal locks in full view, or the dash-mounted gauge indicates inlet restriction as follows:

DASH-MOUNTED GAUGE INLET RESTRICTION INDICATION

Engine	Inches Water/kPa
ASET™ AI, AMI, AC	20″/510 mm/5 kPa
Cummins ISC, ISX, ISL and Signature 600	25″/635 mm/6.2 kPa

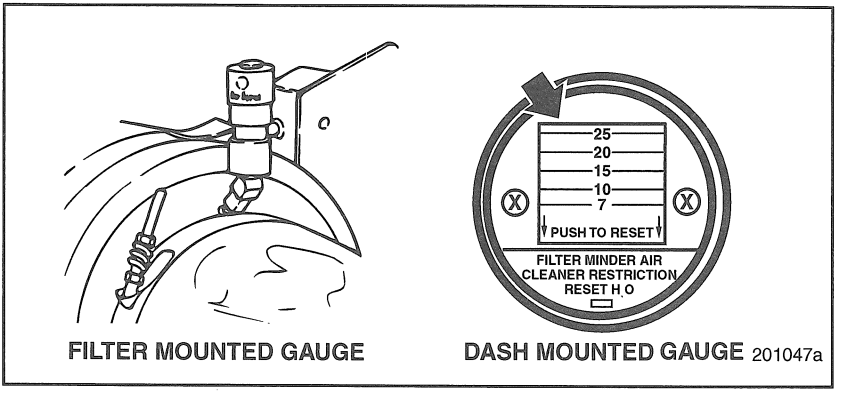


Figure 28 — Air Filter Restriction Gauge

Damage to the air filter element, such as holes in the filter medium, will give an inaccurate restriction reading. Therefore, even if maximum restriction is not indicated, the air filter element should be changed yearly or at 100,000-mile (160 000-km) intervals, whichever comes first.

When replacing the air filter element, or whenever the air inlet system has been disassembled, inspect the inlet air ducts between the air cleaner canister outlet and the turbocharger inlet as follows:

- Inspect the rubber elbows for cracks, splitting and/or holes. Rubber components must be flexible so that they conform to the plastic ducts and ensure a tight seal.
- Inspect plastic ducts for cracks and/or holes.
- Ensure that all hose clamps are properly installed and tightened to specifications. Refer to "HOSE CLAMP TORQUES" on page 120.
- Make sure the plastic ducts do not rub against any components such as air conditioning hoses, wire harnesses, etc.

To properly install a new filter element:

1. Wipe the air cleaner housing clean.
2. Remove the filter element(s).

3. Inspect sealing areas for "dirt tracks" which would indicate that dust has leaked past the seal. If dirt tracks are found, the cause must be determined and corrected.
4. Thoroughly clean the inside of the air cleaner canister with a damp cloth or vacuum cleaner.
5. If equipped with a metal canister, inspect inside the canister for rust. If rust is present:
   a. Remove the air cleaner canister from the chassis.
   b. Remove all loose rust with a wire brush or a coarse Scotch Brite® pad.
   c. Sand with 180–240 grit wet or dry sand paper.
   d. Thoroughly wash the area with PPG DX-440®, DX-436®, DX-437® or equivalent, wax and grease remover and wipe dry.
   e. Prime immediately with PPG DEP-351® epoxy primer.
   f. Reinstall the air cleaner canister.
6. Inspect the sealing areas of the housing for damage. Repair or replace as necessary.
7. Use MACK-approved replacement elements and gaskets. Make sure the new elements and gaskets are not damaged. Be sure to use new gaskets each time the element is changed. Install the cover and, depending upon cover configuration, tighten as follows:
   - Air cleaner with large wing nut in center of cover — hand-tighten wing nut.
   - Air cleaner with three thumb screws around outer edge of cover — hand-tighten thumb screws.
   - Air cleaner with retaining nuts around outer edge of cover — tighten retaining nuts between 8–10 lb-ft (11–14 N•m).

NOTE

DO NOT attempt to clean the air filter element with compressed air, as this could damage the filter medium and possibly result in severe engine damage.



Figure 29 — Replacement Parts and Filters

TURBOCHARGERS

Turbochargers are lubricated by oil from the engine. Scheduled engine oil changes take care of any periodic service requirements.

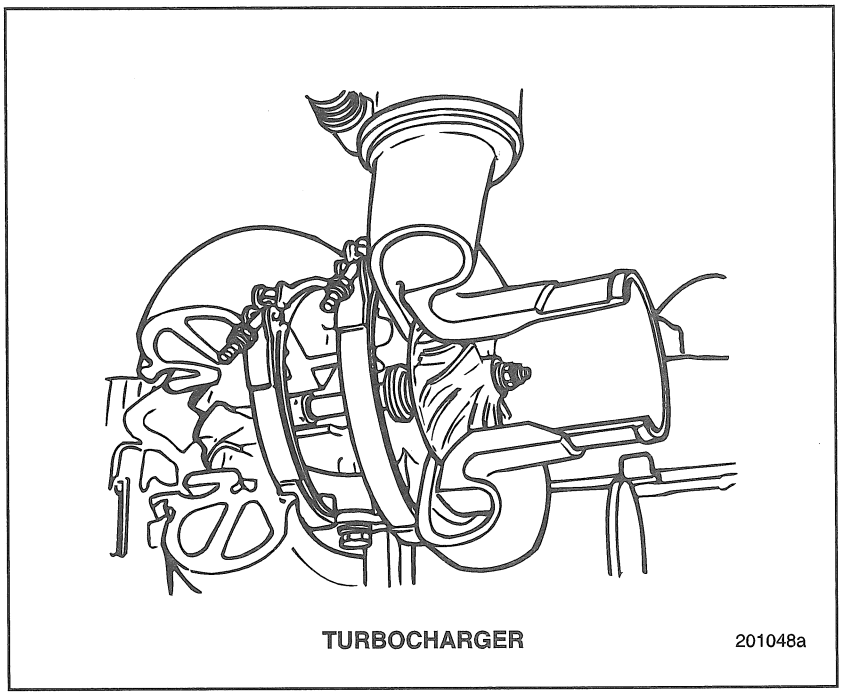


Figure 30 — Turbocharger

Because a turbocharger operates at such high speeds, lubrication at start-up and shutdown is of primary importance.

When the engine is started, idle for three minutes to allow the oil pressure to build. Accelerating the engine to top rpm immediately after starting may damage the turbocharger.

Likewise, when preparing to shut down, idle the engine for three minutes to ensure that the turbocharger is rotating slowly. This idling period dissipates heat and prevents possible turbocharger damage.

At each 150,000 miles/240 000 km or 4500-hour interval (whichever occurs first), thoroughly clean the outside of the turbocharger. Pay particular attention to the areas of the large intake and exhaust pipe connections. Remove the air intake and exhaust pipes from the turbocharger.

⚠ CAUTION

Prior to inspecting the turbocharger, disconnect the batteries by disconnecting the negative cables first, then the positive cables. Do this to prevent the engine from being started while inspecting the turbocharger.

⚠ CAUTION

DO NOT allow any debris or foreign material to enter the turbocharger openings or connecting pipes.

Inspect both housings and the wheel blades for signs of excessive dirt buildup or oil leakage from the bearing housing. Turn the wheel blades with the fingers while pushing in various directions to check for wheel-to-housing rub. If rubbing or a severe buildup of dirt exists, replace the turbocharger.

After completing the inspection, reinstall the air intake and exhaust pipes.

The engine turbocharger operates at very high speed, temperatures and pressure. Turbo bearing lubrication is critical, particularly for a newly installed turbo or one which has not been operated for a period of time and all oil has drained from the bearing and shaft surfaces. To avoid turbocharger bearing failure, the following instructions are recommended:

- Start the engine at least every 30 days to ensure turbo bearing lubrication. Operate engine at low idle for at least three minutes before increasing RPM or driving the vehicle.
- If the engine has not been run for more than 30 days, turbo pre-lube procedure is necessary:

    1. Remove turbo air intake duct and oil line connection at turbo.
    2. Fill oil inlet fitting to overflow with clean engine oil.
    3. Using fingers at compressor wheel, carefully spin and wiggle the turbo shaft to distribute the oil over all bearing surfaces.
    4. Reconnect air intake duct and again fill turbo oil port to overflow, connect oil line and start engine.
    5. Operate engine at low idle for at least three minutes before increasing RPM or driving the vehicle.

Variable Turbine Geometry (VTG) Turbocharger Control Valve Air Filter

On ASET™ AC engines, an oil coalescing air filter prevents oil mist in the chassis air system from condensing inside the VTG control valve. The filter is mounted to the engine block behind the engine oil filters on the left-hand side of the engine. Change the filter at each B, C and D inspection interval. Filter change procedures are as follows:

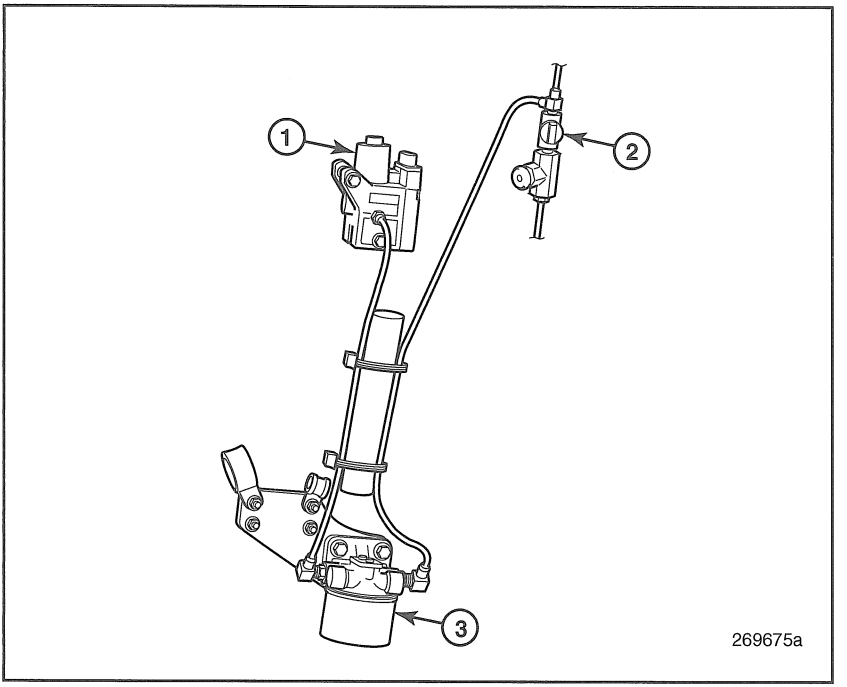


Figure 31 — VTG Control Valve Filter

1. VTG Control Valve 2. Air Line Shut-Off Valve	3. VTG Air Filter

1. Rotate the knob on the air line shut-off valve to the horizontal (off) position. When the valve is closed, residual pressure in the filter and air lines is bled to atmosphere.
2. Remove the spin-on filter.
3. Apply a thin film of clean engine oil to the gasket of the new filter.
4. Install the filter to the adapter and hand-tighten until the gasket contacts the base. Tighten the filter an additional one turn.
5. Rotate the knob on the air line shut-off valve to the vertical (on) position.

CMCAC

The Chassis-Mounted Charge Air Cooling (CMCAC) system requires the following maintenance procedures at the recommended intervals.

NOTE

CX model chassis use an "inverse cooling package" where the radiator is mounted in front of the charge air cooler. Preventive maintenance procedures for this system, such as keeping the frontal area clean, tightening hose clamps and checking core fins and tank-to-core joints, are basically the same as they are for all other chassis.

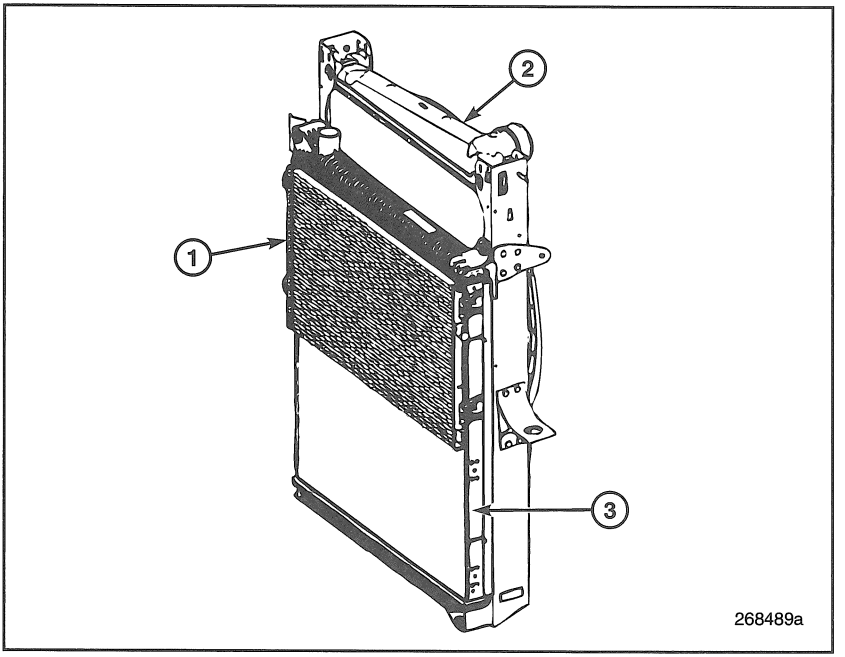


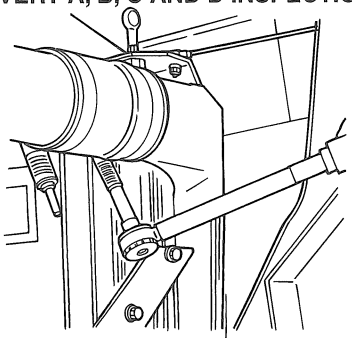
Figure 32 — Inverse Cooling Package — CX Model

1. Air Conditioner Condenser 2. Charge Air Cooler	3. Radiator

Daily Maintenance

Using a firm bristle brush and soapy water, remove all bugs, leaves and other debris from the frontal area.

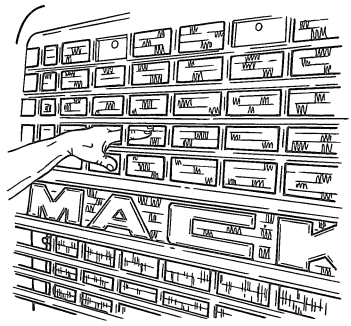
EVERY A, B, C AND D INSPECTION



TORQUING HOSE CLAMPS

CHECK ALL AIR DUCTS AND GASKET CONNECTIONS. TORQUE HOSE CLAMPS TO 45–55 LB-IN (5.1–6.2 N•m) ON ALL MODELS EXCEPT CX AND CH, 70–80 LB-IN (7.9–9 N•m) FOR CX AND CH MODELS.

EVERY C AND D INSPECTION



CHECKING CORE FINS

CHECK CORE FINS FOR EXTERNAL DAMAGE, DEBRIS, OR SALT CORROSION. USE A FIRM BRISTLE BRUSH TO REMOVE CORROSION AND COMPRESSED AIR TO CLEAN DEBRIS FROM THE CORE.

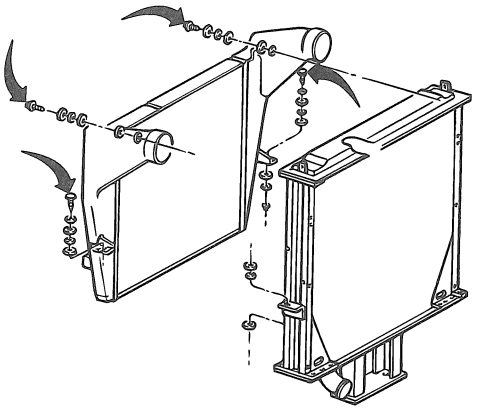
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Figure 33 — Charge Air Cooler Maintenance

NOTE

Clean any debris that may accumulate between the radiator core, charge air cooler core and the air conditioner condenser core.

EVERY C AND D INSPECTION



CHECK WELDS JOINING SIDE TANKS TO CORE FOR CRACKS AND MOUNTING BRACKETS FOR SECURITY AND CONDITION. TORQUE THE MOUNTS TO 30 LB-FT (41 N•m).

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Figure 34 — Charge Air Cooler Maintenance

NOTE

On CX models, checking torque of the radiator-to-charge air cooler mounting bolts is not necessary.

FUEL SYSTEM

NOTE

General field practice is to prime the fuel filters before installation. This practice can allow dirt to enter the outlet port of the filter if caution is not used. Use filtered fuel only when priming the filter. Prime through the series of small holes on the top of the filter. DO NOT prime the filter through the center hold.

Fuel Filters — ASET™ AC and Certain AI/AMI Engines

The standard MACK fuel system used on ASET™ AC and AI/AMI engines (having the AC-style water pump) includes a spin-on secondary fuel filter integral with the fuel supply pump and a remote-mounted spin-on primary fuel filter.

NOTE

There are optional fuel filter systems (such as Davco, Conmet®, etc.), available for ASET™ AC engines. These fuel filter systems use a single remote-mounted filter, eliminating the spin-on primary and secondary filters. For service information concerning these filters, refer to the specific fuel filter manufacturer's service literature.

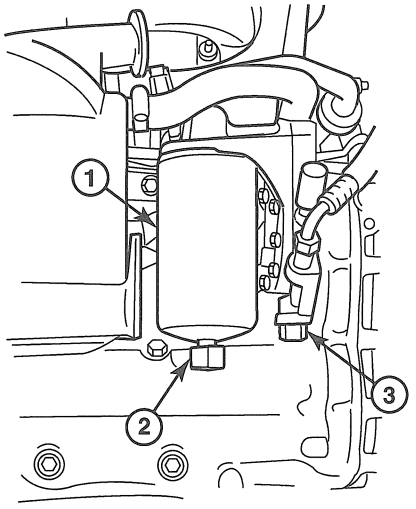


Figure 35 — Secondary Fuel Filter Integral with Fuel Supply Pump

1. Spin-On Secondary Filter 2. Filter Drain (Optional)	3. Plug with O-Ring

After installing the filter, ensure that the drain plug is tight (19 lb-in [2 N•m]).

Fuel Filters — Certain ASET™ AI and AMI Engines

ASET™ AI and AMI engines used in DM models and CV models with engines 300 horsepower and less include two (primary and secondary) fuel filters. The primary filter is red and the secondary filter is green. They are NOT interchangeable.

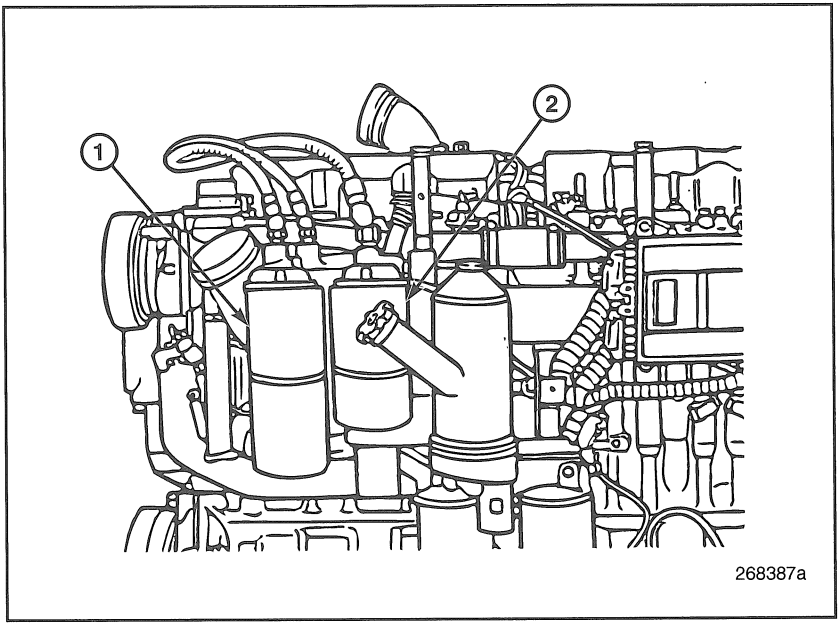


Figure 36 — Primary and Secondary Fuel Filters

1. Secondary Filter	2. Primary Filter

At each specified oil and filter change interval, change the primary and secondary fuel filters as follows:

NOTE

Because of ice buildup in the fuel system or fuel waxing which can clog fuel filters, it may be necessary to reduce the time or mileage interval between fuel filter changes during extremely cold weather.

To install a new filter:

1. Thoroughly wash the area around the fuel filter and mounting adaptor mating area with a suitable solvent and blow dry with compressed air.
2. Using tool J 24783, remove the old filters.
3. Apply a thin film of clean engine oil to the sealing gasket of the new filters.
4. Prime the filter by pouring clean filtered fuel through the series of small holes at the top of the filter. DO NOT prime the filter through the center hole. Use care to avoid dirt entering the center hold of the filter.

5. Install the **new** filters and tighten an additional 3/4 to 1 turn by hand after the gasket contacts the base.

NOTE

Fuel filters used on ASET™ engines have metric threaded spuds. Attempting to install standard E7 fuel filters having English threads on an ASET™ engine will result in the following:

Primary Filter — The diameters of the filter threads and the threaded spud are close in size. Although the filter can be started on the spud threads using force, the threads will be damaged.

Secondary Filter — The diameter of the filter threads is smaller than the diameter of the threaded spud. Consequently, the filter cannot be installed.

Attempting to install the ASET™ filters on an E7 engine having English threaded spuds would not result in damage to the threads as the diameters of the filter threads are large enough to prevent installation of the filters.

⚠ CAUTION

If priming the fuel system becomes necessary, the only acceptable method is to use the hand primer pump located at the front right-hand side of the engine. DO NOT attempt to prime the fuel system by applying air pressure to the fuel tank or by using an auxiliary pump, as these methods may result in severe engine damage caused by fuel that leaked past the supply pump seal into the crankcase.

6. Start the engine and check for leaks.

Fuel/Water Separator

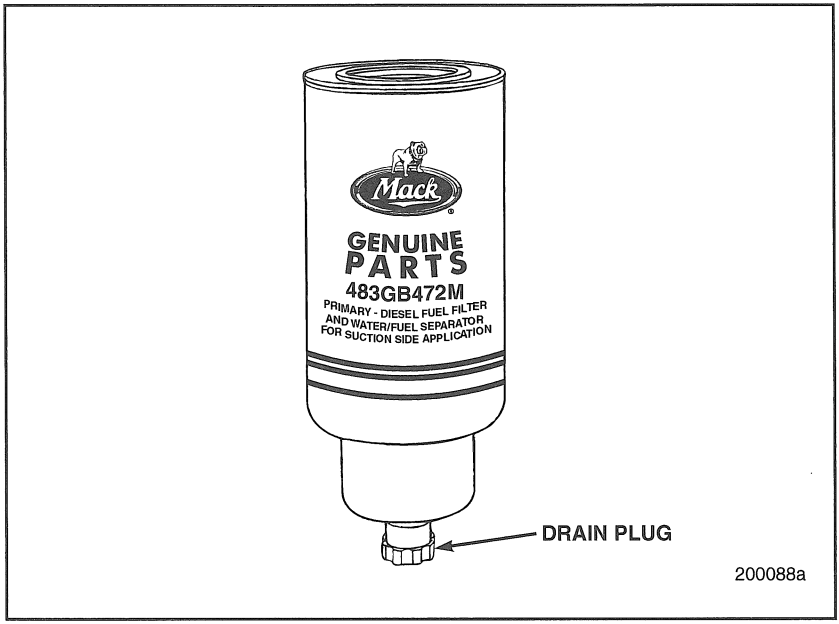


Figure 37 — Fuel/Water Separator

Water in the fuel system can result in fuel system freeze-ups (in cold weather), decreased fuel lubrication qualities which can result in accelerated wear of fuel system components, rust corrosion of fuel components, bacterial growth and sludge formation which can reduce power and shorten the life of the fuel filters.

NOTE

Water-in-fuel is most critical on Electronic Unit Pump (EUP) engines due to the very close-tolerance fuel control valve inside the unit pump. Water in the fuel will cause rust corrosion, resulting in an EUP malfunction which can only be corrected by replacing the pump(s). Rust corrosion may also cause pitting of the nozzle springs which can result in spring breakage.

The MACK fuel/water separator removes water from the fuel system. Small droplets of water in the fuel collect on the filter screen inside the separator. As the droplets accumulate, they drop to the bottom of the separator.

To remove the accumulated water from the separator, loosen the drain plug. Allow the water to drain from the fuel/water separator. When fuel begins to drain from the separator, tighten the drain plug.

NOTE

DO NOT drain the separator while the engine is running.

The fuel/water separator should be drained daily.

The separator element should be replaced at each oil and filter change interval.

Fuel Injector Nozzle Maintenance

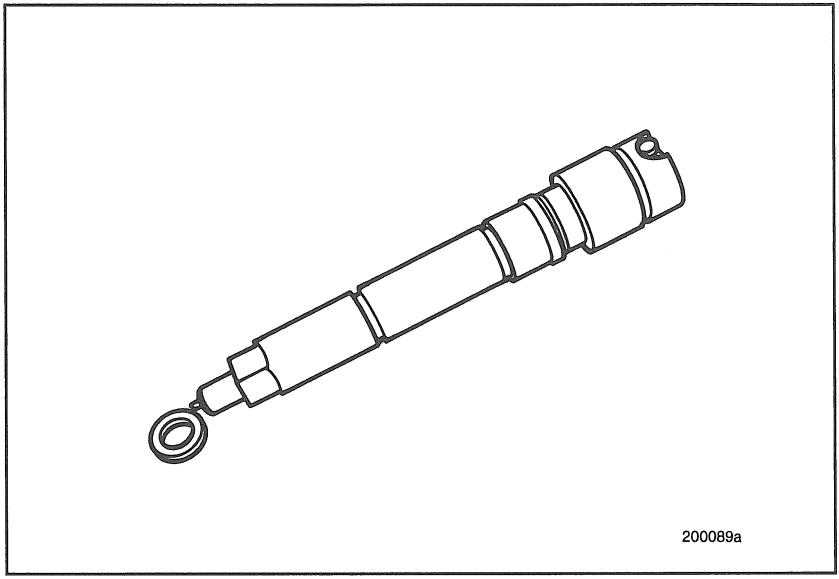


Figure 38 — Fuel Injector Nozzle

At each 150,000 miles/240 000 km or 4500-hour interval (whichever occurs first), remove the injectors from the engine and test the spray pattern and opening pressures. Clean, adjust, repair or replace as required. When cleaning the nozzles, use only an approved method such as the brass brush or ultra-sonic methods as described in the engine tune-up manual. Other types of cleaning methods, such as using a steel wire wheel, will result in damage to the nozzles. Clean out the nozzle holes in the cylinder head, and always use new gaskets and O-rings when reinstalling the injectors.

CRANKCASE BREATHER FILTER

On ASET™ AC engines, the crankcase breather is located on the timing cover, and on ASET™ AI and AMI engines, the breather may be located either on the timing cover or the front valve cover. The breather contains a removable filter element that must be cleaned at each D inspection interval. Regardless of breather location, procedures for cleaning the filter element are the same.

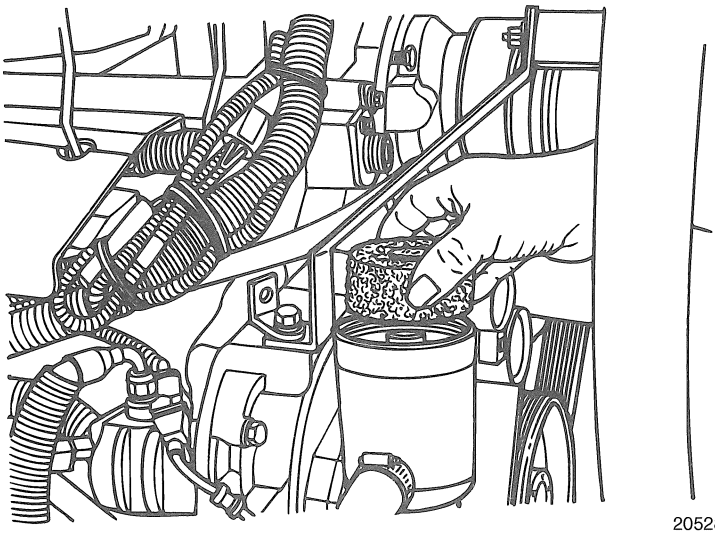


Figure 39 — Crankcase Breather

Clean the filter element as follows:

1. Remove the cover from the top of the canister.
2. Place a thin-blade screwdriver between the outside diameter of the element and the inside wall of the canister.
3. Slide the screwdriver around the inside wall of the canister to break the element free, while exerting upward pressure to remove the element.
4. Wash the filter element in a suitable solvent and blow dry with clean compressed air.
5. Wipe the inside of the canister with a clean cloth.
6. Reinstall the filter element into the canister.
7. Install the canister cover and tighten.

ELECTRICAL SYSTEM

Batteries

A maintenance-free battery does not require the addition of water for its normal expected life. Typical features include heavy-duty construction and a wrought lead-calcium grid to resist vibration, shock, overcharge, heat and thermal runaway. Nevertheless, these batteries are vulnerable to the ravages of cold weather operation if totally ignored.

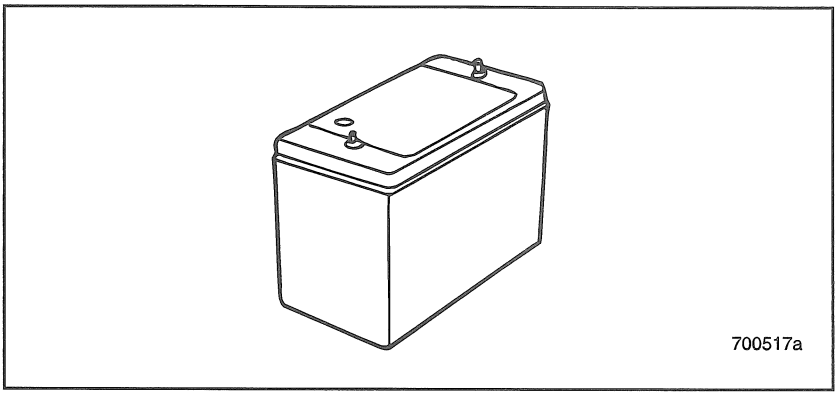


Figure 40 — Battery

Be sure that the batteries used in a particular vehicle are rated for the specified Cold Cranking Amperes (CCAs) necessary to ensure reliable cold weather starts. This is important, since even well-maintained batteries chilled to 0°F (–18°C) may temporarily be capable of providing only 40% of their rated capacity at 80°F (27°C).

Keep the terminals clean to prevent formation of power-robbing corrosion.

In winter, to avoid freezing the electrolyte, the battery must be fully charged. A fully discharged battery will freeze solid at 23°F (–5°C) and possibly sustain permanent damage.

Before the onset of cold weather, be sure to protect this vital component by monitoring its condition as well as inspecting the charging and starting systems.

Battery Warmer

A battery warmer can be added to raise the temperature of the battery core and facilitate quick starting in cold weather.

Battery Condition

The first procedure when testing a battery is to check for external damage such as a cracked case, loose or corroded terminals, or signs of excessive gassing or overcharging.

A battery must be fully charged before a load test is performed. Test the battery with a hydrometer to determine the level of charge.

On maintenance-free batteries equipped with a built-in hydrometer (eye), the battery condition is interpreted as follows:

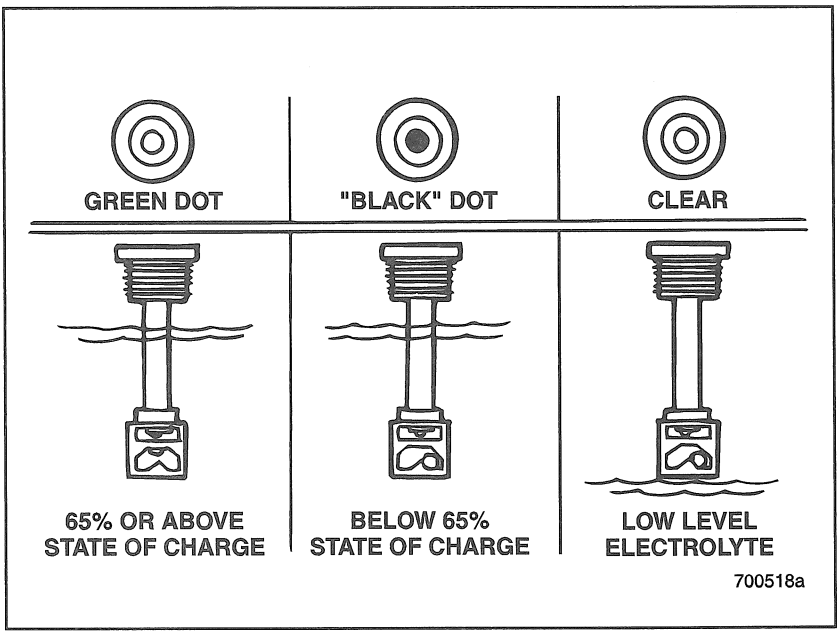


Figure 41 — Battery Condition

- **Green dot visible** — Any green appearance should be interpreted as a green dot and means that the battery is at or above a 65% state of charge and is ready for use or testing. This does *not* automatically mean that the battery is in good condition.
- **Dark — green dot not visible (black dot)** — This indicates that the battery is below a 65% state of charge and must be charged before testing. A black dot does *not* mean that the battery is automatically bad.
- **Clear or light yellow** — This means that the electrolyte level is below the level of the built-in hydrometer, which may have been caused by tipping of the battery, a cracked case, or overcharging. This battery should be replaced.

Charging

Charging should be conducted carefully under controlled conditions. Never charge a frozen battery. If a frozen battery is suspected, thaw it in a warm area for several hours before charging.

The following chart shows the normal charging times necessary to reach a full charge at 80°F (26°C). In colder temperatures, the necessary charging time may increase.

Open Circuit Voltage	Battery Specific Gravity*	State of Charge	Charging Time to Full Charge at 80°F**					
			at 60 amps	at 50 amps	at 40 amps	at 30 amps	at 20 amps	at 10 amps
12.6	1.265	100%	Full Charge					
12.4	1.225	75%	15 min.	20 min.	27 min.	35 min.	48 min.	90 min.
12.2	1.190	50%	35 min.	45 min.	55 min.	75 min.	95 min.	180 min.
12.0	1.155	25%	50 min.	65 min.	85 min.	115 min.	145 min.	280 min.
11.8	1.120	0%	65 min.	85 min.	110 min.	150 min.	195 min.	370 min.

* Correct for temperature.

** If colder, it will take longer.

COMPLETELY DISCHARGED BATTERIES

Extremely cold or completely discharged batteries may not initially show a charge since the electrolyte is nearly pure water and, therefore, a poor conductor. As the acid level in the electrolyte increases during charging, the charging current will also increase. Use the following procedure when charging a completely discharged battery:

1. Measure the voltage at the battery terminals. If it is below 10 volts, current will be very low and may not show up on many battery charger ammeters.
2. Set the charger on the high setting.
3. Some chargers have a polarity protection feature which prevents accidental reversal of the charger leads. A completely discharged battery will not have enough voltage to override this feature, making it appear that the battery will not accept a charge. Check the charger manufacturer's instructions on how to bypass this feature.
4. Once the battery starts to accept a charge, the charging rate will rise very rapidly. Carefully monitor the ammeter to prevent too-high a charging rate.
5. Proceed to charge battery at one-tenth of its rated capacity for one-half hour.

   Example: For battery rated at 64 amps, charge at 6.4 amp setting (64A $\times$ 1/10 = 6.4A) for one-half hour.

NOTE

Batteries with very low voltage (below 11.6 volts) or those that do not initially accept a charge are not necessarily defective. Batteries that have been discharged for long periods of time may be heavily sulfated or hydrated (containing lead shorts that cause the battery to self-discharge). To accept a charge, batteries with either of these conditions may require a longer charging time or a very high initial charge.

Use the following chart to determine the time required for the battery to begin accepting a measurable charge. (If the battery has not started to accept a charge after the specified time, it should be replaced.)

Charger Voltage	Hours
16.0 or more	Up to 4
14.0 to 15.9	Up to 8
13.9 or less	Up to 16

Load Test

A battery must be fully charged before performing a load test. To load-test a battery that is fully charged, proceed as follows:

1. Connect a load tester and voltmeter across the battery terminals.
2. Apply a load so that a figure of 300 amps is obtained for 15 seconds to remove the battery surface charge.
3. Wait 60 seconds to let the battery recover and then apply the proper test load to the battery to determine its condition. To get the proper load, use half the cranking performance rating. Read the voltage after 15 seconds. Remember that the minimum voltage varies according to temperature. Consult the following chart for the proper specification. If the battery voltage does not fall below the minimum test voltage after 15 seconds, the battery is acceptable for use.

Load Test Temperature Correction		
Minimum Voltage	Temperature	
	°F	°C
9.6	70	21
9.5	60	16
9.4	50	10
9.3	40	4
9.1	30	–1
8.9	20	–7
8.7	10	–12
8.5	0	–18

LUBRICATION

Gear Oil Change Interval

All Highway Chassis	
Miles (Kilometers)*	Time*
250,000 miles (402 000 km)	2 years

*Whichever occurs first.

NOTE

An extended drain interval of 500,000 miles/ 804 600 km or three years, whichever occurs first, is permissible for MACK-geared components used in highway chassis provided MACK specification GO-J PLUS gear lubricant is used. Otherwise, gear lubricant must be changed at the two-year, 250,000-mile/ 402 300 km interval, whichever occurs first.

All Vocational Chassis	
Miles (Kilometers)*	Time*
40,000 miles (64 000 km)	1 year/1200 hours

*Whichever occurs first.

NOTE

An extended drain interval of 80,000 miles/ 128 800 km, one year or 1,200 hours, whichever occurs first, is permissible for MACK-geared components used in vocational chassis provided that MACK specification GO-J PLUS gear lubricant is used. Otherwise, gear lubricant must be changed at the one-year, 1200-hour or 40,000-mile/64 000 km interval, whichever occurs first.

NOTE

An SAE 50 grade synthetic transmission oil, TO-A PLUS, is available for use in MACK transmissions as an extended drain interval lubricant. TO-A PLUS is for use in transmissions only, and not to be used in any other geared components. Drain intervals for TO-A PLUS transmission lubricant are 500,000 miles/ 804 600 km or three years (whichever occurs first) for highway applications, and 80,000 miles/128 800 km, one year or 1,200 hours (whichever occurs first) for vocational applications.

Driveshaft Lubrication

The following information pertains to lubrication intervals for Spicer Life™ SPL-170, SPL-250, SPL-170XL and SPL-250XL driveshafts and ArvinMeritor™ RPL20 and RPL25 Permalube™ series and 92N Permalube™ wing-style driveshafts. For all other driveshafts, use the regular chassis lubrication intervals as outlined.

SPICER LIFE™ SPL-170 AND SPL-250 DRIVESHAFT — U-JOINT LUBRICATION

Spicer Life™ SPL-170 and SPL-250 driveshaft U-joints must be lubricated at the following intervals:

- Highway Chassis: Every 100,000 miles (161 000 km) or 6 months*
- Vocational Chassis:
  - — Severe Service: every 600 hours, 20,000 miles (32 000 km) or 180 days*
  - — Extra Severe Service: every 375 hours, 12,000 miles (19 000 km) or 90 days*

* Whichever occurs first.

NOTE

Slip-joints used with the SPL-170 and SPL-250 series driveshafts are "lubed for life" and protected by a bellows. Lubrication of these slip-joints is not required and the bellows must not be disturbed.

SPICER LIFE™ SPL-170XL AND SPL-250XL DRIVESHAFT — U-JOINT LUBRICATION

Spicer Life™ XL series driveshafts are equipped with "extended-lubrication" U-joints. These U-joints are easily identified by the blue plastic cover in the center of the U-joint cross where the grease fitting is usually located. The XL U-joints must be lubricated initially at the following intervals:

- Highway Chassis: 350,000 miles (560 000 km) or 3 years*
- Vocational Chassis (includes city driving and on/off highway): 100,000 miles (161 000 km) or 1 year*

* Whichever occurs first.

After the initial lubrication outlined above, Spicer Life™ XL series driveshafts must be lubricated at the following intervals:

- Highway Chassis: 100,000 miles (161 000 km) or 6 months*
- Vocational Chassis:
  - — Severe Service: 600 hours, 20,000 miles (32 000 km) or 180 days*
  - — Extra Severe Service: 375 hours, 12,000 miles (19 000 km) or 90 days*

* Whichever occurs first.

NOTE

Slip-joints used with the SPL-170XL and SPL-250XL series driveshafts are "lubed for life" and protected by a bellows. Lubrication of these slip-joints is not required and the bellows must not be disturbed.

ARVINMERITOR™ RPL20 AND RPL25 PERMALUBE™ SERIES DRIVESHAFTS

The U-joints and slip-joints on the RPL20 and RPL25 series driveshafts are permanently lubricated and sealed. Lubrication at regular intervals is not required during the life of the driveshaft.

ARVINMERITOR™ 92N PERMALUBE™ WING-STYLE DRIVESHAFTS

The U-joints used on the 92N Permalube™ wing-style driveshafts are permanently lubricated and sealed. Lubrication at regular intervals is not required for the life of the driveshaft. The slip-joints, however, must be lubricated at each specified chassis lubrication interval.

Clutch Release Bearing Lubrication

The clutch release bearing must be lubricated at each chassis lubrication interval as follows:

- Highway Chassis: 25,000 miles (40 000 km)
- Vocational Chassis — Severe Service: Every 300 hours, 10,000 miles (16 000 km) or 90 days, whichever occurs first
- Vocational Chassis — Extra Severe Service: Every 250 hours, 8,000 miles (13 000 km) or 60 days, whichever occurs first

To ensure proper lubrication:

- Check that the lube tube assembly (if equipped) is intact.
- Apply grease to fitting until grease can be seen coming from the back of the release bearing.
- It is recommended that grease be purged from the release bearing during lubrication of the bearing.
- Apply grease to the release bearing yoke shaft, one fitting on each side of the transmission.

Recommended lubricant is NLGI No. 2EP grease.

RELEASE BEARING PADS:

Apply a small amount of recommended grease between the release bearing pads and the clutch release fork when lubricating the clutch release bearing.

RELEASE BEARING LUBE TUBE (IF EQUIPPED):

Lube tubes should be pre-lubed before installation. This is to remove air from the lube tube system to ensure lubricant is delivered to the release bearing during initial installation.

NOTE

Your new MACK truck has been prepared for delivery by your MACK Service Center. After delivery, oil change, filter change, and chassis lubrication intervals become your sole responsibility.

It is important that components be filled with lubricants meeting the specifications as given in "LUBRICANT SPECIFICATIONS" on page 333.

When checking oil levels, the vehicle must be parked on level ground and the units at normal operating temperature. Components must be filled to the correct level. DO NOT OVERFILL.

The oil and filter change intervals outlined in this manual pertain to MACK components. For information concerning oil and oil filter change intervals for vendor components, refer to the specific vendor component service literature.



Figure 42 — Bulldog Lubricants

Oil and Filter Change — ASET™ AI, AMI and AC Engines

Run the engine until normal operating temperature is reached, then shut off and drain the oil before the engine cools.

Thoroughly clean the area around the filters before removing.

Using tool J 24783, remove both spin-on filters.

Prefill each new oil filter with 2 quarts (1.9 liters) of the recommended engine oil. DO NOT allow any contaminants to enter the filters while prefilling.

Apply a thin film of engine oil to the sealing gasket of the new filters.

Install the filters and tighten an additional 3/4 to 1 turn after the gasket contacts the base.

CENTRI-MAX® ULTRA PLUS OIL FILTER

Effective June 4, 2003 for ASET™ AI and AMI engines (beginning with engine serial No. 3M0067), and August 19, 2003 for ASET™ AC engines (beginning with engine serial No. 3O0079), the Centri-Max® ULTRA PLUS centrifugal oil filter was implemented into production. The top and bottom bushings of the Centri-Max® ULTRA PLUS rotor have a smaller inside diameter which provides a significant increase in rotor speed and oil filtration efficiency.

⚠ CAUTION

The previous Centri-Max® ULTRA rotor must not be used with the new Centri-Max® ULTRA PLUS centrifugal oil filter. If the incorrect rotor is used, the rotor will be very loose on the smaller diameter shaft and the rotor will not rotate.

For identification purposes, the Centri-Max® ULTRA PLUS rotor (part No. 236GB42M) is made of black plastic, whereas the previous Centri-Max® ULTRA rotor (part No. 236GB41M) is cream colored.

Change the centrifugal oil filter (Centri-Max® ULTRA PLUS and ULTRA) as follows:

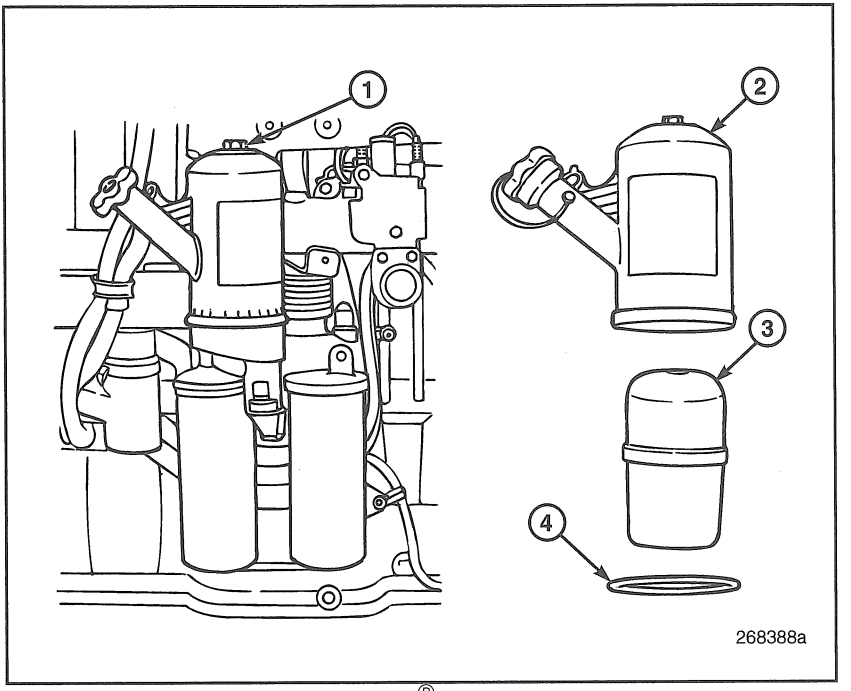


Figure 43 — Centri-Max® ULTRA PLUS Oil Filter

1. To prevent contamination from entering the engine, thoroughly clean the area around the centrifugal oil filter before removing the cover assembly.
2. Loosen the nut (1) at the top of the cover assembly (2), then remove the cover.
3. Remove and discard the rotor (3).
4. Clean the inside of the cover assembly (2).
5. Remove and discard the O-ring (4) from the filter mounting adapter.
6. Install the O-ring on the filter mounting adapter.

7. Install a **new** rotor.
8. Install the cover assembly and tighten the nut to 19 lb-ft (26 N•m).

CENTRI-MAX® PLUS OIL FILTER

Change the Centri-Max® PLUS oil filter as follows:

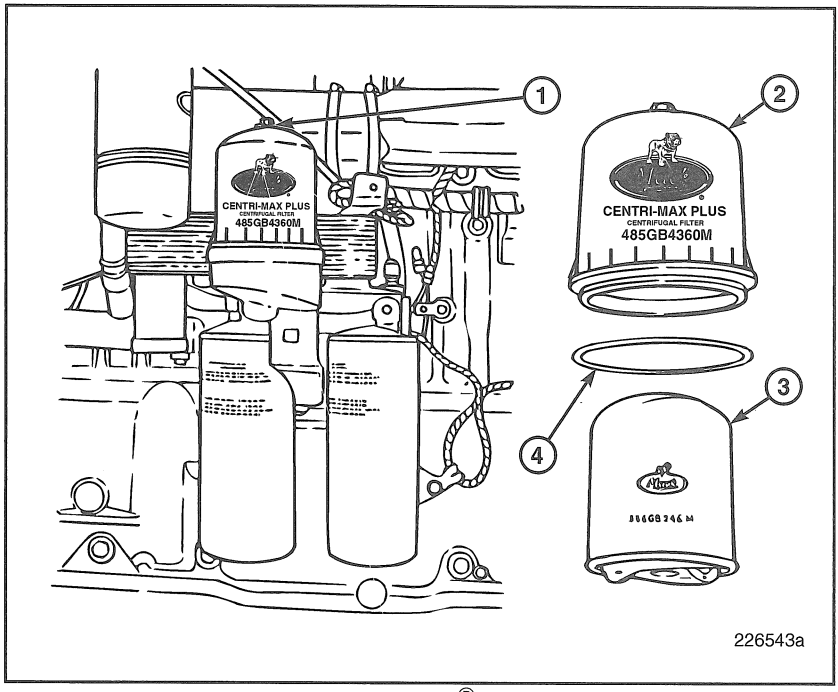


Figure 44 — Centri-Max® PLUS Oil Filter

1. To prevent contamination from entering the engine, thoroughly clean the area around the centrifugal oil filter before removing the cover assembly.
2. Loosen the nut (1) at the top of the cover assembly (2), then remove the cover.
3. Remove and discard the rotor (3).
4. Clean the inside of the cover assembly (2).

5. Install a **new** rotor (3) over the spindle.

⚠ CAUTION

Use only the rotor designed for use with the Centri-Max® PLUS centrifugal filter assembly. Any other rotor will not work.

6. Remove and discard the seal from the cover assembly.
7. Install a **new** seal (4).
8. Apply a thin film of clean engine oil to the seal.
9. Install the cover assembly (2).
10. Tighten the cover assembly nut (1) to 22 lb-ft (30 N•m).

NOTE

For replacement Centri-Max® PLUS cover assemblies supplied through the MACK Parts System, the following torque values for the cover nut apply when installing the new assembly:

- Cover assembly part No. 765GB415M — tighten the cover nut to 15 lb-ft (20 N•m) at installation.
- Cover assembly part No. 765GB415AM — tighten the cover nut to 22 lb-ft (30 N•m) at installation.

At each subsequent oil change, tighten the cover nut to 20–24 lb-ft (27–33 N•m) regardless of the cover assembly part number.

Fill the crankcase with the recommended engine oil. (See "LUBRICANTS AND CAPACITIES" on page 354.) If equipped with a REPTO unit, add one additional quart.

Start the engine and check for leaks. Run the engine for approximately five minutes, then shut it off and recheck the oil level. (Allow the vehicle to sit on level ground for 15 minutes before rechecking.) Add oil if necessary.

OIL LEVEL CHECK

When checking oil levels, the vehicle must be parked on level ground and the units at normal operating temperature. Components must be filled to the correct level. DO NOT OVERFILL.

Oil level must be between the add and full lines on the dipstick as shown in Figure 43.

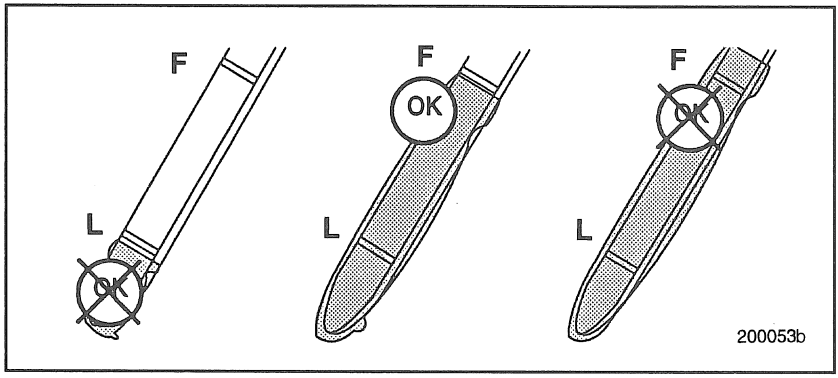


Figure 45 — Dipstick Oil Level Check

Dipstick and oil fill locations are shown in the illustrations below. On conventional cabs, the oil fill tube and dipstick are located on the left-hand side of the engine.

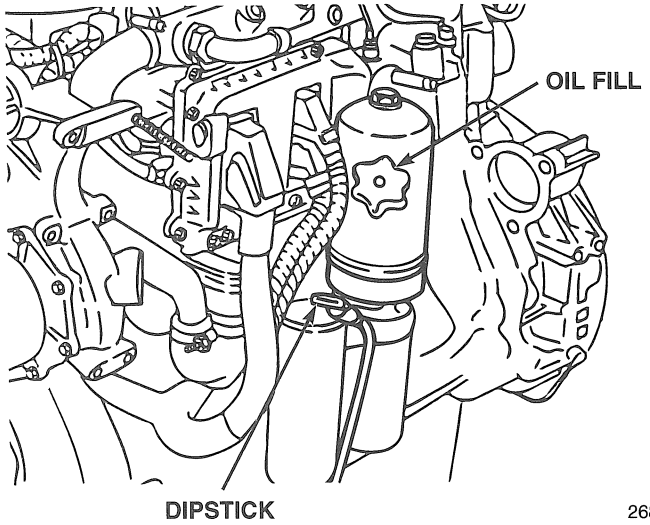


Figure 46 — Conventional Cabs Oil Fill and Dipstick Location (ASET™ AC Engine Shown)

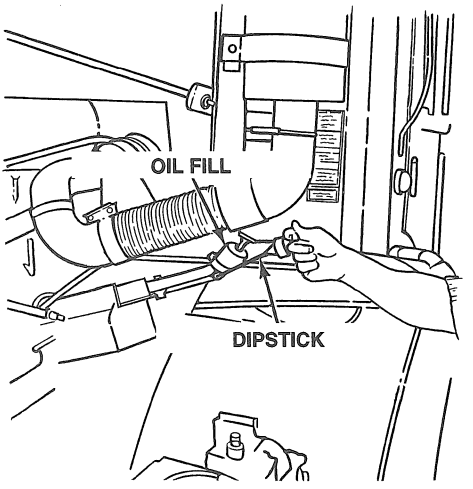


Figure 47 — Cab Forward Chassis Oil Fill and Dipstick Location

NOTE

The Centri-Max® ULTRA and ULTRA PLUS centrifugal oil filters have an oil fill tube integral with the oil filter cover. On MR and LE model chassis, oil can be added to the engine through this fill tube while the cab is tilted. When the cab is lowered, oil is added through the fill tube located at the back of the cab on the right-hand side of the chassis. Refer to the figure on the preceding page for an illustration of the Centri-Max® ULTRA oil filter.

Power Steering Oil Change

Change the power steering fluid and filter once per year (D inspection interval) for vehicles operating in line haul operations, and twice per year (C and D inspection intervals) for chassis operating in short haul operations. Use the same type and grade engine oil as being used in the engine. Refer to "LUBRICANTS AND CAPACITIES" on page 354.

⚠ CAUTION

To avoid dirt from entering the steering system after the lines have been disconnected, clean around all fittings and both hose connections at the power steering gear. Also clean around the reservoir cover.

Run the vehicle until the engine reaches normal operating temperature, then shut off the engine.

Disconnect the pressure and return lines at the steering gear and allow the power steering reservoir and hoses to drain into a suitable container.

Jack up the front end of the vehicle so the wheels can be steered manually. Steer several times from left to right steering stops to pump the remaining fluid out of the system.

Replace the steering system filter element. Before reinstalling the element, clean the inside of the reservoir with a clean cloth. Reconnect the pressure and return lines, then refill the reservoir with the recommended oil.

STEERING GEAR BLEED PROCEDURES — TRW 92 SERIES STEERING GEARS

For chassis equipped with TRW 92 series steering gears (i.e., 392, 492, etc.), bleed air from the steering system by lowering the chassis to the ground, starting the engine and steering the wheels several times from left to right steering stops.

⚠ CAUTION

Make sure the reservoir does not run dry during the purging operation as air may be drawn into the system.

STEERING GEAR BLEED PROCEDURES — SHEPPARD M90 AND M100 STEERING GEARS

For chassis equipped with Sheppard M90 or M100 steering gears, bleed air from the system as follows:

NOTE

Beginning approximately August 2002, an auto-bleed feature was incorporated into Sheppard M90 and M100 steering gears. To bleed the air from these steering gears, it is only necessary to start the engine and fully steer the wheels several times from the left to right steering stops. For Sheppard steering gears without the auto-bleed feature, it is VERY IMPORTANT that the steering gear be bled as described in the following procedures. Manual-bleed M90 and M100 steering gears are identified by the bleeder screw located in the steering gear housing, above the pitman arm shaft. Steering gears with the auto-bleed feature will not have a bleeder screw, and can also be identified by the word “Auto” cast into the housing.

1. With the wheels on the ground, start the engine and turn the steering wheel to a full left turn.
2. Locate the bleeder screw in the steering gear. The bleeder screw is located in the steering gear housing, above the pitman arm shaft.

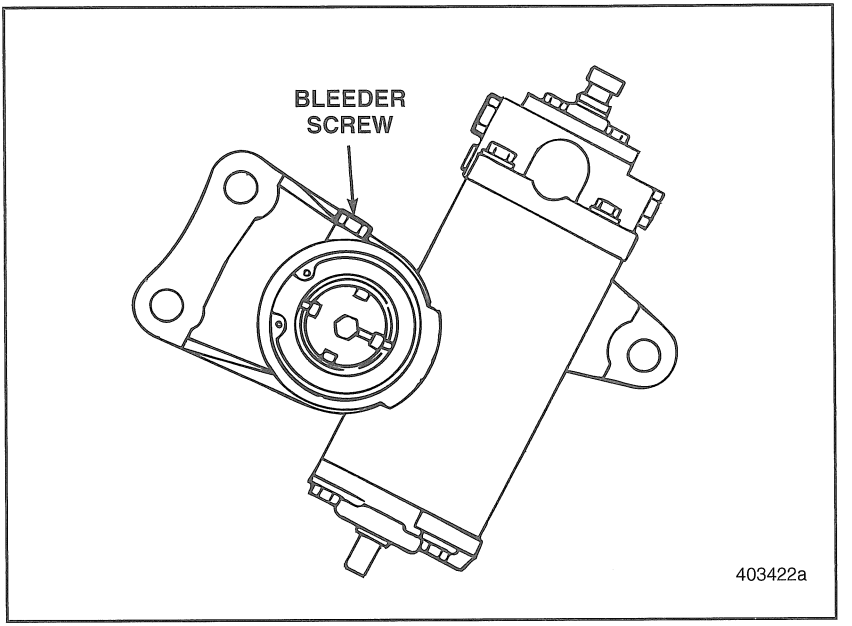


Figure 48 — Sheppard M90 Steering Gear Bleeder Screw Location

3. Using a 1/8″ Allen wrench, open the bleeder screw 2–3 turns.
4. Turn the steering wheel to a full right turn.
5. Close the bleeder screw when the wheels are turned fully to the right.

NOTE

Turning the wheels to a full right turn with the bleeder screw open forces air under pressure from the system. DO NOT steer the wheels to the left with the bleeder screw open as this will draw air back into the system.

6. Repeat the above procedures 2–3 times until a smooth stream of oil flows from the bleeder screw. A smooth stream of oil indicates that all the air has been purged from the system.

⚠ CAUTION

Make sure the reservoir does not run dry during the purging operation as air may be drawn into the system.

Geared Components

Add oil or drain and refill while units are hot. Fill to level of filler plug hole. **DO NOT** overfill. See "LUBRICANT SPECIFICATIONS" on page 333.

When the oil level in any geared unit (transmission, carrier, etc.) is checked, oil must either be seen or felt to be level with the filler plug hole. If oil can only be felt by reaching the finger down into the unit, the oil level is insufficient.

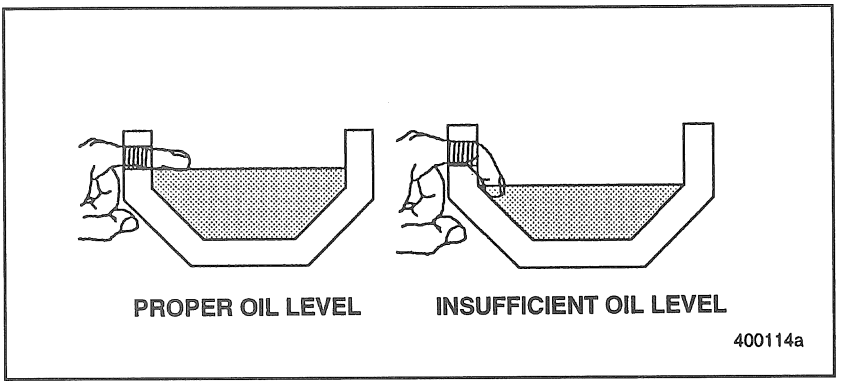


Figure 49 — Oil Level Check

⚠ WARNING

Take care not to burn hands when checking oil level on hot geared units.

Transmissions

Remove and clean the magnetic drain plug and the magnetic oil filter plug (if equipped). Also clean the trough located inside the area from where the magnetic filter plug was removed. After the oil has drained, reinstall the plugs. Remove the fill plug and fill the transmission with enough of the recommended lubricant (see "LUBRICANT SPECIFICATIONS" on page 333) to bring the level to the bottom of the filler plug hole. Reinstall the filler plug.

Remove the breather(s). Clean with a suitable, nonflammable solvent; check for obstructions, and reinstall.

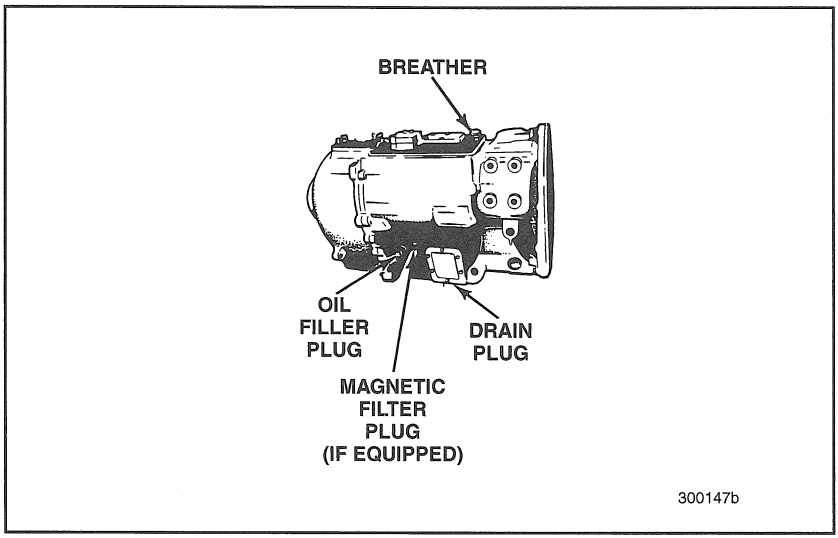


Figure 50 — Fill Plug, Drain Plug, Magnetic Filter Plug and Breather Locations

Do not overtighten the fill plug. Tighten the fill plug as follows:

- Tapered pipe plug finger-tighten first, then tighten an additional 3/4 to 1 turn (not to exceed 55 lb-ft [75 N•m]) with a wrench.
- O-ring boss-style plug tighten to 35–50 lb-ft (48–68 N•m).

Range Shift Valve Filter (Range Shifted Transmissions)

At each C and D inspection interval, remove and clean or replace the range shift valve filter as follows:

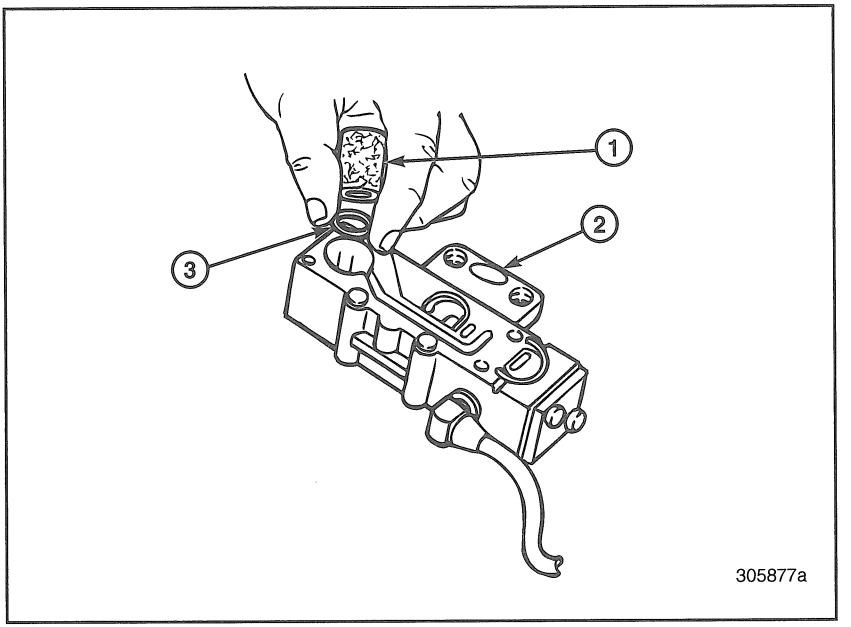


Figure 51 — Range Shift Valve Cover Spring and Filter

1. Filter 2. Valve Housing	3. Filter O-Ring

1. Remove the four top cover screws from the valve.
2. Separate the cover from the valve housing.
3. Remove the filter and filter O-ring.
4. Clean (or replace, if necessary) the filter with a suitable, non-flammable solvent, then dry the filter with clean, dry compressed air.
5. Apply Mobile Grease No. 28 sparingly to the filter O-ring.

NOTE

Do not over-lubricate the O-ring, as this may result in filter restriction. Make sure that the O-ring is only lightly lubricated.

6. Install the O-ring and the filter into the filter bore of the housing. Set the filter on top of the O-ring and make sure the O-ring is properly seated.
7. Apply Mobile Grease No. 28 sparingly to the top cover seal, then install the seal into the groove in the top cover, making sure all portions of the seal are properly located. (If the top cover seal is damaged in any way, it must be replaced.)
8. Install the top cover and the four cover screws. Tighten the screws to 30–40 lb-in (3.4–4.5 N•m).

Eaton® Fuller® Transmissions

Effective with Eaton® Fuller® transmission production beginning in April 1998, a new transmission oil fill plug with an O-ring seal was phased into production. This new plug is used on transmission models RT/RTL/RTLO type 7 and 9 speed models, and also on the FR transmission model series.

This new plug requires a 1/2-inch internal square drive tool rather than the 1-inch external square that was required for oil fill plugs used previously. With the addition of the O-ring seal, thread sealant is no longer required when reinstalling the plug. When the oil fill plug is reinstalled, retorque the new plug to 35–50 lb-ft (47.5–67.8 N•m).

Transfer Case

With the transfer case at operating temperature, remove the magnetic drain plug and drain the oil. Clean and reinstall the plug. Remove the breather, clean with a suitable, nonflammable solvent, check for obstructions, and reinstall. Remove the filler plug and fill the transfer case with enough of the recommended oil to bring the level to the bottom of the filler plug hole. Reinstall the filler plug.

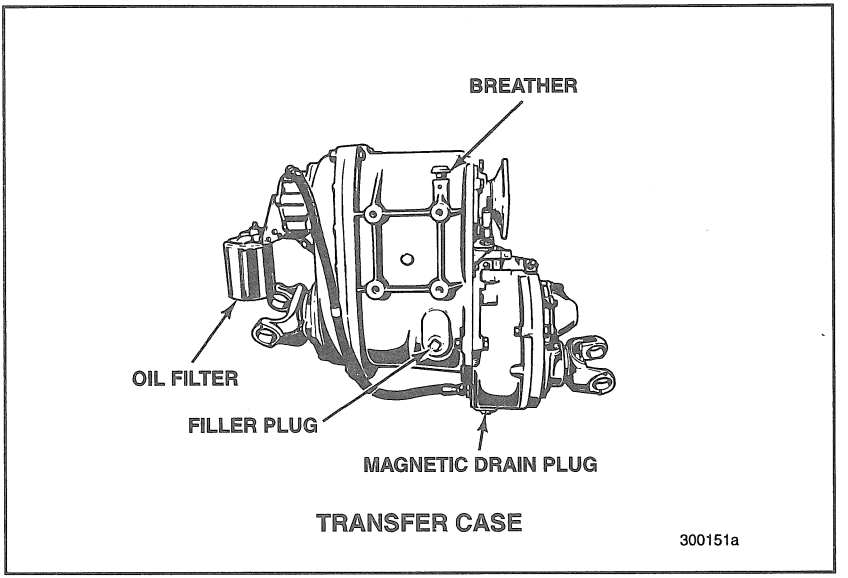


Figure 52 — Transfer Case

NOTE

On transfer cases equipped with an optional PTO, change the oil filter when the oil is changed. The transfer case shown in the illustration above is equipped with an optional PTO. Transfer cases that are not equipped with a PTO do not have an oil filter, and have a shorter hose that runs from the main shaft cover to the countershaft cover.

Rear Engine Power Take-Off (REPTO)

The REPTO unit is lubricated by oil from the engine. Scheduled engine oil changes take care of any periodic service requirements.

When draining engine oil from the engine sump, also remove the REPTO magnetic drain plug which is located as shown in the following illustration. Drain oil into an approved catch container.

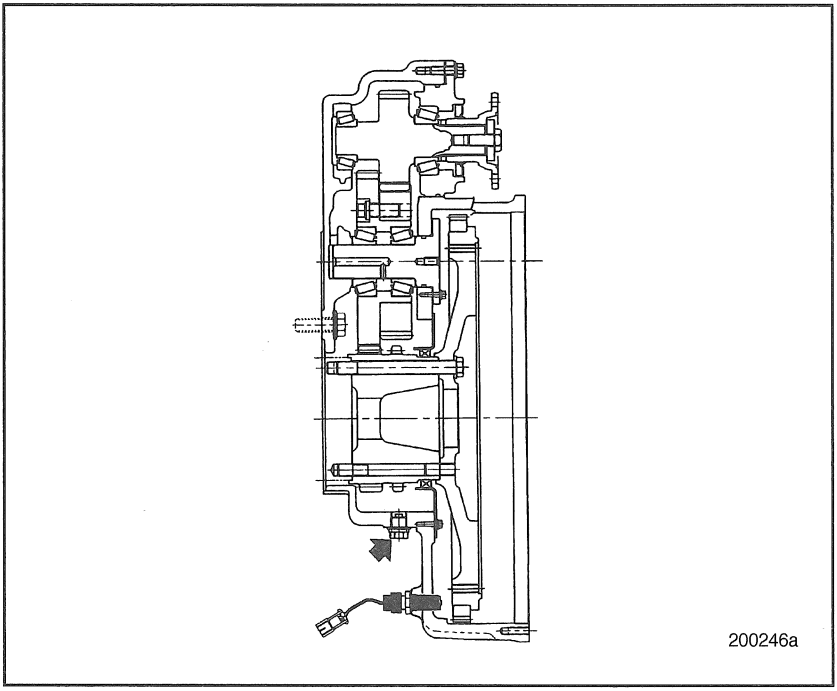


Figure 53 — REPTO Drain Plug Location

Clean and reinstall the magnetic oil drain plugs for the REPTO housing and engine oil pan.

Fill engine sump to the required level with specified fresh engine oil, plus additional oil required for the REPTO unit (approximately one quart).

Transmission, Auxiliary Transmission, Transfer Case Linkages

At each oil change interval, put two drops of engine oil on the movable connections of the linkages for the transmission, auxiliary transmission and transfer case.

Rear Axles

Add oil or drain and refill while axles are hot. Fill to the level of the filler plug hole. **DO NOT** overfill. See "Gear Oils" on page 335.

Rear axles with front-mounted carriers — With the axle at operating temperature, remove the magnetic drain plug and drain the oil from the axle housing. Clean and reinstall the plug. Remove the filler plug and fill the axle housing with enough of the recommended oil to bring the level to the bottom of the filler plug hole. Reinstall the plug.

Rear axles with top-mounted carriers — With the axle(s) at operating temperature, remove the magnetic drain plugs from the interaxle power divider on the front carrier (if so equipped), the carrier bevel gear compartment(s), and the axle housing(s), and allow the oil to drain. Clean and reinstall the plugs. Refer to "Magnetic Strips and Oil Troughs" on page 178 for information concerning the magnetic strips and oil trough cleaning procedures. Remove the filler plug from the interaxle power divider (if equipped) and add one pint (1.5 pints for CRD200 carriers) of the recommended oil. Reinstall the filler plug. Remove the filler plugs from the bevel gear compartment(s) and fill with the recommended oil until level with the bottom of the filler plug hole. Reinstall the filler plug(s). Remove the filler plugs from the axle housing(s) and fill with enough of the recommended oil until level with the bottom of the filler plug hole. Reinstall the filler plug(s). If the axle is equipped with an elbow fitting in the axle housing fill plug hole, the easiest method of filling the housing is by removing the breather fitting from the right-hand side of the carrier and the fill plug from the elbow fitting. Fill the housing through the breather hole until the oil runs out the elbow fitting. Reinstall the fill plug and the breather fitting.

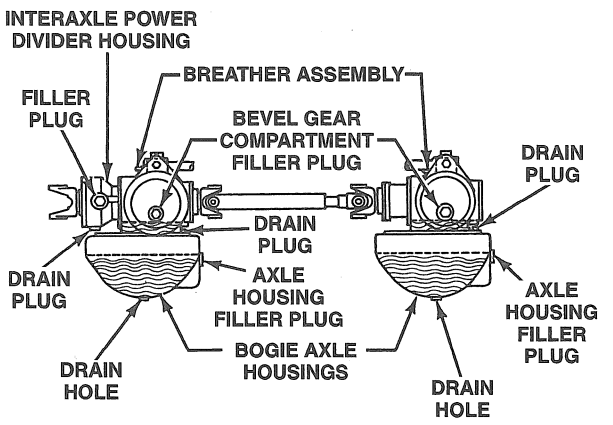


Figure 54 — Filler and Drain Plug Locations

When checking oil level in rear axles having top-mounted carriers, check after the vehicle has been operated, the oil is hot and the chassis is parked on level ground. Check the oil level by removing the fill/level plugs from the axle housings and the bevel gear compartments. The level is correct when oil runs out of the fill plug hole in the axle housing, and slightly below the fill plug hole in the bevel gear compartment. On axle housings with an elbow fitting in the axle housing fill plug hole, oil level must be to the top of the elbow fitting. If the level in the axle housing is low, add oil to the axle housing and the bevel gear compartment until level with the bottom of the fill plug holes. DO NOT add oil if the level in the axle housing is sufficient. Reinstall the plugs.

NOTE

It is not necessary to check oil level in the interaxle power divider. If oil level in the carrier is sufficient, level in the interaxle power divider will also be sufficient.

Interwheel Power Divider

For rear axles equipped with interwheel power dividers, a friction-modifier additive, Bulldog® Power Divider Top Treat (part No. 9853-PDT1), is available to prevent power divider snapping or binding. If power divider snapping or binding is experienced, this additive should be added at each rear axle gear oil change. One container (20 fl.oz.) is required for each carrier. Bulldog® Power Divider Top Treat is available from your local MACK dealer.

Magnetic Strips and Oil Troughs

An oil trough with magnetic strips is attached to the inside of the bevel gear compartment cover. The outside of the cover contains the notice "Internal Magnetic Strips and Oil Trough Require Periodic Cleaning." Clean the oil trough and magnetic strips each time the oil is changed or when the cover is removed.

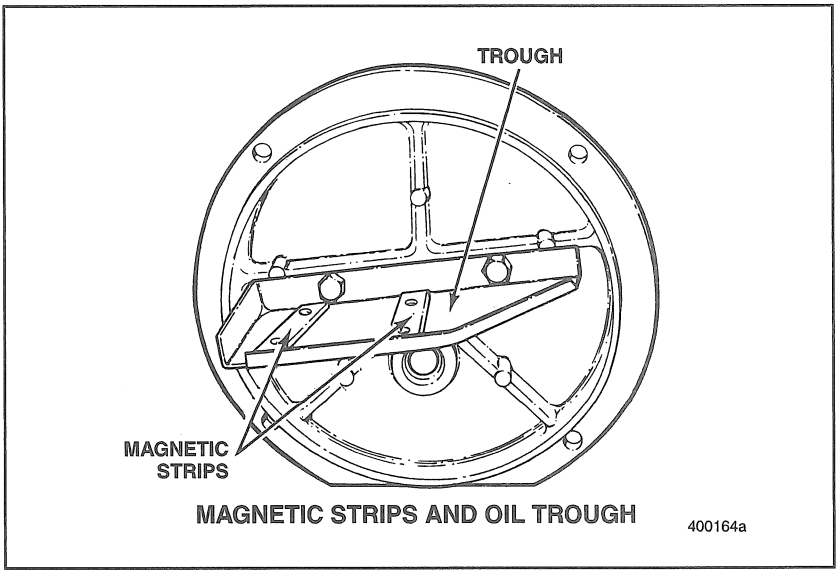


Figure 55 — Magnetic Strips and Oil Trough

Carrier Housing Breathers

Remove the carrier housing breather(s) each time the rear axle(s) oil is changed. Clean the breather(s) in a suitable, nonflammable solvent and check for obstructions. Blow dry with compressed air, then reinstall.

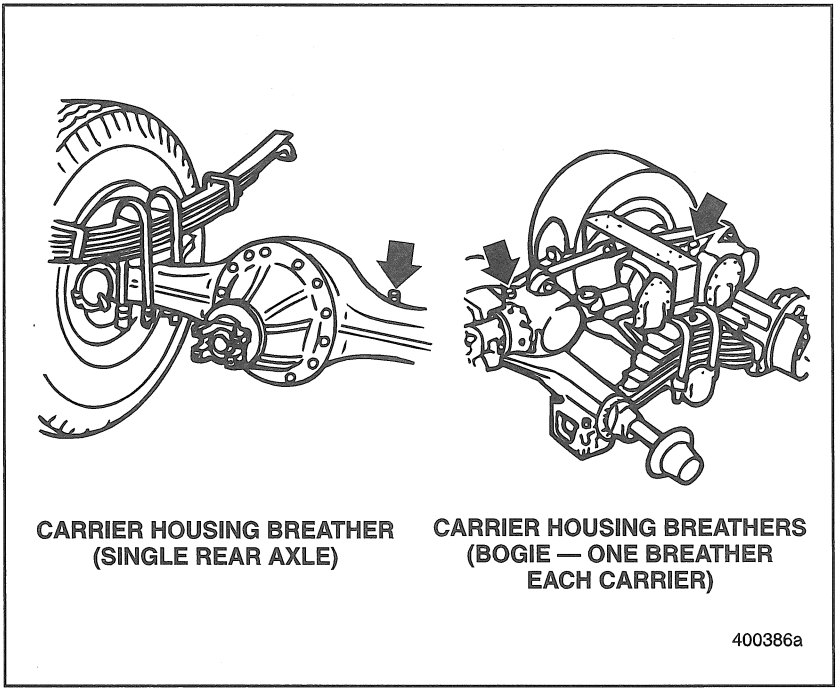


Figure 56 — Carrier Housing Breathers

Wheel Bearing Lubrication

The wheel bearings on standard MACK front non-driving axles may be either oil-lubricated, grease-lubricated or semi-fluid grease-lubricated.

OIL-LUBRICATED FRONT WHEEL BEARINGS

Front axles having oil-lubricated wheel bearings are identified by the transparent plastic hubcap which is inscribed with a mark to indicate the proper oil level. The cap in the center of the transparent window can be removed when it becomes necessary to add oil. Check the oil level regularly, at the daily pre-trip inspection. Add the recommended oil (refer to "Gear Oils" on page 335) when necessary. Oil-lubricated front wheel bearings must be removed, cleaned and inspected at each D inspection interval.

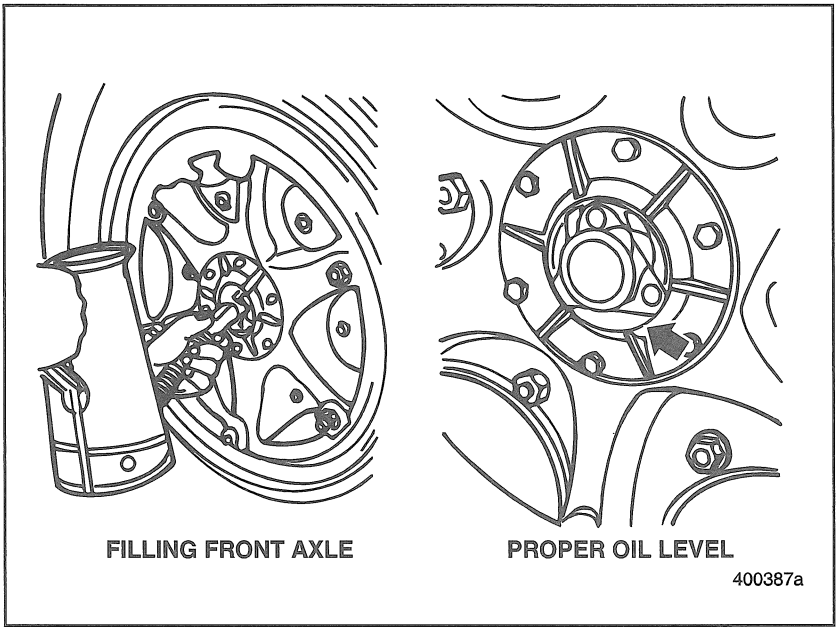


Figure 57 — Front Axle Hub

GREASE-LUBRICATED FRONT WHEEL BEARINGS

The hubcap on front axles having grease-lubricated front wheel bearings may be either a metal cap or a transparent window. Grease-lubricated wheel bearings must be removed, cleaned and repacked with grease at each D inspection interval.

SEMI-FLUID GREASE-LUBRICATED FRONT WHEEL BEARINGS

Front axles with semi-fluid grease-lubricated wheel bearings also have a hubcap with a transparent window and a vent cap in the center. The center vent cap is not to be removed to add oil to the hub assembly. Semi-fluid grease-lubricated wheel bearings must be removed, cleaned and re-lubricated at each D inspection interval.

UNITIZED WHEEL HUBS

Unitized wheel hubs (with pre-set wheel bearings) are sealed and lubricated for life. Disassembly of the hub to clean and lubricate the wheel bearings is not necessary, and doing so may void the manufacturer's warranty. Additionally, wheel bearing adjustments are not necessary with unitized hubs. Consult the wheel hub manufacturer's service literature for additional service information.

For ArvinMeritor™ unitized hub assemblies, the following inspections must be performed at the intervals listed below:

Detailed Inspection

- After the initial 200,000 miles (321 800 km) of operation.
- After every additional 200,000 miles (321 800 km) of operation thereafter.

Basic Inspection

- At each 50,000 mile (80 467 km) interval following the initial 200,000 miles (321 800 km) of operation or at the most frequent preventive maintenance interval (C and D Inspections).

For detailed instructions on performing the Detailed and Basic Inspections, refer to the ArvinMeritor™ service publication, *Maintenance Manual 2, Front Non-driving Steering Axles*. This manual can be obtained by visiting the Tech Library on the ArvinMeritor web site at *www.arvinmeritor.com*.

FRONT DRIVING AXLES

Wheel bearings on front driving axles may be oil- or grease-lubricated. Consult the specific axle manufacturer's service publications for lubrication recommendations, specifications and procedures.

REAR WHEEL BEARINGS

Rear wheel bearings are lubricated by oil from the carrier and require no periodic inspection of lubricant level at the wheel bearings. Rear wheel bearings must be removed, cleaned and inspected at each D inspection interval.

KING PIN UPPER BEARING LUBRICATION

Lubricate the upper king pin bearing with the vehicle on the ground. Apply MG-C grease to the upper bearing grease fitting until grease purges from the joint between the upper steering knuckle and the upper portion of the axle eyelet.

NOTE

The upper king pin cover on MACK FXL18 and FXL20 front axles has two grease fittings. It is only necessary to apply grease to one of the fittings.

KING PIN LOWER BEARING LUBRICATION

Lubricate the king pin lower bearing with the front of the vehicle raised off the ground and supported on jackstands of adequate capacity to support the weight of the vehicle. Apply MG-C grease to the lower bushing grease fitting until grease purges from the joint between the lower steering knuckle and the lower portion of the axle eyelet.

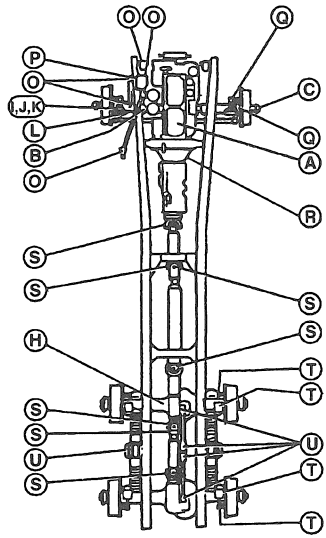
Lubrication Chart

MACK CHASSIS
PREVENTIVE MAINTENANCE SCHEDULE
LUBRICATION CHART

ACTION TAKEN	KEY	ITEM
✔	A	ENGINE CRANKCASE
✔	B	POWER STEERING RESERVOIR
✔	C	FRONT WHEEL BEARINGS
✔	D	**FRONT DRIVE AXLE**
	E	FLYWHEEL PTO
	F	TRANSMISSION
	G	TRANSFER CASE
	H	REAR AXLE
⌯		FRONT DRIVE AXLE
	I	SLIDING SPLINES
	I	UNIVERSALS
	J,K	KING PINS*
	J,K	UNIVERSALS (CARDANS)*
⌯	L	ACCELERATOR HINGE PIN
	L	BRAKE TREADLE HINGE PIN
⌯	L	BRAKE VALVE PLUNGER
⌯	M	SHIFT LINKAGE
	N	CAB TILT RESERVOIR
⌯	O	SPRING PINS*
	O	SHACKLES*
	O	DRAG LINK
	O	STEERING UNIVERSALS
	O	SLIP YOKE
	O	PURGE FITTING
⌯	P	STEERING GEAR
⌯	Q	FRONT SLACK ADJUSTER*
	Q	FRONT BRAKE CAMSHAFT*
	Q	STEERING KNUCKLE PINS*
	Q	CROSS STEERING TUBE SOCKETS*
⌯	R	CLUTCH RELEASE SHAFT*
	R	CLUTCH RELEASE BEARING
⌯	S	PROP SHAFT UNIVERSALS
	S	PROP SHAFT SLIDING SPLINE†
⌯	T	REAR BRAKE CAMSHAFT*
	T	REAR SLACK ADJUSTERS*
	T	SPRING PINS*
	U	TORQUE ROD BALL STUDS
	U	SPRING TRUNNION*

* Indicates lubrication on both sides of vehicle.

† Do not lubricate sliding splines on Spicer life™ driveshafts — Do not disturb bellows.



NOTE
Clean all fittings with non-flammable solvent and wipe clean with a rag before applying grease gun.

NOTE
For lubricant specifications, refer to LUBRICANTS AND SPECIFICATIONS section of this manual.

ACTION TAKEN CODES	
✔	Check Level. Add Lubricant if Necessary
⌯	Lubricate Fitting
⌯	Lubricate Surfaces

000089a

Figure 58 — Mack Chassis Lubrication Chart

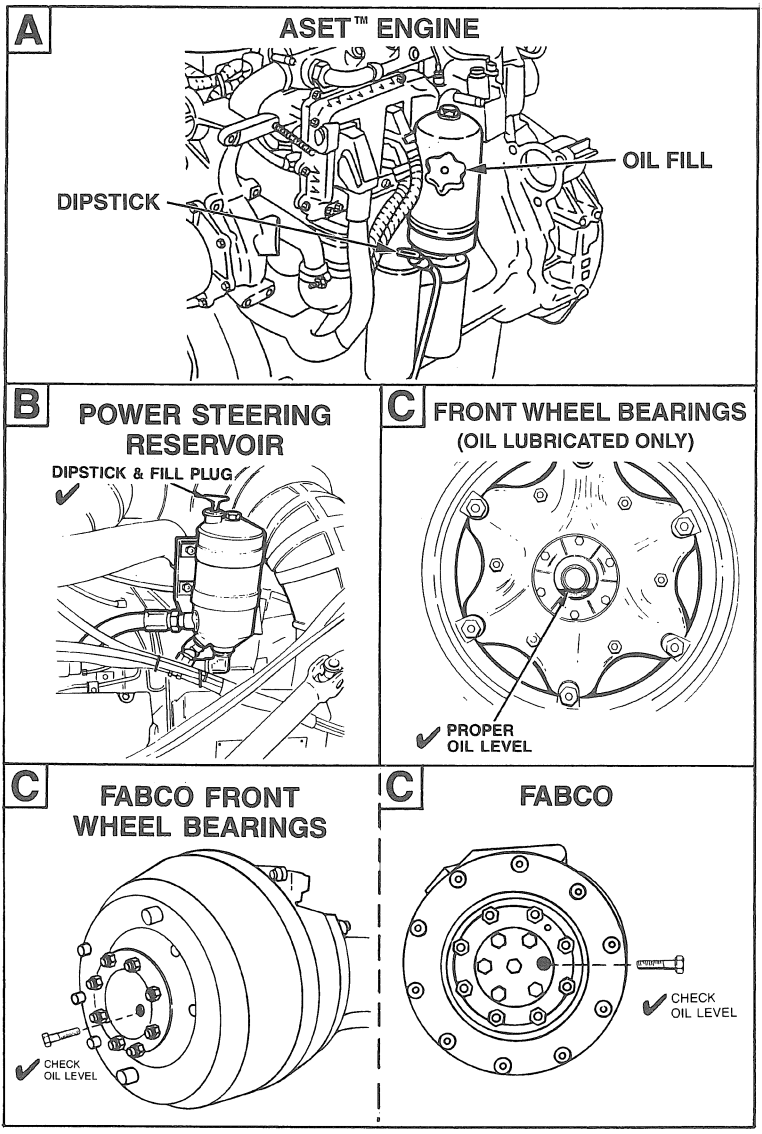


Figure 59 — A–C Key References

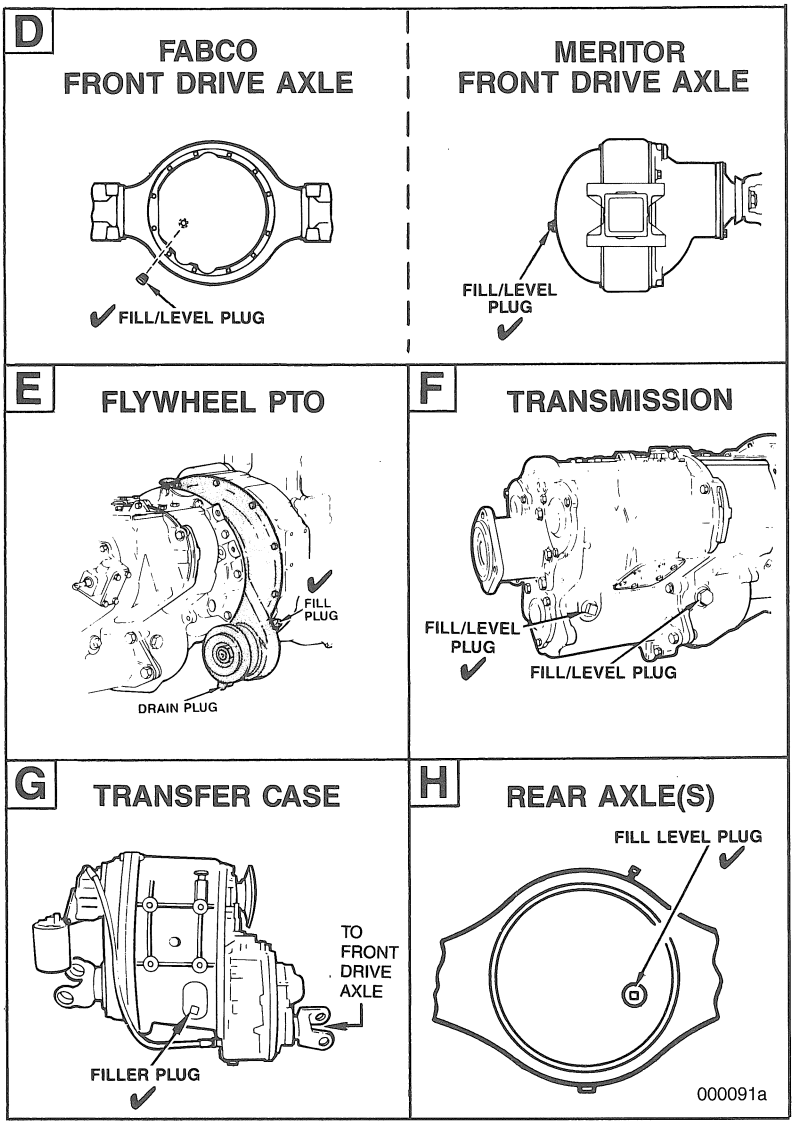


Figure 60 — D–H Key References

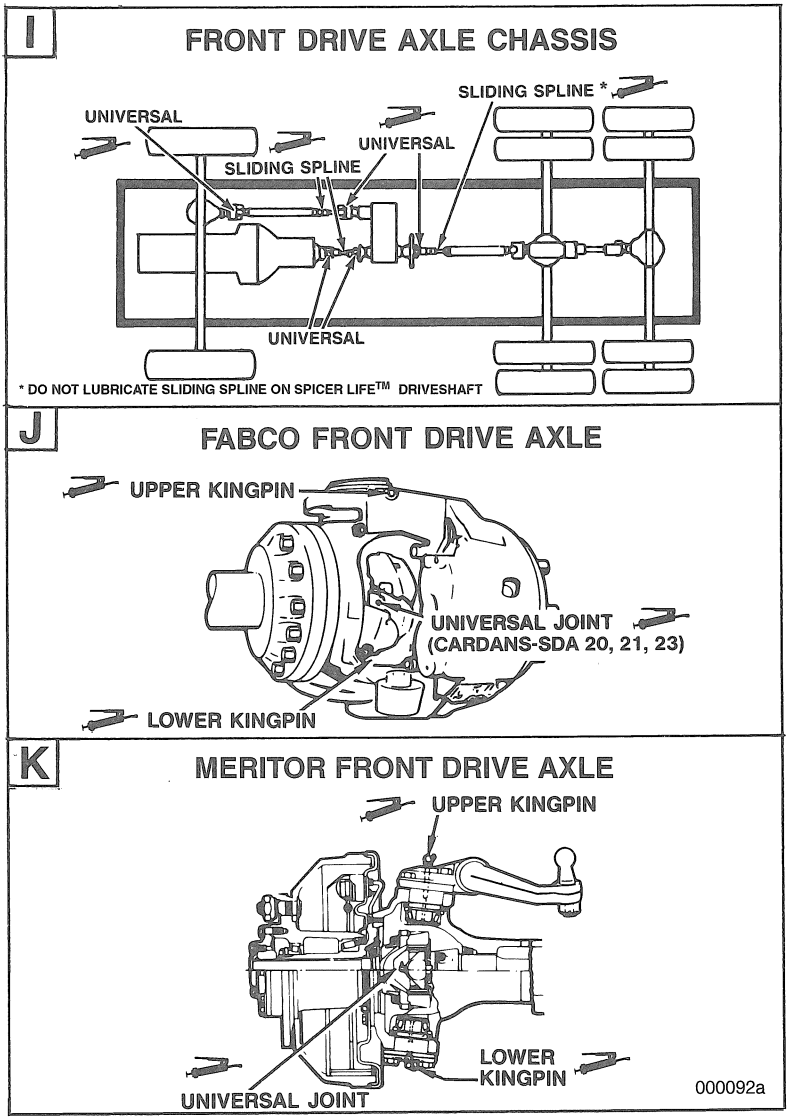
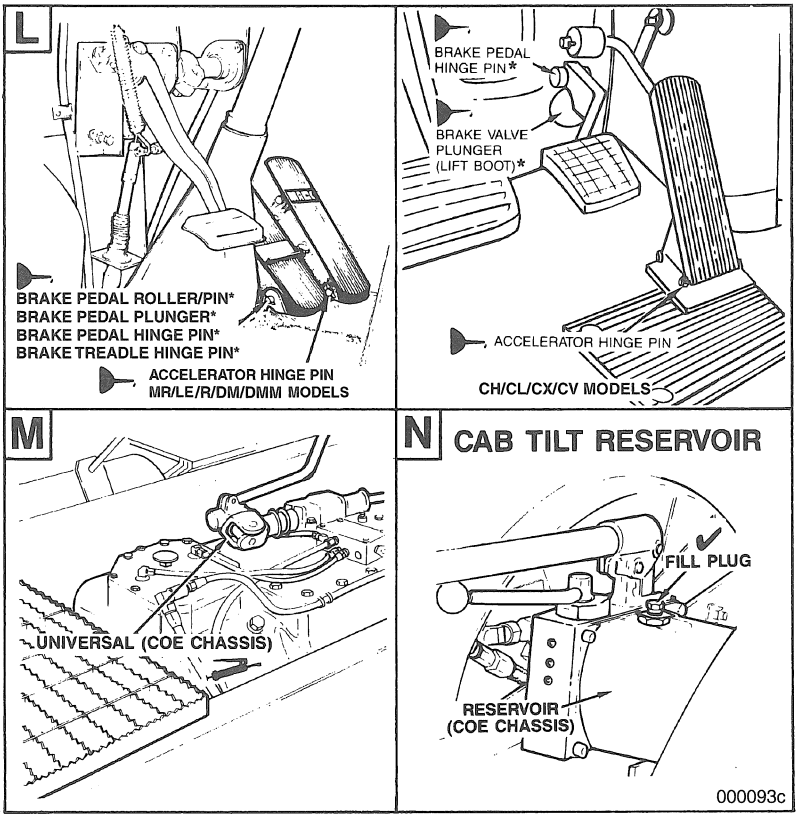
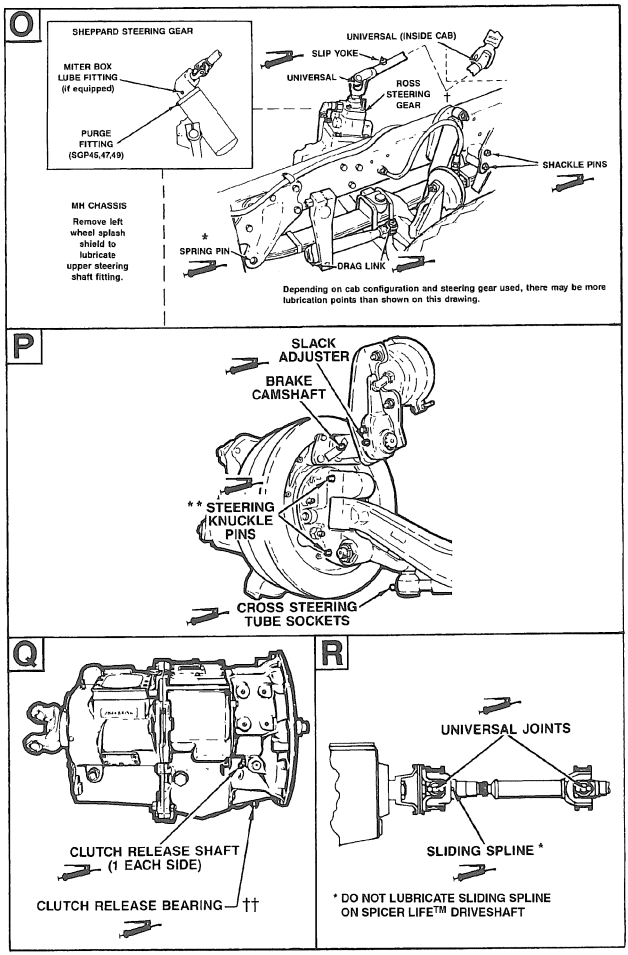


Figure 61 — I–K Key References



*Use MG-C Grease.

Figure 62 — L–N Key References



* CH/CL front axles with taperleaf springs (10,000 lb. and 12,000 lb. rating) and CXN with 12,000 lb. and 12,000 lb. heavy-duty front axles use maintenance-free spring pins and shackle pins that require no lubrication.

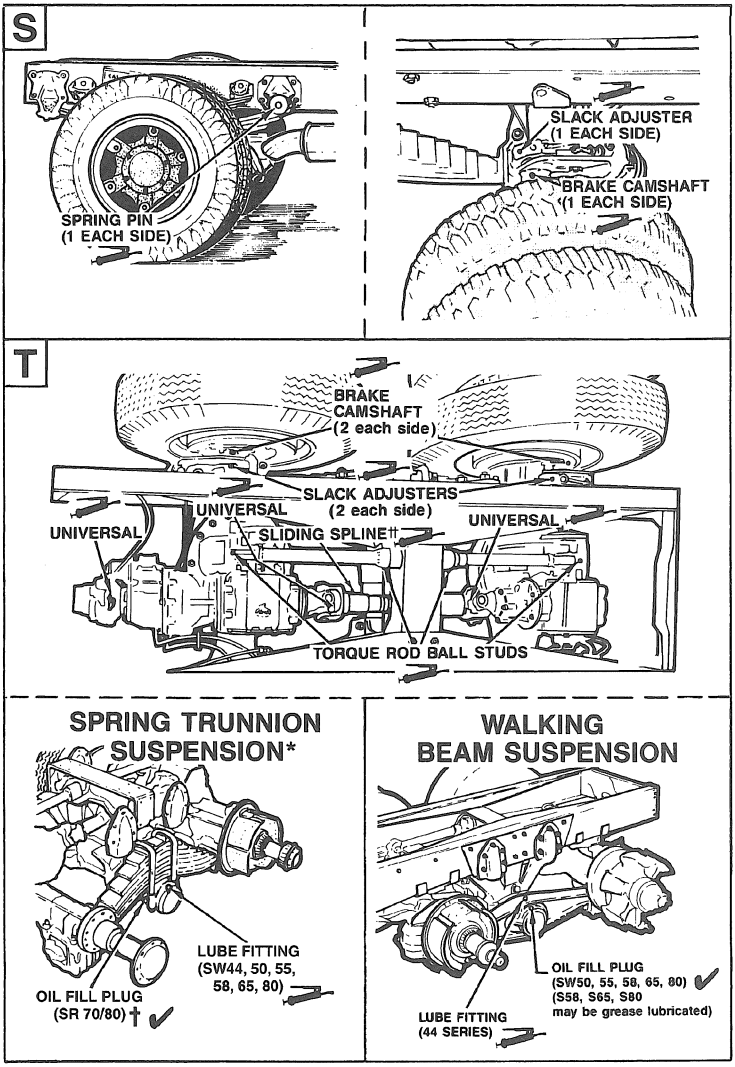
** Lubricate upper knuckle pin bearings with vehicle on ground, lower knuckle pin bushing with vehicle raised.

† On Ross TAS steering gears, apply MGC to the fitting on the trunnion side of the steering gear near the output shaft. Use a hand type grease gun only.

†† Remove inspection cover to access release bearing grease fitting.

000094c

Figure 63 — O–R Key References



*When greasing trunnion, raise chassis slightly, just enough to take weight off trunnion, to ensure grease fully penetrates cavity.
†Use HD or EP oil in SR70/80 spring trunnion.
††Do not lubricate sliding spline on Spicer Life™ driveshafts. 000095c

Figure 64 — S–T Key References

FRONT AXLE STATIC SHAKE TEST

At each A, B, C and D inspection interval, perform a static shake test to check for looseness in the front axle springs and the steering system. To perform this test, apply the parking brakes and run the engine at an idle. With an assistant moving the steering wheel back and forth, check the front springs for looseness at the attachment points. Any movement of the spring indicates that the spring leaf may be broken, possibly at the spring eye wrapper, or the bronze bushing may be worn. If movement is detected, clean and inspect the spring leaf, wrapper and bronze bushing. Worn bushings must be replaced. If the spring wrapper is broken, the spring leaf must be replaced.

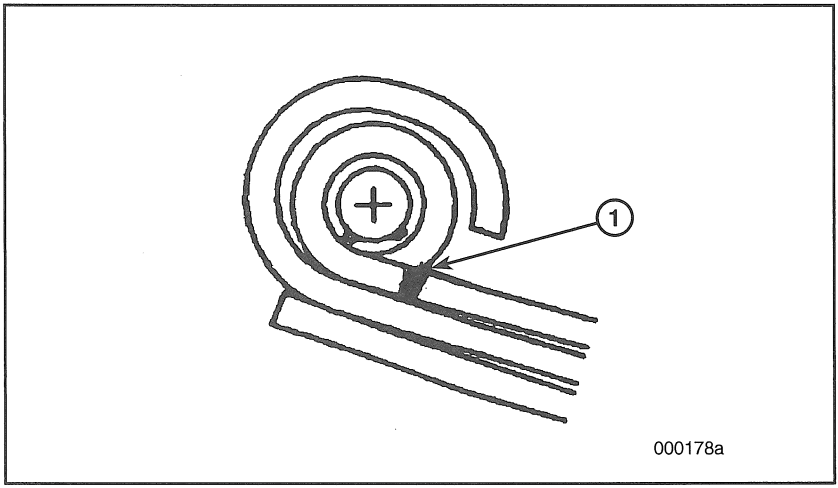


Figure 65 — Spring Eye Wrapper

1. Check this area of spring wrapper leaf for potential cracks.

While performing the shake test, also check the complete steering system (i.e., steering gear mounting, pitman arm, drag link, cross steering tube, steering levers, etc.) for looseness. If any looseness is seen in the steering system, the cause must be investigated and corrected.

STEERING KNUCKLE INSPECTION

At each C and D inspection interval, steam clean and inspect each steering knuckle for cracks. Pay particular attention to the areas of the steering lever boss, cross-steering tube boss and the king pin lower boss. If cracks are noticed, consult your local MACK dealer.

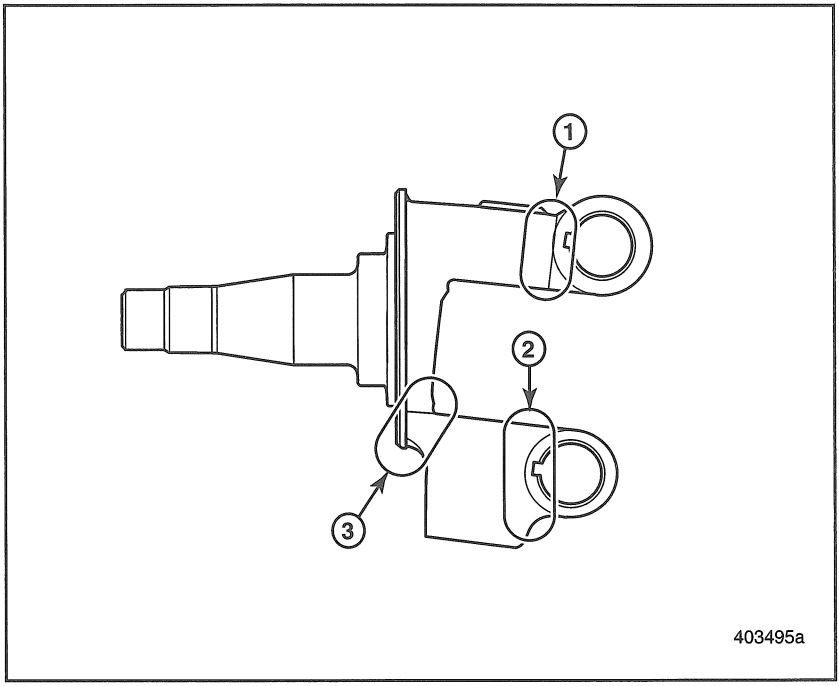


Figure 66 — Inspect Steering Knuckle

1. Steering Lever Boss 2. Cross-Steering Tube Boss	3. King Pin Lower Boss

CARRIER CAPSCREW TORQUE

At each C and D inspection interval, check and adjust the torque of the capscrews that secure the top-mounted carrier to the axle housing. On certain carrier assemblies, two of the capscrews are located inside the bevel gear compartment where they are not visible.

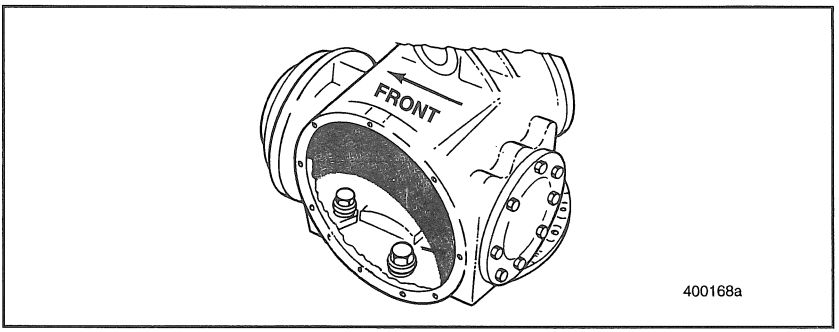


Figure 67 — Carrier Capscrews

The following carrier assemblies have capscrews located inside the bevel gear compartment:

CRD(L)92(1), CRDLP92(1), CRDPC92(1), CRD(L)93(1), CRD112, CRDPC112(1), CRD113(1), CRDP95(1), CRD96(1), CRD200

To gain access to these “hidden” capscrews, drain the bevel gear compartment, and remove the cover. After checking the torque (refer to table on page 193), reinstall the cover and fill the bevel gear compartment with enough of the recommended oil to bring the level to the bottom of the filler plug hole. (See “Gear Oils” on page 335.)

CAPSCREW TORQUE SPECIFICATIONS

Carrier	Torque Lb-ft (N•m)
92/93 Series	132–148 (179–201)
112/113 Series	132–148 (179–201)
95/96 Series	476–528 (645–716)
200 Series	132–148 (179–201)

SPRING CLIP (U-BOLT) TORQUE

⚠ WARNING

Proper spring clip torque must be maintained for safe operation of the vehicle. Loose or improperly torqued spring clips may adversely affect the driver's steering control of the vehicle.

NOTE

Always use an accurately calibrated torque wrench to torque the spring clips.

⚠ CAUTION

After any repair operation that involved the removal and reinstallation of a spring, the spring clips must be retorqued after a minimum of one day and a maximum of one week or 3,000 miles/5 000 km of service.

MACK Tandem Suspensions

Spring clips must be retorqued during the first 3,000 miles/5000 km or 3–4 months (whichever comes first). After the initial break-in period, retorque the spring clips at every C and D inspection interval.

ST34 and ST38 suspensions do not require retorquing at the end of the initial break-in period. Retorque these spring clips at every C and D inspection.

Vendor Tandem Suspensions

Hendrickson	Retorque spring clips at C and D inspection intervals per vendor specifications.
Neway	Retorque all fasteners in the suspension and the frame brackets at first 3,000 miles/5 000 km and thereafter at C and D inspection intervals per vendor specifications.
Reyco	Retorque spring clips and equalizer nuts at first 1,000 miles/1 600 km per vendor specifications. At B, C and D inspection intervals, retorque spring clips, equalizer nuts, torque arm bolts (at hangers and axle seats), and torque arm tube clamp nuts per vendor specifications.

Front (Steering) Axle and Single Rear Axle

Retorque the spring clips on the front (steering) axle and the single rear axle at the first 3,000 miles/5 000 km, and thereafter at every C and D inspection interval.

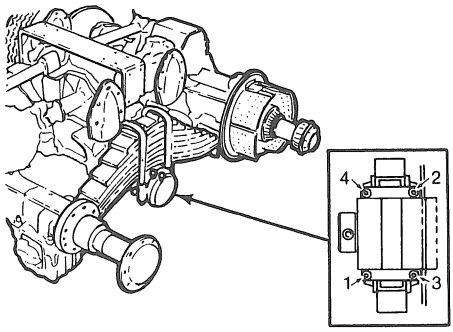
SPRING CLIP NUT TORQUE CHART (FRONT AND REAR AXLES)

Spring Clip Diameter Inches [mm]	Spring Clip Nut Torque Lb-ft (N•m)
0.625 (5/8) [15.9]	200–225 (271–305)
0.750 (3/4) [19.0]	320–340 (434–461)
0.875 (7/8) [22.1] with flat top	400–450 (542–610)
0.875 (7/8) [22.1] with circular top	500–550 (678–746)
1.000 (1) [25.4]	800–880 (1085–1193)
1.125 (1-1/8) [28.6]	1050–1150 (1423–1558)
1.250 (1-1/4) [31.8]	1400–1500 (1897–2033)

Spring Clip (U-Bolt) Torque Procedure

When installing spring clip nuts on either the front or rear springs, the spring clip threads must first be lubricated with NEVER-SIEZE™. NEVER-SIEZE™ must also be applied to the special washers, if so equipped, to remove the frictional drag on the nuts. Use the following recommended tightening sequence to torque the spring clips. Torque requirements are the same for either type of lubricant.

1. Tighten all spring clips until they are snug.
2. Tighten nuts, using the sequence shown below, to approximately one third of the recommended torque. Refer to table on page 196 for proper torque requirements.
3. Repeat tightening the nuts, using the same sequence, gradually increasing the torque through a second, third and fourth stage until the final recommended torque is achieved.



RECOMMENDED TIGHTENING SEQUENCE OF SPRING CLIP (U-BOLT) NUTS

100019a

Figure 68 — Recommended Spring Clip Nut Tightening Sequence

MACK AIR SUSPENSIONS

At each C and D inspection interval, check the air springs for cracks, gouges, distortion, bulges and/or chafing and replace as necessary. If an air spring requires replacement, there is a high likelihood that a problem with another area of the suspension exists. Inspect the suspension and repair as required. Also at each C and D inspection interval, use a solution of soap and water to check the air suspension air system for leaks. Check the system for leaks with the vehicle loaded and the air system at normal operating pressure (governor cut-out).

Torque Requirements

NOTE

Following any repair that requires the removal and reinstallation of the spring clips (U-bolts) on AL, AL II, AL-401LH, MAXAIR 40/40A (AL-405) and MAXLITE™ 20–40, the spring clips must be retorqued after the first 1,000 miles (1 160 km) of service, and thereafter at each specified maintenance interval according to the suspension model as outlined below. Refer to the *MACK Air Suspension and Repair Manual,* 14-101, *MAXAIR 40 (AL-405) Air Suspension and Repair Manual,* 14-102, or the MAXLITE™ 20–40 Rear Air Suspension, 14-104, for additional information.

SPRING CLIP RETORQUE — ALL MACK AIR SUSPENSIONS

At the end of the initial break-in period (1,000 miles [1 610 km]), retorque the spring clips (U-bolts) on all chassis equipped with MACK air suspensions (including MAXAIR™ 40/40A and MAXLITE™ 20–40 suspensions). Thereafter, spring clips must be retorqued at each A, B, C and D inspection interval on all chassis equipped with AL, AL II, AL-401LH and MAXLITE™ 20–40 suspensions. There is no spring clip retorque requirement at any specific service interval (other than at the end of the initial break-in period) for chassis equipped with the MAXAIR™ 40/40A suspension.

- **AL, AL II and AL-401LH** — 400–450 lb-ft (542–610 N•m)

NOTE

On chassis equipped with AL-401LH and either Eaton or ArvinMeritor rear axles, 3/4-inch diameter U-bolts are used. Torque these U-bolts to 260–320 lb-ft (353–434 N•m).

- **MAXAIR™ 40/40A** — 350–400 lb-ft (475–542 N•m)
- **MAXLITE™ 20–40** — 369–479 lb-ft (500–650 N•m)

MAIN SUPPORT MEMBER LOCKNUTS

At the end of the initial break-in period (1,000 miles [1 610 km]), and thereafter at each A, B, C and D interval, retorque the main support member locknuts on AL, AL II and AL-401LH suspensions as follows:

- **AL** — Main support member to air spring lower mounting bracket — 260–320 lb-ft (353–434 N•m)
- **AL II and AL-401LH** — Main support member to cross channel section — 260–320 lb-ft (353–434 N•m)
- **MAXLITE™ 20–40** — Main support member to crossbeam — 62–92 lb-ft (85–125 N•m)

OTHER FASTENERS

At each D inspection interval, check the torque of the following fasteners (refer to the *MACK Air Suspension Service and Repair Manual*, 14-101, *MAXAIR™ 40 (AL-405) Air Suspension Service and Repair Manual*, 14-102, or the MAXLITE™ 20–40 Rear Air Suspension Service Manual, 14-104, for additional information).

MACK AL Air Suspensions	
Fastener	**Torque lb-ft (N•m)**
Air Spring-to-Frame Bracket — Inboard	50–70 (68–95)
Air Spring-to-Frame Bracket — Outboard	20–30 (27–41)
Air Spring-to-Lower Mounting Bracket (Cross Tube)	20–30 (27–41)
Longitudinal Torque Rod Bar Pin	150–205 (203–278)
Transverse Torque Rod, Frame Side, Straddle-Type Mount	175–200 (237–271)
Transverse Torque Rod, Axle Side, Straddle-Type Mount	175–200 (237–271)
Transverse Torque Rod, Axle-Side, Taper Ball Socket	400–450 (542–610)
Frame Bracket Rebound Roller Bolt	50–70 (68–95)
Shock Absorber, Top and Bottom Nuts	50–70 (68–95)

MACK AL II and AL-401LH Air Suspensions	
Fastener	**Torque lb-ft (N•m)**
Air Spring-to-Frame Bracket — Outboard	20–30 (27–41)
Air Spring-to-Lower Mounting Bracket (Cross Channel)	20–30 (27–41)
Longitudinal Torque Rod Bar Pin	150–205 (203–278)
Transverse Torque Rod, Frame Side, Straddle-Type Mount	175–200 (237–271)
Transverse Torque Rod, Axle Side, Straddle-Type Mount	175–200 (237–271)
Frame Bracket Rebound Roller Bolt	50–70 (68–95)
Shock Absorber, Top and Bottom Nuts (AL II only)	90–110 (122–149)
Shock Absorber, Top Nut (AL-401LH only)	90–110 (122–149)
Shock Absorber, Bottom Stud Nut (AL-401LH only)	50–70 (68–95)

MAXLITE™ 20–40 Air Suspensions	
Fastener	**Torque lb-ft (N•m)**
Air Spring Upper Bracket-to-Frame	124-172 (167–233)
Air Spring-to-Upper Bracket	37 (50)
Air Spring-to-Crossbeam	37 (50)
Transverse Torque Rod-to-Axle Housing	199–273 (270–370)
Transverse Torque Rod-to-Frame Bracket	199–273 (270–370)
Shock Absorber-to-Bracket Bolts (Upper and Lower)	170–236 (230–320)

Air Suspension Control Switch

The air suspension control switch located on the dashboard is used to exhaust the air from the air suspension air bags when coupling and uncoupling a trailer, or when raising and lowering a dump body. The air bags must be reinflated before the vehicle is operated.

NOTE

On trucks equipped with a dump body, always exhaust the air from the air bags before raising the body to prevent damaging the bags and to improve chassis stability while dumping a load. Reinflate the air bags after lowering the dump body.

NOTE

Do NOT operate a vehicle with air exhausted from the air suspension air bags, as damage to the chassis driveline will result. Always reinflate the air bags after coupling or uncoupling a trailer, or after lowering a dump body.

Height Control Valve

At each D inspection interval, check functionality of the height control valve. Refer to the *MACK AL and AL II Air Suspension Service and Repair Manual*, 14-101, *MAXAIR™ 40 (AL-405) Air Suspension Service and Repair Manual*, 14-102, or the MAXLITE™ 20–40 Rear Air Suspension Service Manual, 14-104, for additional information.

Ride Height — MACK AI, AL II and MAXAIR™ 40/40A Air Suspensions

Air suspensions function best when the ride height is properly adjusted. Check ride height and adjust, if necessary, at each D inspection interval.

NOTE

Driveline universal joint operating angles are affected by variations in ride height. Failure to maintain the proper ride height setting is likely to lead to driveline vibration, and subsequent drivetrain durability problems.

Ride height is measured from the bottom of the frame rail to the bottom of the main support member. For the AL, AL II and AL-401LH, this dimension must be 4.25 ± 0.125 inch (108 ± 3 mm) as shown in the following illustration.

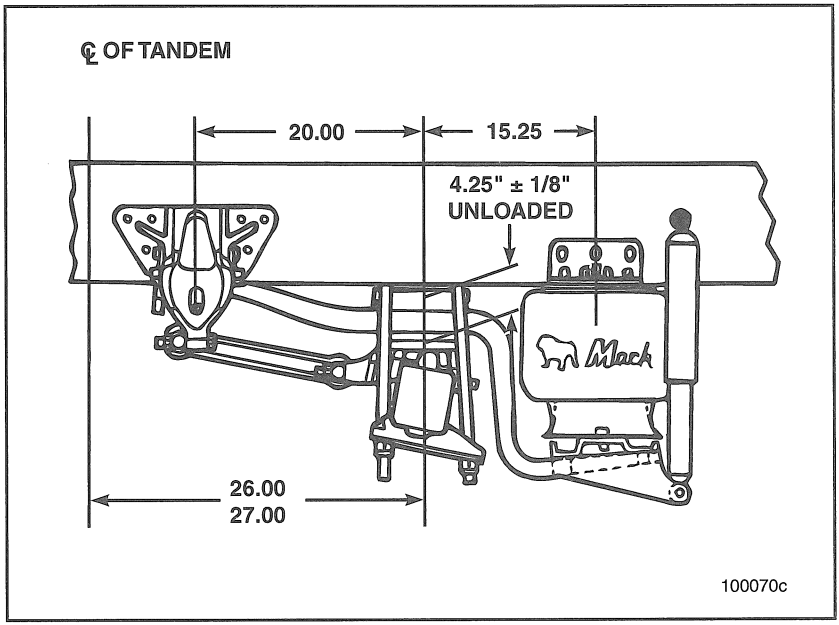


Figure 69 — AL, AL II and AL-401LH Ride Height Dimension

This dimension is the most important measurement when adjusting ride height. A gauge is available from Hendrickson Truck Suspension Systems to facilitate checking this dimension. The part number for this gauge is as follows:

- Hendrickson part No. 45745-050 — AL, Al II, AL-401LH

Ride height dimensions for the MAXAIR™ 40 suspension depends on suspension version. To determine the suspension version, look for an "X" located on the spring clip (U-bolt) top cap.

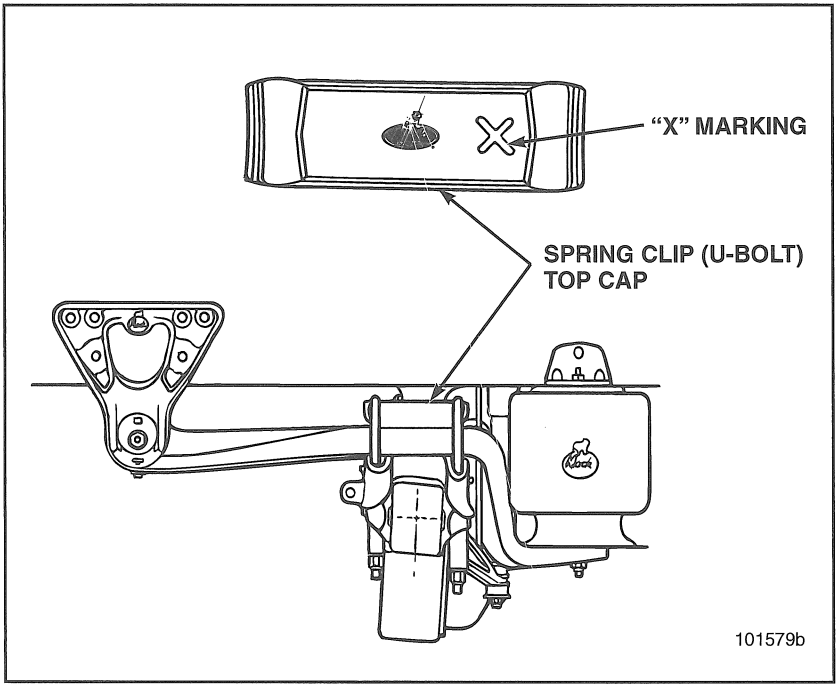


Figure 70 — MAXAIR™ 40 Spring Clip Top Cap "X" Marking

Ride height is measured from the bottom of the frame rail to the bottom of the main support member as shown in the illustration below. Depending on suspension version, the ride height dimension is as follows:

- If an "X" is present, ride height must be adjusted to 4-7/8″ ± 1/8″ (unloaded).
- If there is no "X" present, ride height must be adjusted to 5-1/4″ ± 1/8″ (unloaded).

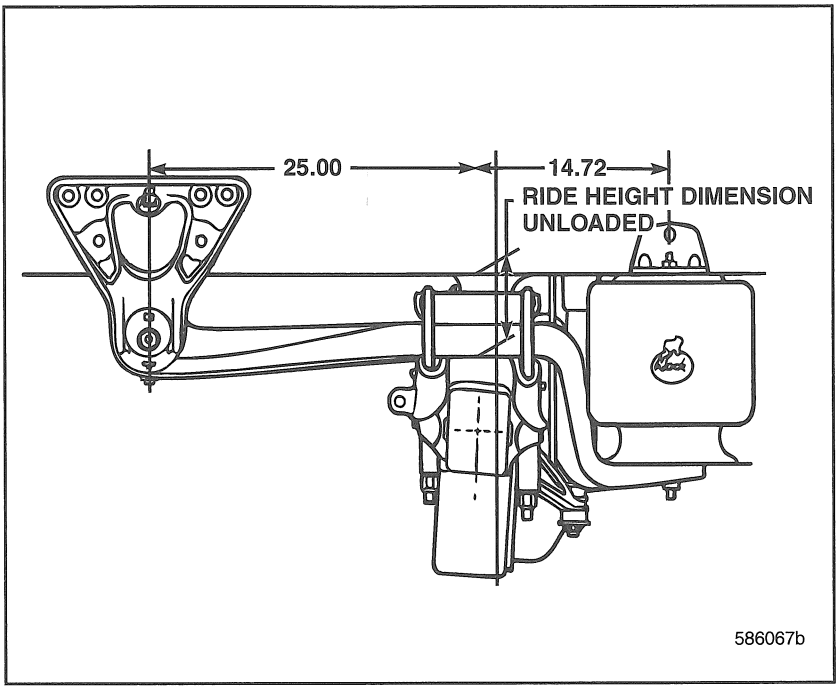


Figure 71 — MAXAIR™ 40 Ride Height Measurement

⚠ CAUTION

It is critical to identify the suspension version to determine the ride height setting before making any ride height adjustments. Setting the ride height to the incorrect dimension could result in driveline damage, and such damage is not covered under warranty.

This dimension is the most important measurement when adjusting ride height. Gauges are available from Hendrickson Truck Suspension Systems to facilitate checking this dimension. Part numbers for these gauges are as follows:

- Hendrickson part No. 45745-127 — MAXAIR™ 40/40A suspension with a ride height setting of 5-1/4″ ± 1/8″
- Hendrickson part No. 45745-164 — MAXAIR™ 40/40A suspension with a ride height setting of 4-7/8″ ± 1/8″ (spring clip [U-bolt] top cap marked with an “X”)

NOTE

The ride height gauge part No. 45745-164 for the ride height setting of 4-7/8″ ± 1/8″, is marked with an “X” at various locations on both the front and back of the gauge. These “X” markings coincide with the “X” marking located on the top spring clip (U-bolt) cap.

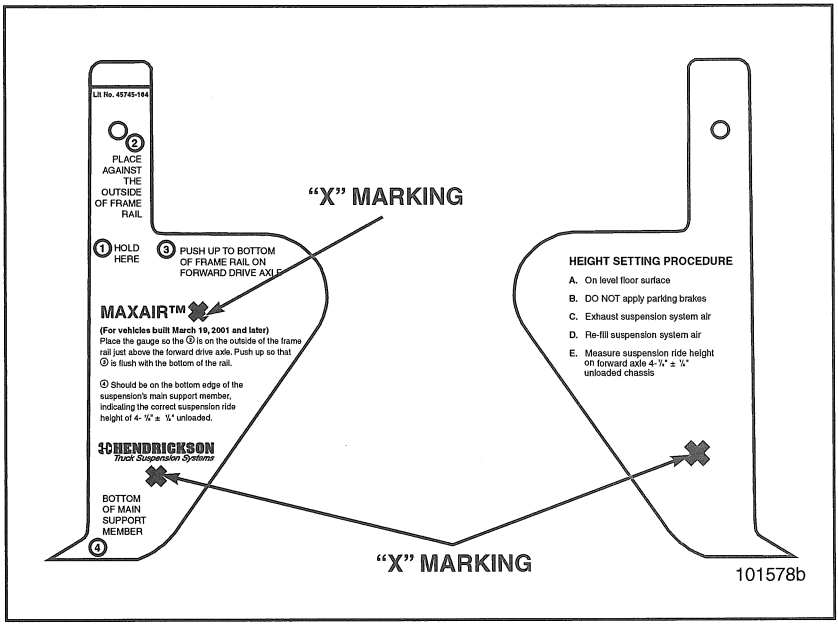


Figure 72 — MAXAIR™ 40 Ride Height Gauge 45745-164

Ride height must be measured on the axle to which the height-control valve linkage is attached. In most applications, this is usually on the left-hand side of the vehicle, at the front-rear axle location. On tandem axle assemblies, frame slope may cause the ride height to vary from the specified dimension on the axle which does not have a height-control valve. Ride height should be set when the vehicle is unloaded and parked on a level surface. Prior to checking or setting ride height, drive the vehicle forward and backward a few feet several times, and bring the vehicle to a stop without using the brakes. Chock the wheels to prevent the vehicle from moving, and do not set the parking brakes. With the air system fully pressurized, use the air suspension control inside the cab to exhaust, then reinflate the air suspension. Wait until airflow to the suspension has stopped, then check ride height.

On MACK AL, AL II and MAXAIR™ 40/40A air suspensions, changes to ride height are made by adjusting the height-control valve linkage. The following different height-control valve and linkage configurations are used on MACK chassis:

- Height-control valve linkage with rubber rod ends
- Height-control valve linkage with threaded rod ends
- Height-control valve with adjustable arm

Ride height adjustment is different for each valve/linkage configuration. Adjustment procedures are outlined in the following text.

On chassis equipped with height-control valve linkage having rubber rod ends, loosen the hose clamp at the bottom rod end, then slide the rod end up or down on the linkage rod to achieve the specified ride height. Retighten the hose clamp when the adjustment is complete.

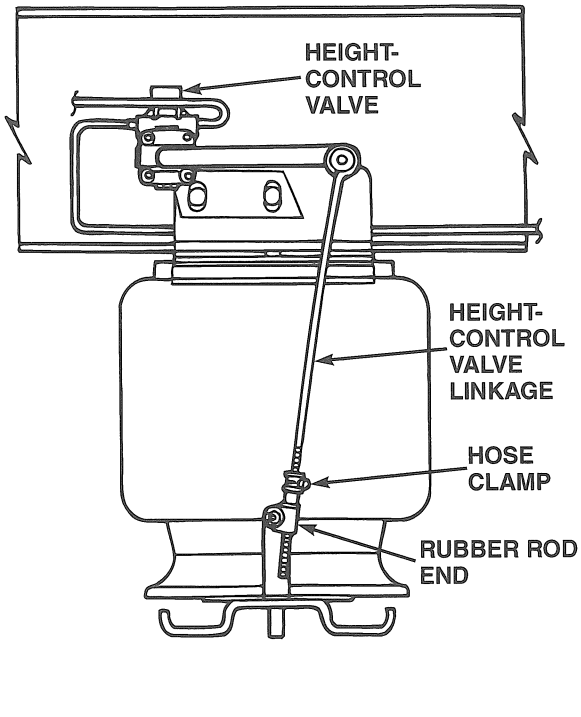


Figure 73 — Height-Control Valve Linkage with Rubber Rod Ends (Except AL-405)

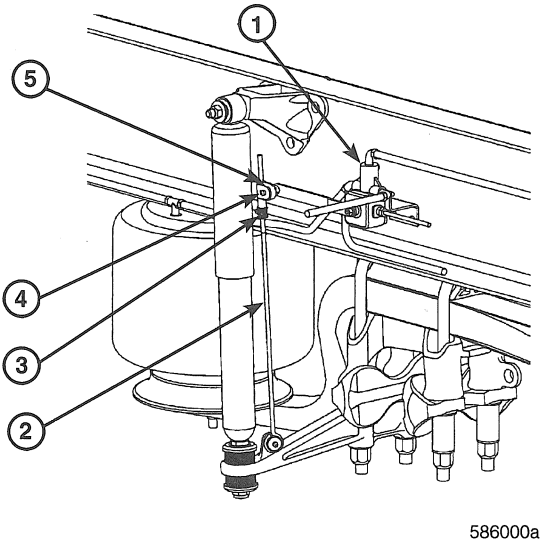


Figure 74 — Height-Control Valve with Rubber Rod Ends (AL-405)

1. Height-Control Valve 2. Linkage Rod 3. Clamp	4. Extension Arm Rubber Joint 5. Extension Arm Locknuts (100–150 lb-in)

On chassis equipped with a height-control valve linkage having threaded rod ends, disconnect the linkage from the bracket on the cross channel. Loosen the jam nut, then turn the rod end to achieve the specified ride height. Reattach the linkage to the bracket on the cross channel and torque all linkage fasteners (jam nut and attachment hardware) to 100–150 lb-in (11–17 N•m).

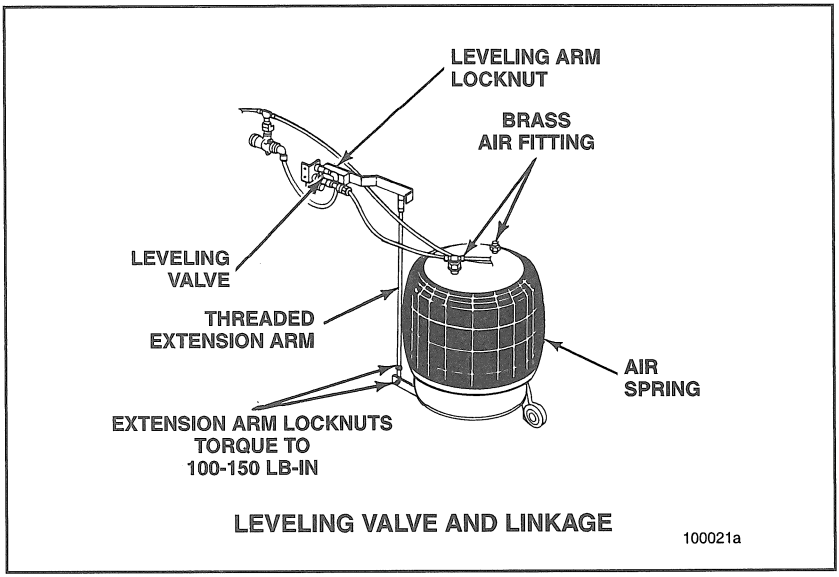


Figure 75 — Height-Control Valve and Linkage

On chassis equipped with a height-control valve that has an adjustable arm, the valve has a stud that passes through an elongated hole in the arm. The arm is secured with a locknut. To adjust ride height on these chassis, loosen the control arm locknut and reposition the arm to achieve the specified ride height. Retorque the arm locknut to 100–150 lb-in (11–17 N•m).

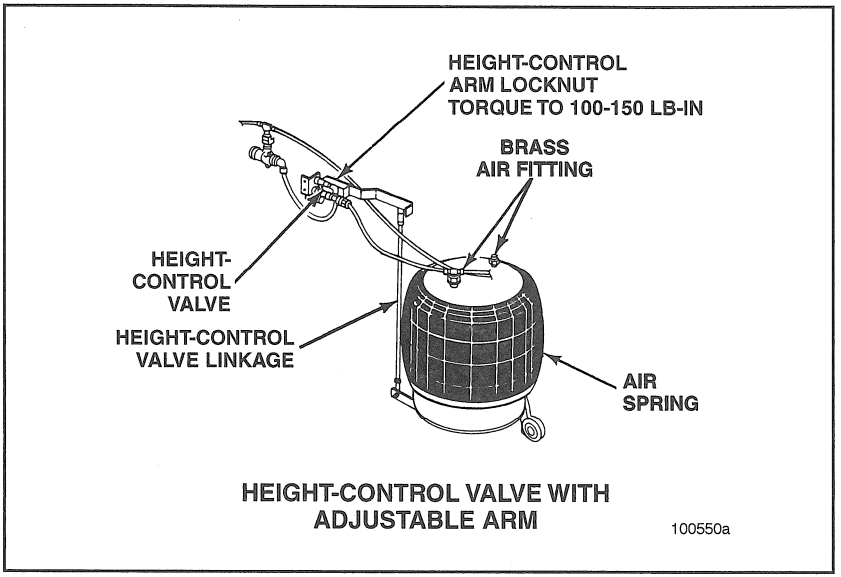


Figure 76 — Height-Control Valve with Adjustable Arm

In addition to the adjustable height-control valve linkages, the height-control valve on most chassis is adjustable by moving the entire valve assembly so that ride height can be fine-tuned. On these chassis, one hole in the valve mounting bracket is elongated to allow for adjustment. To fine-tune ride height, loosen the locknuts on the valve mounting studs slightly, then rotate the entire valve assembly to achieve the specified ride height. Retorque the valve mounting locknuts to 50–100 lb-in (6–11 N•m).

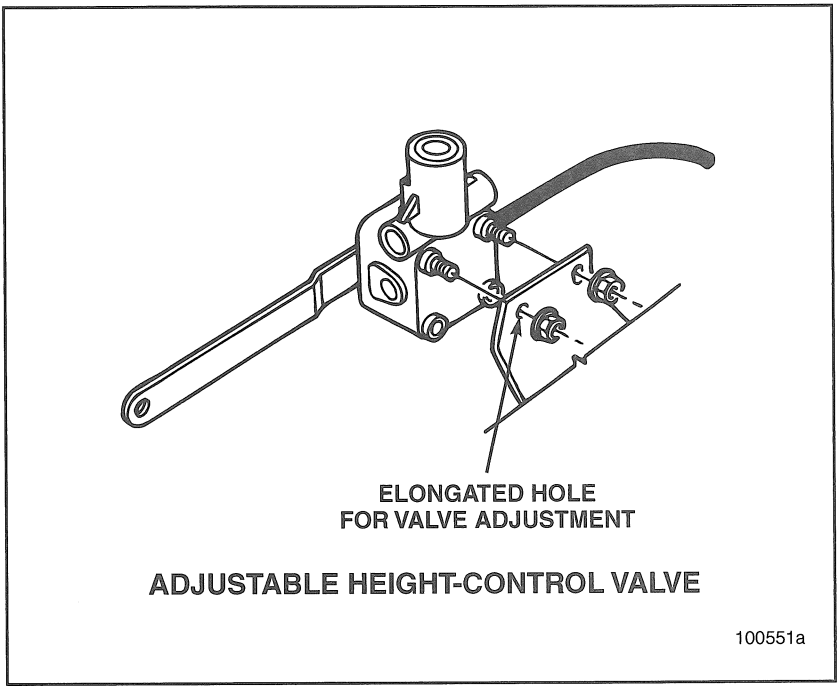


Figure 77 — Adjustable Height-Control Valve

After ride height adjustments are complete, exhaust and reinflate the suspension. Wait until airflow to the suspension has stopped, then recheck the ride height.

Ride Height — MaxLite™ 20–40 Air Suspensions

Air suspensions function best when the ride height is properly adjusted. Check ride height and adjust, if necessary, at each D inspection interval.

NOTE

Driveline universal joint operating angles are affected by variations in ride height. Failure to maintain the proper ride height setting is likely to lead to driveline vibration and subsequent drivetrain durability problems.

On the MaxLite™ 20–40 air suspension, ride height is set to 8.5 inches (216 mm). This dimension is measured from the top of the left-hand axle stop to the top center of the axle housing on the front-rear axle using ride height gauge part No. TS89604.

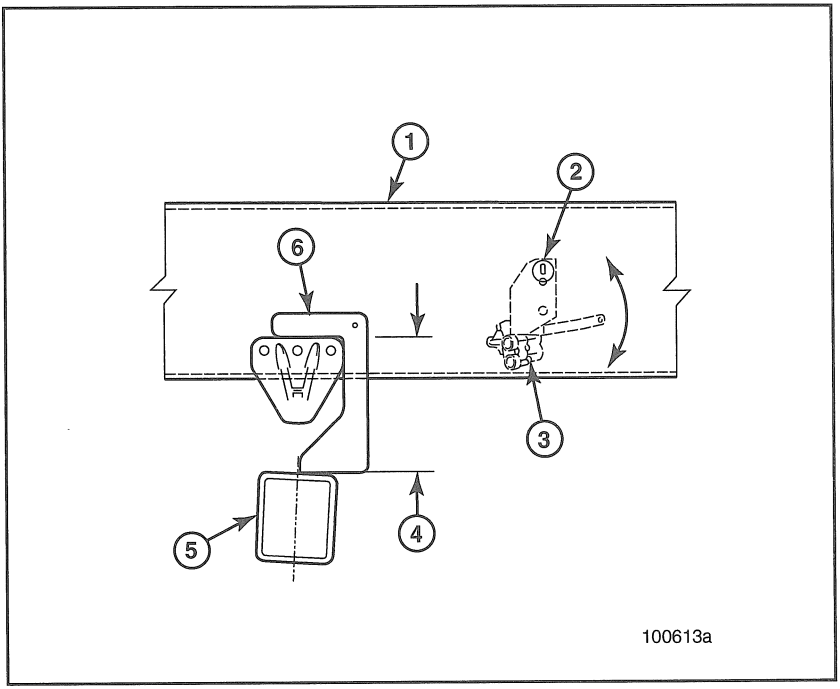


Figure 78 — Ride Height Measurement

1. LH Frame Rail	4. Ride Height Dimension
2. Adjustment Access Hole	5. Axle Housing
3. Height Control Valve	6. Ride Height Gauge (TS89604)

Ride height must be checked and adjusted when the vehicle is uploaded and parked on a level surface. Prior to checking or adjusting ride height, perform the following:

- Be sure the front steer axle and rear drive axle tires are properly inflated.
- Center the suspension by driving the vehicle back and forth twice without using the service brakes to bring the vehicle to a stop.
- Do not apply the parking brakes.
- Place blocks under the front wheels to prevent the vehicle from moving.
- Make sure the front wheels are pointing straight ahead.
- Make sure the transmission is in neutral.

Measure ride height as follows:

1. Completely exhaust the air pressure from the suspension.

⚠ DANGER

Stay clear of the chassis when air pressure from the suspension is being exhausted. The chassis can drop quickly, which can cause serious injury or death to anyone underneath the vehicle.

2. Start the engine and use the suspension switch in the cab to inflate the suspension.
3. Shut the engine off, then use the ride height gauge (part No. TS89604) to measure ride height. Ride height should be 8.5 inches (216 mm) as indicated by the gauge.

If ride height is not within specifications, adjust as follows:

NOTE

Ride height must be adjusted with the vehicle unloaded, parked on a level surface, transmission in neutral and the front wheels blocked to prevent the vehicle from moving.

1. Loosen the height control valve bracket mounting bolt so that the bracket is free to pivot about the bolt.
2. Insert the adjustment socket (tool No. J 44544) through the access hole located in the frame.

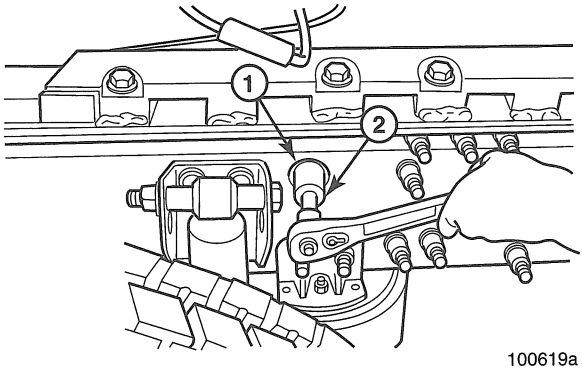


Figure 79 — Adjusting Ride Height

1. Access Hole (LH Frame Rail)	2. Adjustment Socket J 44544

3. Adjust ride height by rotating the valve and bracket as follows:
   - Rotate clockwise to raise ride height.
   - Rotate counterclockwise to lower ride height.
4. Once proper ride height is obtained, tighten the height control valve mounting bracket bolt to 37 lb-ft (50 N•m).
5. Remove the adjustment socket from the frame, and then exhaust and reinflate the suspension. Wait until airflow to the suspension has stopped, then recheck ride height. Readjust as necessary.

AXLE ALIGNMENT

NOTE

Jack up the front end and shake the wheels horizontally. Wheel bearing end play must be from 0.001 to 0.005 inch (.025 to .13 mm). Check all steering linkage components for excessive looseness. These steps must be taken so as not to introduce errors into geometry readings when checking toe-in, camber and caster. Also check for proper tire pressure.

Check axle alignment at first A inspection interval, thereafter at each C and D inspection for front axles and each D inspection for rear axles.

TOE SPECIFICATIONS*

MACK non-driving front axles: FAW 12, 14.3, FA(W) 18, 20, FA23 and FXL 12, 14.6, 18, 20	1/16″ ± 1/32″ (.06″ ± .03″) or .07° ± .035° or 1.5 mm/m ± .75 mm/m
ArvinMeritor™ or Eaton non-driving front axles	1/16″ ± 1/32″ (.06″ ± .03″) or 0°4′ ± 0° ± 2′ (0°2′ to 0°6′) or .07° ± .03° (.03° to .10°) or 1.5 mm/m ± .75 mm/m
ArvinMeritor™ or Marmon-Herrington front driving axles	1/16″ ± 1/16″ (.06″ ± .06″) or 0°4′ ± 0°4′ (0° to 0°8′) or .07° ± .07° (0° to .14°) or 1.5 mm/m ± 1.5 mm/m
Note: Toe-out ** FABCO Front Driving Axles (SDA1800, 2100, 2300)	1/16″ ± 1/16″ (.06″ ± .06″) or 0°4′ ± 0°4′ (0° to 0°8′) or .07° ± .07° (0° to .14°) or 1.5 mm/m ± 1.5 mm/m

* Set toe toward zero side of specification on vehicles equipped with steel belted radial tires or vehicles with lightly loaded front axles.

** HUNTER and JOSAM alignment equipment measurements indicating toe-out will be expressed as a negative number, i.e., –.07° for HUNTER, –1.5 mm/m for JOSAM.

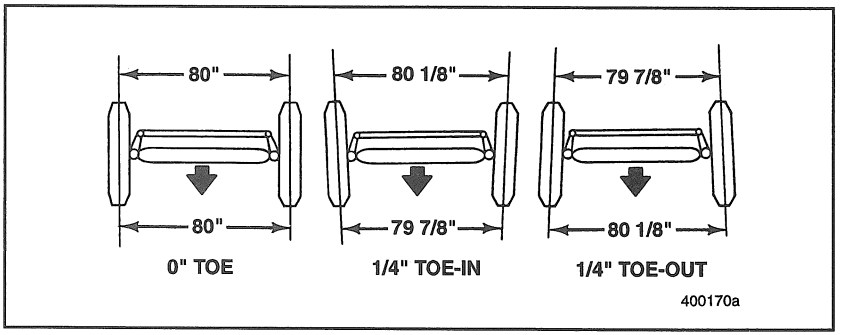


Figure 80 — Toe Measurements

CAMBER SPECIFICATIONS

VEHICLES BUILT AFTER JANUARY 1, 1995	
MACK non-driving front axles:	
FAW 12, 14.3	0° ± 7/16° (0° ± .43°)
FA(W) 16, 18, 20	1/4° ± 7/16° (.25° ± .43°)
FA23	3/4° ± 7/16° (.75° ± .43°)
FXL 12, 14.6, 18, 20	1/4° ± 7/16° (.25° ± .43°)
VEHICLES BUILT PRIOR TO JANUARY 1, 1995	
MACK non-driving front axles (except FA23)	0° to 0°30′ (0° to .5°)
MACK FA23 non-driving front axle	0°30′ to 1° (.5° to 1°)
Eaton non-driving front axles:	
EFA-12F4 and EFA-20F4 Axles	
Left side	7/16° ± 7/16° (.43° ± .43°)
Right side	–1/16° ± 7/16° (–.06° ± .43°)
E12021 Axles	
Left side	1/8° ± 7/16° (.13° ± .43°)
Right side	–1/8° ± 7/16° (–.13° ± .43°)
Dana non-driving front axles:	
I-120	
Left side	–1/8° ± 7/16° (–.13° ± .43°)
Right side	–1/8° ± 7/16° (–.13° ± .43°)
ArvinMeritor™ non-driving front axles	–0°41′ to 0°11′ (–.69° to .19°)
Driving front axles:	
ArvinMeritor™	0° to 0°30′ (0° to .5°)
FABCO (SDA1800, 2100, 2300)	0°15′ to 0°45′ (.25° to .75°)
Marmon-Herrington (MT23)	0°24′ to 0°36′ (.4° to .6°)

All measurements must be taken with the vehicle in the unloaded condition.

Specifications for vehicles built prior to 1993 may be different. See previously published information, or alignment equipment manufacturer's charts for specifications on older vehicles.

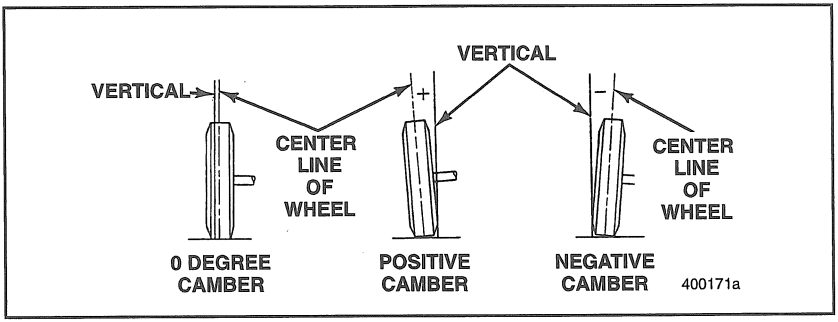


Figure 81 — Camber Angles

CASTER SPECIFICATIONS

Single non-driving front axle (all models except CX and CH) — Power Steering	4° to 6°
Single non-driving front axle — Power Steering: CH chassis prior to 12/9/96 CH chassis after 12/9/96 and CX	 1° to 3° 3° to 5°
Single non-driving front axle — Manual Steering: All except ArvinMeritor™ ArvinMeritor™ axles (except on CH chassis) ArvinMeritor™ axles (CH chassis)	 1° to 3° 0° to 2° 1° to 3°
Single front driving axle: All Marmon-Herrington (MT23) after January 1, 1995	 3°30′ to 5°30′ (3.5° to 5.5°) 2°30′ to 4°30′ (2.5° to 4.5°)
Two front axles: Front drive axles Front non-driving front axle Rear non-driving front axle	 3°30′ to 5°30′ (3.5° to 5.5°) 4° to 6° 4°30′ to 6°30′ (4.5° to 6.5°)

All measurements must be taken with the vehicle in the unloaded condition, and the steering axle and drive axle(s) on a level surface.

RH and LH caster readings must not vary more than 0°30′ (.5°).

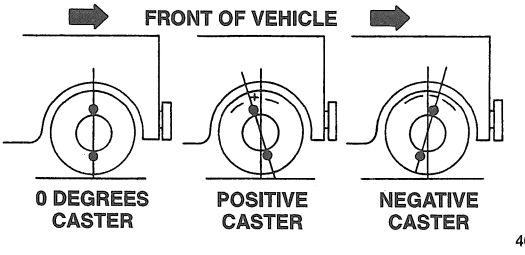


Figure 82 — Caster Angles

Rear Drive Axle Alignment Specifications

THRUST

Adjustable Suspensions	0″ ± 1/8" (0″ ± .125″) 0° ± .08° 0 mm/m ± 1.4 mm/m
Non-adjustable	0″ ± 1/4″ (0″ ± .25″) 0° ± .16° 0 mm/m ± 2.8 mm/m

Specifications are for Thrust Angles on Rear Drive Axles

SCRUB (Parallelism)

Adjustable Suspensions	0° ± 1/8″ (0″ ± .125″) 0° ± .08° 0 mm/m ± 1.4 mm/m
Non-adjustable Suspensions	0″ ± 1/4″ (0″ ± .25″) 0° ± .16° 0 mm/m ± 2.8 mm/m

Specifications are for Scrub (Parallelism) on Rear Drive Axles

WHEEL TORQUE PROCEDURES

Spoke Wheels

Tighten the wheel nuts in the sequence shown below. When replacing tire and rim assemblies, tighten lightly the first time and hold runout to under 1/8 inch (3.2 mm). Tighten nuts a quarter turn at a time, in sequence, to the torques listed below and recheck.

It is recommended that final nut tightening be done with a torque wrench. If an air impact wrench is used, periodic checks should be made with a torque wrench to ensure the accuracy and condition of the air wrench. The torque of the air impact wrench also depends upon the air line pressure from which it is operated.

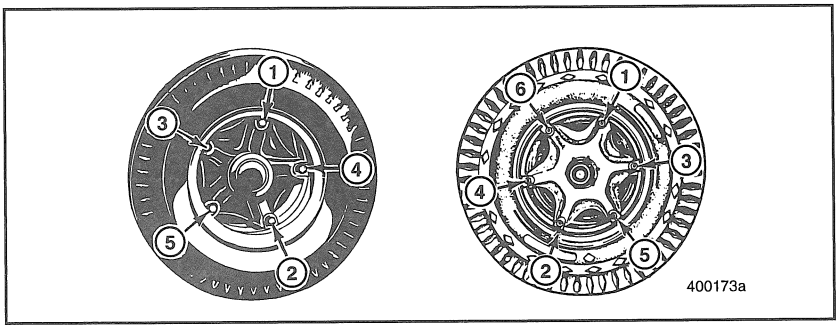


Figure 83 — Spoke Wheel Nut Tightening Sequence

SPOKE WHEEL TORQUE SPECIFICATIONS

Description	Stud Nut Size	Torque Lb-ft (N•m)*
Front Wheel Clamp Stud Nuts	5/8″-11 UNC	122–135 (165–183)
Front Wheel Clamp Stud Nuts (except FA18 and FA20 Series Axles)	3/4″-10 UNC	175–225 (237–305)
Front Wheel Clamp Stud Nuts (FA[W]18 and FA[W]20 Series Axles)	3/4″-10 UNC	240–260 (325–353)
Rear Wheel Clamp Stud Nuts	3/4″-10 UNC	175–225 (237–305)

* Threads must be dry.

See following note.

NOTE

Before installation of the wheel assemblies, thoroughly clean the brake drum, hub and rim assembly surfaces (particularly in the case of hub piloted wheels). After any procedure that requires the removal and reinstallation of the wheel assemblies, retorque the wheel nuts during the first 50–100 miles (80–161 km) of use.

Disc Wheels (Stud Piloted Ball Seat)

Single Disc Wheels (Stud Piloted Ball Seat) — Tighten the wheel nuts in the sequence shown below to the specified torque value given in table on page 230.

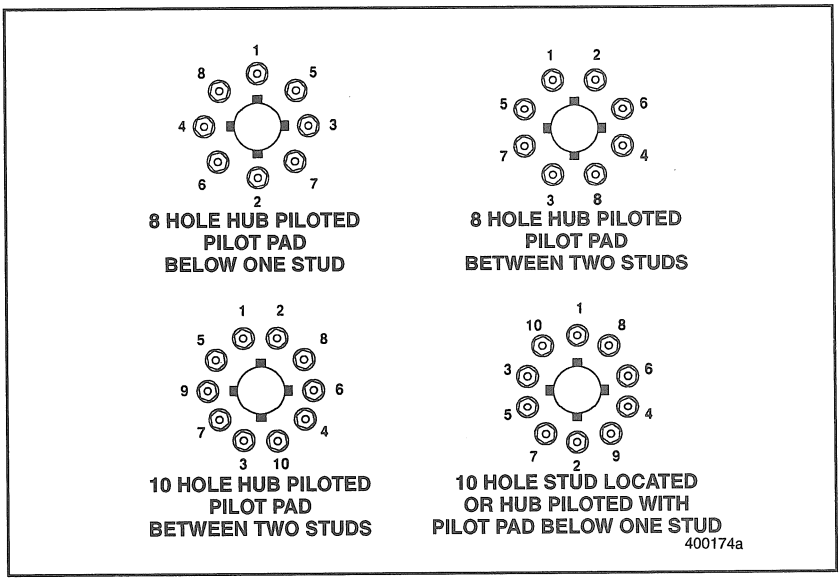


Figure 84 — Disc Wheels with Stud Piloted Ball Seat Tightening Sequence

Dual Disc Wheels (Stud Piloted Ball Seat) — Loosen outer wheel nuts first, then tighten the inner nuts in sequence shown (Figure 84) to the specified torque value given in table on page 230. After inner nuts are tightened, tighten outer wheel nuts, in sequence, to the specified torque value.

When installing wheels, tighten wheel nuts lightly first, then tighten a quarter turn at a time, in sequence, to the specified torque and recheck. When installing dual wheels, install the inner wheel first. Use the above procedure to tighten the inner wheel nuts. After the inner wheels have been installed, use the same procedure to install the outer wheels.

Disc Wheels (Hub Piloted)

Single and Dual Disc Wheels — Mounting faces of the hub, flange mounting surfaces of the wheels and mounting surfaces of the flange nuts should be clean and free of any foreign material or excess paint. The hub pilot pads should also be free of paint. To prevent corrosion, anti-sieze compound may be applied to the hub pilot pads. Primer and paint thickness on critical mounting surfaces of each wheel should not total more than 0.003-inch maximum. The hub and drum critical mounting surfaces should not be painted.

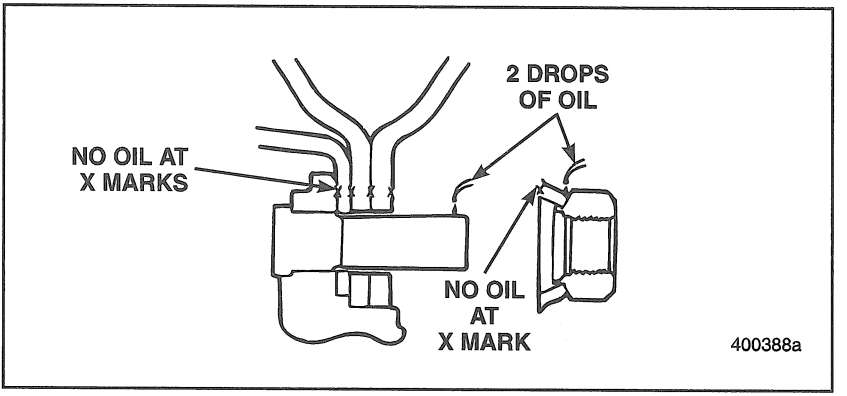


Figure 85 — Flanged Nut Installation

When installing flanged nuts, apply two drops of oil on the leading threads of each stud, and if the flange nuts have been used before, apply two drops of oil to the junction of the nut and flange of each flange nut. DO NOT get oil between the flange and the wheel.

To install hub piloted wheels:

1. Locate one of the hub pilot pads at the 12 o'clock position.

NOTE

Before mounting the wheels, be sure the drum is properly positioned on the raised step of the pilot pad.

2. With the wheel(s) square to the hub, mount the wheel(s) as far back on the pilot pad as possible. Be careful not to scrape the stud threads when installing the wheel(s). Install the flange nuts and hand-tighten.
3. Starting at the top stud position, partially torque the nuts in the sequence as shown in the illustration Figure 84.
4. Using the same sequence, torque the flange nuts to the final torque as given in table on page 230.

⚠ CAUTION

DO NOT use cone locknuts on stud located wheels, or ball-seat type nuts on hub piloted wheels. Sufficient contact surface between the nut and wheel will not be obtained, which may result in wheel loss.

Retorquing Hub Piloted Wheels

Hub piloted wheels must be retorqued during the first 50–100 miles following any procedure that requires the removal and reinstallation of the wheel assemblies. Always retorque the flange nuts when the components are at ambient temperature.

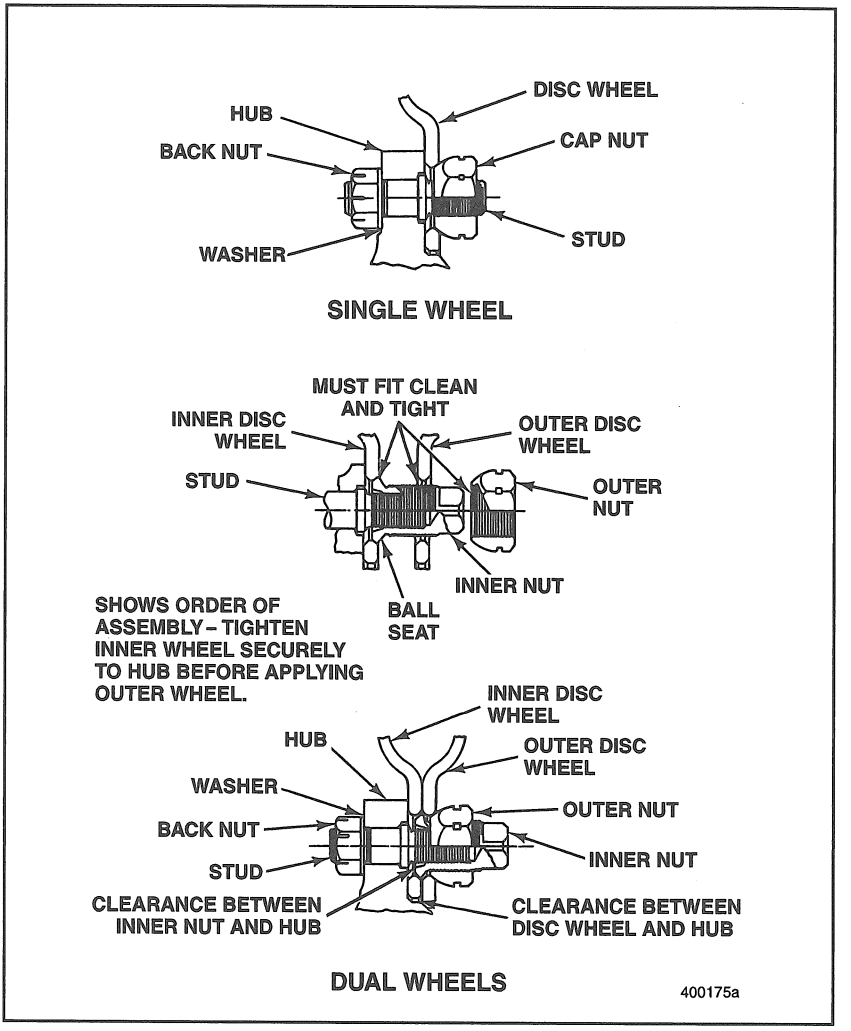


Figure 86 — Disc Wheel Assembly (Stud Piloted Ball Seat)

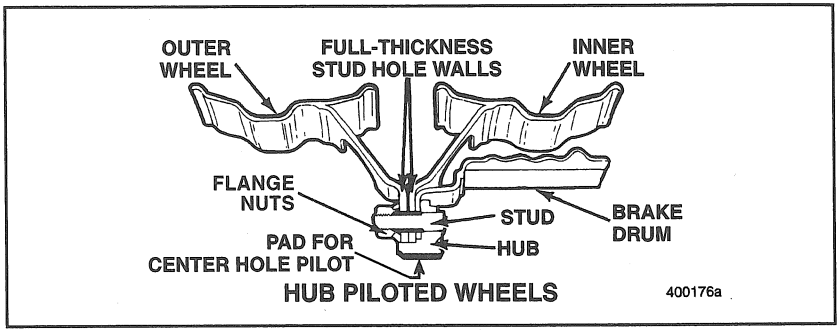


Figure 87 — Hub Piloted Wheels

It is recommended that final nut tightening be done with a torque wrench. If an air impact wrench is used, periodic checks should be made with a torque wrench to ensure the accuracy and condition of the air wrench. The torque of the air impact wrench also depends upon the air line pressure from which it is operated.

WHEEL NUT TORQUE SPECIFICATIONS

Description	Stud Nut Size and Type	Torque Lb-ft (N•m)*
Cap Nuts — Single (front) or inner and outer (rear) with shoulder or head-type studs	3/4″-16 UNF shoulder	450–500 (610–678)
	1-1/8″-16 UNF shoulder (3/4″ backnut)	450–500 (610–678)
	1-1/8″-16 UNF shoulder (7/8″ or 1″ backnut)	650–750 (881–1017)
	1-1/8″-16 UNF head	450–500 (610–678)
	15/16″-12 UNF shoulder or head	750–900 (1017–1220)
	1-5/16″-12 UNF shoulder or head	750–900 (1017–1220)
Backnut (inner end of wheel stud: shoulder-type studs with threads on both ends)	3/4″-16 UNF 7/8″-14 UNF 1″-14 UNF	175–200 (237–271) 175–250 (237–339) 175–300 (237–407)
Flange nuts for hub piloted wheels	M22 x 1.5 (metric threads)	450–500 (610–678)**

* Threads must be dry.

** If the wheels have been removed, apply a small amount of oil to the lead threads of the stud and between the nut body and flange of the cone locknut when reinstalling. Avoid getting oil on the face of the nut, wheels or tires.

Chain Clearance Spacers

Some chassis may be equipped with rear axle chain clearance spacers to provide additional clearance between the dual rear wheels and rear suspension components if tire chains are to be used. The spacer shown in the illustration below is used on chassis that are equipped with disc wheels. This type of spacer bolts to the hub assembly, and, depending upon rear wheel size and configuration, one or two spacers may be used. On chassis equipped with spoke wheels, different configuration chain clearance spacers are used. These spacers slide over, but are not bolted to, the hub assembly.

On those chassis having chain spacers bolted to the hub assembly, mounting nut torque should be checked at each A, B, C and D inspection interval. Wheel removal is necessary when mounting nut torque is checked. Also, if the chassis uses two spacers, it is necessary to remove the outer spacer to check the inner spacer nut torque.

Using the tightening sequence illustrated below, torque the chain spacer mounting nuts to a value of 450–500 lb-ft (610–678 N•m).

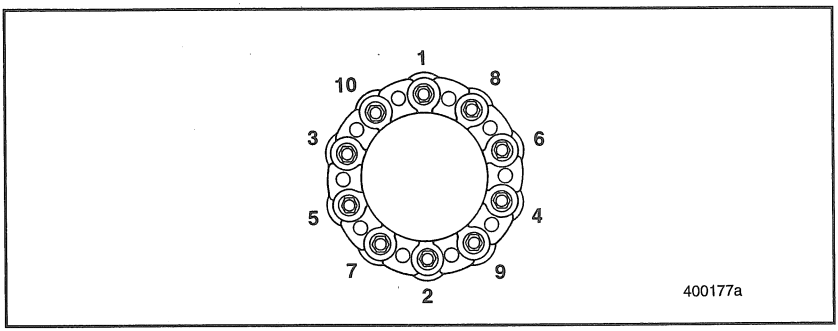


Figure 88 — Wheel Nut Tightening Sequence with Chain Clearance Spacers

NOTE

After any procedure that requires the removal and reinstallation of the wheel assemblies, retorque the wheel nuts during the first 50–100 miles (80–161 km) of use.

It is recommended that final nut tightening be done with a torque wrench. If an air impact wrench is used, periodic checks should be made with a torque wrench to ensure the accuracy and condition of the air wrench. The torque of the air impact wrench also depends upon the air line pressure from which it is operated.

TIRE INFORMATION

Tire Inspection

Inspect tires daily, and look for bulges, cuts, penetrations, uneven wear and/or oil contamination. If any damage is found, the tire must be thoroughly inspected by a qualified tire inspector and repaired or replaced immediately, at his discretion.

If uneven tire wear is found, a thorough inspection of the chassis, inspecting those items that influence tire wear, should be performed. Chassis inspection and alignment must be performed by a qualified technician.

Factors That Influence Tire Wear

The following factors will influence tire wear, affecting both wear rate and uneven tire wear:

- Tire Pressure and Loading
- King Pin Play
- Toe Adjustment
- Axle Alignment
- Tire Selection and Matching
- Turning Angle
- Wheel Balance
- Shock Absorbers
- Wheel Runout, Radial and Lateral
- Vocation (How the Chassis Is Used)
- Tire Condition/Damage
- Spring Pin Play
- Oil Contamination
- Torque Rod Play
- Tire Mounting

- Fifth Wheel Setting
- Tie Rod End Play
- Wheel Bearing Play
- Lack of Lubrication on Fifth Wheel Top Plate

Oil Contamination of Tires

Oil contamination will soften rubber and eventually destroy the tire. Ensure that oil leakage does not occur by inspecting the following areas regularly:

- Engine oil seals
- Transmission oil seals
- Axle hub seals
- Drive axle seals
- Oil filters and oil lines

Tire Selection

Select the proper tire for the vehicle vocation and axle position. Tire selection should be matched to the manufacturer's application guidelines. Consult a qualified tire specialist for proper tire selection.

The overall ratio of an axle is affected by the number of revolutions the tires make in a mile, and will change if tire size, make, ply type and tread design are changed. Particularly on all-wheel-drive vehicles using the MACK TC(S) 15/25 transfer case, overall ratio match between the front and rear axles must be maintained or damage to the front drive axle, driveline or transfer case may result. Unless replacement tires are identical to the originals, consult your MACK distributor or service facility to select replacements that will maintain ratio match within acceptable limits.

Tire Inflation

Proper tire inflation pressures ensure maximum mileage and overall tire performance. Consult the specific tire manufacturer's books for correct inflation pressures per load, or refer to the vehicle safety certification label.

⚠ WARNING

Never operate a vehicle with underinflated (or overloaded) tires, as this condition will cause excessive heat build-up which can result in sudden tire destruction, property damage and personal injury.

Tire Rotation

Radial tires should be rotated only when necessary. If the tires are wearing evenly, there is no need to rotate. If irregular wear becomes apparent, or if wear rate on the tires is perceptively different (from axle to axle or left side to right side of vehicle), then the tires should be rotated in such a manner as to alleviate the condition.

NOTE

Some tires have tread that is uni-directional; consult manufacturer product information. Other than these specific tires, there is no restriction on criss-cross rotation or reversing direction.

Tire Wear and Driving Habits

All tires will wear out faster when subject to high speeds, as well as hard cornering, rapid starts, sudden stops, frequent turning at high turning angles, and frequent driving on surfaces which are in poor condition. Surfaces with holes and rocks or other objects can damage tires and cause axle misalignment.

Tire Loading

Consult the tire manufacturer's data book for complete information on the allowable loads for your tires. Load capacity may vary with inflation pressure, and the speed at which the tire will be used. Tires which are loaded beyond their maximum allowable loads will build up excessive heat that will result in rapid wear and/or sudden tire destruction.

⚠ CAUTION

For additional tire information (i.e., high-speed limits, inflation pressures, etc.), consult the product information available through the specific tire manufacturer.

TIRE SERVICING

⚠ DANGER

Safety precautions must be taken when handling truck tires. Particularly when servicing multi-piece wheel rims, proper safety precautions must be observed. Failure to comply with the following procedures may result in serious injury or death.

When removing tire and wheel assemblies or rim and wheel assemblies from the vehicle, set the spring brakes and chock the wheels which are not being removed. Use a heavy-duty jack to raise the vehicle.

Instruct all tire and rim handling personnel on how to mount tires safely.

Completely deflate the tires by removing the valve core before disassembling the tire from the rim.

Use proper tools to mount and demount the tires.

Use approved rust-retarding compounds to keep rims clean and free from rust and corrosion.

Use the correct size rim for the specified tire.

Avoid rim damage when changing the tires.

Examine the inside of the tire before mounting. Dry thoroughly if any moisture is found.

Use proper tubes and flaps with radial tires.

Use the correct tire lubricant sparingly, especially in radial tire application, to minimize the possibility of fluid entering the tire.

Install the side or lock ring splits directly opposite (180 degrees) the valve stem slot.

⚠ DANGER

Failure to follow proper safety precautions when servicing multi-piece wheel rims may result in serious injury or death.

DO NOT over-inflate the tires.

DO NOT overload the rims.

DO NOT remove the tire from the rim before completely deflating.

DO NOT attempt to correct seating of the side and lock rings by hammering while the tire is inflated. DEFLATE THE TIRE FIRST.

DO NOT use corroded, damaged or distorted rims, rings or trim parts.

DO NOT fail to identify different makes of similar clamps; paint each make a different color.

DO NOT use petroleum oil or grease on tire beads or rims. They will ruin the tires.

DO NOT use mismatched side and lock rings.

DO NOT inflate the tires before all side and lock rings are in place.

DO NOT inflate the tire unless it is placed in a safety cage or a portable lock ring guard.

AIR BRAKE SYSTEM

Dual Circuit Brake System Function Test

The following Dual Circuit Brake System Function Test should be performed at each C and D inspection interval, or after any air system service procedures that involve disconnecting and reconnecting air lines where incorrect reconnection, such as the treadle valve, is a possibility.

1. Block the wheels to prevent the vehicle from moving.
2. Start the engine and build air system pressure to governor cutout.
3. Stop the engine.
4. Completely drain one air reservoir.
5. Release the parking brakes.
6. Apply and hold the treadle valve.
7. Have an assistant check for proper results by observing the movement of the slack adjusters as indicated below:

   TRUCK:

   - The brakes on the rear drive axle(s) should always apply as indicated by movement of the slack adjuster.
   - The low-air warning buzzer and warning lamp should activate for at least two of the tests.
   - TRACTOR:
   - The brakes on either the steering axle or the rear drive axle(s) should always apply as indicated by movement of the slack adjuster.
   - The low-air warning buzzer and warning lamp should activate for at least two of the tests.
8. Repeat the above procedures for the remaining air reservoirs (do not include air reservoirs for air starter if so equipped).

Long Stroke Chambers

Prior to 1/27/97, type 24 long stroke brake chambers were standard equipment on 34,000 to 44,000 lbs. rear axle suspensions, with type 30 brake chambers as an available option. After 1/27/97, type 30 brake chambers became the standard chamber on 34,000 to 44,000 lbs. rear axle suspensions.

The long stroke concept provides increased stroke to reduce adjustment frequency, improved service chamber power, increased spring force for parking, and the use of smaller chambers while still developing adequate braking force.

There is a difference in diaphragm configuration between the long stroke and standard chambers. The diaphragm used in the long stroke chamber has a depth of 1.53 inches (38.8 mm), while the standard diaphragm has a depth of 1.25 inches (31.8 mm). Stroke length is 2.50 inches (63.5 mm) for long stroke chambers and 2.25 inches (57.2 mm) for the standard stroke chambers.

The standard stroke diaphragm must not be installed in the long stroke chamber. To prevent confusion and/or mismatch of parts, both the diaphragm and housing(s) are identified by prominent markings.

Long Stroke Identification

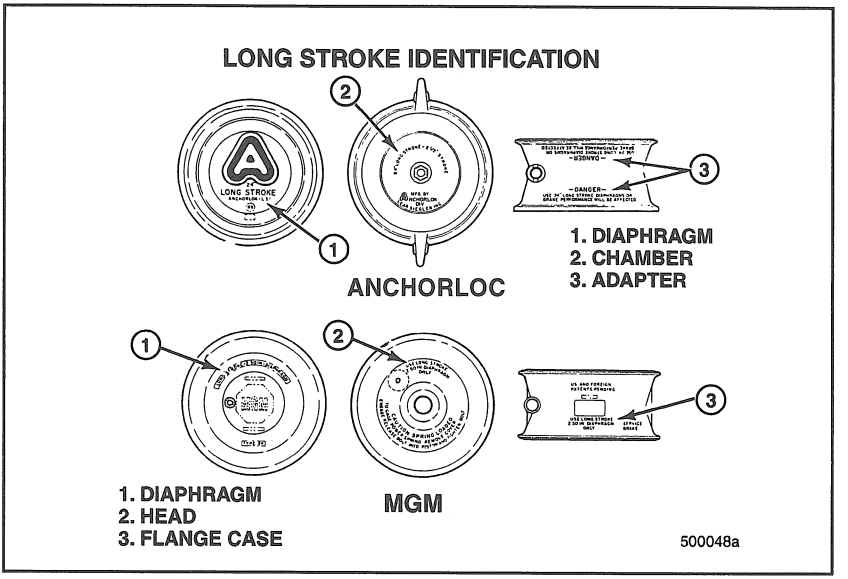


Figure 89 — Long Stroke Identification

BRAKE ADJUSTMENT

Cam Brake Adjustment

PROCEDURE FOR CHECKING PUSH ROD TRAVEL

1. With the brakes released, measure the distance between the flat surface of the brake chamber to the center of the push rod clevis pin. (If the chassis is equipped with Haldex automatic slack adjusters, measure to the far side of the clevis pin hole.)

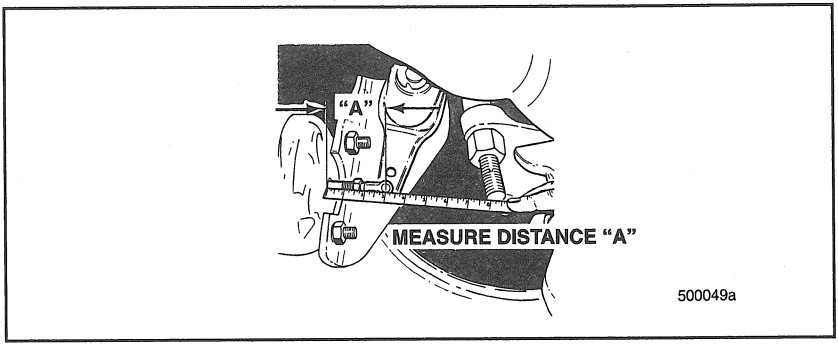


Figure 90 — Brakes Released Measurement

2. Make and hold a full brake treadle application.
3. With the brakes applied, again measure the distance between the flat surface of the brake chamber to the center of the push rod clevis pin (far end of the clevis pin hole for Haldex automatic slack adjusters).

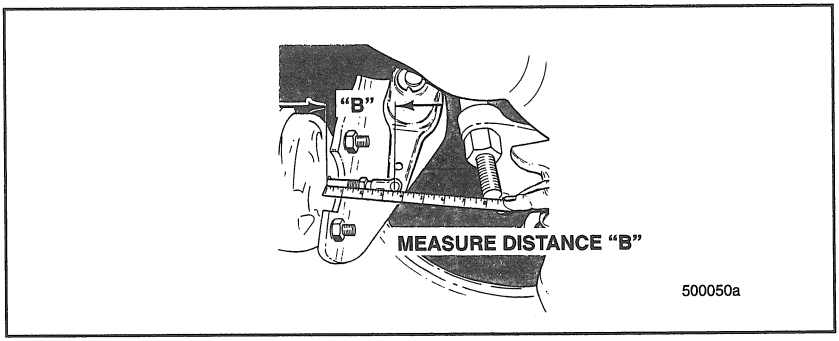


Figure 91 — Brakes Applied Measurement

4. Subtract the measurement made with the brakes released from the measurement made with the brakes applied. The difference is the stroke.
5. Compare the stroke measurement with the maximum stroke shown in the last column of the chart below.

PUSH ROD TRAVEL SPECIFICATIONS

Chamber Size	Effective Diaphragm Area (Sq. In.)	Overall Diameter Inches	Maximum Applied Stroke Inches (mm)
9 —	9	5-1/4	1-3/8 (34.9)
12 —	12	5-11/16	1-3/8 (34.9)
16 —	16	6-3/8	1-3/4 (44.4)
20 —	20	6-13/16	1-3/4 (44.4)
24 —	24	7-1/4	1-3/4 (44.4)
24L —	24	7-1/4	2 (50.8)
30 —	30	8-1/8	2 (50.8)
36 —	36	9	2-1/4 (57.1)

⚠ DANGER

Proper brake adjustment must be maintained for the safe operation of your truck.

⚠ DANGER

Raise the axle to be adjusted and support on safety stands.

- ***Support front axle under the axle housing or center of axle.***
- ***Support rear axle under the lower spring trunnion.***

Chock the wheels that remain on the ground.

Release the parking brake while adjusting the brakes.

MANUAL SLACK ADJUSTERS

Adjust the brakes whenever the push rod-applied stroke exceeds the maximum allowable stroke as given in the table on page 242.

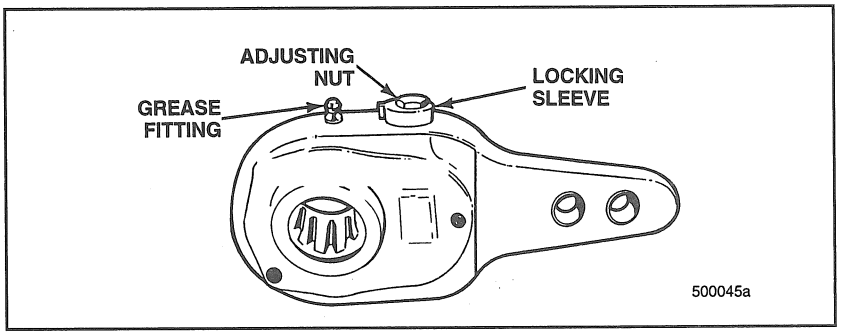


Figure 92 — Manual Slack Adjuster

Position the wrench over the adjusting screw and depress the adjusting lock sleeve BEFORE attempting to turn the adjusting screw. With the brake chamber push rod in the released position, turn the adjusting screw, while rotating the wheel, until the brake linings are against the brake drum. Back off the adjusting screw until the wheel rotates freely. When the adjustment is complete, be sure the locking sleeve is returned to its locked position by allowing the sleeve to engage the hex head of the adjusting screw.

NOTE

Be sure all wheels are on the ground when the brakes are applied.

After proper adjustment, apply the brakes. The slack adjuster arm and brake chamber push rod should form an angle of 90 degrees. The brake chamber push rod should also form a 90-degree angle with the flat mounting surface of the brake chamber. All slack adjusters on the vehicle must be at the same angle.

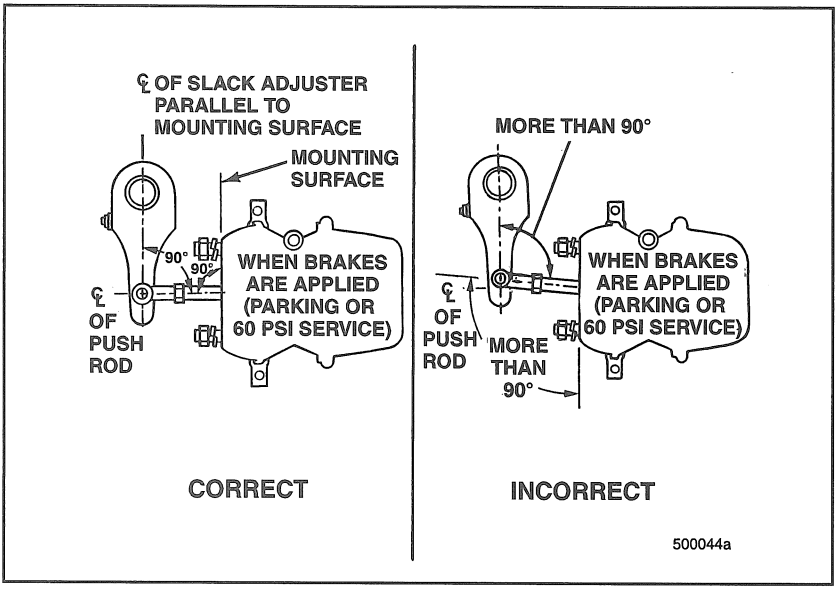


Figure 93 — Proper Slack Adjustment

AUTOMATIC SLACK ADJUSTERS

Automatic slack adjusters are designed to automatically maintain proper brake chamber stroke and compensate for brake lining wear during normal use. The only time automatic slack adjusters will need adjustment is during initial installation, removal or to back off the brake shoes during brake work such as brake shoe relining, brake drum reconditioning, etc. DO NOT rely on automatic slack adjusters to take up excessive initial clearance. For procedures to adjust automatic slack adjusters, refer to the *Air and Brake System Service Manual*, 16-104.

⚠ CAUTION

Before attempting to turn the manual adjusting nut on ArvinMeritor™ automatic slack adjusters, the pawl must first be removed or damage to the pawl teeth may result.

CAB MOUNT MAINTENANCE — LE AND MR MODELS

Cab Mounting Maintenance and Alignment Adjustment — LE and MR Model Chassis

At each C and D inspection interval, cab rear mounting alignment must be checked and adjusted, if necessary, and the anti-vibration pads on the frame-mounted V-brackets must be inspected. Replace any pads that are missing or damaged.

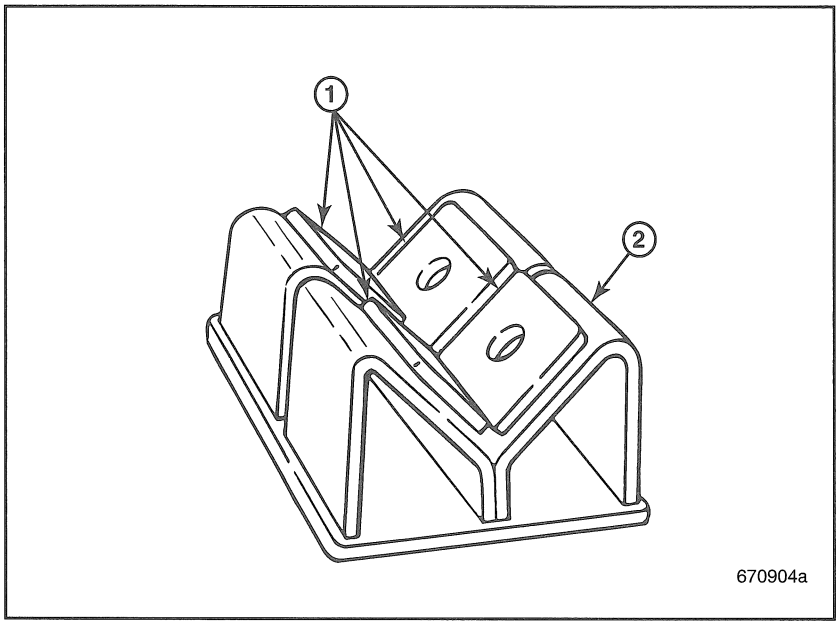


Figure 94 — Cab Mount Anti-Vibration Pads

1. Anti-Vibration Pads	2. V-Bracket

CAB MOUNT/LATCH ALIGNMENT — LE MODELS

To check cab mount alignment, raise the cab, apply a generous amount of white lithium grease to all four anti-vibration pads on the V-bracket, then lower the cab until the cab latch hook fully engages the V-block. As the hook engages, observe that it enters the block without contacting the edges. Raise the cab and examine the grease on the anti-vibration pads for uniform contact with the mating surfaces of the V-block. Also, when raising the cab, make sure there is no contact or interference between the cab latch hook and the cab V-block. On the right-hand side of the vehicle, make sure the cab latch hook does not contact the turbocharger inlet tube when fully opened. These checks must be performed on each side of the vehicle.

ADJUSTMENT

The mounting bolt holes in the frame-mounted cab mount bracket, latch cylinder mounting plate and cab rear mount V-block are all slotted for adjustment purposes. The frame-mounted bracket can be tilted fore and aft along the vertical centerline of the bracket, and the cab-mounted V-block can be tilted up and down along the horizontal centerline of the block so that uniform contact between the V-block and anti-vibration pads can be obtained. The latch cylinder can be moved in the inboard and outboard directions so that uniform side-to-side contact can be obtained.

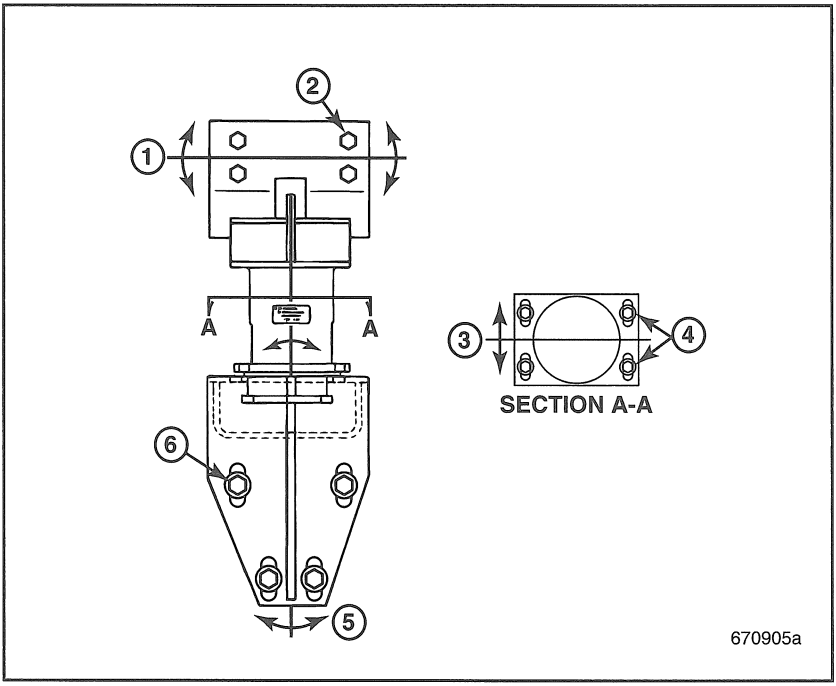


Figure 95 — Adjustment Points — LE Model Cab

1. Tilt Up/Down	4. Loosen Four Bolts
2. Loosen Eight Bolts	5. Tilt Fore/Aft
3. Move Inboard/Outboard	6. Loosen Four Bolts

NOTE

The front inner two mounting bolts of the V-block are located behind a body panel. The panel must be removed to access these two bolts.

If the grease print on the anti-vibration pads shows that the V-block is not sitting evenly in the V-bracket in the front-to-back directions (i.e., heavy contact against the front two pads and light contact against the rear two pads), loosen the frame bracket and V-block mounting bolts and tilt the bracket and V-block as required to obtain uniform contact. If the grease print shows that the V-block is not contacting the anti-vibration pads in the side-to-side directions (i.e., heavy contact against the inner two pads and light contact against the outer two pads), loosen the latch cylinder mounting bolts and move the cylinder assembly inboard or outboard as necessary to obtain uniform contact.

After completing the alignment adjustments, tighten the mounting bracket fasteners as follows:

- **Cab Latch Cylinder Mounting Plate** — 25 lb-ft (34 N•m)
- **Frame-Mounted Cab Mount Bracket** — 74 lb-ft (100 N•m)
- **Cab Rear Mount V-Block** — 48 lb-ft (65 N•m)

If the latch hook on the right-hand side of the chassis contacts the turbocharger inlet tube, loosen the inlet tube clamps and rotate the tube inboard, away from the latch hook.

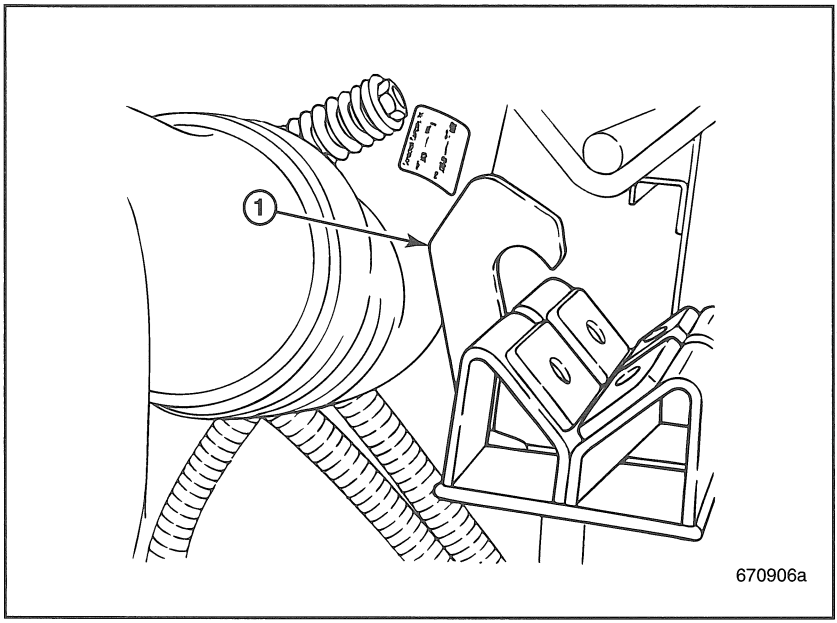


Figure 96 — Adjust Inlet Tube to Avoid Contact with Cab Latch

1. Avoid Contact Between Tube and Latch

CAB MOUNT/LATCH ALIGNMENT — MR MODELS

To check cab mount alignment, raise the cab, apply a generous amount of white lithium grease to all four anti-vibration pads on the V-bracket, then lower the cab until the cab latch hook fully engages the V-block. As the hook engages, observe that it enters the block without contacting the edges. Raise the cab and examine the grease on the anti-vibration pads for uniform contact with the mating surfaces of the V-block. Also, when raising the cab, make sure there is no contact or interference between the cab latch hook and the cab V-block. These checks must be performed on each side of the vehicle.

ADJUSTMENT

The bolt holes in the latch cylinder mounting plate and the cab rear mount V-block are slotted for adjustment purposes. The V-block can be moved fore and aft along the horizontal centerline of the cab to ensure the cab latch hook enters the slot in the V-block without interference. The latch cylinder assembly can be moved in the inboard and outboard directions (relative to the frame) so that uniform side-to-side contact on the anti-vibration pads can be obtained. The mounting bolt holes for the frame-mounted cab mount bracket are not slotted. For uniform front-to-back contact on the anti-vibration pads, it will be necessary to loosen the two mounting bolts and tilt the bracket as necessary to obtain uniform contact.

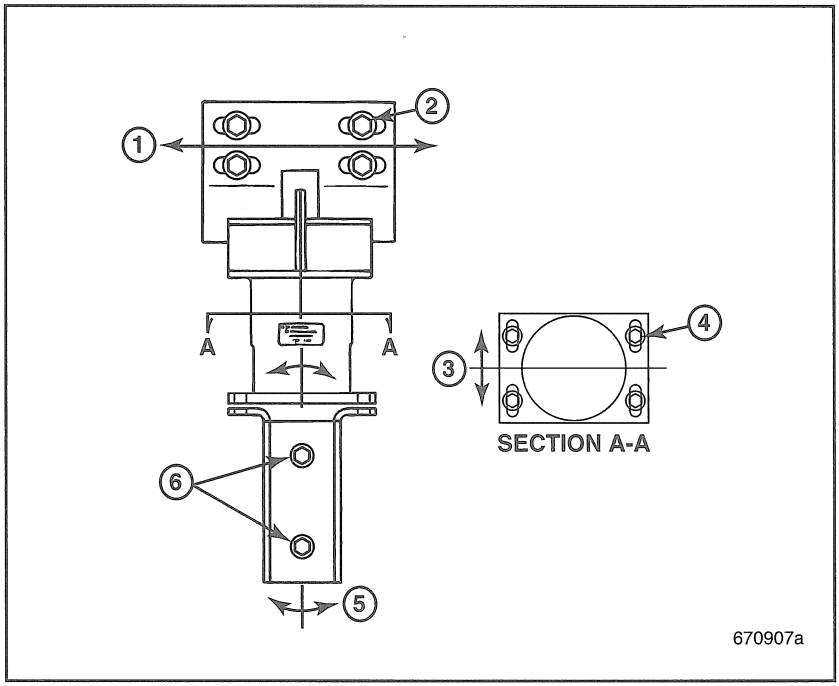


Figure 97 — Adjustment Points — MR Models

1. Move Fore/Aft	4. Loosen Four Bolts
2. Loosen Eight Bolts	5. Tilt Fore/Aft
3. Move Inboard/Outboard	6. Loosen Six Bolts

If the grease print shows that the cab rear mount V-block is not contacting the anti-vibration pads evenly in the fore and aft directions (i.e., heavy contact against the forward two pads and light contact against the rearward two pads), loosen the frame-mounted cab mount bracket and tilt the bracket as necessary to obtain uniform contact. If the grease print shows that the cab rear mount V-block is not contacting the anti-vibration pads evenly in the side-to-side directions (i.e., heavy contact against the inner two pads and light contact against the outer two pads), loosen the latch cylinder mounting bolts and move the cylinder assembly inboard or outboard as necessary to obtain uniform contact. After performing the adjustments to the frame-mounted bracket and the cab latch cylinder mounting plate, verify that the latch hook is centered in the V-block when the cab is completely lowered and does not contact the latch hook as the cab is being raised or lowered. If the latch book is not centered or it contacts the V-block, loosen the eight rear cab mount V-block mounting bolts and move the block fore and aft as required.

After completing the alignment adjustments, tighten the mounting bracket fasteners as follows:

- **Cab Latch Cylinder Mounting Plate** — 25 lb-ft (34 N•m)
- **Frame-Mounted Cab Mount Bracket** — 74 lb-ft (100 N•m)
- **Cab Rear Mount V-Block** — 48 lb-ft (65 N•m)

CLUTCH ADJUSTMENT

In order for the clutch to release properly, the clutch release bearing must travel 1/2 to 9/16 inch (12.7–14.3 mm), and there must be 1/8 inch (3.2 mm) of clearance between the clutch release yoke and the release bearing wear pads.

Through normal use the friction surfaces of the clutch wear, causing an increase in release bearing travel. As bearing travel increases, the clearance between the release yoke and wear pads decreases, which becomes evident as a decrease in clutch pedal free travel in the cab. When a decrease in free travel is noticed, adjustment of the clutch release bearing travel is necessary to maintain proper clutch release operation. An improperly adjusted clutch will slip and eventually burn out.

Clutch Release Bearing Travel Adjustment

When clutch pedal free travel decreases to 1/2 inch (12.7 mm), the following adjustment procedure must be used to ensure proper clutch adjustment:

1. Remove the inspection cover from the transmission bell housing.
2. Measure release bearing travel. Release bearing travel is the distance between the rear face of the clutch release bearing and the clutch brake. There should be 1/2 to 9/16 inch (12.7–14.3 mm) of release bearing travel.

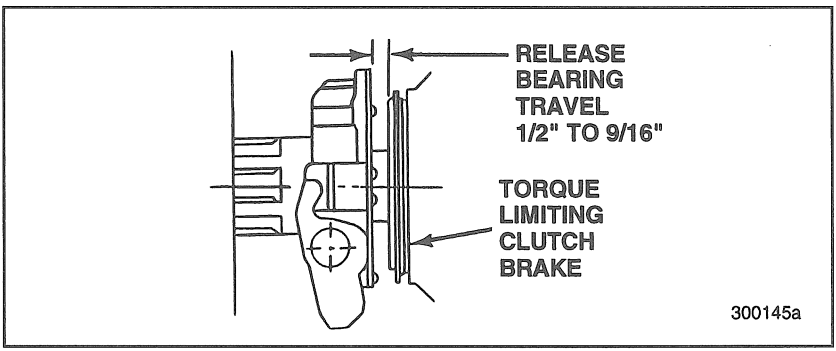


Figure 98 — Release Bearing Travel

If travel is not within specification, adjust as follows:

Spicer Easy Pedal 14- and 15-1/2-Inch Angle Spring Clutches with Kwik-Adjust™ Component

A. Using the engine barring tool J 38587-A, rotate the engine in the direction of normal rotation until the Kwik-Adjust™ component is visible through the bell housing inspection hole.

B. Insert a 5/8-inch socket or box wrench through the inspection hole, over the hex headed bolt on the Kwik-Adjust™ component.

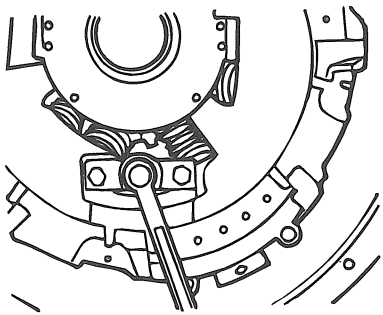


Figure 99 — Adjusting Clutch

C. Depress and turn the bolt in the direction of the arrow embossed on the clutch to adjust for wear.

NOTE

The clutch must be released before attempting to turn the adjusting nut.

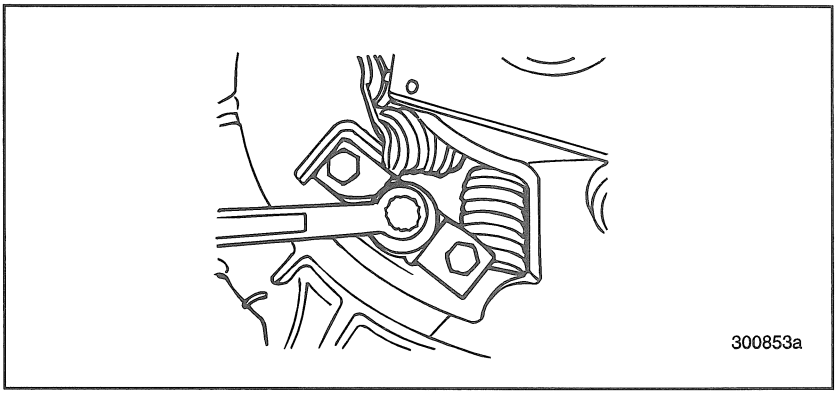


Figure 100 — Adjusting Release Bearing Travel

- Turning the Kwik-Adjust™ component clockwise moves the release bearing toward the transmission (decreases clutch travel).
- Turning the Kwik-Adjust™ component counterclockwise moves the release bearing toward the engine (increases release bearing travel).

D. The Kwik-Adjust™ component will re-engage at each sixth turn and a flat of the hex headed bolt will align with the flat edge of the bracket.

NOTE

The Kwik-Adjust™ component on some chassis may utilize a square headed bolt requiring a 3/4-inch, 12-point wrench or socket for clutch adjustment, and re-engages at every 1/4 turn.

E. Release the clutch and remeasure release bearing travel.

ArvinMeritor™ 15-1/2-Inch Clutch

A. Using the engine barring tool J 38587-A, rotate the engine in the direction of normal rotation until the clutch adjusting lock plate is visible through the bell housing inspection hole.

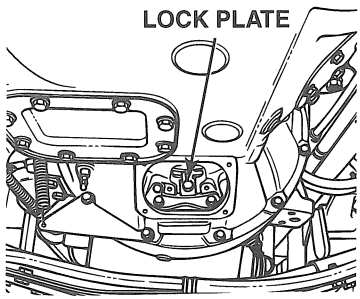


Figure 101 — Clutch Adjusting Lock Plate

B. Remove the screw and washer from the lock plate and then remove the lock plate.

NOTE

The clutch must be released before attempting to turn the clutch adjusting ring.

C. Rotate the adjusting ring to obtain the 1/2 inch of release bearing travel. The adjusting ring can be rotated by using a universal clutch adjusting tool J 36216 or a large screwdriver as a lever against the notches on the adjusting ring. Moving the adjusting ring one notch moves the release bearing approximately 0.020 inch (0.50 mm).

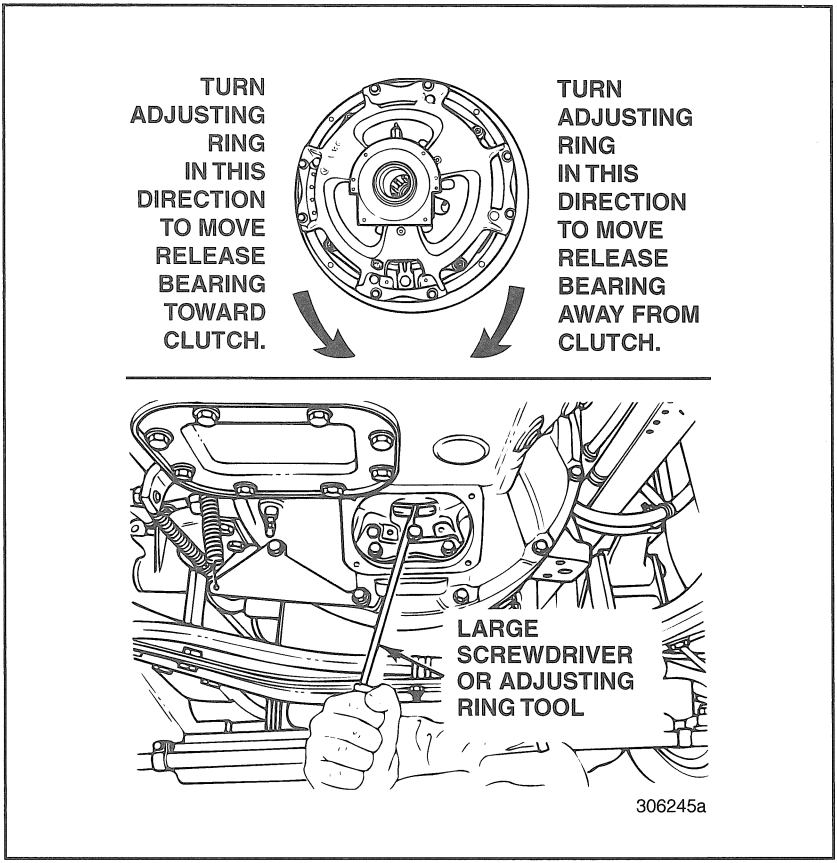


Figure 102 — Adjusting Clutch

D. Release the clutch and remeasure release bearing travel.

E. If release bearing travel is within the specification of 1/2″–9/16″ (12.7–14.3 mm), reinstall the lock plate and tighten the capscrew to 25–30 lb-ft (34–41 N•m).

Clutch Pedal Free Travel Adjustment

After the 1/2 inch (12.7 mm) of release bearing travel has been properly adjusted, clutch pedal free travel must be checked and adjusted as required. Most MACK chassis utilize a standard cable-operated clutch release system. CX, CV, CH and CL model chassis may also be equipped with an optional air-operated clutch assist release system. Clutch pedal free travel specifications for both release systems are as follows:

- **Standard cable-operated clutch release system —** 1-3/4 ± 1/4 inch (44.5 ± 6.4 mm)
- **Air-operated clutch assist release system —** 1-1/8 ± 1/4 inch (28.7 ± 6.4 mm)

Clutch pedal free travel adjustments are performed by adjusting the clutch dog adjusting bolt. Typically, the clutch dog must be positioned on the splined clutch release shaft with the lock bolt centered in the slot. On chassis equipped with the air-operated clutch assist system, with the clutch dog in this position and the clutch pedal released (clutch engaged), there should be approximately 3.0–3.8 inches (76.2–96.5 mm) of cylinder rod exposed from the cylinder body to the bottom of the rod end. This dimension provides proper cable travel and ensures that the cylinder will not bottom when the clutch pedal is pushed in (clutch disengaged).

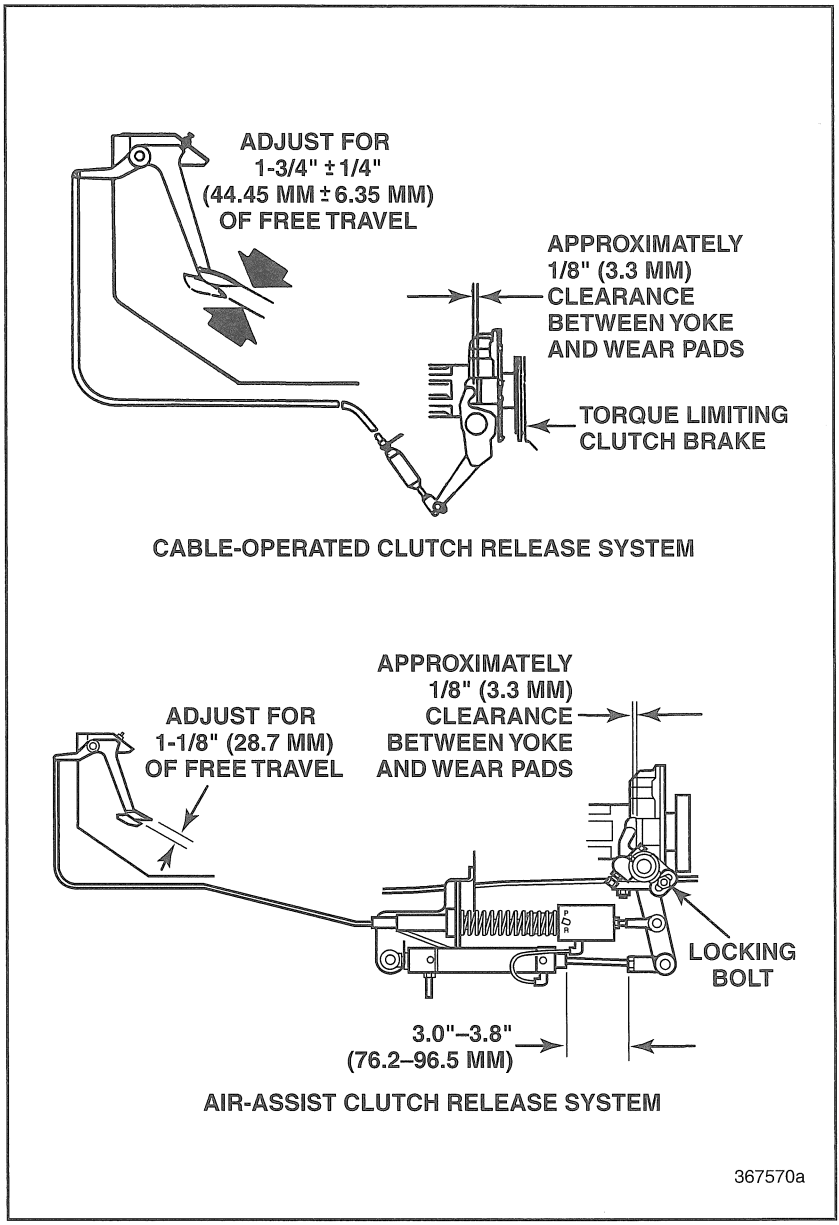


Figure 103 — Clutch Pedal Free Travel

If clutch pedal free travel is not within specifications, adjust as follows:

NOTE

Adjustments to the external linkage are seldom necessary and should only be made to compensate for wear in the linkage assembly or release mechanism. NEVER attempt to adjust the external linkage to compensate for wear of the clutch friction surfaces. Release bearing travel must be set BEFORE adjusting free pedal.

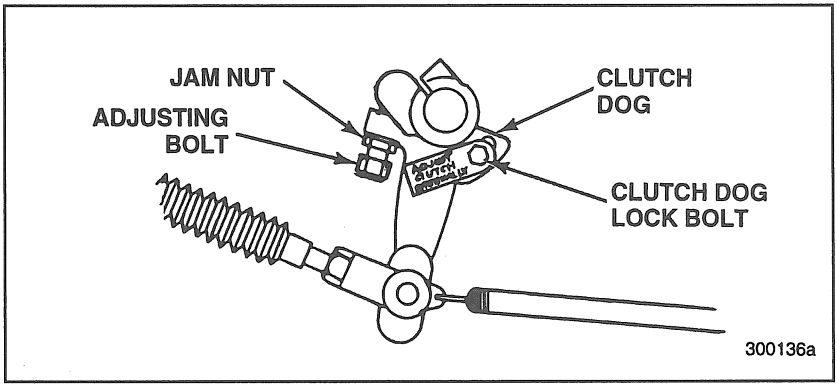


Figure 104 — Pedal Free Travel Adjustment (Standard Cable-Operated Shown)

1. Loosen the clutch dog lock bolt.
2. Loosen the jam nut on the clutch dog adjusting bolt.
3. Turn the adjusting bolt counterclockwise to increase clutch pedal free travel or clockwise to decrease free travel.
4. When free travel has been adjusted, tighten the adjusting bolt jam nut and the clutch dog lock bolt, then recheck free pedal.

Clutch Brake Adjustment

After the release bearing travel and the clutch pedal free travel have been properly adjusted, check and verify that clutch brake squeeze can be felt within the last 1/2 to 1 inch (12.7–25.4 mm) of clutch pedal travel.

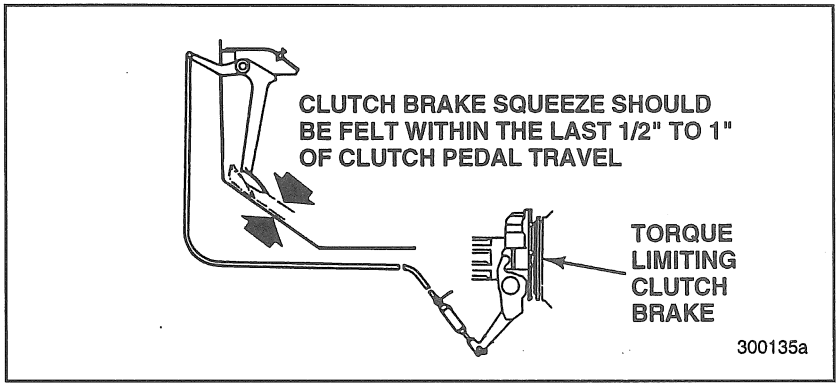


Figure 105 — Clutch Brake Squeeze (Spicer Easy Pedal)

Check the position at which clutch brake squeeze occurs as follows:

1. Insert a 0.010-inch feeler gauge between the rear face of the clutch release bearing and the clutch brake.
2. Fully depress the clutch pedal.
3. Slowly release the clutch pedal, and stop releasing as soon as the feeler gauge can be pulled from between the release bearing and the clutch brake.
4. Measure to see if the pedal is within the last 1/2 to 1 inch of travel.

NOTE

In most instances, brake squeeze will occur within specifications after the release bearing travel and clutch free pedal have been properly set. Some models, however, have adjustable pedal stops which may be adjusted if clutch brake specifications cannot be met.

After completing all the clutch adjustments, reinstall the transmission bell housing inspection cover.

Clutch Assist Cylinder Filter

The air-operated clutch assist release system consists of a cable-operated air regulator and a single-acting air cylinder. The air cylinder contains an exhaust port at the "blind-end" of the cylinder where air exhausts from the cylinder as the cylinder rod retracts, and is drawn into the cylinder when the cylinder rod extends. The exhaust port includes a sintered-bronze filter to prevent contaminants from entering the cylinder. If the clutch pedal feels "spongy," or increased pedal effort is noticed, remove the filter from the exhaust port, clean in a suitable non-flammable solvent, blow dry with compressed air and reinstall.

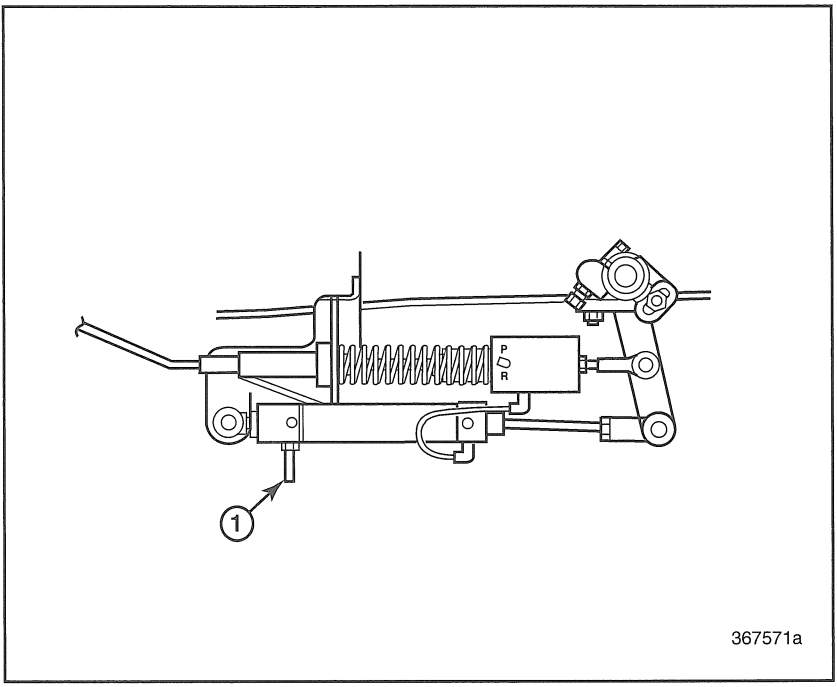


Figure 106 — Clutch Assist Cylinder Filter

1. Sintered Bronze Filter

Spicer Solo™ 15-1/2-Inch Clutch

INSTALLATION PROCEDURE

Install the Solo™ clutch on the flywheel the same way as the current Spicer Easy Pedal clutch. (Solo™ clutch is completely interchangeable with the Easy Pedal clutch.) Mount the Solo™ clutch on the flywheel with eight (8) 7/16″ × 2-1/4″ Grade 5 or better bolts with lock washers and tighten to 40–50 lb-ft (54–68 N•m).

Remove the four (4) yellow-colored shipping bolts in a crisscross pattern. This will release the pressure plate and hold the driven disc in proper position. Remove the aligning tool. (Do not be concerned if the release bearing housing touches the clutch cover.) Save these four yellow shipping bolts in case you have to remove this clutch for some reason.

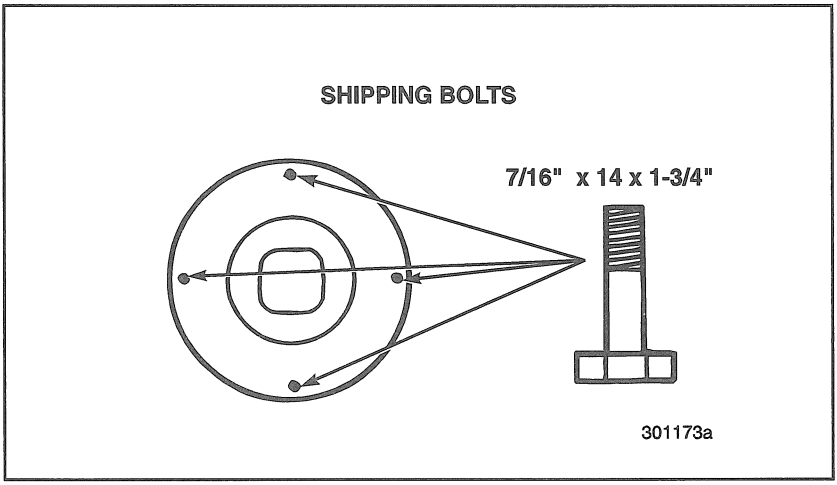


Figure 107 — Shipping Bolts

Make sure the four (4) positive separator pins in the intermediate plate have been set with a 1/4-inch diameter punch flush against the flywheel (reference Spicer wall chart "Form No. 1279-SCD").

Install the transmission the same way as with the Easy Pedal clutch.

⚠ CAUTION

Do NOT use the cross-shaft release lever to pull the transmission into its final position. Doing so may cause the Solo™ to "over-adjust," thus preventing you from properly setting up the clutch. (Refer to "ADJUSTMENT PROCEDURE" on page 265.)

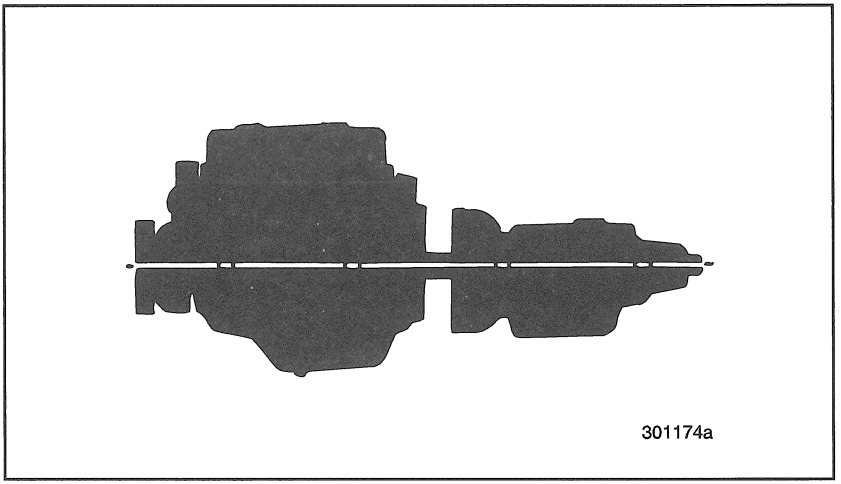


Figure 108 — Transmission Installation

ADJUSTMENT PROCEDURE

Adjustment of the Solo™ clutch is accomplished by stroking the MACK linkage cross-shaft release lever (clutch dog lever arm) five times. Use a pipe over the cross-shaft release lever or wrench on the cross-shaft release lever to rotate it until the release bearing comes to a complete stop and "squeezes" the clutch brake. Repeat this procedure a minimum of five times. This "release bearing to clutch brake contact" will ensure that:

- The Solo™ has adjusted fully to its new environment, and
- The linkage is capable of pulling the bearing far enough to obtain "clutch brake squeeze," clutch brake should be felt within the last 1/2 to 1 inch of clutch pedal travel.

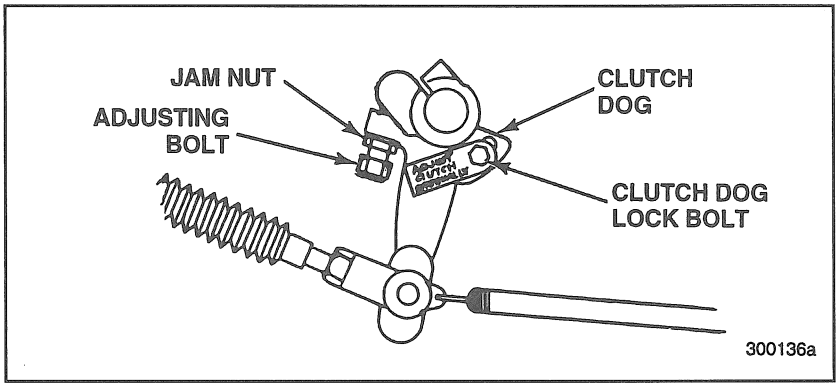


Figure 109 — Clutch Linkage

The MACK external linkage can now be connected and set for proper travel. Hook up the cable and set the clutch dog to achieve proper clutch brake in the cab. The clutch brake squeeze should be felt within the last 1/2 to 1 inch of clutch pedal travel.

Check the position at which clutch brake squeeze occurs as follows:

A. Insert a 0.010-inch feeler gauge between the rear face of the clutch release bearing and the clutch brake.

B. Fully depress the clutch pedal.

C. Slowly release the clutch pedal, and stop releasing the pedal as soon as the feeler gauge can be pulled from between the release bearing and clutch brake.

D. Measure to see if the pedal is within the last 1/2 to 1 inch of travel.

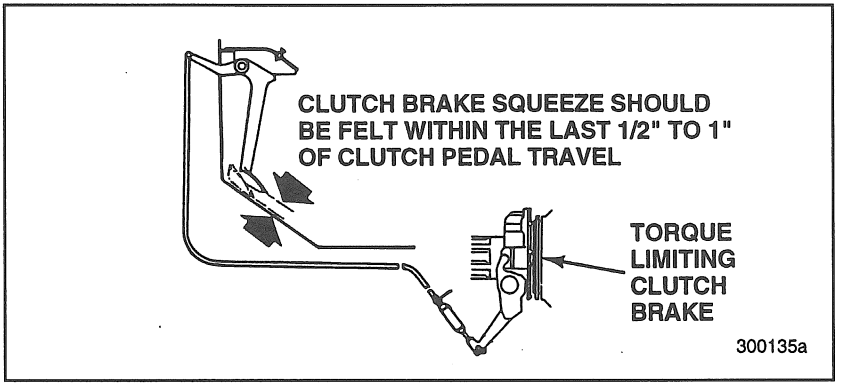


Figure 110 — Clutch Brake Squeeze (Spicer Solo™)

CYLINDER HEAD RETORQUE PROCEDURES

Cylinder Head Retorque Procedures

Any procedure involving the removal and reinstallation of the cylinder heads requires that the cylinder head capscrews be retorqued after performing an acceptable engine run-in procedure (such as dynamometer tests, road test, etc.) in which normal operating temperature was achieved. No further retorque is required.

NOTE

To ensure proper joint clamp loading during cylinder head reinstallation, make sure the capscrews (and the corresponding tapped holes in the cylinder block) are thoroughly cleaned, and the underside of the capscrew heads, threads and washers are well oiled. Follow the proper cylinder head installation and capscrew torque procedures as outlined in the specific overhaul manual for the engine being serviced.

After performing a proper engine run-in in which normal operating temperature was reached, retorque the cylinder head capscrews using the tightening sequence shown in the following illustrations. Retorque one capscrew at a time by backing off until loose. Then, using an accurately calibrated torque wrench, retighten to the value listed in the chart below. Repeat this procedure for each remaining capscrew making sure the proper tightening sequence is followed.

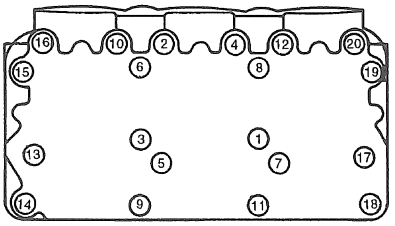


Figure 111 — Capscrew Tightening Sequence

ASET™ Capscrew Torque Value — 205 lb-ft (278 N•m)

VALVE ADJUSTMENT

Initial Valve Adjustment

An initial valve lash check and adjustment must be performed at the following intervals:

- Highway Usage — All MACK ASET™ AC Engines — First B inspection
- Vocational Usage — All MACK ASET™ AI and AMI Engines — First B inspection, or no later than the first C inspection

NOTE

All MACK engines require valve lash adjustments be made with the engine cold (coolant temperature less than 100°F [38°C]), not running (static) and with the piston at 30 degrees after top dead center on the compression stroke (inlet and exhaust valves closed). Always refer to the engine ID plate for proper valve lash adjustment specifications, and for the slave piston lash adjustment for Jake Brake-equipped engines. Refer to Figure 130 in this book for an illustration of the engine ID plate. Jake Brake slave piston lash adjustments are outlined at the end of this valve adjustment section.

Regular Valve Adjustment

After the initial valve adjustment, valves must be adjusted at 150,000 miles (241 000 km) or 4,500 hours for all operating conditions.

VALVE AND ENGINE BRAKE ADJUSTMENT SPECIFICATIONS

Valve Yoke Balance

- Engines with "pinned" valve yokes — 0.010 inch (0.254 mm)

Inlet and Exhaust Valve Lash

Engine	Cold Static	
	Inlet	Exhaust
ASET™	0.016 in. (0.406 mm)	0.024 in. (0.610 mm)

Engine Brake Lash

- MACK PowerLeash™ — 0.045 inch (1.143 mm)
- J-Tech™ — 0.021 inch (0.533 mm).

Valves must be adjusted in firing order sequence with the piston on the compression stroke 30 degrees after top dead center. The flywheel on the ASET™ engine is marked in 120-degree increments to indicate engine position at which the valves must be adjusted. Access to the valve adjustment markings on the flywheel is gained by removing the cover from the bottom of the flywheel housing. Special tool J 38587, which engages the flywheel through an access hole provided in the flywheel housing, is recommended to rotate the engine.

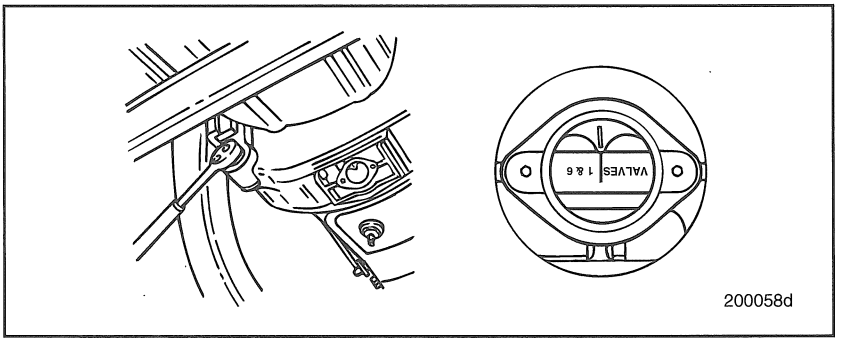
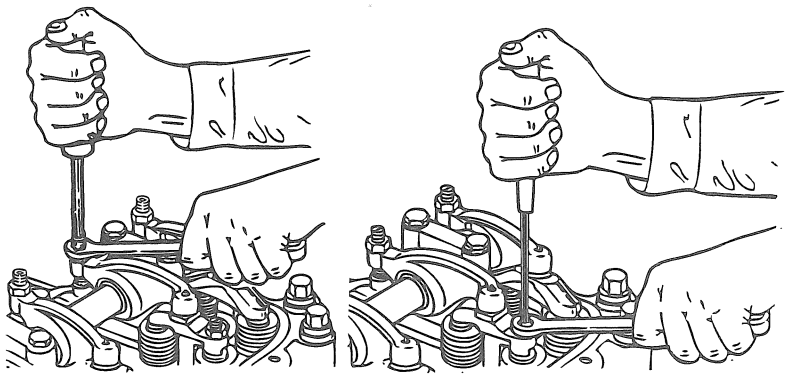


Figure 112 — Flywheel Timing Indicator

Valve Yoke Adjustment

Pinless valve yokes are used at the inlet, and also at the exhaust valves on non-brake engines. These valve yokes are self-leveling in operation, so the yoke does not have a leveling adjustment screw. On brake-equipped engines (PowerLeash™ and J-Tech™), pinned valve yokes are used at the exhaust valve locations. On these engines, it is necessary to adjust valve yoke balance first, then rocker arm lash.

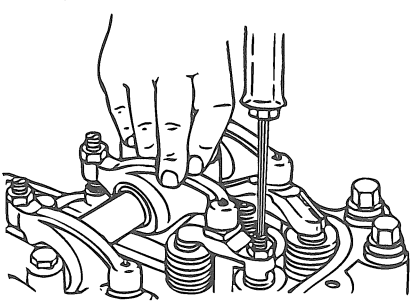
On ASET™ engines equipped with a J-Tech™ engine brake, the exhaust yoke contains a hollow adjusting screw through which an actuator pin passes. This type of valve yoke adjusting screw is adjusted with an 8 mm wrench, rather than a screwdriver. During the valve yoke adjustment procedures, do not allow anything to press down on the actuating pin. The pin must be fully extended approximately 1/4 inch (6.350 mm) above the top of the hollow adjusting screw. If the pin is held down and not fully extended, an improper adjustment and possible engine failure will result.

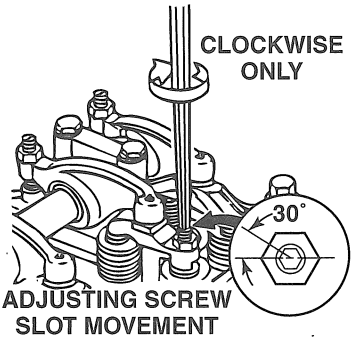


1. **LOOSEN THE EXHAUST ROCKER ARM ADJUSTING SCREW LOCKNUT AND BACK THE ADJUSTING SCREW OUT SEVERAL TURNS.**
2. **LOOSEN THE EXHAUST YOKE ADJUSTING SCREW LOCKNUT.**

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Figure 113 — Exhaust Valve Yoke Adjustment

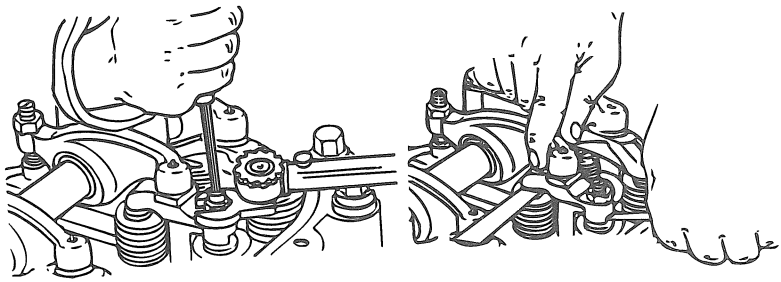




3. EXERT MODERATE FORCE ON THE EXHAUST YOKE BY PRESSING ON ROCKER ARM SLIPPER END. TURN THE YOKE ADJUSTING SCREW DOWN UNTIL IT SOLIDLY CONTACTS THE OUTBOARD VALVE STEM TIP. (A LIGHT DRAG SHOULD BE FELT ON THE ADJUSTING SCREW.)
4. TURN THE ADJUSTING SCREW AN ADDITIONAL 30 DEGREES CLOCKWISE. A 30-DEGREE TURN IS EQUAL TO 1/2 OF A FLAT ON THE ADJUSTING SCREW JAM NUT.

201052e

Figure 114 — Exhaust Valve Yoke Adjustment



5. HOLDING THE EXHAUST YOKE ADJUSTING SCREW IN THIS POSITION, TIGHTEN THE ADJUSTING SCREW LOCKNUT TO A VALUE OF 33 LB-FT (44 N•m).

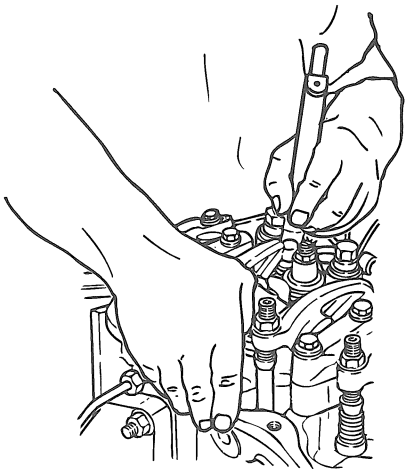
6. CHECK THE EXHAUST VALVE YOKE ADJUSTMENT BY INSERTING A 0.010 INCH (.25 MM) THICKNESS GAUGE BETWEEN THE INBOARD AND OUTBOARD VALVE STEM TIPS AND THE YOKE, AND EXERTING A MODERATE FORCE IN THE ROCKER ARM SLIPPER END. AN EQUAL "DRAG" SHOULD BE FELT ON BOTH THICKNESS GAUGES. IF NOT, READJUST THE YOKE ADJUSTING SCREW.

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Figure 115 — Exhaust Valve Yoke Adjustment

Valve Lash Adjustment

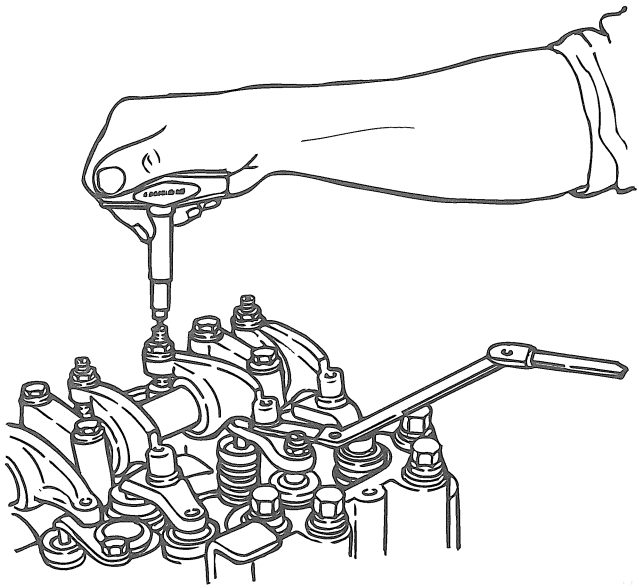
Spring-loaded pushrods are used for the exhaust valves and solid pushrods are used for the inlet valves. When exhaust valve lash is adjusted, the pushrod springs must be compressed. The following procedures explain how to use a torque screwdriver (such as Kent Moore tool No. J 29919) to properly adjust exhaust valve lash on engines equipped with spring-loaded pushrods. These same procedures, however, can be used to adjust inlet valve lash.



1. PUSH DOWN ON THE ADJUSTING SCREW SIDE OF THE ROCKER ARM AND INSERT THE APPROPRIATE THICKNESS GAUGE BETWEEN THE ROCKER ARM AND YOKE. LEAVE THE THICKNESS GAUGE IN PLACE.

201054c

Figure 116 — Valve Lash Adjustment



2. USING THE TORQUE SCREWDRIVER (TOOL NO. J 29919), SLOWLY TURN THE ROCKER ARM ADJUSTING SCREW CLOCKWISE. AT THE EXHAUST LOCATIONS, THE PUSHROD SPRING WILL COMPRESS AS THE ADJUSTING SCREW IS BEING TIGHTENED. AT THE INLET LOCATIONS, THE EXTRA CLEARANCE WILL BE "TAKEN-UP" AS THE ADJUSTING SCREW IS BEING TIGHTENED.

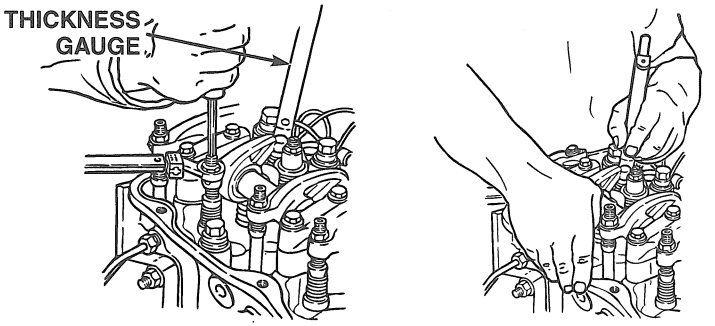
3. CONTINUE TIGHTENING THE ADJUSTING SCREW UNTIL THE TORQUE SCREWDRIVER CLICKS. AT THE EXHAUST LOCATIONS, THE PUSHROD SPRING SEATS ARE NOW IN CONTACT, THE PUSHROD IS SOLID AND VALVE LASH IS NOW PROPERLY SET. DO NOT TIGHTEN THE ADJUSTING SCREW ANY FURTHER. AT THE INLET LOCATIONS, WHEN THE TORQUE SCREWDRIVER CLICKS, ALL EXCESSIVE LASH HAS BEEN "TAKEN-UP," AND INLET VALVE LASH IS NOW SET TO THE THICKNESS OF THE GAUGE.

268391b

Figure 117 — Valve Lash Adjustment

NOTE

The torque screwdriver may allow the valve adjusting screw to loosen slightly when it "clicks" at the pre-set torque. Always recheck valve lash adjustment.



4. HOLD THE ADJUSTING SCREW IN PLACE WITH A 5 MM ALLEN WRENCH AND USE AN ACCURATELY CALIBRATED TORQUE WRENCH TO TIGHTEN THE JAM NUT TO 45 LB-FT (61 N•m).

5. CHECK ADJUSTMENT BY PUSHING DOWN ON THE ADJUSTING SCREW END OF THE ROCKER ARM TO COMPRESS THE PUSH ROD SPRING AND INSERTING THE APPROPRIATE THICKNESS GAUGE BETWEEN THE ROCKER ARM SLIPPER FACE AND VALVE YOKE. THE THICKNESS GAUGE SHOULD BE SNUG. IF NOT, REPEAT THE ADJUSTMENT.

201055d

Figure 118 — Valve Lash Adjustment

NOTE

When exerting pressure on the rocker arm to keep the pushrod spring compressed, drag on the thickness gauge should feel normal as when performing an adjustment on an engine that is not equipped with spring-loaded pushrods. When hand-pressure is released, a significant increase in drag on the thickness gauge will be felt due to the force of the pushrod spring.

On engines equipped with a J-Tech™ engine brake, the exhaust valve adjusting screw incorporates a 14 mm hex at the bottom of the screw. To adjust exhast valve lash on these engines, a 14 mm crow's foot wrench, adapter and long extension are required along with the T-handle torque screwdriver.

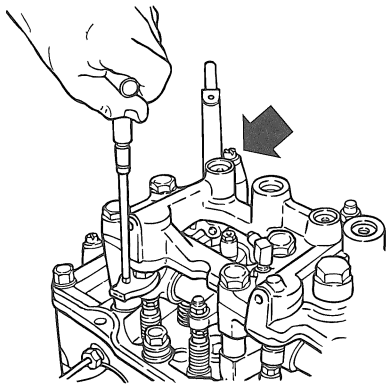


Figure 119 — Adjusting Valve Lash on J-Tech™ Equipped Engines

1. Loosen the spherical locknut and back the adjusting screw out a couple of turns.
2. Push down on the adjusting screw end of the rocker arm to compress the pushrod spring, then insert the appropriate thickness gauge between the rocker arm slipper face and the valve yoke.

⚠ CAUTION

The J-Tech™ exhaust rocker arm adjusting screw spherical jam nut is a through-hardened nut. When tightening these nuts, be aware of the following:

- *Always use the proper 20 mm size wrench to tighten the spherical jam nut. Tighten the nut to 45 lb-ft (61 N•m). Using an improper size wrench will lead to jam nut breakage.*
- *Overtightening the spherical jam nut when adjusting valves may result in jam nut breakage. If there is too much or too little drag on the thickness gauge, loosen the jam nut and readjust valve lash. Do not overtighten the spherical nut in an attempt to obtain correct valve lash.*

3. Using a 14 mm crow's foot wrench, long extension, adapter and T-handle torque screwdriver (J 29919), slowly turn the adjusting screw clockwise. When the screwdriver clicks, valve lash is properly set.
4. While holding the adjusting screw in place, tighten the spherical nut to 40 lb-ft (54 N•m). To avoid spherical nut breakage, be sure to use the proper size wrench (20 mm).

ALTERNATE PROCEDURE FOR ADJUSTING VALVE LASH ON NON-BRAKE OR J-TECH™-EQUIPPED ENGINES

If an oz-in or lb-in torque screwdriver or torque wrench is not available, valve lash can be adjusted (for both brake and non-brake engines) in the same manner as described above (by installing the appropriate thickness gauge and tightening the adjusting screw), but using careful hand-pressure to compress the pushrod spring instead of the 6 lb-in torque screwdriver.

Use a standard screwdriver or 5 mm internal hex wrench in place of the torque screwdriver to turn the adjusting screw. Turn the screw clockwise until a large increase in resistance is felt, indicating that the pushrod is fully compressed and the internal stops of the pushrod upper and lower spring seats are bottomed against each other. No further tightening force is to be applied to the adjusting screw, or an inaccurate valve adjustment may result. At that point, valve lash should be properly set and the adjusting screw jam nut can be tightened to 45 lb-ft (61 N•m).

Always recheck the adjustment by exerting downward pressure by hand on the adjusting screw end of the rocker arm to fully compress the pushrod while rechecking with the thickness gauge. When holding the pushrod compressed for the lash overcheck, normal thickness gauge drag will result. However, after the valve lash is set, and downward pressure on the rocker arm is released, the pushrod spring pressure will put increased drag on the thickness gauge.

VALVE ADJUSTMENT

Valve Adjustment — MACK PowerLeash™-Equipped Engines

On engines equipped with the MACK PowerLeash™ engine brake, valve adjustments are made in three stages. The exhaust valve yoke is adjusted first, followed by the engine brake hydraulic actuator, with exhaust and inlet valve lash adjusted last. Begin the adjustment procedures at cylinder No. 1 by rotating the engine in the direction of normal rotation until the valve adjustment mark for cylinders 1 and 6 is aligned in the center of the access window. When adjustments for cylinder No. 1 are completed, continue by rotating the engine in the direction of normal rotation until the valve adjustment mark for the next cylinder in firing order sequence is aligned in the center of the access window, then adjust the valve yoke, engine brake actuator and inlet and exhaust valve lash for that cylinder.

NOTE

On engines equipped with the MACK PowerLeash™ engine brake, the exhaust rocker arm has two adjusting screws. The adjusting screw located at the pushrod end of the rocker arm adjusts engine brake actuator lash, while the adjusting screw located at the valve actuating end of the rocker arm adjusts exhaust valve lash.

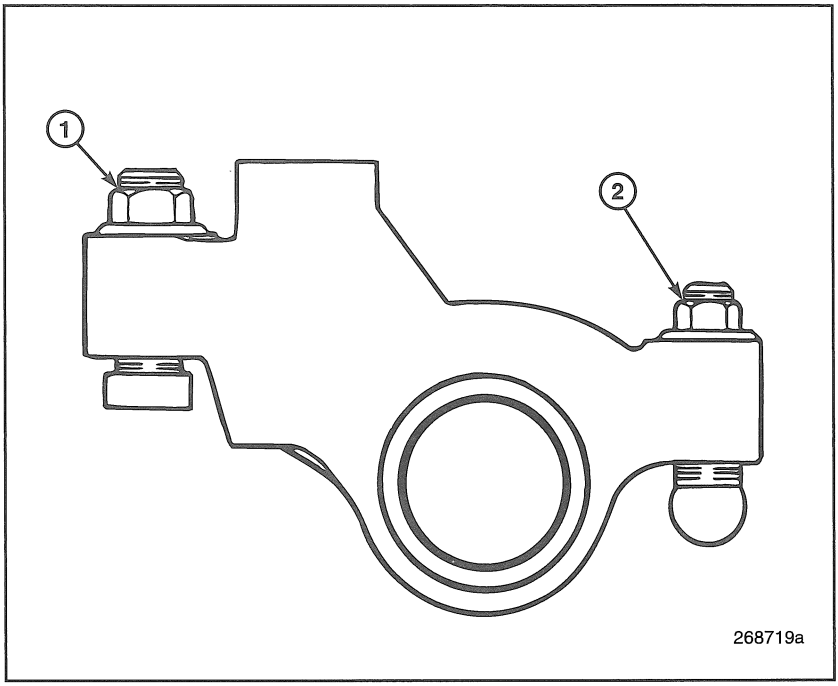
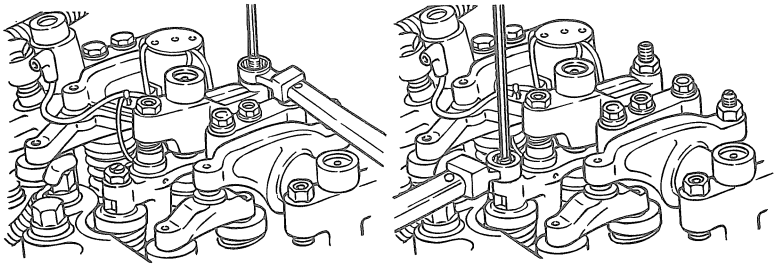


Figure 120 — MACK PowerLeash™ Rocker Arm

1. Exhaust Valve Lash Adjusting Screw	2. Engine Brake Lash Adjusting Screw — This is **NOT** the valve lash adjusting screw

MACK PowerLeash™ Valve Yoke Adjustment

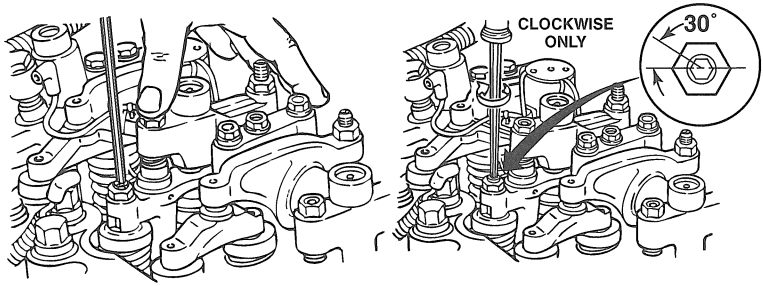


1. LOOSEN THE ENGINE BRAKE HYDRAULIC ACTUATOR ADJUSTING SCREW LOCKNUT (LOCATED ON THE PUSHROD END OF THE EXHAUST ROCKER ARM) AND BACK THE ADJUSTING SCREW OUT SEVERAL TURNS.

2. LOOSEN THE EXHAUST VALVE YOKE SCREW LOCKNUT.

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Figure 121 — MACK PowerLeash™ Exhaust Yoke Adjustment

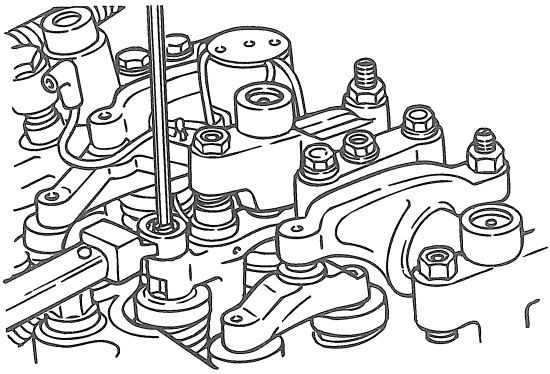


3. EXERT MODERATE FORCE ON THE EXHAUST VALVE YOKE BY PRESSING ON THE END OF THE EXHAUST ROCKER ARM ABOVE THE YOKE. TURN THE YOKE ADJUSTING SCREW CLOCKWISE UNTIL IT SOLIDLY CONTACTS THE OUTBOARD VALVE STEM TIP (A LIGHT DRAG SHOULD BE FELT ON THE ADJUSTING SCREW).

4. AFTER THE ADJUSTING SCREW SOLIDLY CONTACTS THE VALVE STEM TIP, TURN THE SCREW CLOCKWISE AN ADDITIONAL 30 DEGREES. A 30-DEGREE TURN IS EQUAL TO 1/2 OF A FLAT ON THE ADJUSTING SCREW JAM NUT.

268721b

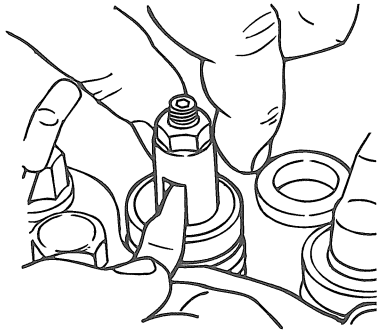
Figure 122 — MACK PowerLeash™ Exhaust Valve Yoke Adjustment

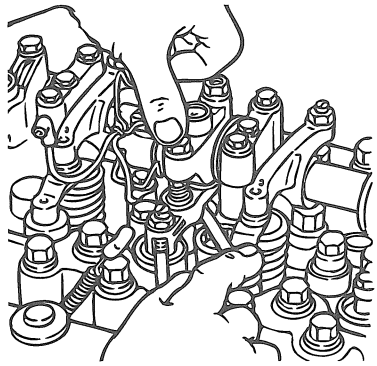


5. HOLDING THE VALVE YOKE ADJUSTING SCREW IN THIS POSITION, TIGHTEN THE ADJUSTING SCREW LOCKNUT TO 33 LB-FT (44 N•m).

268722a

Figure 123 — MACK PowerLeash™ Exhaust Valve Yoke Adjustment





6. CHECK THE VALVE YOKE ADJUSTMENT BY INSERTING 0.010" (0.25 MM) THICKNESS GAUGES BETWEEN THE INBOARD AND OUTBOARD VALVE STEM TIPS AND THE VALVE YOKE. IT WILL BE NECESSARY TO PULL THE VALVE YOKE UP TO INSERT THE THICKNESS GAUGE BETWEEN THE VALVE STEM TIP AND THE YOKE.

   WHILE EXERTING A MODERATE FORCE ON THE ROCKER ARM END ABOVE THE YOKE, CHECK THAT AN EQUAL "DRAG" IS FELT ON BOTH THICKNESS GAUGES. IF DRAG IS NOT EQUAL, READJUST THE VALVE YOKE.

268723a

Figure 124 — MACK PowerLeash™ Exhaust Valve Yoke Adjustment

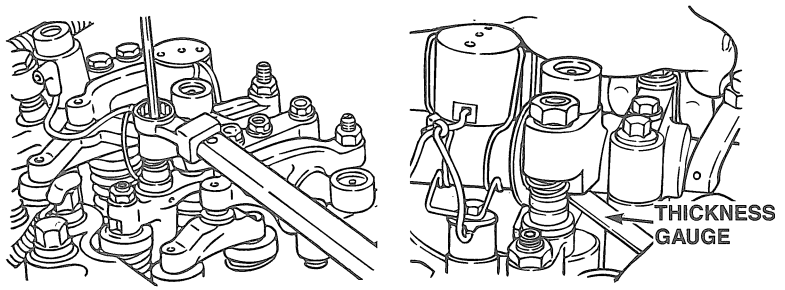
Engine Brake Hydraulic Actuator Lash Adjustment

NOTE

The torque screwdriver is mandatory for performing the engine brake hydraulic actuator lash adjustment on engines equipped with the MACK PowerLeash™ engine brake.

NOTE

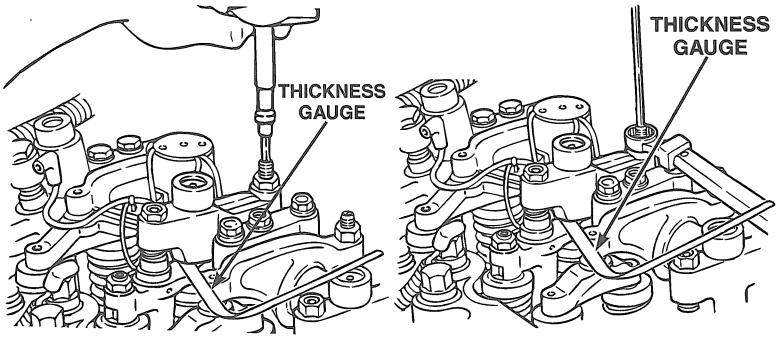
The engine brake hydraulic actuator must be adjusted prior to adjusting exhaust lash.



1. IF NOT ALREADY LOOSENED, LOOSEN THE ENGINE BRAKE ADJUSTING SCREW (LOCATED ABOVE THE PUSHROD) AND BACK THE ADJUSTING SCREW OUT SEVERAL TURNS.
2. LOOSEN THE SWIVEL-HEAD ADJUSTING SCREW LOCKNUT (LOCATED ON THE VALVE ACTUATING SIDE OF THE EXHAUST ROCKER ARM) AND BACK THE ADJUSTING SCREW OUT SEVERAL TURNS.
3. PUSH DOWN ON THE PUSHROD END OF THE EXHAUST ROCKER ARM TO FULLY DEPRESS THE PUSHROD SPRING, AND INSERT A 0.045" (1.143 MM) THICKNESS GAUGE BETWEEN THE HYDRAULIC ACTUATOR AND THE ACTUATOR PIN LOCATED ABOVE THE INBOARD EXHAUST VALVE.

268724a

Figure 125 — MACK PowerLeash™ Actuator Lash Adjustment



4. USING THE T-HANDLE SCREWDRIVER (TOOL NO. J 29919), SLOWLY TURN THE ACTUATOR ADJUSTING SCREW CLOCKWISE. AS THE SCREWDRIVER IS BEING TURNED, THE PUSHROD SPRING WILL COMPRESS. CONTINUE TIGHTENING THE ADJUSTING SCREW UNTIL THE SCREWDRIVER CLICKS. AT THE POINT WHERE THE SCREWDRIVER CLICKS, THE PUSHROD SPRING SEATS ARE IN CONTACT AND THE PUSHROD IS SOLID. AT THAT POINT, HYDRAULIC ACTUATOR LASH IS PROPERLY SET. DO NOT TIGHTEN THE SCREWDRIVER ANY FURTHER.
5. REMOVE THE T-HANDLE SCREWDRIVER, THEN USE A HEX-BIT SCREWDRIVER TO HOLD THE ADJUSTING SCREW IN POSITION. USE AN ACCURATELY CALIBRATED TORQUE WRENCH TO TIGHTEN THE JAM NUT TO 45 LB-FT (61 N•m).

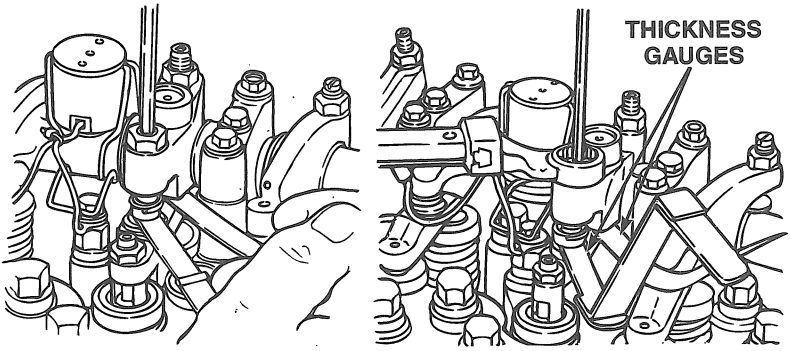
268725a

Figure 126 — MACK PowerLeash™ Actuator Lash Adjustment

NOTE

After completing the hydraulic actuator plunger lash adjustment, leave the 0.045″ (1.143 mm) thickness gauge in place. This keeps the plunger and pushrod spring compressed so that exhaust valve lash can be adjusted.

MACK PowerLeash™ Exhaust Valve Lash Adjustment



1. WITH THE 0.045" (1.143 MM) THICKNESS GAUGE IN PLACE BETWEEN THE VALVE YOKE AND THE HYDRAULIC ACTUATOR PLUNGER, INSERT A 0.024" (0.610 MM) THICKNESS GAUGE BETWEEN THE ADJUSTING SCREW "FOOT" AND THE VALVE YOKE. USING A 5 MM ALLEN WRENCH, TURN THE ADJUSTING SCREW UNTIL A LIGHT "DRAG" IS FELT ON THE THICKNESS GAUGE.
2. HOLDING THE ADJUSTING SCREW IN POSITION, USE AN ACCURATELY CALIBRATED TORQUE WRENCH TO TIGHTEN THE JAM NUT TO 45 LB-FT (61 N•m).
3. REMOVE THE THICKNESS GAUGES FROM BETWEEN THE SWIVEL-HEAD ADJUSTING SCREW AND VALVE YOKE, AND FROM BETWEEN THE BRAKE LASH ADJUSTER PLUNGER AND THE ACTUATING PIN.
4. RECHECK THE EXHAUST VALVE LASH ADJUSTMENT BY PRESSING DOWN ON THE PUSHROD END OF THE EXHAUST ROCKER ARM AND INSERTING THE 0.024" (0.610 MM) THICKNESS GAUGE BETWEEN THE SWIVEL-HEAD ADJUSTING SCREW AND THE VALVE YOKE. IF THE ADJUSTMENT IS NOT CORRECT, BOTH ENGINE BRAKE AND EXHAUST VALVE LASH MUST BE READJUSTED.

268726a

Figure 127 — MACK PowerLeash™ Exhaust Valve Lash Adjustment

MACK PowerLeash™ Inlet Valve Lash Adjustment

Inlet valve lash is adjusted in the same manner as on non-brake engines.

After completing the adjustments for cylinder No. 1, continue adjusting the remaining valves by rotating the engine in the direction of normal rotation until the valve adjustment mark for the next cylinder in firing order sequence is aligned in the center of the access window, then adjust the valves for that cylinder.

J-Tech™ Engine Brake Slave Piston Lash Adjustment

On ASET™ engines equipped with a J-Tech™ engine brake, slave piston lash is set to 0.021 inch (0.533 mm). Lash setting is measured with a standard thickness gauge.

NOTE

Slave piston lash must be adjusted whenever the valves are adjusted, or after removal and reinstallation of the Jake housing assemblies.

⚠ CAUTION

Make slave piston lash adjustment carefully. After the slave piston screw locknut is properly tightened, recheck and readjust as necessary.

NOTE

Verify that the slave piston adjusting screws are fully retracted and that all the spherical jam nuts are turned down snug against the rocker arms before rotating the engine crankshaft for valve lash adjustment. Rotating the engine crankshaft with the spherical jam nuts loose could damage the brake master pistons, and rotating the engine crankshaft with the slave piston adjusting screws not fully retracted could cause engine damage.

Adjust slave piston lash along with inlet and exhaust valve lash adjustments in firing order sequence. Adjust slave piston lash as follows:

1. Loosen the slave piston adjusting screw locknut.
2. Loosen the slave piston adjusting screw until the slave piston is fully retracted into its bore (no drag on the screw).
3. Insert a 0.021-inch (0.533 mm) thickness gauge between the actuator pin in the yoke adjusting screw and the slave piston stem. Turn the adjusting screw until a **light drag** is felt on the thickness gauge.
4. Hold the slave piston adjusting screw and tighten the locknut to 25 lb-ft (34 N•m).
5. After tightening the jam nut, always recheck the adjustment by exerting downward pressure by hand on the adjusting screw end of the rocker arm while rechecking lash adjustment with a thickness gauge.

ENGINE BRAKE MAINTENANCE

J-Tech™ Engine Brake Maintenance

The J-Tech™ engine brake requires very little maintenance. The engine brake is, however, sensitive to engine oil condition, contamination and viscosity. Use only MACK recommended engine oil, and change the oil and filters at the intervals recommended in this manual.

To keep the engine brake operating at peak performance, a tune-up kit is available from your MACK dealer. This kit should be installed every 5 years, 500,000 miles (805 000 km) or 15,000 hours, whichever occurs first, or at a major in-chassis engine overhaul.

Severe operating conditions, such as high levels of dust or unusually frequent engine brake usage, may require more frequent preventive maintenance intervals. Additionally, if an engine failure has occurred and the engine oil is contaminated with debris, coolant or fuel, the engine brake must be inspected for damage.

Refer to the following for a listing and an illustration of the components included in the tune-up kit.

J-TECH™ ENGINE BRAKE (JAKE® BRAKE MODEL 690A AND 690B) TUNE-UP KITS

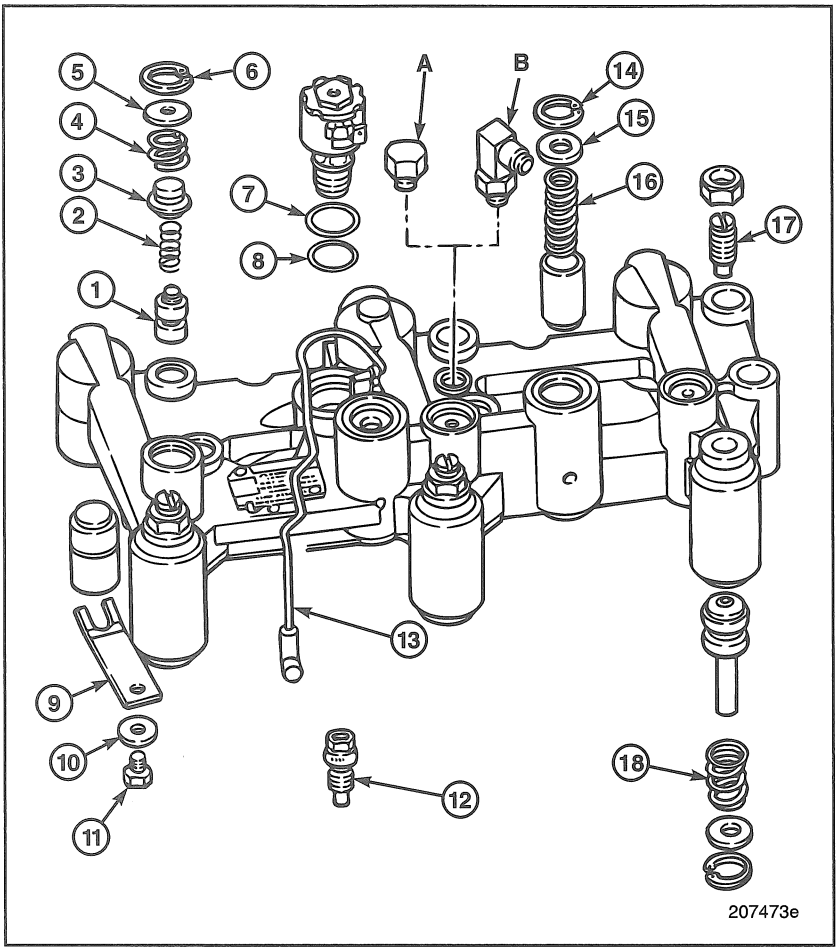


Figure 128 — J-Tech™ Engine Brake Tune-Up Kit

A. Oil supply port plug. Used from production phase-in of the Model 690A engine brake units (June 2000) to production phase-in of external oil supply (third quarter 2000).

B. Oil supply elbow fitting with integral check valve used with the external oil supply line. Production phase-in of external oil supply occurred third quarter 2000.

- The tune-up kit includes the following components:
  1. Valve, control
  2. Spring, inner, control valve
  3. Collar, control valve
  4. Spring, outer, control valve
  5. Washer, control valve retaining
  6. Snap ring, control valve retaining
  7. Seal ring, upper
  8. Seal ring, middle
  9. Spring, flat
  10. Washer, flat
  11. Capscrew
  12. Oil supply screw with integral check valve
  13. Harness, solenoid
  14. Snap ring, accumulator retaining
  15. Washer, accumulator
  16. Spring, accumulator
  17. Reset screw
  18. Spring, slave piston

NOTE

Troubleshooting information for the J-Tech™ engine brake can be found under "J-Tech™ Engine Brake Troubleshooting" on page 319.

ENGINE DIAGNOSTIC CHART

The following troubleshooting guide provides a systematic approach to diagnosing problems which may develop with a diesel engine. The guide lists the probable causes in the order they are most likely to occur. Check the causes in the order they are given.

NOTE

The V-MAC® III Electronic Control System monitors engine function and is capable of displaying a diagnostic blink code when an active fault is detected. Explanations of the diagnostic blink codes can be found in the applicable V-MAC Operator's Guide supplied with each vehicle:

- V-MAC® III (TS799)

Also, extensive diagnostic and service procedures can be found in the applicable V-MAC Service Manual:

- V-MAC® III (8-211)

NOTE

When operating in cold weather, fuel waxing can cause many problems similar to engine symptoms. Be sure to check for fuel congealing before proceeding to troubleshoot a problem.

ENGINE WILL NOT CRANK	
POSSIBLE CAUSE	**CORRECTION**
1. Batteries have low output.	1. Check the batteries. Charge or replace as required.
2. Loose or corroded battery connections.	2. Clean and tighten battery connections.
3. Broken or corroded wires.	3. Check following voltage at connections: — Switch to starter — Battery to starter Replace as required.
4. Faulty starter or starter solenoid.	4. Check operation of starter and solenoid. Repair as required.
5. Faulty key switch.	5. Replace key switch.
6. Internal seizure.	6. Bar the engine over one complete revolution. If the engine cannot be turned, internal damage is indicated. Disassemble engine and repair as required.

ENGINE CRANKS — WILL NOT START	
POSSIBLE CAUSE	**CORRECTION**
1. Slow cranking speed.	1. Check corrections listed under "Engine will not crank."
2. Code(s) present.	2. Correct cause of code(s). Refer to ENGINE MISFIRES — CODE(S) PRESENT chart.
3. No fuel to engine.	3. Check for fuel in the fuel tank. Also check for plugged fuel tank connections, restricted or kinked fuel suction lines, fuel transfer pump failure or clogged fuel filters.
4. Faulty EUP fuel-return check valve.	4. Check for free poppet movement.
5. Defective fuel transfer pump.	5. Check transfer pump for minimum output pressure. Change fuel filters if low. Look for air leaks and recheck pressure. If still below minimum, replace transfer pump.
6. Poor quality fuel or water in fuel.	6. Drain fuel from tank. Replace fuel filters and fill fuel tank with MACK specified diesel fuel.
7. Incorrect engine oil viscosity.	7. Drain oil. Replace oil filters and fill crankcase with recommended grade oil.
8. Low compression.	8. Check cylinder compression. If low, refer to LOW COMPRESSION chart.
9. If equipped with PowerLeash™ or J-Tech™ engine brake, solenoid valve stuck in "ON" position.	9. Ensure that electrical current at the engine brake solenoid is "OFF" (low current). If the solenoid is "stuck" open with low current applied, replace the solenoid.
10. Faulty electrical connections.	10. Check electrical connections at ECU, engine position and engine-speed sensor connections.
11. Solenoid valve lower O-ring damaged or missing (MACK PowerLeash™ engine brake).	11. Remove solenoid valve from rocker shaft and inspect lower O-ring. Replace if damaged or missing.
12. ASET™ AC engines equipped with pre-pump filter, clogged or partially clogged pre-pump filter.	12. Remove, clean or replace and reinstall pre-pump filter.

ENGINE MISFIRES — CODE(S) PRESENT	
POSSIBLE CAUSE	**CORRECTION**
1. Code(s) present.	1. Correct cause of code(s). Check harness, battery and ground connections. If code(s) remain, replace ECU. If code is still present after replacing ECU, reinstall original ECU and refer to item 7 in ENGINE MISFIRES — NO CODE(S) chart.

ENGINE MISFIRES — NO CODE(S)	
POSSIBLE CAUSE	**CORRECTION**
1. Poor quality fuel, or water or dirt in the fuel.	1. Drain fuel from tanks. Replace fuel filters and fill tank with MACK-specified diesel fuel.
2. ASET™ AC engines equipped with pre-pump filter, clogged or partially clogged pre-pump filter.	2. Remove, clean or replace and reinstall the pre-pump filter screen.
3. Air in fuel system.	3. Check fuel system for air leaks. Repair as necessary. (Air generally gets into the fuel system on the suction side of the fuel pump.)
4. Broken or leaking high-pressure fuel lines.	4. Check for fuel leaks. Repair as necessary.
5. Restrictions in fuel lines or drain lines.	5. Check for proper fuel flow. If no flow, replace lines.
6. Low fuel supply pressure.	6. Check to be sure there is fuel in the fuel tank. Check for sharp bends or kinks in the fuel line between the fuel tank and the fuel transfer pump. Also check for clogged suction pipe (in the fuel tank) or a plugged fuel suction hose. Check for air in the fuel system, and check the fuel pressure. If the pressure is lower than specified, replace the fuel filters. If still low, replace the transfer pump.
7. Improper valve lash adjustment.	7. Check adjustment. Correct as necessary.

ENGINE MISFIRES — NO CODE(S) (CONTINUED)	
POSSIBLE CAUSE	**CORRECTION**
8. Defective fuel injection nozzles or electronic unit pumps.	8. **Note**: The following test will register a fault in the ECU which may be cleared after test is completed. Make sure all EUP terminal wires are connected and tight. With the engine operating at low idle (625–675 rpm) and using V-MAC Support Software connected to the chassis, perform cylinder cut out test as outlined in Support Software manual, 8-333. If the cylinder is firing correctly, the engine sound will change. If a cylinder does not change the engine sound, that cylinder is not firing correctly. **Note**: Starting with step 7 software, you must not short out the terminals on the EUPs. The use of cylinder cut out test is the only **recommended** procedure for determining if a cylinder is bad. In step 8, you can kill the engine by shorting out the terminals on an EUP. With step 5, shorting out the terminals is the only way to determine if a cylinder is bad. If a cylinder is not firing correctly, determine if a fuel pulse is present in the high-pressure injection line by touching the line firmly with a screwdriver about one inch from the EUP. **Note**: When it is difficult to determine if the problem is the EUP or the nozzle, first switch the EUP with that of an adjacent cylinder and recheck for a pulse in both affected cylinders. If the problem follows with the EUP, then the EUP is at fault. If the problem remains with the original cylinder, then the nozzle may be at fault. Compare the pulse felt with the EUP shorted vs. not shorted. If a normal pulse is detected when the EUP is not shorted, the problem may be in the injection nozzle or the engine valve adjustment. First check engine valve adjustment. If OK, repair or replace the nozzle. If no pulse is detected, replace the unit pump for that cylinder. **Note**: A tachometer that senses injection-line pressure can also be used to check if pulse is present (use J 39638 Tech Tach or equivalent). If an engine rpm is recorded on the tachometer, the problem may be in the injection nozzle or the engine valve adjustment. If no reading is obtained, replace the unit pump for that cylinder.

ENGINE MISFIRES — NO CODE(S) (CONTINUED)	
POSSIBLE CAUSE	**CORRECTION**
9. Cylinder head gasket leakage.	9. Check for visible signs of leakage, coolant in the oil, or traces of oil in the coolant. Use a compression tester to check each cylinder. Replace cylinder head gasket, if necessary.
10. Worn camshaft lobe.	10. With valve lash properly adjusted, check the rocker arm movement. If not within specifications, replace worn parts.
11. Engine brake slave piston adjustment too tight, if equipped with J-Tech™ engine brake.	11. Readjust slave piston clearance to specifications.

ENGINE STALLS AT LOW SPEEDS	
POSSIBLE CAUSE	**CORRECTION**
1. Code(s) present.	1. Correct cause of code(s).
2. Idle speed set too low.	2. Check idle setting. Adjust as necessary.
3. Fuel tank vent clogged or partially clogged.	3. Check fuel tank vents. Repair as necessary.
4. ASET™ AC engines equipped with pre-pump filter, clogged or partially clogged pre-pump filter.	4. Remove, clean or replace and reinstall the pre-pump filter screen.
5. Low fuel supply.	5. Check for sufficient fuel in the fuel tank. Check for fuel leaks. Check for kinks or sharp bends in the fuel lines. Check fuel pressure; it must be within specifications. If not, replace fuel filters. If still low, repair or replace transfer pump.
6. Injection pump overflow valve leaking, or stuck opened or closed.	6. Repair or replace valve.
7. Defective fuel injection nozzle.	7. Isolate defective nozzle and replace. Refer to item 7 in ENGINE MISFIRES — NO CODE(S) chart.
8. Defective unit pump.	8. Refer to item 7 in ENGINE MISFIRES — NO CODE(S) chart.

ENGINE STALLS AT LOW SPEEDS (CONTINUED)	
POSSIBLE CAUSE	**CORRECTION**
9. High parasitic load.	9. Check for excessive loading due to engaged auxiliary attachments.
10. Cylinder cutting out.	10. Isolate cylinder and determine cause of cutting out. Refer to item 7 in ENGINE MISFIRES — NO CODE(S) chart.

NOTE

If equipped with MACK PowerLeash™ engine brake, refer to "MACK PowerLeash™ Engine Brake Troubleshooting" section.

ERRATIC ENGINE SPEED	
POSSIBLE CAUSE	**CORRECTION**
1. Air leaks in fuel suction line.	1. Check for air leaks. Repair as necessary.

LOW POWER

NOTE

When diagnosing low power complaints, it is possible for the trouble to be traced to chassis components other than the engine. Make sure the chassis rolls freely when the brakes are released.

POSSIBLE CAUSE	CORRECTION
1. Code(s) present.	1. Correct cause of code(s).
2. EGR vavle-to-cooler pipe cracked or bellows leaking. Causes low boost pressure.	2. Inspect EGR valve-to-cooler pipe and correct or replace leaking components(s).

LOW POWER (CONTINUED)

3. EGR valve sticking open. Causes low boost pressure, poor performance.	3. Inpsect EGR components for carbon fouled, soot build up or corrosion. Replace valve to correct.
4. Restrictions in the air intake system such as a clogged air filter(s).	4. Check the air pressure in the air intake manifold. Replace the air filter and make necessary repairs to the air system.
5. Poor quality fuel.	5. Drain fuel tank(s), clean system and replace fuel filters. Fill tank with MACK-specified diesel fuel. Bleed system.
6. Low fuel pressure.	6. Check fuel supply lines for kinks or restrictions. Check for air in system. Check fuel pressure. If low, replace fuel filters. If still low, replace or repair fuel transfer pump. Also check for sticking, binding or defective fuel overflow valve. Repair or replace.
7. ASET™ AC engines equipped with pre-pump filter, clogged or partially clogged pre-pump filter.	7. Remove, clean or replace and reinstall the pre-pump filter screen.
8. Improper valve lash adjustment.	8. Adjust valve lash to specified clearance.
9. Plugged fuel tank vents.	9. Clean the fuel tank vents.
10. Fuel injection nozzle failure.	10. Isolate defective nozzle. Repair or replace. Refer to item 7 in ENGINE MISFIRES NO CODE(S) chart.
11. Carbon or other friction causing deposits in turbocharger.	11. Inspect turbocharger. Clean, repair or replace as required.
12. High altitude operation.	12. Engines lose horsepower with increases in altitude. The percentage of power loss is governed by the altitude at which the engine is operated.

LOW POWER (CONTINUED)	
13. High coolant/inlet air temperatures.	13. At engine coolant temperatures above 225°F (107°C), the electronic control system will reduce engine power as an added measure of engine protection. Engine power will also be reduced if the electronic control system detects an inlet air temperature that is higher than expected. Power will return to normal when engine coolant and inlet air temperatures return to normal operating ranges.
14. Low boost pressure.	14. Check for restrictions in the air intake system.
15. Exhaust restriction.	15. Check for restrictions in the exhaust system.
16. Low compression.	16. Check items listed for low compression.
17. Restrictions in charge air cooler.	17. Perform restriction pressure test. Clean any restrictions.
18. Restrictions in charge air cooler inlet or outlet tubes.	18. Disconnect tubing and clean restrictions.
19. Leaking charge air cooler.	19. Repair or replace leaking cooler.
20. If equipped with engine brake (either PowerLeash™ or J-Tech™), hydraulic actuator or slave piston adjustment too tight.	20. Readjust hydraulic actuator or slave piston clearance to specifications.

ENGINE WILL NOT ACHIEVE NO-LOAD GOVERNED RPM	
POSSIBLE CAUSE	**CORRECTION**
1. Code(s) present.	1. Correct cause of code(s).
2. Air in fuel system.	2. Check system for air leaks and correct as required. Air will generally enter the fuel system on the suction side of the fuel transfer pump.
3. Restricted fuel lines or stuck overflow valve.	3. Check flow in fuel lines. Check overflow valve for defects, improper setting, sticking or defective spring.
4. High idle adjustment set too high.	4. Check high idle adjustments. Adjust as required.

EXCESSIVE ENGINE VIBRATION	
POSSIBLE CAUSE	**CORRECTION**
1. Loose vibration damper hub nut bolt.	1. Check condition of mounting. Make necessary repairs and retorque.
2. Defective or damaged vibration damper.	2. Replace part.
3. Fan blade not balanced.	3. Loosen or remove fan belts. Run the engine for a short period of time at the rpm where the vibration was most noticeable. If the vibration disappears, replace the fan assembly.
4. Engine supports loose, worn or defective.	4. Tighten all mounting bolts, or replace components as required.
5. Engine misfiring or running rough.	5. Check items listed in ENGINE MISFIRES table under Engine Diagnostic Chart section.

EXCESSIVE BLACK OR GRAY SMOKE	
POSSIBLE CAUSE	**CORRECTION**
1. Code(s) present.	1. Correct cause of code(s).
2. Insufficient air for combustion.	2. Check air cleaner for restrictions. Check inlet manifold pressure, and inspect the turbocharger for proper operation. Repair or replace as required.
3. Excessive exhaust back pressure.	3. Check for faulty exhaust piping or restrictions in the muffler. Repair or replace as required.
4. Improper grade of fuel.	4. Drain fuel from tank(s). Replace fuel filters and fill tank(s) with MACK-specified diesel fuel.
5. Faulty fuel injection nozzle or unit pump.	5. Isolate faulty nozzle and replace. Refer to item 7 in the ENGINE MISFIRES — NO CODE(S) chart.
6. Charge air cooler core leakage.	6. Pressure-test charge air cooler. If test results are unsatisfactory, remove, repair or replace charge air cooler core as needed.

EXCESSIVE BLUE OR WHITE SMOKE	
POSSIBLE CAUSE	**CORRECTION**
1. Code(s) present.	1. Correct cause of code(s).
2. No code(s) present, faulty cylinder.	2. Isolate faulty cylinder and repair as required.
3. Engine lubricating oil level too high.	3. Drain excess lubricating oil. If the oil is contaminated with either fuel or coolant, completely drain the oil pan. Change the oil filters. Locate the source of the leak and correct. Fill with MACK-specified engine oil. Check the oil level with the dipstick. DO NOT overfill.
4. EGR cooler leaking coolant into air/ EGR inlet tubes.	4. Pressure-test coolant side of EGR cooler by submersion using low air pressure. Replace any coolers which produce bubbles through EGR passages.
5. Turbocharger passing oil.	5. Check for oil in the inlet manifold. Check for air inlet restriction (clogged air filter). Repair or replace turbocharger as required.
6. Worn piston rings.	6. Check cylinder walls for scuffing. Clean or replace sleeves as required. Install new piston rings.
7. Engine misfiring or running rough.	7. Check items as outlined in the ENGINE MISFIRES — NO CODE(S) chart.
8. Low fuel pressure.	8. Check fuel lines and filters for blockage.

EXHAUST GAS SEEPING INTO CAB	
POSSIBLE CAUSE	**CORRECTION**
1. Cracked EGR valve housing.	1. Replace EGR valve.
2. Cracked EGR valve-to-cooler pipe including expansion joint (bellows).	2. Inspect EGR valve-to-cooler pipe and correct or replace leaking component.
3. Exhaust leak at EGR poppet valve.	3. Exhaust leak past EGR valve poppet stem and support bushing. Replace EGR valve.
4. Exhaust leak at turbocharger inlet and exhaust.	4. Inspect, locate and repair exhaust leak.

EXCESSIVE FUEL CONSUMPTION	
POSSIBLE CAUSE	**CORRECTION**
1. Restrictions in the air induction system.	1. Inspect system. Remove restrictions and replace defective parts as required.
2. External fuel system leakage.	2. Check external piping on fuel system for signs of fuel leakage. Repair as required.
3. Defective injection nozzle assembly.	3. Isolate defective nozzle assembly. Repair or replace as required. Refer to item 7 in ENGINE MISFIRES — NO CODE(S) chart.
4. Internal engine wear.	4. Overhaul engine.
5. Code(s) present.	5. Correct cause of code(s).

EXCESSIVE OIL CONSUMPTION	
POSSIBLE CAUSE	**CORRECTION**
1. External oil leaks.	1. Check engine for visible signs of oil leakage. Look for loose or stripped oil drain plugs, broken gaskets (cylinder head cover, etc.) and front and rear oil seal leakage.
2. External oil line leakage (J-Tech™, turbo, EGR feeds, etc.).	2. Check lines, hoses and connections for leaks. Ensure connections are at proper torque specifications. Replace any hoses or lines found to be leaking. Replenish oil.
3. Seal leak past EGR valve piston shaft.	3. Inspect EGR valve for oil loss over exhaust manifold.
4. Clogged crankcase breather pipe.	4. Remove obstructions.
5. Excessive exhaust back pressure.	5. Check exhaust pressure. Repair as required.
6. Worn valve stem seals.	6. Replace valve stem seals.
7. Worn valve guides.	7. Replace valve guides.
8. Air compressor passing oil.	8. Repair or replace air compressor.
9. Turbocharger passing oil.	9. Check for oil in the inlet manifold. Check for excessive inlet restriction (such as dirty air filter). Repair/ replace air filter or turbocharger as required.
10. Internal engine wear.	10. Overhaul engine.

ENGINE OVERHEATS	
POSSIBLE CAUSE	**CORRECTION**
1. Coolant level low.	1. Locate cause. Look for leaking gaskets or loose or leaking hoses. Repair, replace or tighten as required. Replenish coolant.
2. EGR cooler coolant leak.	2. Replacement of the EGR cooler is required as no weld repairs are allowed to this stainless steel unit.
3. Plugged radiator core.	3. Remove, repair or replace radiator as required.
4. Winterfront (if equipped) not opened.	4. Open or remove winterfront at specified ambient temperatures.
5. Loose or worn fan belts.	5. Adjust belt tension or replace belts as required.
6. Restricted airflow through radiator.	6. Remove any restrictions from the outer surface of the radiator.
7. Defective radiator pressure cap.	7. Test pressure of the radiator cap. Replace cap if required.
8. Defective coolant thermostat or temperature gauge.	8. Check opening temperature of thermostat. Check for correct installation. Check temperature gauge. Replace if defective.
9. Fan improperly positioned or fan drive not operating properly.	9. Check operation of fan. Repair as required.
10. Shutters not opening properly (for chassis equipped with shutters).	10. Check shutter operation. Repair as required.
11. Combustion gases in coolant.	11. Determine point where gases are entering the cooling system. Repair or replace parts as required.
12. Plugged oil cooler.	12. Remove/replace oil cooler.
13. Defective water pump.	13. Remove, repair and reinstall water pump as required.

HIGH EXHAUST TEMPERATURE	
POSSIBLE CAUSE	**CORRECTION**
1. Operating chassis in wrong gear ratio for load, grade and/or altitude.	1. Instruct operator on correct gear selection for load and grade conditions.
2. Restrictions in the air induction system.	2. Inspect air induction system. Remove restrictions and/or replace defective parts.
3. Air leaks in the air induction system.	3. Check pressure in the air intake manifold. Look for leaking piping and/or loose clamps. Make necessary repairs.
4. Leaks in the exhaust system (before the turbocharger).	4. Check exhaust system for leaks. Make necessary repairs.
5. Restrictions in the exhaust system.	5. Inspect system. Make necessary repairs.
6. Improper valve lash adjustment.	6. Adjust valve lash setting to specified clearance.
7. Defective fuel injection nozzle assembly.	7. Isolate defective nozzle assembly. Remove, repair and/or replace, and reinstall.
High Pyrometer — Normal Boost	
9. Loose ducting.	9. Repair loose connections.
10. Charge air cooler core fin obstructions.	10. Clean core fins.
High Pyrometer — Low Boost	
11. Blockage in ducting between the air cleaner and the turbocharger.	11. Check for blockage and repair.
12. Dirty turbocharger.	12. Remove turbocharger and clean.
13. Leaks in the pressurized side of the air induction system.	13. Check for leaks. Repair as required.
14. Charge air cooler core leak or inlet manifold leak.	14. Check for damage. Repair or replace as necessary.
15. Charge air cooler leakage.	15. Pressure test charge air cooler. Remove and replace if test results are unsatisfactory.
16. EGR gas too hot.	16. EGR gas flow rate too high or poor heat transfer due to EGR cooler fouling. Check EGR cooler to ensure debris in the coolant has not become lodged in the cooler fins, restricting coolant flow. Check EGR valve operation to ensure full operation.

LOW ENGINE OIL PRESSURE	
POSSIBLE CAUSE	**CORRECTION**
1. Oil level insufficient. Oil leaking from oil line, gasket, etc.	1. Check engine oil level. Add oil if necessary. Check for oil leaks. Repair as required.
2. Incorrect oil viscosity.	2. Drain oil, change oil filters, and fill with the proper grade oil meeting MACK specifications.
3. Defective oil pressure gauge.	3. Check the operation of the oil pressure gauge. If defective, replace.
4. Clogged oil filter(s).	4. Replace oil filters. Clean or replace oil cooler. Drain oil and refill with oil meeting MACK specifications.
5. Engine oil diluted with diesel fuel.	5. Check fuel system for leaks. Make necessary repairs. Drain diluted oil, change oil filters, and refill with oil meeting MACK specifications.
6. Defective oil pump relief valve.	6. Remove oil pressure relief valve and check condition of seat. Check that relief valve spring is not sticking, and check for proper spring tension. Check cap. Check assembly parts. Using the incorrect parts will result in incorrect oil pressure. Make any necessary repairs or install a new relief valve.
7. Oil pump gears not meshing properly.	7. Check mounting arrangement. If the engine has been rebuilt, check that the gear ratio of the oil pump drive and driven gears are correct. Incorrect gear combinations will result in immediate gear failure and possible engine damage. Check for correct oil pad gasket.
8. Excessive clearance between crankshaft and bearings.	8. Overhaul the engine. Replace any worn/defective parts.
9. Incorrect oil filter mounting pad gasket.	9. Check for correct oil pad gasket.
10. EGR valve not functioning properly due to low oil pressure.	10. Determine reason for low oil pressure. Refer to LOW ENGINE OIL PRESSURE chart.

ENGINE OIL PRESSURE DROPS SUDDENLY	
POSSIBLE CAUSE	**CORRECTION**
1. If equipped with J-Tech™ engine brake, upper solenoid valve seal missing or damaged.	1. Remove solenoid valve and replace upper seal ring.
2. If equipped with J-Tech™ engine brake, leaking external oil line(s).	2. Locate leaking line and replace as required.

OIL IN THE COOLING SYSTEM	
POSSIBLE CAUSE	**CORRECTION**
1. Defective oil cooler.	1. Replace oil cooler as required.
2. Blown head gasket.	2. Replace head gasket.
3. Cylinder head porosity.	3. Replace cylinder head.

COOLANT IN ENGINE OIL	
POSSIBLE CAUSE	**CORRECTION**
1. Cylinder sleeve seat leakage.	1. Repair sleeve seat seal.
2. Defective oil cooler core.	2. Replace oil cooler as required.
3. Cylinder head pipe plug leaking.	3. Repair leak.
4. Cylinder head gasket failure.	4. Pressure-test cooling system and repair as required.
5. Cracked cylinder head.	5. Pressure-test cooling system and repair as required.

LOW COMPRESSION	
POSSIBLE CAUSE	**CORRECTION**
1. Improper valve lash adjustment.	1. Adjust valve lash to specified clearance.
2. Blown head gasket.	2. Replace head gasket.
3. Broken or weak valve springs.	3. Check and replace defective parts.
4. Burned valves, seats or parts.	4. Remove, recondition and reinstall heads.
5. Piston rings stuck, worn, broken or improperly seated.	5. Overhaul engine.
6. Camshaft or valve lifters worn.	6. Replace camshaft and/or valve lifters. Overhaul engine if required.

FUEL IN LUBE OIL	
POSSIBLE CAUSE	**CORRECTION**
1. Excessive idling, especially in cold weather.	1. Minimize idling time and use all recommended cold weather accessories.
2. Injector nozzle malfunctioning.	2. Remove and pop-test nozzles. Clean or replace nozzles as required.
3. Unit pump O-ring leaking.	3. Replace O-ring.

NON-COMPLIANT EMISSIONS	
POSSIBLE CAUSE	**CORRECTION**
1. Excessive idling, especially in cold weather causing carbon buildup in the EGR cooler that blocks the flow of exhaust gas.	1. Minimize idling time and use all recommended cold weather accessories.
2. High EGR temperature out of the cooler indicates a failed cooler or coolant block.	2. Replace EGR cooler or correct coolant block.
3. EGR valve not working or sticking.	3. Check for correct oil supply to valve. Check for oil coking or corrosion at the actuator bushing area. Also check for wire harness failure including connectors.
4. EGR valve housing cracked.	4. Inspect EGR housing and replace as necessary.
5. EGR valve not functioning properly due to low oil pressure.	5. Determine reason for low oil pressure. Refer to LOW ENGINE OIL PRESSURE chart.
6. Turbocharger position does not follow the command.	6. This could be caused by mechanical or electrical problems with the VGT. Check codes related to VGT and check for mechanical problems at the turbo. Replace as necessary.

MACK PowerLeash™ Engine Brake Troubleshooting

ENGINE BRAKE WILL NOT OPERATE — MACK POWERLEASH™ ENGINE BRAKE	
POSSIBLE CAUSE	**CORRECTION**
1. Blown fuse, open electrical circuit.	1. If 12 volts is not present at the engine brake solenoid, check for an "open" in the circuit. Replace any broken, chafed or brittle wires. Check the solenoid leads (both ground and power) for signs of shorts and replace as required. Check fuse and replace as necessary.
2. Dashboard control switch or clutch switch defective or out of adjustment (clutch switch only).	2. Use a multi-meter to test for voltage at switches. Disconnect switches and test switch function by checking continuity in the various switch positions. Replace as required. Check and adjust clutch switch as required.
3. Mounting bracket-to-rocker shaft mounting screws loose or missing.	3. Inspect for missing or loose mounting bracket-to-rocker shaft screws. Repair as required.
4. Blocked oil supply screen at the bottom of the front rocker shaft mounting brackets (rocker shaft mounting bracket Nos. 1 and 4).	4. Remove rocker shaft assemblies and clean oil supply screens.
5. Brake lash not adjusted properly.	5. The MACK PowerLeash™ engine brake is very sensitive to adjustment. Incorrect adjustment may hold the valve open during positive power, leading to engine failure, or may cause the engine brake to work poorly or not at all. Confirm that the engine brake hydraulic actuator is properly adjusted to specifications (0.045″ [1.143 mm]).
6. Engine oil pressure low.	6. The MACK PowerLeash™ engine brake requires 25 psi (172.4 kpa) at 1100 rpm to operate. Check oil pressure registered on the dashboard gauge. If low, determine the cause.

ENGINE BRAKE ACTIVATES WITH DASHBOARD SWITCH TURNED OFF — MACK POWERLEASH™ ENGINE BRAKE

POSSIBLE CAUSE	CORRECTION
1. Solenoid lower O-ring damaged or missing.	1. Remove the solenoid and inspect lower O-ring for damage. Replace as required.
2. Solenoid not fully seated in rocker shaft bore.	2. Remove the solenoid, inspect and replace the O-rings as required. Reinstall the solenoid to its full seated position before snapping the retaining spring clips in place. The clips must require a moderate force to snap them around the rocker shaft and must provide enough spring tension to prevent any free-movement of the solenoid or spring clips. If spring clip tension cannot be maintained, replace the clips.
3. Engine brake system wired improperly.	3. Compare engine brake wiring with chassis wiring diagram. Correct wiring as required.

⚠ CAUTION

The solenoid must be fully seated by significant hand pressure. The retaining clips will not seat a solenoid that has not already been fully seated.

ENGINE BRAKE SLOW TO OPERATE OR WEAK IN EFFECT — MACK POWERLEASH™ ENGINE BRAKE	
POSSIBLE CAUSE	**CORRECTION**
1. Engine oil cold and thick.	1. Allow engine to warm before operating engine brake. Change engine oil if viscosity indicates that the oil has thickened.
2. Hydraulic lash adjuster plunger not moving in bore.	2. Inspect engine brake hydraulic actuator plunger for freedom of movement in the bore. Spring pressure should keep the plunger seated against the lower snap ring. If the plunger does not move freely, replace the rocker arm assembly.
3. Control pistons binding in rocker arm bores.	3. Remove control piston from rocker arm. Inspect piston and bore for scoring or burrs. If any are present, replace rocker arm assembly.
4. Defective ball check valve.	4. Remove the control piston, then remove the ball check valve. Make sure that the check ball is seated in the bore and can be moved off its seat. Make sure there is spring tension against the check ball. Flush the ball check valve in a suitable, non-flammable solvent. If the ball check valve does not function properly, replace the rocker arm assembly.
5. Switch operation sluggish.	5. Check operation of dash switch and clutch switch. Readjust or replace as required.
6. Solenoid valve operation erratic.	6. Check current draw of solenoid when engine brake is activated. Current should be approximately 1.59 amps.

OIL PRESSURE DROPPING BELOW MINIMUM REQUIRED FOR ENGINE BRAKE OPERATION — MACK POWERLEASH™ ENGINE BRAKE	
POSSIBLE CAUSE	**CORRECTION**
1. Loose or missing mounting bracket-to-rocker shaft bolts.	1. Inspect mounting bracket-to-rocker shaft bolts. Replace and retorque as required.
2. Plugged or damaged oil supply screen.	2. Remove the rocker shaft assembly and inspect the oil supply screen located in the oil supply port of the number one rocker shaft mounting bracket. Clean or replace as required.
3. Aeration of engine oil.	3. Check for aeration of engine oil. With the engine running, activate, then deactivate the engine brake and observe oil escaping from the rocker arm, in the area of the hydraulic actuator. If there are bubbles in the oil or the oil is foamy, air is present. Aeration of engine oil can be caused by an overfilled or under-filled crankcase, or a crack or leak in the oil pump pickup tube. Correct or replace as necessary.
4. Engine oil diluted by fuel oil.	4. Perform an oil analysis to determine fuel dilution. Correct source of fuel dilution as required.
5. Engine oil level too low.	5. Consult the engine manual or the maintenance and lubrication manual for oil capacities. Add oil and/or recalibrate dipstick as required.
6. Worn rocker arm shaft bores or rocker shaft.	6. Inspect rocker arm shaft bores and rocker shaft for wear. Replace components as required.
7. Worn main and/or rod bearings or camshaft bushings.	7. Inspect/measure main bearings, rod bearings and camshaft bushings. Replace as required.

ONE OR MORE CYLINDERS FAIL TO STOP BRAKING OR ENGINE STALLS — MACK POWERLEASH™ ENGINE BRAKE

POSSIBLE CAUSE	CORRECTION
1. Control piston spring broken.	1. Remove control piston from hydraulic actuator and inspect spring. Replace rocker arm if spring is broken.
2. One or more control pistons stuck in the "ON" or 'UP" position.	2. Inspect control pistons for freedom of movement in the actuator bore. If binding is evident, replace the rocker arm. Check engine oil for contamination.
3. Solenoid O-ring missing or damaged (allows oil to enter the hydraulic actuators with the solenoid valve closed).	3. Remove solenoid valve and inspect O-ring. Replace if missing or damaged.
4. Solenoid valve exhaust port plugged.	4. Remove solenoid valve and inspect exhaust port for restrictions. Clean exhaust port as required.
5. Clutch switch stuck in "ON" position or out of adjustment.	5. Check clutch switch for proper operation. Readjust or replace as required.

⚠ CAUTION

Engine stalling and potential engine damage can occur if the engine brake is operated at cold engine oil temperatures. The V-MAC® III engine control system on vehicles equipped with a MACK PowerLeash™ engine brake includes a feature that prevents the engine brake from being activated until the engine coolant temperature reaches at least 125°F (52°C). The engine brake will not function until sufficient engine warm-up time has elapsed, regardless of the dashboard engine brake switch settting.

ENGINE MISSES OR LOSES POWER — MACK POWERLEASH™ ENGINE BRAKE	
POSSIBLE CAUSE	**CORRECTION**
1. Hydraulic actuator adjustment too tight.	1. Readjust engine brake lash in accordance with procedures outlined in this bulletin.

J-Tech™ Engine Brake Troubleshooting

ENGINE BRAKE DOES NOT OPERATE — J-TECH™ ENGINE BRAKE	
POSSIBLE CAUSE	**CORRECTION**
1. Blown fuse/circuit breaker or defective wiring.	1. Check fuse/circuit breaker. Replace as necessary. Replace any broken, brittle or chafed wires. Check solenoid tab for signs of shorting. Replace as necessary.
2. On/Off switch, clutch switch or multi-position switch out of adjustment or defective.	2. Check switch adjustment as necessary. Check for voltage at each switch. Check for defective switch by checking continuity of each switch. Adjust or replace switch as necessary.
3. Electrical fault.	3. A constant 12-volt low amperage signal is supplied to the engine brake solenoids by the V-MAC III module when the ignition switch is turned on. During an engine braking event, the current to the solenoids is increased to activate the engine brake. The most accurate method of checking electrical functionality of the engine brake solenoid circuit is by using an ammeter to measure current at the solenoids when the engine brake is activated. When the engine brake is activated, current should be approximately 1.59 amps. For additional information, consult the *V-MAC® III Service Manual*, 8-211.
4. Low engine oil pressure.	4. Determine cause of low oil pressure and repair as required.
5. Slave piston lash improperly adjusted.	5. Check slave lash adjustment. Refer to "VALVE ADJUSTMENT" on page 269.

ENGINE BRAKE DOES NOT OPERATE AT LOW ENGINE RPM — J-TECH™ ENGINE BRAKE	
POSSIBLE CAUSE	**CORRECTION**
1. Inlet check valve leaking.	1. J-Tech™ Model 690 engine brake (manufactured prior to 6/00) used a check valve assembly that was assembled into the housing. This valve was replaced in production by an oil suppy screw having an integral check valve. Inspect the check valve assembly. If the check valve components are present, remove and replace with an oil supply screw. The J-Tech™ Model 690A/690B engine brake uses an external oil supply line to supply oil to the engine brake units. On these models, a second check valve is integral with the elbow fitting in the engine brake unit.

ENGINE BRAKE ACTIVATES WITH SWITCHES TURNED OFF — J-TECH™ ENGINE BRAKE	
POSSIBLE CAUSE	**CORRECTION**
1. Solenoid valve seal center ring damaged.	1. Remove solenoid and replace sealing rings; three O-rings are used on the model 690 engine brake, and two O-rings are used on the model 690A/690B engine brake.
2. Engine brake improperly wired.	2. Verify wiring according to wiring diagrams.

ENGINE BRAKE SLOW TO OPERATE OR WEAK IN EFFECT — J-TECH™ ENGINE BRAKE	
POSSIBLE CAUSE	**CORRECTION**
1. Low engine oil pressure.	1. Determine cause of low engine oil pressure and repair as required.
2. Air in oil.	2. Determine cause of air in engine oil. Check for overfilled oil sump or a leak on the suction side of the oil pump.
3. Engine oil cold and thick.	3. Allow engine to reach normal operating temperature before operating engine brake.
4. Improper slave piston adjustment or slave piston sticking in bore.	4. Verify slave piston adjustment. Ensure that the slave piston responds smoothly to the reset screw by loosening the jam nut and turning the screw through its full travel for full slave piston motion. Make sure the piston travels the full range without binding or sticking.
5. Reset screw not sealing properly.	5. Remove reset screw and check for debris on the plunger or surface of the slave piston. Make sure that the plunger moves freely with light pressure. Tip of plunger should be smooth and free of nicks or scratches. Replace reset screw, if necessary.
6. Solenoid screen clogged stopping supply of oil to brake.	6. Remove solenoid valve and clean screen.
7. Master piston not moving in bore.	7. Inspect master piston and bore for scoring or burrs. If any are present, clean surface with crocus cloth. If unable to remove burrs, replace piston or housing. Inspect engine oil for signs of contaminants. If any are present, replace oil and filters, and correct cause of contamination.
8. Control valves binding in housing bores.	8. Remove and clean the engine brake housings. Remove and clean the control valves. Inspect the control valve bores for burrs. If any burrs are present, clean with a crocus cloth. Replace the control valve if it still does not move up and down easily in the bore.

ENGINE BRAKE SLOW TO OPERATE OR WEAK IN EFFECT — J-TECH™ ENGINE BRAKE	
POSSIBLE CAUSE	**CORRECTION**
9. Defective control valve.	9. Remove control valve. Make sure check ball is seated in bore and can be moved off seat. Make sure there is spring pressure against the ball. Flush in solvent. Replace, if necessary.
10. Switch operation sluggish.	10. Check dashboard switches, clutch switch or other control switches. Readjust or replace as required. Check clutch return springs for proper operation. Check all controls for correct operation and replace as required.
11. Solenoid valve operation erratic.	11. Check solenoid valve specifications. Disconnect solenoid leads to and provide 12 volts directly to the solenoid. Verify that the pin at the top of the solenoid depresses when 12 volts are applied. Replace solenoid valve as required.

OIL PRESSURE DROPPING BELOW MINIMUM REQUIRED FOR ENGINE BRAKE OPERATION — J-TECH™ ENGINE BRAKE	
POSSIBLE CAUSE	**CORRECTION**
1. Upper solenoid seal ring damaged.	1. Remove solenoid and inspect seal ring. Replace all seal rings.
2. Aeration of lubrication oil.	2. Check for aeration of engine oil. Activate, then deactivate the engine brake and observe escape oil coming from the control valve cover. If oil has bubbles or is foamy, air is present in the system. Aeration can be caused by an overfilled or underfilled crankcase, or a crank or other leak in the oil suction tube.
3. Worn rocker arm bores/bushings or shaft journals.	3. Inspect rocker arm bores and shaft journals. Repair as required.
4. Low engine oil pressure.	4. Refer to causes and corrections in the LOW ENGINE OIL PRESSURE table in Engine Diagnostic section.

ONE OR MORE CYLINDERS FAIL TO STOP BRAKING OR ENGINE STALLS — J-TECH™ ENGINE BRAKE	
POSSIBLE CAUSE	**CORRECTION**
1. Control valve inner spring broken.	1. Replace inner spring.
2. One or more control valves stuck in "on" or up position.	2. Check control valves for binding. Remove, clean or replace as necessary. Inspect engine oil for contamination.
3. Solenoid valve sticking in "on" position.	3. If solenoid cap remains down with no electrical current supplied, replace the solenoid valve.
4. Solenoid center seal ring damaged (allows oil to enter brake with solenoid valve closed).	4. Remove solenoid and replace all seal rings.
5. Solenoid valve exhaust plugged.	5. Remove any restrictions at the exhaust (bottom) of solenoid valve.

BRAKE DIAGNOSTIC CHART

The following troubleshooting chart summarizes some common dual braking system problems, probable causes and corrections. Use this chart as a guide to service the dual brake system.

CONDITION	LOW AIR PRESSURE WARNING RED LIGHT DOES NOT GO OUT AFTER STARTUP.
POSSIBLE CAUSE	**CORRECTION**
1. Loss of one section of the dual system.	1. Observe dual pressure gauge to determine which section is out. Vehicle can be moved with EXTREME care.
2. Loss of complete air brake system.	2. Vehicle cannot be moved. Spring brakes will automatically be set. Look for a malfunction in the main air supply system.
CONDITION	**LOW AIR PRESSURE WARNING RED LIGHT COMES ON WHILE DRIVING VEHICLE.**
POSSIBLE CAUSE	**CORRECTION**
1. Loss of one section of the dual system.	1. Observe dual pressure gauge to establish which section is out. Vehicle can be operated with EXTREME care to the nearest safe parking area.
2. Loss of complete air brake system.	2. Spring brakes will automatically apply. Vehicle cannot be moved. Look for a malfunction in the main air supply system.
3. Governor leaking.	3. Check for leakage. Repair or replace governor.
4. Compressor discharge valves leaking.	4. Repair compressor.

CONDITION	LOW AIR PRESSURE WARNING RED LIGHT DOES NOT GO OUT AFTER STARTUP.
CONDITION	**AIR PRESSURE DROPS QUICKLY WITH ENGINE STOPPED AND BRAKES FULLY APPLIED.**
POSSIBLE CAUSE	**CORRECTION**
1. Treadle valve leaking.	1. Perform leakage test and make necessary repairs.
2. Brake chamber leakage.	2. Repair or replace brake chamber.
3. Hose, tubing or fittings leaking.	3. Check all plumbing and make necessary repairs.

CONDITION	AIR PRESSURE DROPS QUICKLY WITH ENGINE STOPPED AND BRAKES RELEASED.
POSSIBLE CAUSE	**CORRECTION**
1. Treadle valve leaking.	1. Perform leakage test and make necessary repairs.
2. Hoses, tubing or fittings leaking.	2. Check all plumbing and make necessary repairs.
3. Parking brake chamber leaking.	3. Replace diaphragm.
CONDITION	**AIR PRESSURE WILL NOT RISE TO NORMAL**
POSSIBLE CAUSE	**CORRECTION**
1. Reservoir drain cock opened.	1. Check drain cock. Close if opened.
2. Excessive air leakage from system components.	2. Perform air leakage test, and make necessary repairs.

CONDITION	AIR PRESSURE DROPS QUICKLY WITH ENGINE STOPPED AND BRAKES RELEASED.
POSSIBLE CAUSE	**CORRECTION**
3. Governor out of adjustment.	3. Check governor setting. Make adjustment, if necessary.
4. Defective air pressure gauge.	4. Replace air pressure gauge.
5. Faulty compressor.	5. Repair or replace.
CONDITION	**AIR PRESSURE RISES TO NORMAL SLOWLY**
POSSIBLE CAUSE	**CORRECTION**
1. Engine speed too low.	1. Check speed and make adjustment.
2. Excessive air leakage from system components.	2. Perform air leakage test and make necessary repairs.
3. Faulty air compressor.	3. Repair or replace.
CONDITION	**AIR PRESSURE RISES ABOVE NORMAL**
POSSIBLE CAUSE	**CORRECTION**
1. Defective air gauge.	1. Disconnect gauge and install master gauge. Observe air pressure.
2. Governor out of adjustment.	2. Adjust or replace governor.
3. Restriction in line between governor and compressor unloading mechanism.	3. Check line for kinks or other restrictions. Replace as required.
4. Air compressor unloading mechanism malfunction.	4. Repair or replace as required.

CONDITION	INSUFFICIENT BRAKES
POSSIBLE CAUSE	**CORRECTION**
1. Low air pressure in the brake system, excessive leaks or delivery pressure below normal.	1. Check system pressure. Make necessary repairs.
2. Brake adjustment, lubrication or relining necessary.	2. Check condition of brakes. Make necessary repairs.
3. Mechanical failure of brake wheel component.	3. Check brake wheel components. Make necessary repairs.
4. Restriction in brake air line.	4. Check brake piping for kinks or other restrictions. Repair as required.
CONDITION	**BRAKES APPLY TOO SLOWLY**
POSSIBLE CAUSE	**CORRECTION**
1. Brake adjustment or lubrication necessary.	1. Check brakes and make necessary repairs.
2. Check causes under "Air Pressure Drops Quickly with Engine Stopped and Brakes Fully Applied."	2. Follow corrections as outlined for possible causes.
3. Restriction in tubing or hoses.	3. Check brake piping for kinks or other restrictions.
CONDITION	**BRAKES RELEASE TOO SLOWLY**
POSSIBLE CAUSE	**CORRECTION**
1. Treadle valve not returning to full released position.	1. Check for accumulated dirt, gravel, etc., around treadle valve pedal. Clean and lubricate treadle roller and hinge pin, or repair or replace treadle valve.
2. Brake adjustment or lubrication necessary.	2. Check brakes. Correct as necessary.
3. Restrictions in tubing or hoses.	3. Check brake piping for kinks or other restrictions. Repair as required.
4. Exhaust port of brake valve, quick release valve or relay valve clogged or restricted.	4. Check valves for proper operation. Repair as necessary.

CONDITION	BRAKES DO NOT RELEASE
POSSIBLE CAUSE	**CORRECTION**
1. Broken or weak return springs.	1. Replace faulty springs.
2. Treadle valve not fully released.	2. Repair or replace valve. Clean under pedal and check for seized hinge pin.
3. Restrictions in tubing or hoses.	3. Check brake piping for kinks or other restrictions. Repair as necessary. Check that hand control is not partially applied.
4. Parking brake chamber leaking.	4. Repair or replace.
CONDITION	**BRAKES GRAB**
POSSIBLE CAUSE	**CORRECTION**
1. Grease or oil on brake lining.	1. Replace brake lining.
2. Brake drum out of round.	2. Check brake drum for concentricity. If out of round, machine within allowable limitations.
3. Defective brake valve.	3. Repair or replace brake valve.
4. Brake linkage binding.	4. Check brake linkage for freedom of movement.
CONDITION	**UNEVEN BRAKES**
POSSIBLE CAUSE	**CORRECTION**
1. Brake adjustment, lubrication or relining needed.	1. Adjust, lubricate or reline brakes as necessary.
2. Grease or oil on brake linings.	2. Replace brake lining.
3. Brake shoe or chamber release springs broken.	3. Replace springs.
4. Brake drum out of round.	4. Check brake drum concentricity. If out of round, machine within allowable limitations.
5. Brake chamber diaphragm leaking.	5. Repair or replace brake chamber.

CONDITION	BRAKES DO NOT RELEASE
POSSIBLE CAUSE	**CORRECTION**
1. Restricted or broken tubing or hoses.	1. Check system. Locate problem area. Repair or replace parts.
2. Faulty treadle valve.	2. Repair or replace.

SPECIFICATIONS AND CAPACITIES

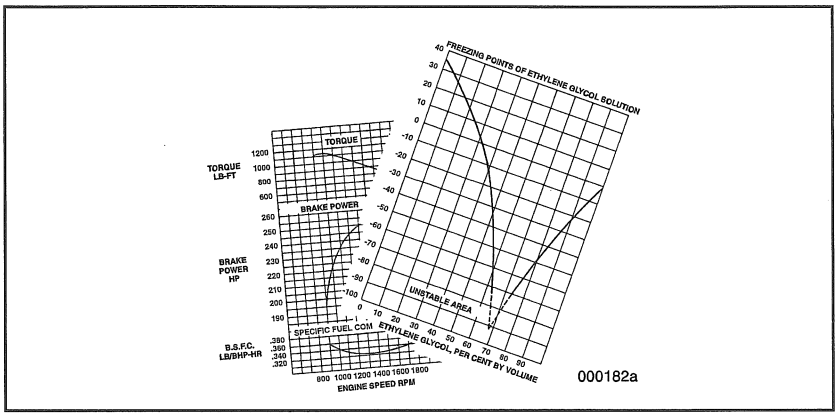


Figure 129 — Specifications and Capacities

NOTE

Components used on certain contract-engineered vehicles may require lubricants other than those specified in this manual. Refer to the operator's manual supplied with these vehicles for a listing of specified lubricants.

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LUBRICANT SPECIFICATIONS

Lubrication of vital engine parts and chassis components, such as oil-lubricated wheel bearings, can best be accomplished by using the highest quality, recommended type and SAE grade lubricants.

To obtain the proper performance level lubricants, show these specifications to your oil supplier. Purchase from a reputable distributor who will assume the responsibility of recommending the proper lubricants for the vehicle. Service components in accordance with MACK recommendations. DO NOT mix brands or types of lubricants.

Engine Oils for MACK Diesel Engines

EO-N PREMIUM PLUS '03

EO-N Premium Plus '03 diesel engine oil is mandatory for use in MACK ASET™ AI, AMI and AC engines. EO-N Premium Plus '03 diesel engine oils exceed API performance category CI-4, and have demonstrated high performance capabilities in laboratory and field tests. To satisify the requirements of EO-N Premium Plus '03, an oil must pass the MACK T-8E test which is a 300-hour test that measures the ability of the oil to resist soot-related oil thickening, and the T10 test which is a 300-hour test that measures the resistance of the oil to oxidation at higher oil temperatures, and the ability of the oil to control abrasive wear. The T-10 test also measures cylinder wear and bearing corrosion protection. EO-N Premium Plus '03 specification oil also must exceed other industry standard tests that determine general and soot-related wear and resistance to oxidation at higher temperatures.

Use the SAE grade oil as indicated in the following table for seasonal temperature changes.

LUBRICANT SPECIFICATIONS

Oil Specification	Ambient Temperature in Degrees °F (°C)	SAE Viscosity Grade	
EO-N Premium Plus '03	Above 0° (–18°)	15W40	5W40**
	Consistently 0° (–18°) or below*	10W40	5W40**

* At extremely low temperatures, use an engine block heater to keep the engine warm during extended shutdown or layovers.

** Synthetic Oil

Gear Oils

GO-J and GO-J PLUS specification oils are compounded gear oils (mineral or synthetic base) for use in all MACK components which require gear oil as a lubricant. These two classes of oils have different drain intervals, with GO-J used for standard drain intervals and GO-J PLUS used for extended drain intervals. For an explanation of vehicle usage and an outline of oil change interval mileage/time requirements, refer to "PREVENTIVE MAINTENANCE PROGRAM" on page 10.

NOTE

GO-J and GO-J PLUS gear oils are mandatory for use in all MACK components which require gear oil as a lubricant.

GENERAL REQUIREMENTS

Both GO-J and GO-J PLUS gear oils must be blended from well-refined virgin base stock (or synthetic) and properly compounded with load-carrying and lubricity additives. Water content must be less than 600 ppm (ASTM D-6304, Proc. C). To be approved as MACK Specification GO-J or GO-J PLUS, these oils must meet SAE J 2360, must be stable and must not contain any abrasive or corrosive ingredients.

GEAR OILS FOR MACK COMPONENTS

Geared Component	Recommended SAE Grade GO-J and GO-J PLUS*	
	Mineral	Synthetic
Carriers	80W90, 80W140, 85W140	75W90, 75W140, 80W140
Flywheel PTO	80W90, 80W140, 85W140	75W90, 75W140, 80W140
Transfer Case	80W90, 80W140, 85W140	75W90, 75W14, 80W140
Oil-Lubricated Wheel Bearings	80W90, 80W140, 85W140	75W90, 75W140, 80W140

* GO-J PLUS is required for MACK geared component extended service drain interval.

GEAR OILS FOR MACK TRANSMISSIONS

Model	Ambient Temperature F° (C°)	Recommended SAE Grade GO-J and GO-J PLUS*	
		Mineral	Synthetic
All MACK Transmissions	All Temperature Operations	80W90, 80W140, 85W140	75W90, 75W140, 80W140

* GO-J PLUS or TO-A PLUS is required for MACK transmission extended service drain interval.

⚠ CAUTION

Maximum safe operating oil temperature for MACK transmissions is 250°F (121°C) for mineral-based oil, and 300°F (148°C) for synthetic-based oil.

Transmission Oil

TO-A PLUS specification transmission oil is an SAE 40 or 50 grade oil intended for use in all MACK transmissions being used in the Extended Drain Interval Program. For an explanation of vehicle usage and an explanation of oil change interval time/mileage requirements, refer to "PREVENTIVE MAINTENANCE PROGRAM" on page 10. TO-A PLUS is a transmission fluid only.

⚠ CAUTION

TO-A PLUS specification oil is intended for use as a transmission lubricant only. DO NOT use TO-A PLUS in transfer cases, carriers or any other component that specified GO-J or GO-J PLUS gear oil.

GENERAL REQUIREMENTS

This oil must be an SAE 40 or 50 transmission oil, must be stable, must not contain any abrasive or corrosive ingredients and must be approved as MACK Specification TO-A PLUS. Water content must be less than 600 ppm ASTM D-6304, Proc. C.

TRANSMISSION FLUID FOR MACK TRANSMISSIONS

Model	Ambient Temperature F° (C°)	Recommended SAE Grade TO-A PLUS*
All MACK Transmissions	All Temperature Operations	SAE 40 or 50

* TO-A PLUS or GO-J PLUS is required for MACK transmission extended service drain interval.

Greases

Grease must be high quality, and free of water, acid or other contents which are harmful to the unit.

MG-C (CHASSIS LUBE)

General Requirements

This grease shall be composed of oils and such additives as are required to provide the specified properties. This shall be an "EP" grease, and the thickener must be lithium based.

Specific Requirements

NLGI Grade	2
Appearance	Smooth
Worked Penetration:	
60 Strokes, mm/10, D217*	265–295
Dropping point °F (°C), Min., D566* or D2265*	348°F (175°C)
Rust Protection, Rating, Max., D1743*	Pass
Water Washout, 80°C, % Max., D1264*	10
Oil Separation, Mass %, Max., D1742*	10
High Temperature Life, Hrs., Min., D3527*	40
EP Performance:	
Load Wear Index, Kgf, Min., D2596*	30
Weld Point, Kgf, Min., D2596*	200
Timken OK Load, Lbs. (Kg.), Min., D2509*	40 (18)
Four Ball Wear Scar, mm, Max., D2266*	0.6
Water, Mass %, Max., D95*	0.20
Elastomer Compatibility:	Cr NBR-L
Volume Δ , %, D4289*	0 to 30/–5 to +30
Shore A Hardness Δ , Pts. D4289*	0 to –10 /+2 to –15

BASE OIL PROPERTIES

Viscosity, 40°C, cSt. Min., D445*	145
Pour Point, °F (°C), Max., D97*	5°F (–15°C)
Flash Point, °F (°C), Min., D92*	400°F (205°C)
Viscosity Index, Min., D2270*	70

MOLYBDENUM DISULFIDE (WHEN PRESENT)

Concentration, %, Min., X-ray Fluorescent Spectrograph	1.0
Particle Size, Microns, Max., Fisher Subseive	2.0

There is a trend toward the use of multi-purpose grease. Some of the ingredients used in multi-purpose greases are considered fillers or abrasives by the roller bearing manufacturers. The use of these multi-purpose greases may void warranties.

ANDEROL 776 (EXTREME PRESSURE GREASE)

This grease is a tacky, synthetic diester-based grease containing molybdenum disulfide, and is formulated to have excellent load carrying ability and low friction.

Specific Requirements

Optimum Operating Range, °F (°C) –40° to 300° (–40° to 149°)	
NLGI Number	1
Worked Penetration, D217*	310
Worked Stability, 100,000 strokes, D217*	350
Dropping Point °F (°C), D566*	365° (185°)
Oil Separation, 30 hours @ 212°F (100°C), % FTMS 791, No. 321.2	1
Evaporation, 22 hours @ 210°F (99°C), % D972*	1
Humidity Cabinet, hours, min., ASTM D1748	100
Four Ball Wear, 1200 rpm, 167°F (75°C), 40 KG, hr., mm., D2266*	0.4
Four Ball EP, Weld-Point, KG, ASTM D2783	180

* ASTM test procedure.

BG-A (CLUTCH RELEASE BEARING GREASE)

High temperature grease made for ball and roller bearings. This grease must be NLGI grade 1 or 2, have a minimum melting point of 350°F (178°C), and be stable and non-fibrous.

RG-A (BRAKE)

An extreme pressure lubricant which has high resistance to corrosion and water leakage, superior adhesive-cohesive properties and low cold shear at sub-zero temperatures. For use in ArvinMeritor™-Standard Stopmaster brakes, it must comply with specification 1779-W-283. Shell Darina No. 1, Sun Sunnaplex No. 1 and Texaco Thermatex EP-1 are approved equivalents.

WG-A (WHEEL BEARING GREASE)

WG-A grease must be composed of only soaps and oils, and must be free of fillers and abrasives. This grease must be non-corrosive to bearing parts in service or storage, and it will show no oil separation in service or storage. Also, WG-A must be a smooth, texture-type grease and have a dropping point in excess of 250°F (121°C) when tested in accordance with ASTM method D217–52T.

Moisture content should not be greater than 0.5%. The oil should have a viscosity of 75 to 100 seconds at 210°F (99°C), near 0°F (–31°C) cold test, and it should be a refined product. For normal applications, this grease should have an ASTM penetration at 77°F (25°C) (ASTM method D217–52T) not heavier than 265 when applied to the bearings.

WG-A grease shall not work softer than 310 penetration with 60 strokes in the grease worker or in service. With 5000 strokes in the grease worker, WG-A shall not be softer than 340 penetration. The worked grease (5000 strokes) shall not thicken to an ASTM penetration heavier than 250 when heated to 220°F (105°C) for a test period of 16 hours, and shall not show excessive oil separation after this test.

SEMI-FLUID GREASE (WHEEL BEARING LUBRICANT)

Semi-fluid grease, such as Mobilith® SHC® 007, is a high-performance, extreme-pressure grease which combines a synthetic-base fluid with a lithium complex soap thickener. The thickener system provides structural stability, a high dropping point and excellent resistance to water wash.

Specific Requirements

NLGI Grade	00
Soap Type	Lithium Complex
Structure, Visual	Smooth: Tacky
Color, Visual	Red
Worked Penetration:	
• 60 strokes, ASTM D217	415
• 10,000 strokes, ASTM D217	420
• 100,000 strokes, ASTM D217	420
Viscosity of Oil, ASTM D445	
• cSt @ 40°C	460
• cSt @ 100°C	46.5
• SUS @ 100°F	2400
• SUS @ 210°F	215
ISO VG	460
EP and Wear Protection	
• Four-Ball Wear Test, ASTM D2266	Scar diameter, 0.70 mm max.
• Four-Ball EP Weld Load, ASTM D2596	250 kg
• Load Wear Index	45
Corrosion Prevention, ASTM D1743, rust test Pass	0.0
Emcor/SKF Water Wash Test, IP 220 (modified)	
US Steel Mobility, g/min. 64.4°F (18°C)	27
Bomb Oxidation, ASTM D942, psi loss,	
• 100 hour 210°F	2
• 500 hour 210°F	4

Fluids

Fluids must be high quality and free from water, acid or other contents which are harmful to the unit.

BF-B (BRAKE FLUID)

Use heavy-duty-type hydraulic brake fluid meeting the specifications of FMVSS116, type DOT 3, 4 or 5.

CF-A (CAB TILT)

Use fluid meeting military specification MIL-H-5606E.

Diesel Fuel

Effective October 1,1993, the Environmental Protection Agency (EPA) mandated that all diesel fuel sold for highway use be less than 500 parts per million (ppm) sulfur content. Use of fuel oil additives to compensate for the .05% low sulfur is **NOT** recommended by Mack Trucks, Inc. Always use a good quality fuel meeting the specifications as given in table on page 344.

DIESEL FUEL

DF-A (Diesel Fuel Grades #1D and #2D)

The selection of the proper fuel oil is essential for good economy, performance and engine life. Use diesel fuel oils meeting the specifications as given below. Grade #2D diesel fuel is to be used for most climatic conditions, while grade #1D is intended for use during cold weather operations. Blends of grades 1 and 2 may be used to suit the various climatic conditions which may be encountered.

FUEL GRADES #1D AND #2D REQUIREMENTS

Property	Requirements		ASTM Method
	#2D	#1D	
Viscosity, cSt @ 104°F (40°C)	2.2–3.0	1.3–2.4	D445
API Gravity @ 60°F (15°C)	32–38	38–42	D287
Volatility, °F (°C)			
IBP, Min.	320 (160)	320 (160)	D86
50%	475 to 550 (246 to 288)	430 to 460 (221 to 238)	
90%, Max.	640 (338)	500 to 550 (260 to 288)	
Cetane Number, Min.	40	40	D613
Total Sulfur, % Max.	0.05	0.05	D4294
Pour Point, °F (°C)	–10 (–23) during winter months	–20 (–29) Max.	D97
Corrosion — Copper Strip @ 212°F (100°C)	No. 3B	ASTM 1-Max.	D130
Conradson Carbon on 10% Residium, Max.	.35	.25	D4530
Ash Content, % Max.	.01	.01	D482
Water and Sediment, % Max.	.05	.05	D1796
Flash Point, °F (°C)	125 (52)	125 (52)	D93
Rust Prevention	Light Rusting Max.	Light Rusting Max.	D665A

The products furnished under this specification may be either cracked residuals, blends or straight-run distillates, provided they come within the scope of the specifications as listed in table on page 344. Straight-run distillates, however, are preferred to recycled or cracked fuels.

NOTE

For premium diesel fuel, use the Engine Manufacturer's Association recommended specification FQP1B.

Ultra-Low Sulfur Diesel Fuel

Use of certain ultra-low sulfur diesel fuels is approved by Mack Trucks, Inc., as long as the fuel complies with the most recent ASTM recommendation of a 520 mm maximum wear scar when tested in accordance with ASTM D6079-02 for lubricity, and that it meets an 80% reflectance when tested in accordance with ASTM 6468 for thermal stability.

Additives intended to compensate for the lower sulfur content (other than as added by the fuel supplier) are not recommended by Mack Trucks, Inc.

Handling and Storing Fuel

Correct handling and storage of diesel fuel during cold and/or inclement winter weather is a key to satisfactory truck performance and reliability.

Observe the following hints and suggestions:

- Storage tanks for diesel fuel should permit periodic removal of sludge and water accumulations. This should be performed on a regular basis at approximately 10-day intervals.
- Fuel should be stored only in clean, non-contaminated tanks situated in a cool, dry location.

⚠ CAUTION

Never store diesel fuel in a galvanized container. The fuel will dissolve the zinc in the galvanized coating. This zinc will then remain in solution in the fuel until it is run through the engine where it will be deposited in the pump and/or injectors causing serious damage.

- When parking vehicle overnight or longer, fill its fuel tank(s) to prevent build-up of internal condensation.
- Remove accumulations of snow, ice, oil or other debris from area of filler cap before removing cap from vehicle fuel tank. Also remove snow-ice accumulations at tank vent.

Diesel Fuel and Winter Operation

For winter operation, certain fuel properties become more critical. These properties include:

- Cetane Number — A measure of the ignition value, or the time required to heat, vaporize and ignite the fuel. The higher this rating number, the faster the fuel will burn.
- Pour Point — A temperature-related point at which fuel will no longer flow through system lines and cannot be pumped.
- Cloud Point — A temperature-related point at which fuel may continue to flow through system lines but filter restriction (plugging) can occur due to crystallizing of the heavier parafinic components of the fuel (also referred to as *jelling* or *waxing* in the fuel).
- Impurities — Water and sediment are of particular importance. Water contamination can cause fuel line freeze-up, injection pump and nozzle damage, as well as component corrosion.

NOTE

When operating in cold weather, fuel waxing can cause many problems similar to engine troubleshooting symptoms. Be sure to check for fuel congealing before proceeding to troubleshooting remedies outlined under "ENGINE DIAGNOSTIC CHART" on page 294.

Diesel Fuel Additives

Due to potential damage to the fuel system or engine, the use of supplemental diesel fuel additives other than those added by the fuel manufacturer, is not recommended by Mack Trucks, Inc.

NOTE

Adding isopropyl alcohol to reduce water contamination and freezing is NOT recommended.

⚠ CAUTION

Never blend gasoline with diesel fuel. This can cause an explosive mixture resulting in component destruction and engine/fuel system damage.

CETANE IMPROVERS

Mack Trucks, Inc. currently approves the use of cetane improvers and certain pour-point depressants to improve the combustibility and flow characteristics of the fuel *only if these additives are contained in the fuel as delivered* and not added by the consumer.

NOTE

- Be aware that the minimum Cetane rating is now 40 instead of 45, but higher ratings may still be necessary for operation in high altitudes or extreme cold weather.
- Also note that some experts say Cetane improvers may cause *gum-up* problems.

Cetane improvers have the following benefits:

- Easier cold weather starting
- Smoother engine operation
- Reduced diesel *knock*
- Faster engine warm-up
- Lower emissions
- Reduced misfirings and white smoke cleanup time

Fuel Warmers

The use of thermostatically controlled fuel warmers which will maintain fuel temperatures above the gel point and below the flash point of the fuel.

NOTE

The only fuel warmers approved for use on MACK engines are those which use the coolant to regulate the temperature of the fuel. Exhaust gas fuel warmers are not satisfactory, nor are they approved for use.

Engine Block Heater

The combination of a fuel warmer, one which uses the engine coolant as the heating medium, and a block heater will alleviate winter starting and operating problems associated with fuel waxing.

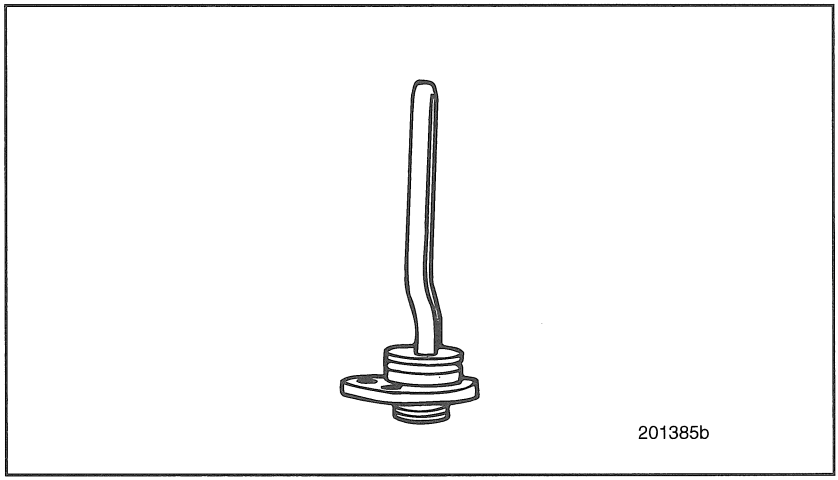


Figure 130 — Engine Block Heaters

ANTIFREEZE SPECIFICATIONS

Ethylene glycol- or propylene glycol-based antifreezes are required in MACK Class 8 trucks. All ethylene-glycol and propylene-glycol coolants must be low silicate antifreezes which meet ASTM D4985 test and TMC RP329 criteria. These antifreezes are sometimes referred to as heavy-duty diesel coolants. Passenger car coolants do NOT meet this specification.

Be sure to maintain the required level of antifreeze protection for anticipated winter temperatures in your area of operation. Mack Trucks, Inc. recommends an antifreeze mix in the range between 40% to 60%, depending upon climatic conditions in which the vehicle will be operated.

⚠ CAUTION

Do not exceed a 60% solution of ethylene glycol or propylene glycol to water. A higher percentage will not increase protection. Concentrations over 60% adversely affect freeze protection and heat transfer rates.

Additional guidelines for maintaining correct antifreeze protection include the following:

- Do not use antifreeze containing anti-leak additives in trucks equipped with coolant filters or conditioners. Also, do not use soluble oil type antifreeze in any MACK cooling system.
- Always mix the water/antifreeze solution before adding it to the cooling system.
- After adding coolant, run the engine until a minimum normal operating temperature is reached. Check the coolant level and add coolant as needed.
- Concentration of antifreeze in the cooling system must be checked with a refractometer twice per year.
- Change coolant at the recommended interval as outlined in "COOLING SYSTEM" on page 93.

A proper coolant mixture contains MACK-approved antifreeze and quality water meeting the minimum acceptable specifications listed in the following table:

Property	Limit	ASTM Test Method
Chloride (Cl), gr/gal (ppm)	2.4 (40) max.	D512b, D512d, D4327
Sulfate (SO4), gr/gal (ppm)	5.9 (100) max.	D516b, D516d, D4327
Total Hardness, gr/gal (ppm)	10 (170) max.	D1126b
Total Solids, gr/gal (ppm)	20 (340)	D1293

Water can be tested by any reputable testing laboratory. If water meeting the above specifications is not available, use de-ionized or distilled water rather than ordinary tap water to minimize the adverse effects of minerals in the water.

COOLANT CAPACITIES

Coolant System Capacities

⚠ CAUTION

Capacities may vary due to hoses and size of radiator, as well as accessory cooling equipment. After running the engine until normal operating temperature is reached, check the coolant level and add coolant as needed.

Use the chart shown below in conjunction with the Ethylene-Glycol and Propylene-Glycol Protection Charts in this section to determine the amount of antifreeze needed to protect your vehicle.

Model	Engine	Coolant Capacity Quarts (Liters)
CX600 Series	ASET™ AC	33 (31)
CXN Series	ASET™ AC	36 (34)
CV500/700 Series	ASET™ AI, AMI Cummins ISL Engines	33 (31) 25 (24)
CH600 Series	ASET™ AC	38 (36)
CHN Series	ASET™ AC	36 (34)
CT112 (AB)	ASET™ AI, AMI	34 (32)
CL700 Series	Cummins ISX and Signature	62 (59)
LE600 Series	ASET™ AI, AMI Cummins ISC Engines	38 (36) 31.5 (30)
MR600 Series	ASET™ AI, AMI	40 (38)
RB600 Series	ASET™ AI, AMI	33 (31)
DM600 Series	ASET™ AI, AMI	33 (31)

Use the following antifreeze protection charts to determine the percentage of antifreeze needed to achieve specific protection levels for various coolant systems.

ETHYLENE-GLYCOL PROTECTION CHART

Ethylene Glycol	Ambient Air Temperature
40%	–12°F (–24°C)
50%	–34°F (–37°C)
60%	–62°F (–52°C)

PROPYLENE-GLYCOL PROTECTION CHART

Propylene Glycol	Ambient Air Temperature
40%	–6°F (–21°C)
50%	–27°F (–33°C)
60%	–56°F (–49°C)

LUBRICANTS AND CAPACITIES

NOTE

Components used on certain contract-engineered vehicles may require lubricants other than those specified in this manual. Refer to the operator's manual supplied with these vehicles for a listing of specified lubricants.

MACK Engines

(See table on page 334 for recommended SAE Grades)

Engine	Lubricant	System Capacity** Quarts (Liters)
ASET™ AI, AMI and AC	EO-N PREMIUM PLUS '03	41.5 (39.3)*
ASET™ AI, AMI in CV and RD All-Wheel Drive models	EO-N PREMIUM PLUS '03	33.5 (31.7)***
ASET™ AMI-370	EO-N PREMIUM PLUS '03	56 (53)*

* Add 1 qt. for chassis equipped with MACK Rear Engine Power Take-Off (REPTO).

** Total system capacity (dry, after engine overhaul).

*** If equipped with Luber-Finer® oil filter, oil capacity is increased by 4 qts. (3.8 liters).

Oil Change Capacity:

- All models except CV with All-Wheel Drive

  40 qts. (38 liters) — with oil filter change

- CV with All-Wheel Drive

  36 qts. (34.1 liters) — with oil filter change — equipped with Luber-Finer® oil filter

  32 qts. (30 liters) — with oil filter change — not equipped with Luber-Finer® oil filter

NOTE

Some residual oil remains in the system (oil cooler, lines, etc.) when the oil is drained.

Cummins Engines

Model	Lubricant	System Capacity Quarts (Liters)
ISC Series	Heavy-Duty Engine Oil SAE Grade 15W40 Meeting API Classification CE/SG	21 (19.9) Standard Oil Pan 22 (20.8) Deep Oil Pan
ISL Series	Heavy-Duty Engine Oil SAE Grade 15W40 Meeting API Classification CG-4 or CH-4	25 (23.7) Standard Oil Pan and Oil Pan with Block Stiffener
ISX Series and Signature 600 Series	Heavy-Duty Engine Oil SAE Grade 15W40 Meeting API ClassificationCF-4/SG	52 (49.2)

Transfer Case

(Refer to "Gear Oils" on page 335 for recommended SAE grades)

Transfer Case	Lubricant	Capacity — Pints (Liters)
TC15 Series	GO-J/GO-J PLUS**	20 (9.5)
TC25 Series	GO-J/GO-J PLUS**	20 (9.5)

** GO-J PLUS required for MACK geared component extended service drain intervals.

MACK MAXITORQUE® ES T300 Series Transmissions

(Refer to "GEAR OILS FOR MACK TRANSMISSIONS" on page 336 for recommended SAE grades)

T300 Model Designation	Lubricant	Capacity* Pints (Liters)
T305	GO-J, GO-J PLUS**, TO-A PLUS**	20 (9.5)
T306		24 (11.4)
T306G		20 (9.5)
T307		30 (14.2)
T307M		30 (14.2)
T308		24 (11.4)
T308M		30 (14.2)
TM308		24 (11.4)
TM308M		30 (14.2)
T309		24 (11.4)
T309L		24 (11.4)
T309LR		24 (11.4)
TM309		24 (11.4)
TM309M		30 (14.2)
T310		24 (11.4)
T310M/MLR		30 (14.2)
T310ME		30 (14.2)
T313LR		30 (14.2)
T313L		30 (14.2)
T318LR		30 (14.2)
T318L		30 (14.2)
T313LR21		30 (14.2)
T313L21		30 (14.2)
T318LR21		30 (14.2)
T318L21		30 (14.2)

* Exact amount depends on inclination of transmission. Also, if equipped with a transmission oil cooler or RMPTO, specified oil capacity may vary. Fill to level of filler opening. DO NOT overfill.

** GO-J PLUS and TO-A PLUS required for extended drain interval. TO-A PLUS is a transmission lubricant only, and not to be used in other geared components.

Allison Transmissions*

ALLISON TRANSMISSION LUBRICANTS AND CAPACITIES

Transmission*	Lubricant	Capacity — Quarts (Liters)	
		Initial Fill**	Refill***
4000/4500 RDS	Dexron® III or Castrol® TranSynd®		
Deep oil sump with PTO		51 (48)	45 (43)
Deep oil sump without PTO		48 (45)	42 (40)

Grade (SAE) or oil type	Minimum Ambient Temperature °F (°C)
0W-20 (Arctic oil) or TranSynd®	–22 (–30)
Dexron® III	–25 (–13)
10W	–4 (–20)
15W-40	5 (–15)
30	32 (0)
40	50 (10)

Temperatures below those listed above require pre-heat.

* All capacities are for the transmission alone and do not include external piping such as for filters, coolers, etc.

** Initial fill capacity is the amount of lubricant needed to fill a totally dry transmission such as after an overhaul.

*** Refill capacity is the amount of lubricant needed to fill a unit that has been drained for the purpose of changing the transmission fluid.

For Allison transmission oil level check and change intervals, refer to the Allison transmission service literature.

Eaton® Fuller® Manual Transmissions

EATON® FULLER® MANUAL TRANSMISSIONS

Transmission	Lubricant**	Capacity Pints (Liters)*
9 Speeds	Eaton-Approved Synthetic Transmission Lubricants*** E500™ and E250™ (refer to Note 3 on page 22)	
RT-13609 Series		27 (12.8)
RT-14609 Series		27 (12.8)
RT-14709 Series		27 (12.8)
RT-16709 Series		27 (12.8)
10 Speeds	Grade (SAE) / Ambient Temp. °F (°C)	
RT-14908LL Series	50 / All Temperatures	28 (13)
RT-16908LL Series		28 (13)
FR-12210 Series		23.5 (11.1)
FR-13210 Series		23.5 (11.1)
FR-14210 Series		23.5 (11.1)
FR-15210 Series		23.5 (11.1)
FR-16210 Series		23.5 (11.1)
FROF-17210C		23.5 (11.1)
FROF-18210C		23.5 (11.1)
	The following oil specifications are not approved for extended drain intervals or the Eaton extended warranty program. Heavy-Duty Engine Oil Meeting Specification MIL-L-2104 D or Caterpillar TO-4	
11 Speeds		
RTO-14909ALL		28 (13)
RTO-16909ALL		28 (13)
13 Speeds	Grade (SAE) / Ambient Temp. °F (°C)	
RT-14913 Series	50 / Above 10° (–12°)	28 (13)
RT-16913 Series	40 / Above 10° (–12°)	28 (13)
RTLOF-18913A	30 / Below 10° (–12°)	28 (13)
15 Speeds		
RT-14915 Series		28 (13)
RT-16915 Series		28 (13)
18 Speeds	Refer to lubricant specifications on previous page.	
RT-14918 Series		28 (13)
RTLO-16918B		28 (13)
RTLOF-18918B		28 (13)
RTLOF-20918B		28 (13)

* Capacities listed are approximate. Exact amount depends upon degree of engine and transmission inclination. Always fill transmission to level of filler plug hole. DO NOT overfill. Capacity of transmissions equipped with PTOs or oil coolers will be greater than capacities listed.

** Do not use multi-viscosity or EP (Extreme Pressure) GL-5 gear oils. **DO NOT MIX OILS IN THE TRANSMISSION.**

*** Eaton-approved synthetic lubricants are required for extended drain intervals and the Eaton extended warranty. Refer to Eaton® Fuller® service literature for recommended drain intervals and warranty information.

EATON® FULLER® AUTOSHIFT™

Model	Lubricant*	Capacity Pints (Liters)**
	Eaton-Approved Synthetic Lubricants*** E500™ and E250™ (Refer to Note 3 on page 22) Grade (SAE) — Ambient Temp. °F (°C)	
RTO-14910(B)(C)-AS2		26 (12)
	50 — All Temperatures	
RTO-16910(B)(C)-AS2		26 (12)
RTLO-14918(A)(C)-AS2	The following oil specifications are not approved for extended drain intervals or the Eaton extended warranty. Heavy-Duty Engine Oil	28 (13)
RTLO-16918(A)(C)-AS2	Meeting Specification MIL-L-2104 D or Caterpillar TO-4 Grade (SAE) — Ambient Temp. °F (°C)	28 (13)
	50 — Above 10° (–12°)	
	40 — Above 10° (–12°)	
	30 — Below 10° (–12°)	

* Do not use multi-viscosity or EP (Extreme Pressure) GL-5 gear oils. **DO NOT MIX OILS IN THE TRANSMISSION.**

** Capacities listed are approximate. Exact amount depends upon degree of engine and transmission inclination. Always fill transmission to level of filter plug hole. DO NOT overfill. Capacity of transmissions equipped with PTOs or oil coolers will be greater than capacities listed.

*** Eaton-approved synthetic lubricants are required for extended drain intervals and the Eaton extended warranty. Refer to Eaton® Fuller® service literature for recommended drain intervals and warranty information.

EATON® FULLER® ULTRASHIFT™

Transmission*	Lubricant	Capacity Pints (Liters)
RTO-14910B-DM2 RTO-16910B-DM2	Eaton-Approved Synthetic Lubricants*** E500™ and E250™ (Refer to Note 3 on page 22) Grade (SAE) — Ambient Temp. °F (°C) 50 — All Temperatures The following oil specifications are not approved for extended drain intervals or the Eaton extended warranty. Heavy-Duty Engine Oil Meeting Specification MIL-L-2104 D or Caterpillar TO-4 Grade (SAE) — Ambient Temp. °F (°C) 50 — Above 10° (–12°) 40 — Above 10° (–12°) 30 — Below 10° (–12°)	26 (12) 26 (12)

* Do not use multi-viscosity or EP (Extreme Pressure) GL-5 gear oils. **DO NOT MIX OILS IN THE TRANSMISSION.**

** Capacities listed are approximate. Exact amount depends upon degree of engine and transmission inclination. Always fill transmission to level of filler plug hole. DO NOT overfill. Capacity of transmissions equipped with PTOs or oil coolers will be greater than capacities listed.

*** Eaton-approved synthetic lubricants are required for extended drain intervals and the Eaton extended warranty. Refer to Eaton® Fuller® service literature for recommended drain intervals and warranty information.

Eaton® Fuller® Lightning™ Transmissions (with Top 2 [T2] and without Top 2)

Model	Lubricant*		Capacity Pints (Liters)**
	Eaton-Approved Synthetic Lubricants*** E500 and E250 (Refer to Note 3 on page 22)		
	Grade SAE	Ambient Temp. °F (°C)	
	50	All Temperatures	
	The following oil specifications are not approved for extended drain intervals or the Eaton extended warranty.		
FRLO-14410C-T2 FRLO-15410C-T2 FRLO-16410C-T2	Heavy-Duty Engine Oil Meeting Specification MIL-L-2104 D or Caterpillar TO-4		27 (12.8) 27 (12.8) 27 (12.8)
	Grade SAE	Ambient Temp. °F (°C)	
FRLO-14410C FRLO-15410C FRLO-16410C	50 40 30	Above 10° (–12°) Above 10° (–12°) Below 10° (–12°)	27 (12.8) 27 (12.8) 27 (12.8)

* Do not use multi-viscosity or EP (Extreme Pressure) GL-5 gear oils. **DO NOT MIX OILS IN THE TRANSMISSION.**

** Capacities listed are approximate. Exact amount depends upon degree of engine and transmission inclination. Always fill transmission to level of filler plug hole. DO NOT overfill. Capacity of transmissions equipped with PTOs or oil coolers will be greater than capacities listed.

*** Eaton-approved synthetic lubricants are required for extended drain intervals and the Eaton extended warranty. Refer to Eaton® Fuller® service literature for recommended drain intervals and warranty information.

ArvinMeritor™ Transmissions

Model	Lubricant*	Capacity Pints (Liters)***
MO-13G9B-M13	Full-Synthetic Oil Meeting	20.5 (9.7)
MO-14G9B-M14	ArvinMeritor Specification O-81**	20.5 (9.7)
MO-15G9B-M15	Temperature / SAE Grade	20.5 (9.7)
MO-11G10(A)(C)-M11	Above –40°F (–40°C) SAE 50	20.5 (9.7)
MO-13G10(A)(C)-M13		20.5 (9.7)
M-14G10A-M14		20.5 (9.7)
MO-14G10(A)(C)-M14		20.5 (9.7)
M-15G10A-M15		20.5 (9.7)
MO-15G10(A)(C)-M15	Petroleum Oil with Rust and Oxidation	20.5 (9.7)
MO-16G10C-M16 (A)(C)	Inhibitor Meeting	20.5 (9.7)
	API Specification GL-1	
	Temperature / SAE Grade	
	Above 10°F (–12°C) 90	
	Above –15°F (–26°C) 80	
	Heavy-Duty Engine Oil	
	Meeting Specification	
	MIL-L-2104, E, or F	
	or	
	API CD, CE, SG, SH or SJ	
	Temperature / SAE Grade	
	Above 10°F (–12°C) 50	
	Above 10°F (–12°C) 40	
	Above –15°F (–26°C) 30	

* Do not use multi-viscosity or EP (Extreme Pressure) GL-5 gear oils. **DO NOT MIX OILS IN THE TRANSMISSION.**

** Refer to ArvinMeritor Bulletin TP-90114, "Lubricant Specifications" for full-synthetic oil specifications.

*** Capacities listed above are approximate, always fill transmission to the bottom of the plug hole. On chassis equipped with an oil pump and/or cooler, operate the engine for five minutes after initially filling the transmission, then recheck the oil level.

For ArvinMeritor™ transmission oil level check and change intervals, refer to ArvinMeritor™ transmission service literature.

Transmission Technologies Corporation

TRANSMISSION TECHNOLOGIES LUBRICANTS AND CAPACITIES

Model	Lubricant*		Capacity Pints (Liters)
LPSO140-10S	Heavy-Duty Engine Oil		18 (8.5)
LPSO150-10S	Meeting Specification		18 (8.5)
PSO140-10S	MIL-L-2104D or E		18 (8.5)
PSO145-10V	or		18 (8.5)
PSO150-10S	API-CD, CE, SF, or SG		18 (8.5)
PSO165-10S	or		18 (8.5)
	Caterpillar TO-4		18 (8.5)
	Grade (SAE)	Ambient Temp °F (°C)	18 (8.5)
	30 or 40	Above 0° (–18°)	
	30	Below 0° (–18°)	
	Automotive Gear Oil API MT-1		
	Grade (SAE)	Ambient Temp °F (°C)	
	80W90	Above 0° (–18°)	
	75W	Below 0° (–18°)	
	Synthetic Transmission Oil Meeting Spicer Specification MS-961-T		
	Grade (SAE)	Ambient Temp °F (°C)	
	50	All	

* EP Gear Oils are not recommended when operating temperatures exceed 230°F (110°C). Do not mix engine, transmission or gear oils. Synthetic SAE 50 transmission oil required for vehicles equipped with engines having horsepower ratings of 399 and greater.

For transmission oil level check and change intervals, refer to appropriate transmission service literature.

Auxiliary Transmissions

Transmission	Lubricant	Capacity Pints (Liters)
Spicer	Heavy-Duty Engine Oil Meeting Specification MIL-L-2104D or MIL-L-46152B, or API SF or CD	
ATO-1000-4C/D		14 (6.6)
APO-1000-4C		14 (6.6)
AMO-1000-4C		14 (6.6)
	Ambient Temperature °F (°C) / Grade SAE: Above 0° (–18°) — 30, 40, 50; Below 0° (–18°) — 30	
Fuller	Heavy-Duty Engine Oil Meeting Specification MIL-L-2105D or API SF or CD	
AT1202A		11 (5)
	Ambient Temperature °F (°C) / Grade SAE: Above 10° (–12°) — 40, 50; Below 10° (–12°) — 30	

For auxiliary transmission service information and lubricant change intervals, refer to the specific auxiliary transmission manufacturer's service literature.

Front Driving Axle

FRONT DRIVING AXLE LUBRICANTS AND CAPACITIES

Front Axle	Lubricant	Capacity Pints (Liters)
Marmon-Herrington		
MT22		
Housing	GL-5	17 (8.0)
Hub Ends	GL-5	1.7 (0.8)

For front axle service information and lubricant change intervals, refer to the specific axle manufacturer's service literature.

Steering System

STEERING SYSTEM LUBRICANTS AND CAPACITIES

Steering System	Lubricant	Capacity Pints (Liters)
Power Steering Reservoir Capacity	E-ON PREMIUM PLUS* '03	4 (1.9) Single Gear 8 (3.8) Dual Gear

* Viscosity of steering gear lubricant should be the same as used in the engine.

Rear Axles

(See "GEAR OILS FOR MACK COMPONENTS" on page 336 for MACK recommended SAE grades)

REAR AXLE LUBRICANTS AND CAPACITIES

Rear Axle	Carrier	Lubricant	Capacity Pints (Liters)
MACK			
RA23R	CRD203 (1)	GO-J/GO-J PLUS*	34.5 (16.3)
RA30	CRD203 (1)	GO-J/GO-J PLUS*	34.5 (16.3)
RAD38	CRD118 (1)	GO-J/GO-J PLUS*	32 (15.1)
ArvinMeritor™			
RS-21-145	R145 Series	GL-5 or MIL-PRF-2105E	32.3 (15.3)
RS-23-160	R160 Series	GL-5 or MIL-PRF-2105E	39.5 (18.7)
RS-23-161	R160 Series	GL-5 or MIL-PRF-2105E	37.2 (17.6)
RS-23-180	R180 Series	GL-5 or MIL-PRF-2105E	47.3 (22.4)
RS-23-186	R180 Series	GL-5 or MIL-PRF-2105E	47.3 (22.4)
RS-30-185	R180 Series	GL-5 or MIL-PRF-2105E	46.6 (22)
Eaton			
23105D/S	23105	GL-5 or MIL-PRF-2105E	48 (22.7)
30105S	30105	GL-5 or MIL-PRF-2105E	46 (21.5)
30055P	30055	GL-5 or MIL-PRF-2105E	36 (17)

* GO-J PLUS required for MACK geared component extended service drain interval.

For service information, SAE grades and lubricant change intervals for axles other than those manufactured by Mack Trucks, Inc., refer to the specific axle manufacturer's service literature.

Tandem Axles

(See table on page 336 for MACK recommended SAE grades)

TANDEM AXLE LUBRICANTS AND CAPACITIES

Axle Model	Carrier	Lubricant	Capacity** Pints (Liters)	
			Front-Rear Axle	Rear-Rear Axle
S(-)(-)34R	CRDPC92 (1) CRD93(1)	GO-J/GO-J PLUS*	35 (16.6)	34 (16.1)
	CRD(P)202(1)/ CRD 203(1)	GO-J/GO-J PLUS*	36 (17)	34.5 (16.3)
S(-)(-)38R	CRDPC92(1)/ CRD93(1)	GO-J/GO-J PLUS*	35 (16.6)	34 (16.1)
	CRDP202(1)/ CRD 203(1)	GO-J/GO-J PLUS*	36 (17)	34.5 (16.3)
S(-)(-)40	CRDPC92(1)/ CRD93(1)	GO-J/GO-J PLUS*	35 (16.6)	34 (16.1)
	CRDPC202(1)/ CRDPC203(1)	GO-J/GO-J PLUS*	36 (17)	34.5 (16.3)
S(-)(-)440	CRDPC92(1)/ CRD93(1)	GO-J/GO-J PLUS*	35 (16.6)	34 (16.1)
	CRDP202(1)/ CRD203(1)	GO-J/GO-J PLUS*	36 (17)	34.5 (16.3)
S(-)462	CRDPC92(1)/ CRD93(1)	GO-J/GO-J PLUS*	35 (16.6)	34 (16.1)
	CRDP202(1)/ CRD203(1)	GO-J/GO-J PLUS*	36 (17)	34.5 (16.3)
S46H	CRDPC92(1)/ CRD93(1)	GO-J/GO-J PLUS*	35 (16.6)	34 (16.1)
	CRDP202(1)/ CRD203(1)	GO-J/GO-J PLUS*	36 (17)	34.5 (16.3)
S(-)501	CRDPC112/ CRD113	GO-J/GO-J PLUS*	35 (16.6)	34 (16.1)
	CRDP202(1)/ CRD203(1)	GO-J/GO-J PLUS*	36 (17)	34.5 (16.3)

Axle Model	Carrier	Lubricant	Capacity** Pints (Liters)	
			Front-Rear Axle	Rear-Rear Axle
S(-)52	CRDPC112/ CRD113	GO-J/GO-J PLUS*	35 (16.6)	34 (16.1)
	CRDP202(1)/ CRD203(1)	GO-J/GO-J PLUS*	36 (17)	34.5 (16.3)
S(-)582	CRDPC112/ CRD113	GO-J/GO-J PLUS*	35 (16.6)	34 (16.1)
	CRDP202(1)/ CRD203(1)	GO-J/GO-J PLUS*	36 (17)	34.5 (16.3)
S(-)652	CRDP95/CRD96	GO-J/GO-J PLUS*	38 (17.9)	36 (17)
Dana Spicer				
DS/ RS405(P)	DS/RS405(P)	GL-5	31 (14.7)***	28 (13.2)***
DS/ RS462P	DS/RS462P	GL-5	40 (18.9)***	37 (17.5)***
DS/ RS463(P)	DS/RS463(P)	GL-5	40 (18.9)***	37 (17.5)***
DST40(P)	DST40	GL-5	31 (14.7)***	28 (13.2)***
DST41(P)	DST41	GL-5	31 (14.7)***	28 (13.2)***

Axle Model	Carrier	Lubricant	Capacity** Pints (Liters)	
			Front-Rear Axle	Rear-Rear Axle
ArvinMeritor				
RT40-145(A)	RT40-145	GL-5	30.2 (14.3)	25.8 (12.2)
RT40-160	RT40-160	GL-5	39.1 (18.5)	34.4 (16.3)
RT46-160	RT46-160	GL-5	39.1 (18.5)	34.4 (16.3)
RT46-164	RT46-164	GL-5	39.1 (18.5)	34.4 (16.3)
RT46-164EH/P	RT46-164	GL-5	38 (18.0)	33 (15.0)
RT46-16HEH/HP	RT46-16	GL-5	38 (18.0)	33 (15.0)

* GO-J PLUS required for MACK geared component extended service drain intervals.

** Proper oil level is best determined by checking oil level in reference to the oil filler plug hole.

*** Carrier capacity assumes 0-degree installation angle. Installation angles exceeding 10 degrees, or when vehicle must negotiate continuous or long grades, a standpipe may be required to raise oil level. Refer to Eaton Roadranger® service literature for additional information.

For service information, SAE grades and lubricant change intervals for axles other than those manufactured by Mack Trucks, Inc., refer to the specific axle manufacturer's service literature.

MACK ENGINE LINE-UP

MACK ASET™ AC ENGINE MODELS

Engine Model	Operating Range	Rated Power	Peak Power	Peak Torque	Torque Rise	Cruise RPM	High Idle / Idle
AC-310/330 Maxicruise®	1100–1800 rpm	310 HP (231 kW) @ 1800 rpm	330 HP (246 kW) @ 1400–1500 rpm	1360 lb-ft (1844 N•m) @ 1100 rpm	50%	1500 rpm	1850/2100 rpm 500–750 rpm
AC-330/350 Maxicruise®	1100–1800 rpm	330 HP (246 kW) @ 1800 rpm	350 HP (261 kW) @ 1400–1500 rpm	1460 lb-ft (1980 N•m) @ 1100 rpm	52%	1500 rpm	1850/2100 rpm 500–750 rpm
AC-355/380 Maxicruise®	1100–1800 rpm	355 HP (265 kW) @ 1800 rpm	380 HP (283 kW) @ 1400–1500 rpm	1560 lb-ft (2115 N•m) @ 1100 rpm	51%	1500 rpm	1850/2100 rpm 500–750 rpm
AC-380/410 Maxicruise®	1100–1800 rpm	380 HP (283 kW) @ 1800 rpm	410 HP (306 kW) @ 1400–1500 rpm	1660 lb-ft (2250 N•m) @ 1100 rpm	50%	1500 rpm	1850/2100 rpm 500–750 rpm
AC-350 Econodyne®	1200–1800 rpm	350 HP (261 kW) @ 1800 rpm	350 HP (261 kW) @ 1500–1800 rpm	1360 lb-ft (1844 N•m) @ 1200 rpm	33%	1600 rpm	1850/2100 rpm 500–750 rpm
AC-400 Econodyne®	1200–1800 rpm	400 HP (298 kW) @ 1800 rpm	400 HP (298 kW) @ 1500–1800 rpm	1460 lb-ft (1980 N•m) @ 1200 rpm	25%	1600 rpm	1850/2100 rpm 500–750 rpm
AC-427 Econodyne®	1200–1800 rpm	427 HP (318 kW) @ 1800 rpm	427 HP (318 kW) @ 1600–1800 rpm	1560 lb-ft (2115 N•m) @ 1200 rpm	25%	1600 rpm	1850/2100 rpm 500–750 rpm
AC-460E Econodyne®	1200–1800 rpm	460 HP (343 kW) @ 1800 rpm	460 HP (343 kW) @ 1600–1800 rpm	1660 lb-ft (2251 kW) @ 1200 rpm	24%	1600 rpm	1850/2100 rpm 500–750 rpm
AC-460P Econodyne®	1200–1800 rpm	480 HP (358 kW) @ 1800 rpm	487 HP (363 kW) @ 1600 rpm	1660 lb-ft (2251 N•m) @ 1200 rpm	19%	1600 rpm	1850/2100 rpm 500–750 rpm

MACK ASET™ AI AND AMI ENGINE MODELS

Engine Model	Operating Range	Rated Power	Peak Power	Peak Torque	Torque Rise	Cruise RPM	High Idle / Idle
AI-300A	1300–1950 rpm	300 HP (224 kW) @ 1950 rpm	325 HP (242 kW) @ 1700–1900 rpm	1200 lb-ft (1627 N•m) @ 1300 rpm	49%	1700 rpm	2100 rpm / 500–750 rpm
AMI-300 Maxidyne®	1300–2100 rpm	300 HP (224 kW) @ 2100 rpm	325 HP (242 kW) @ 1700–1900 rpm	1200 lb-ft (1627 N•m) @ 1300 rpm	60%	1700 rpm	2170 rpm / 500–750 rpm
AMI-335 Maxidyne®	1300–2100 rpm	335 HP (250 kW) @ 2100 rpm	365 HP (272 kW) @ 1700–1900 rpm	1340 lb-ft (1817 N•m) @ 1300 rpm	60%	1700 rpm	2170 rpm / 500–750 rpm
AMI-370 Maxidyne®	1300–2100 rpm	370 HP (275 kW) @ 2100 rpm	405 HP (302 kW) @ 1700–1900 rpm	1480 lb-ft (2007 N•m) @ 1300 rpm	60%	1700 rpm	2170 rpm / 500–750 rpm
AI-350 Econodyne®	1300–1950 rpm	350 HP (261 kW) @ 1950 rpm	350 HP (261 kW) @ 1500–1950 rpm	1256 lb-ft (1703 N•m) @ 1300 rpm	34%	1700 rpm	2100 rpm / 500–750 rpm
AI-375A Econodyne®	1300–1950 rpm	375 HP (280 kW) @ 1950 rpm	375 HP (280 kW) @ 1600–1950 rpm	1350 lb-ft (1830 N•m) @ 1300 rpm	25%	1700 rpm	2100 rpm / 500–750 rpm
AI-400 Econodyne®	1300–1950 rpm	400 HP (298 kW) @ 1950 rpm	400 HP (298 kW) @ 1600–1950 rpm	1350 lb-ft (1830 N•m) @ 1300 rpm	26%	1700 rpm	2100 rpm / 500–750 rpm
AI-427 Econodyne®	1300–1950 rpm	427 HP (318 kW) @ 1950 rpm	427 HP (318 kW) @ 1600–1950 rpm	1438 lb-ft (1950 N•m) @ 1300 rpm	27%	1700 rpm	2100 rpm / 500–750 rpm
AI-460 Econodyne®	1300–1950 rpm	460 HP (343 kW) @ 1950 rpm	460 HP (343 kW) @ 1600–1950 rpm	1531 lb-ft (2076 kW) @ 1300 rpm	26%	1700 rpm	2100 rpm / 500–750 rpm

NOTE

On all ASET™ engines, no-load full-throttle (high idle) is adjustable, using the V-MAC® Service Support Software, from the rated speed plus 50 rpm to 2100 rpm, with 2100 rpm being the default setting (1900 rpm is the high idle default setting for the E7-460E engine). Also, low idle is adjustable from 500 to 750 (with 650 being the default setting).

ASET™ AC, AI and AMI Engines

Bore and Stroke: 4.875″ × 6.5″ (123.8 mm × 152.4 mm)

Firing order: 1-5-3-6-2-4

Displacement: 728 cu. in. (12 liters)

Thermostat: 180°F (82°C)

NOTE

ASET™ AC engines and AI/AMI engines with new-style water pump use two thermostats.

Radiator Cap:

AC Engines — 16-lb. pressure cap

AI, AMI Engines — 10-lb. pressure cap

Oil Change Capacity:

40 qts. (38 liters) — all models except CV All-Wheel Drive, and CV and CT models with AMI-370 engines — with oil filter change

36 qts. (34.1 liters) — CV All-Wheel Drive models — with oil filter change when equipped with Luber-Finer® oil filter

32 qts. (30 liters) — CV All-Wheel Drive models — with oil filter change, not equipped with Luber-Finer® oil filter

56 qts. (53 liters) — CV and CT models with AMI-370 engines — with oil filter change

NOTE

Some residual oil remains in the system (oil cooler, lines, etc.) when the oil is drained.

Engine Information Plate

In compliance with the emissions standards requirements, an exhaust emission control information plate is affixed to all MACK diesel engines. This plate gives basic engine identification information, valve clearances and engine brake actuator clearance. This plate is located on the forward cylinder head cover in most applications. On MR and LE model chassis, the plate is located on the rear cylinder head cover.

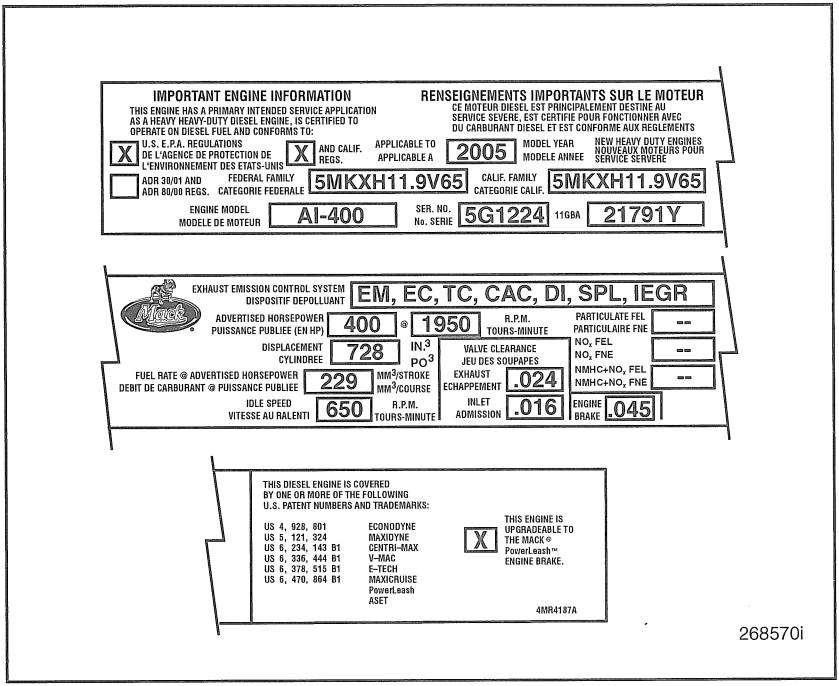


Figure 131 — Engine Information Plate

CONVERSION CHART

CONVERSION CHART

1 inch	=	25.4 millimeters
1 mile	=	1.61 kilometers
1 pint (U.S. liquid)	=	.473 liter
1 quart (U.S. liquid)	=	.946 liter
1 gallon (U.S. liquid)	=	.83267 Imperial gallon
1 cubic inch	=	.01639 liter
1 pound-foot	=	1.3558 Newton meters
1 horsepower	=	.746 kilowatt
1 pound/square inch	=	6.895 kilopascals
degrees Fahrenheit	=	(1.8 x degrees Celsius) + 32
1 millimeter	=	.03937 inches
1 kilometer	=	.6214 miles
1 liter	=	2.1134 pints (U.S. liquid)
1 liter	=	1.0567 quarts (U.S. liquid)
1 Imperial gallon	=	1.2009 gallons (U.S. liquid)
1 liter	=	61.024 cubic inches (U.S. liquid)
1 Newton meter	=	.7376 pound-foot
1 kilowatt	=	1.34 horsepower
1 kilopascal	=	.145 pound/square inch
degrees Celsius	=	.556 x (degrees Fahrenheit –32)

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MAINTENANCE RECORD

SERVICE PERFORMED	DATE	MILEAGE	SERVICED BY

SERVICE LITERATURE

If you would like to know more about servicing your new MACK Truck, several options are available. We offer three different types of literature which are described in Figure 132, Figure 133 and Figure 134. Decide which type fits your needs and order from your local dealer or distributor. Service literature can also be ordered online at www.macktrucks.com.

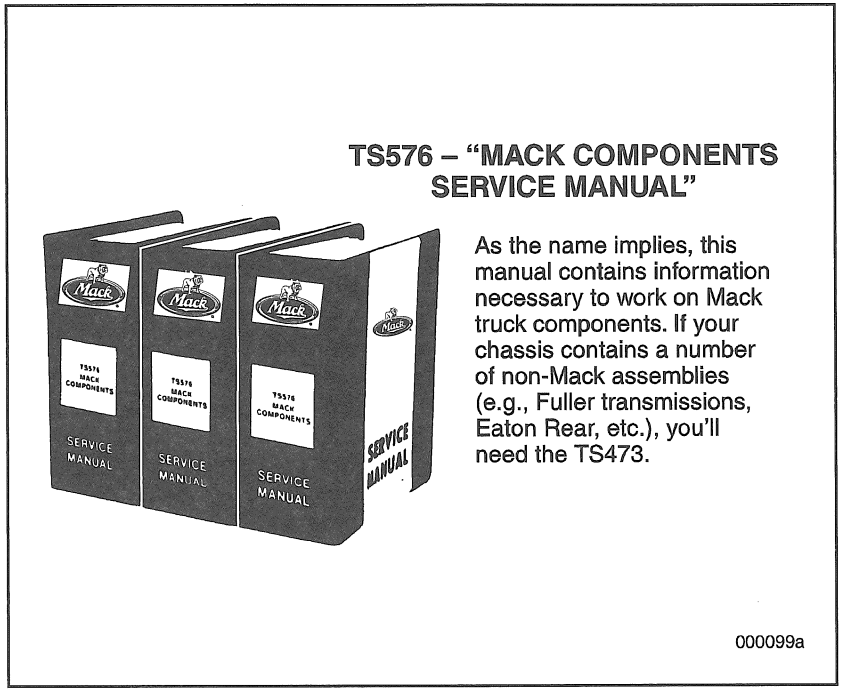
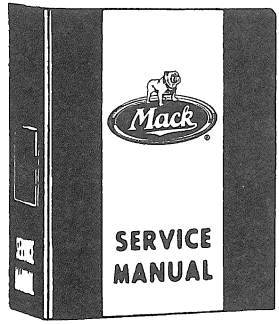


Figure 132 — TS576 — Mack Components Service Manual

T473 – "CUSTOM HIGHWAY TRUCK SERVICE MANUAL"

This collated service manual is ordered when a MACK chassis contains a number of vendor components not covered in the MACK Components Service Manual. A complete chassis number and GSO number must appear on the BR313 when ordering a custom manual. Also available electronically as the TS473E with the MACK service information supplied on CD.



000100b

Figure 133 — T473 — Custom Highway Truck Service Manual

INDIVIDUAL COMPONENT SERVICE MANUALS



Each manual contains complete overhaul, repair and other technical information for the component. Order by specific component name (engine, trans., etc.) and manual identification number. Order one at a time if you prefer.

000101b

Figure 134 — Individual Component Service Manuals

CALIFORNIA PROPOSITION 65 WARNING

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects and other reproductive harm.

CALIFORNIA PROPOSITION 65 WARNING

Battery posts, terminals and other related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and other reproductive harm.

Batteries also contain other chemicals known to the State of California to cause cancer.

Wash hands after handling.



TS49405

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