SECTION 00: GENERAL INFORMATION

CONTENTS

ILLUSTRATIONS

1. FOREWORD

This manual includes procedures for diagnosis, service, maintenance and repair for components of the X3 series coaches listed on the front cover page. This manual should be kept in a handy place for ready reference by the technician. If properly used, it will meet the needs of the technician and owner.

Information provided in Section 1 through 24 pertains to standard equipment items, systems and components as well as the most commonly used optional equipment and special equipment offered on the coach models covered by this manual. At the beginning of each section: a Table of Contents and a list of illustrations give the page number on which each subject begins and where each figure is located. Coach operating information is provided in a separate Operator's Manual. Audio/Video system operator instructions are also included in a separate manual.

More specific information on engine and transmission operating, maintenance, and overhaul information is contained in the applicable engine or transmission service manual published by the engine or transmission manufacturer. Engine and transmission parts information is contained in the applicable engine or transmission parts catalog published by the engine or transmission manufacturer. All information, illustrations and specifications contained in this manual are based on the latest product information available at the time of publication approval. The right is reserved to make product changes at any time without notice.

NOTE
Typical illustrations may be used; therefore minor illustration difference may exist when compared to actual parts or other publications.

Prévost Car occasionally sends Maintenance Information, Warranty Bulletins, Safety Recalls or other literature to update users with the latest service procedures. They are issued, when required, to supplement or supersede information in this manual. Update sheet should be filled out and bulletins should be filed at the end of their respective section for future reference.

2. SCHEMATICS

Vehicle AIR SCHEMATICS are provided at the end of Section 12, "Brake". SUSPENSION AIR SCHEMATICS are provided at the end of Section 16, "Suspension". Moreover, ELECTRICAL SCHEMATICS are provided in the technical publications box. Refer to those schematics for detailed circuit information or during diagnosis.

3. PRECAUTIONS TO BE OBSERVED BEFORE WELDING

⚠ CAUTION
Precautions are to be observed before welding to minimize the risk of <u>major and costly damage</u> caused to the vehicle electronic components.

NOTE
*For **X3-45 Multiplex** vehicles, also execute procedure no: PR060034 "MULTIPLEX MODULES DISCONNECTION PROCEDURE PRIOR TO WELDING" included at the end of this section.*

⚠ CAUTION
For vehicles equipped with a WCL system, disconnect electronic controller connector.

⚠ CAUTION
Cover electronic control components and wiring to protect from hot sparks, etc.

⚠ CAUTION
Position welding machine ground clamp as close as possible to the work. Ensure that the welding machine ground return clamp is well secured and makes a good electrical contact with a large metallic area of the <u>chassis</u> located as close as possible to the welding point.

⚠ CAUTION
Do not use TIG welding process on the vehicle. This high frequency current process can seriously damage the electronic components.

STEEL – STEEL WELDING

CAUTION

Before welding, perform multiplex modules disconnection procedure.

NOTE

Welding surfaces must be free of scale, slag, rust, paint, grease, humidity or other foreign material that would render welding impossible.

DANGER

Only a qualified and experienced person must do welding.

- FCAW (Flux Cored Arc Welding) process ;
- Electrode wire conforms to A5.20 AWS (American Welding Society) specifications ;
- E4801T-9-CH, type electrode wire with 0,045“ diameter (1,14 mm) ;

Material Thickness	Voltage	Current	Wire Feed Rate	Shielding Gas
1/8” to ½”	26 ± 2 volts	260 Amps	450 ipm. approx.	75% argon – 25% CO2 or 100% CO2

If necessary and with great care to prevent perforating the material, it is possible to use a conventional electric arc welding machine according to the following specifications:

- SMAW (Shielded Metal-Arc Welding) process ;
- Welding rod conforms to A5.1 of AWS (American Welding Society) specifications; E 7018 type welding rod with 1/8” diameter (3,2 mm).
- Current: 100 amperes to 150 amperes; optimum at 120 amps.

It is important to grind weld bead starts and stops and also to grind arc strikes from surfaces.

STEEL - STAINLESS STEEL OR STAINLESS STEEL - STAINLESS STEEL WELDING

CAUTION

Before welding, perform multiplex modules disconnection procedure.

NOTE

Welding surfaces must be free of scale, slag, rust, paint, grease, humidity or other foreign material that would render welding impossible.

DANGER

Only a qualified and experienced person must do welding.

- GMAW (Gas Metal-Arc Welding) process;
- Welding wire conforms to AWS (American Welding Standards) A5.9 specifications;
- 308LSi type welding wire with 0.035" diameter (0,9 mm);

STEEL - STAINLESS STEEL WELDING

Steel Thickness	SS Thickness	Voltage	Current	Wire Feed Rate	Shielding Gas
Less than 1/8”	Any type	20±1.5 volts	130±15 Amps	290 ipm approx.	90% He, 7.5% Ar, 2.5% CO2

1/8" and more	Any type	22±1.5 volts	160±15 Amps	330 ipm approx.	90% He, 7.5% Ar, 2.5% CO_2

STAINLESS STEEL - STAINLESS STEEL WELDING

SS Thickness	Voltage	Current	Wire Feed Rate	Shielding Gas
Any type	20 ± 1.5 volts	130 ± 15 Amps	290 ipm approx.	90% He – 7.5% Ar, 2.5% CO_2

If necessary and with great care to prevent perforating the material, it is possible to use a conventional electric arc welding machine according to the following specifications:

- SMAW (Shield Metal-Arc Welding) process;
- Welding rod conforms to AWS (American Welding Standards) A5.4 specifications; 308L-17 type welding rod with 3/32" diameter (2,4 mm);
- Current: - 50 amperes to 90 amperes, optimum at 60 amperes.

It is important to grind weld bead starts and stops and also to grind arc strikes from surfaces.

4. SAFETY NOTICE

This maintenance manual has been prepared in order to assist skilled mechanics in the efficient repair and maintenance of PRÉVOST vehicles.

This manual covers only the procedures as of manufacturing date.

Safety features may be impaired if other than genuine PRÉVOST parts are installed.

Torque wrench tightening specifications must be strictly observed. Locking devices must be installed or replaced by new ones, where specified. If the efficiency of a locking device is impaired, It must be replaced.

This manual emphasizes particular information outlined by the wording and symbols:

DANGER

Directs the operator's attention to unsafe practices which could result in serious personal injury or death.

WARNING

Directs the operator's attention to unsafe practices which could result in serious personal injury or severe damage to the vehicle.

CAUTION

Directs the operator's attention to unsafe practices where personal injury is not likely but damage to vehicle components could occur.

NOTE

Indicates supplementary information essential to the proper operation of the vehicle. Although, the mere reading of such information does not eliminate the hazard, understanding of the information will promote its correct use.

4.1 DATA PLATES AND CERTIFICATIONS

Delay and confusion can be avoided by placing the complete vehicle identification number of the coach and the serial numbers of the engine on parts orders and correspondence. Also, the transmission, axles, power steering pump chassis and other major components are identified by serial numbers.

4.1.1 Engine

The engine serial and model numbers are stamped on the cylinder block (as viewed from the flywheel end) on the left side just below the fire deck and above the cast-in Detroit Diesel logo (Fig. 1).

In addition, option plates made of laminated paper are located on the rocker cover (starter side). The engine serial and model number and a list of the optional engine equipment are written on the option plates. Refer to this information when ordering replacement parts (Fig. 1).

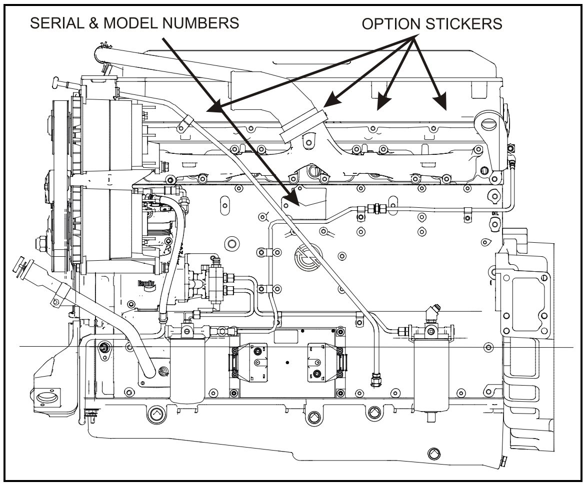


FIGURE 1 : DETROIT DIESEL SERIES 60 00043

4.1.2 Transmission

The transmission identification plate is located on the oil level dipstick side of the transmission (WT) or on transmission, on the vehicle R.H. side (ZF) (Fig. 2 & 3). The identification plate shows the transmission serial number, part number (assembly number), and model number. Use all three numbers when ordering parts.

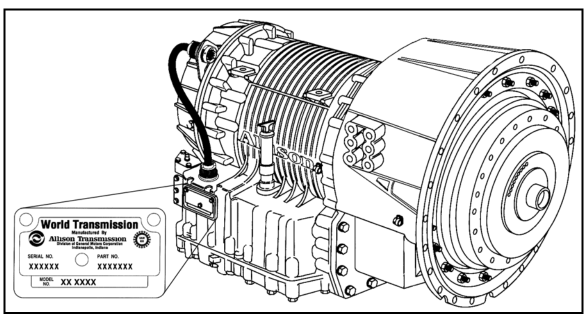


FIGURE 2: WORLD TRANSMISSION 07076

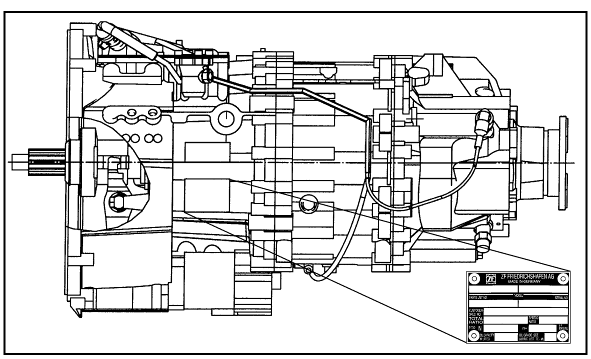


FIGURE 3: ZF-ASTRONIC TRANSMISSION 00040

4.1.3 Drive Axle

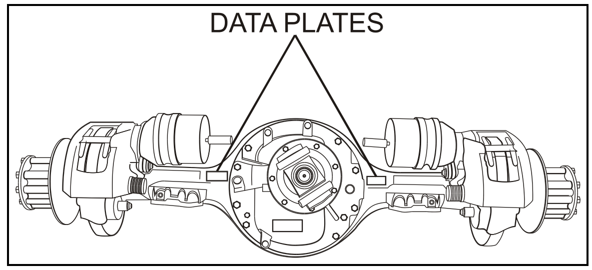


FIGURE 4: TYPICAL SERIAL & MODEL NUMBERS 00007

4.1.4 Front Axle

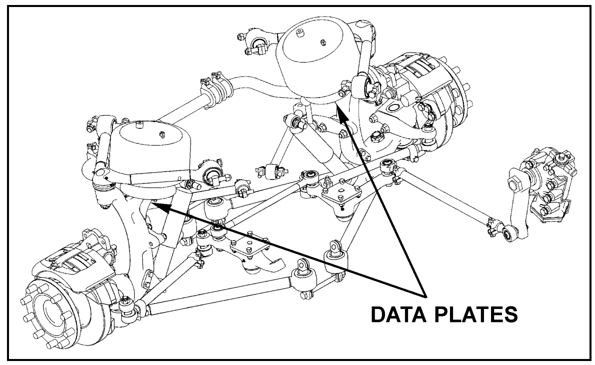


FIGURE 5: ISS TYPICAL SERIAL & MODEL NUMBERS 16136

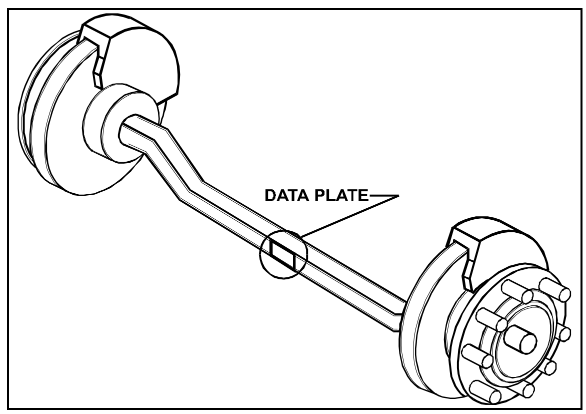


FIGURE 6: I-BEAM AXLE TYPICAL SERIAL & MODEL NUMBERS 00008

4.1.5 Power Steering Pump

Power steering pump serial number is located on a tag on the pump (Fig. 7). The pump is mounted on the engine beside the crankshaft pulley.

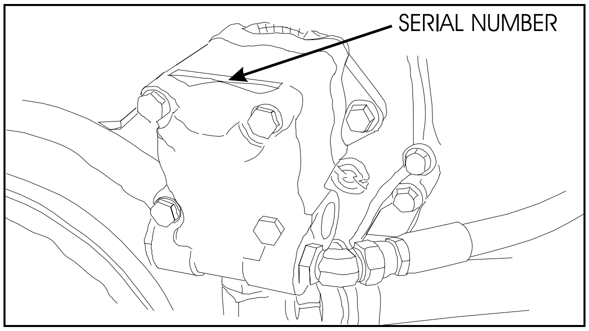


FIGURE 7 : POWER STEERING PUMP NAMEPLATE 00035

4.1.6 Coach Final Record

The Coach Final Record is a record of all data pertaining to the assembly of the coach. This record is included in the technical publication package supplied with the coach. Retain this record in the company records office for reference and safe-keeping.

4.1.7 Safety Certification

Coach components meet specifications and standards as follows:

- Material and parts conform to ASTM and/or SAE standards in effect at the time of manufacture.

- All factory-installed interior materials meet FMVSS 302 for fire resistance.

- Certified according to Provincial, State and Federal Safety standards (Canadian and US) BMCSS, FMVSS, and CMVSS.

Other applicable certification labels are affixed to the component.

4.1.8 DOT Certification Label

This certifies that coaches manufactured by Prevost Car Inc., comply with all Federal Motor Vehicle Safety Standards at the time of manufacture. Information such as date of manufacture, model year, gross vehicle weight rating, tire types and inflation pressure is also etched on this plate. The DOT Certification plate is affixed to the side of the L.H. control panel.

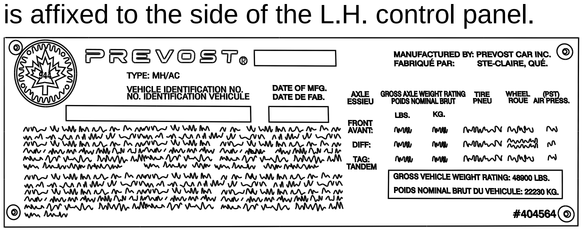


FIGURE 8: DOT CERTIFICATION PLATE 00016

4.1.9 EPA Engine Label

The exhaust emission certification label affixed inside the engine compartment above the lavatory maintenance service valves certifies that the engine conforms to federal and any state exhaust emission regulations. It gives the operating conditions under which certification was made.

4.1.10 Fuel Tank Label

The fuel tank label is molded on the side of the fuel tank. To read this label, unscrew the fuel tank access panel nuts located at the left in the condenser compartment.

4.1.11 Vehicle Identification Number (VIN)

The seventeen digit vehicle identification number (VIN) is located on a plate (Fig. 9 & 10) located on the windshield frame pillar (driver's side). The VIN is visible from the outside of the coach. Make sure the correct vehicle identification number is given when ordering replacement parts. Using the VIN when ordering parts will facilitate processing.

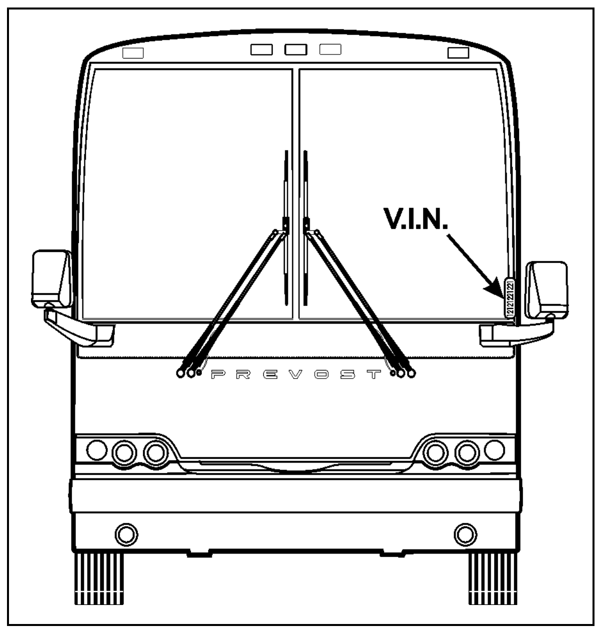
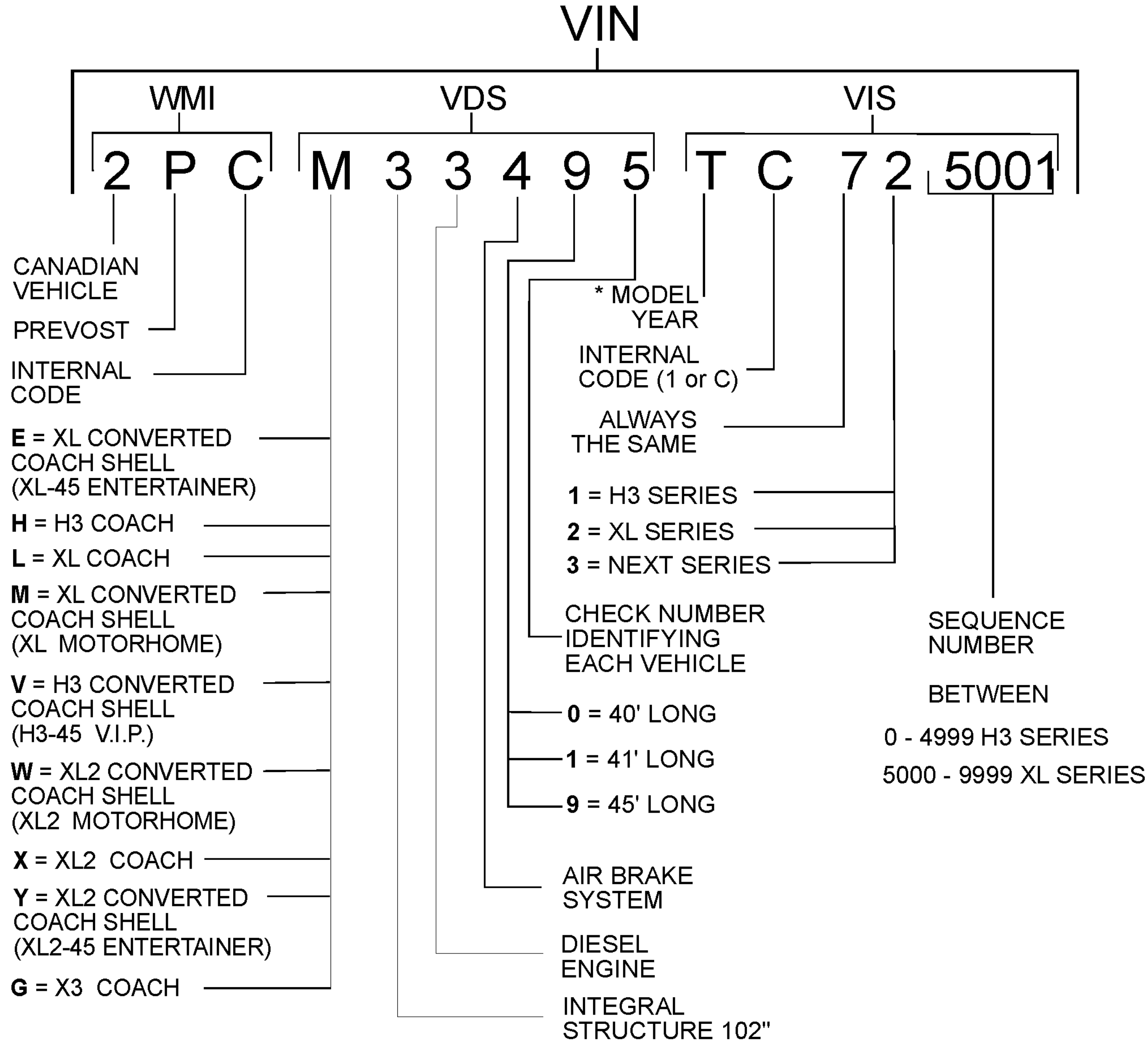


FIGURE 9 : VEHICLE I.D. 00048

NOTE

Record the VIN in the coach documentation and keep with company records. The VIN will normally be used for vehicle registration and for obtaining vehicle insurance coverage.



VIN Vehicle Identification Number: a structured combination of characters assigned to a vehicle by the manufacturer for identification purposes.

WMI World Manufacturer Identifier: Designating the manufacturer of the vehicle.

VDS Vehicle Descriptor Section: Provides information describing the general attributes of the vehicle.

VIS Vehicle Indicator Section: Combination of characters assigned by the manufacturer to distinguish one vehicle from another.

FIGURE 10 : VEHICLE IDENTIFICATION NUMBER 00050

YEAR	CODE	YEAR	CODE
2000	Y	2006	6
2001	1	2007	7
2002	2	2008	8
2003	3	2009	9
2004	4	2010	A
2005	5	2011	B

5. FASTENER STRENGTH IDENTIFICATION

Most commonly used metric fastener strength property classes are 9.8 and 10.9 with the class identification embossed on the head of each bolt. Customary (inch) strength classes range from grade 2 to 8 with radial line identification embossed on each bolt head actual grade (i.e., a grade 7 bolt will have 5 embossed radial lines on the bolt head). Some metric nuts will be marked with single digit strength identification numbers on the nut face. Fig. 12 shows the different strength markings. When replacing metric fasteners, be careful to use fasteners of the same or greater strength than the original fasteners (the same number marking or higher). It is also important to select replacement fasteners of the correct size. Correct replacement fasteners are available through the parts division. Some metric fasteners available in after-market parts sources were designed to metric standards of countries other than the United States and may be of a lower strength, may not have the numbered head marking system, and may be of a different thread pitch.

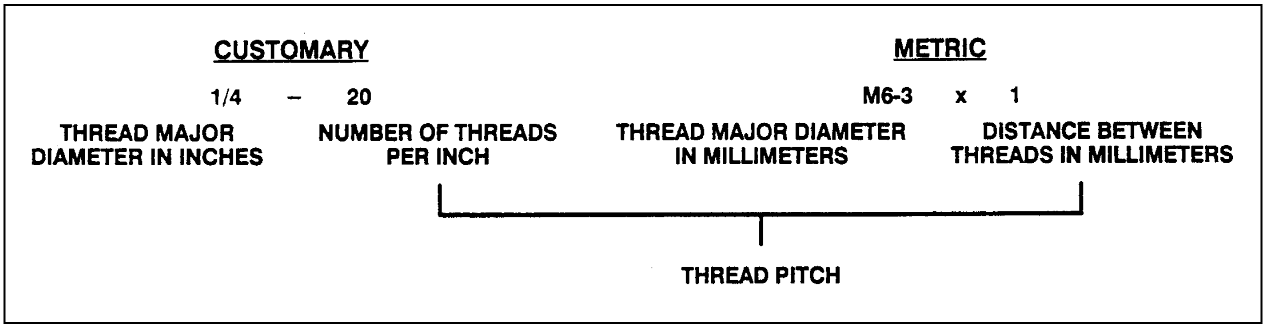


FIGURE 11 : THREAD NOTATION 00002

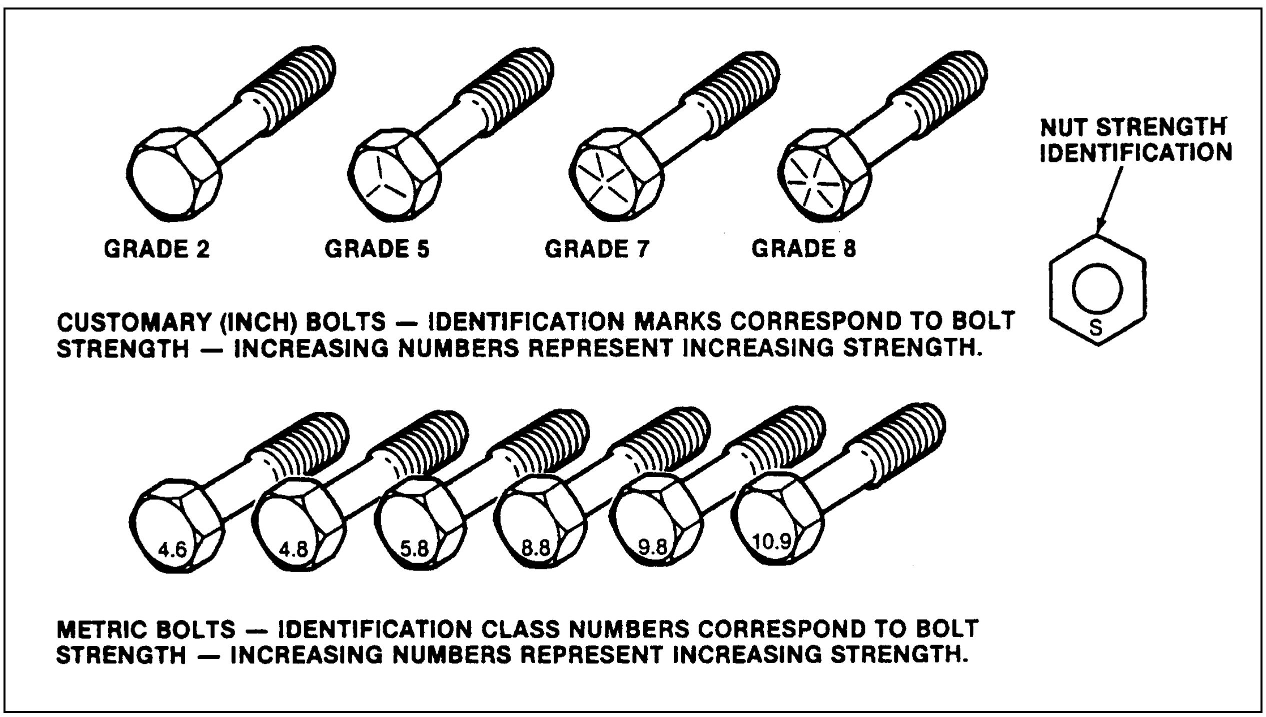


FIGURE 12: BOLT STRENGTH MARKINGS 00003

The metric fasteners used on the coach are designed to new standards and may not yet be manufactured by some non-domestic fastener suppliers. In general, except for special applications, the common sizes and pitches are:

- M 8 X 1.25;
- M 10 X 1.5;
- M 12 X 1.75;
- M 14 X 2;

5.1 SELF-LOCKING FASTENERS

A self-locking fastener is designed with an interference fit between the nut and bolt threads. This is most often accomplished by distortion of the top thread of an all-metal nut or bolt or by using a nylon patch on the threads. A nylon insert or the use of adhesives may also be used as a method of interference between nut and bolt threads (Fig. 13).

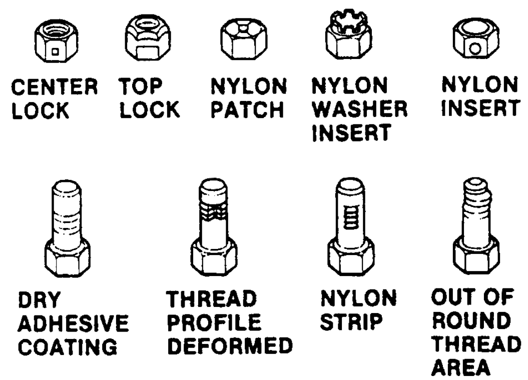


FIGURE 13 : SELF-LOCKING FASTENERS 00004

5.2 RECOMMENDATIONS FOR REUSE

Clean, unrusted self-locking fasteners may be reused as follows:

a) Clean dirt and other foreign matter from the fastener;

b) Inspect the fastener to ensure there is no crack, elongation, or other sign of fatigue or overtightening. If there is any doubt, replace with a new self-locking fastener of equal or greater strength;

c) Assemble parts and hand start fastener;

d) Observe that, before the fastener seats, it develops torque per the chart in table two. If there is any doubt, replace with a new self-locking fastener of equal or greater strength;

e) Tighten the fastener to the torque specified in the applicable section of this manual;

Fasteners which are rusty or damaged should be replaced with new ones of equal or greater strength.

SELF-LOCKING FASTENER TORQUE CHART

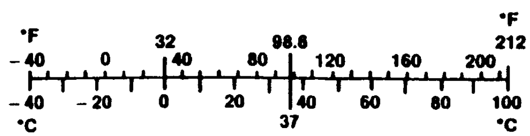
METRIC		6 & 6.3	8	10	12	14	16	20
NUTS AND ALL-METAL BOLTS	Nm	0.4	0.8	1.4	2.2	3.0	4.2	7.0
	Lbf-in	4.0	7.0	12	18	25	35	57
ADHESIVE OR NYLON COATED BOLTS	Nm	0.4	0.6	1.2	1.6	2.4	3.4	5.6
	Lbf-in	4.0	5.0	10	14	20	28	46

US STANDARD		¼	5/16	3/8	7/16	½	9/16	5/8	¾
NUTS AND ALL-METAL BOLTS	Nm	0.4	0.6	1.4	1.8	2.4	3.2	4.2	6.2
	Lbf-in	4.0	5.0	12	15	20	27	35	51
ADHESIVE OR NYLON COATED BOLTS	Nm	0.4	0.6	1.0	1.4	1.8	2.6	3.4	5.2
	Lbf-in	4.0	5.0	9.0	12	15	22	28	43

5.3 SIX LOBED SOCKET HEAD

Six lobed socket head (Torx) fasteners are used in some applications on vehicles covered in this manual. The tools designed for these fasteners are available commercially. However, in some cases, if the correct tool is not available, a hex socket head wrench may be used.

Multiply	by	to get equivalent number of:
LENGTH		
Inch	25.4	millimeters (mm)
Foot	0.305	meters (m)
Yard	0.914	meters
Mile	1.609	kilometers (km)
AREA		
$Inch^2$	645.2	$millimeters^2$ (mm^2)
	6.45	$centimeters^2$ (cm^2)
$Foot^2$	0.093	$meters^2$ (m^2)
$Yard^2$	0.836	$meters^2$
VOLUME		
$Inch^3$	16 387.0	mm^3
	16.387	cm^3
	0.016	liters (l)
Quart	0.946	liters
Gallon	3.785	liters
$Yard^3$	0.765	$meters^3$ (m^3)
MASS		
Pound	0.453	kilograms (kg)
Ton	907.18	kilograms (kg)
Ton	0.907	ton (t)
FORCE		
Kilogram	9.807	newtons (N)
Ounce	0.278	newtons
Pound	4.448	newtons
TEMPERATURE		
Degree Fahrenheit	(†0F − 32) ÷ 1.8	Degree Celsius (C)



Multiply	by	to get equivalent number of:
ACCELERATION		
$Foot/sec^2$	0.305	$meter/sec^2$ (m/s^2)
$Inch/sec^2$	0.026	$meter/sec^2$
TORQUE		
Pound-inch	0.113	newton-meters (N·m)
Pound-foot	1.35	newton-meters
POWER		
Horsepower	0.746	kilowatts (kW)
PRESSURE OR STRESS		
Inches of water	0.249	kilopascals (kPa)
Pounds/sq. in.	6.895	kilopascals
ENERGY OR WORK		
BTU	1 055.0	joules (J)
Foot-pound	1.356	joules
kilowatt-hour	3 600 000.0 or 3.6×10^6	joules (J = one W's)
LIGHT		
Foot candle	1.076	$lumens/meter^2$ (lm/m^2)
VELOCITY		
Miles/hour	1.609	kilometers/hr (km/h)

FIGURE 14: METRIC - US STANDARD CONVERSION TABLE

00005

DECIMAL AND METRIC EQUIVALENTS

FRACTIONS	DECIMAL IN.	METRIC MM	FRACTIONS	DECIMAL IN.	METRIC MM
1/64	.015625	.39688	33/64	.515625	13.09687
1/32	.03125	.79375	17/32	.53125	13.49375
3/64	.046875	1.19062	35/64	.546875	13.89062
1/16	.0625	1.58750	9/16	.5625	14.28750
5/64	.078125	1.98437	37/64	.578125	14.68437
3/32	.09375	2.38125	19/32	.59375	15.08125
7/64	.109375	2.77812	39/64	.609375	15.47812
1/8	.125	3.1750	5/8	.625	15.87500
9/64	.140625	3.57187	41/64	.640625	16.27187
5/32	.15625	3.96875	21/32	.65625	16.66875
11/64	.171875	4.36562	43/64	.671875	17.06562
3/16	.1875	4.76250	11/16	.6875	17.46250
13/64	.203125	5.15937	45/64	.703125	17.85937
7/32	.21875	5.55625	23/32	.71875	18.25625
15/64	.234375	5.95312	47/64	.734375	18.65312
1/4	.250	6.35000	3/4	.750	19.05000
17/64	.265625	6.74687	49/64	.765625	19.44687
9/32	.28125	7.14375	25/32	.78125	19.84375
19/64	.296875	7.54062	51/64	.796875	20.24062
5/16	.3125	7.93750	13/16	.8125	20.63750
21/64	.328125	8.33437	53/64	.828125	21.03437
11/32	.34375	8.73125	27/32	.84375	21.43125
23/64	.359375	9.12812	55/64	.859375	21.82812
3/8	.375	9.52500	7/8	.875	22.22500
25/64	.390625	9.92187	57/64	.890625	22.62187
13/32	.40625	10.31875	29/32	.90625	23.01875
27/64	421875	10.71562	59/64	.921875	23.41562
7/16	.4375	11.11250	15/16	.9375	23.81250
29/64	.453125	11.50937	61/64	.953125	24.20937
15/32	.46875	11.90625	31/32	.96875	24.60625
31/64	.484375	12.30312	63/64	.984375	25.00312
1/2	.500	12.70000	1	1.00	25.40000

FIGURE 15: CONVERSION CHART 00006

PREVOST

MULTIPLEX MODULES DISCONNECTION PROCEDURE PRIOR TO WELDING

PROCEDURE NO: PR060034	REVISION 3 2007-02-27

Material : N/A

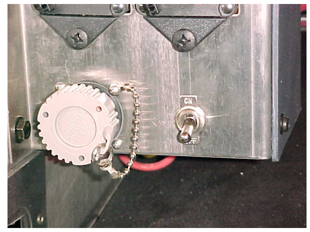
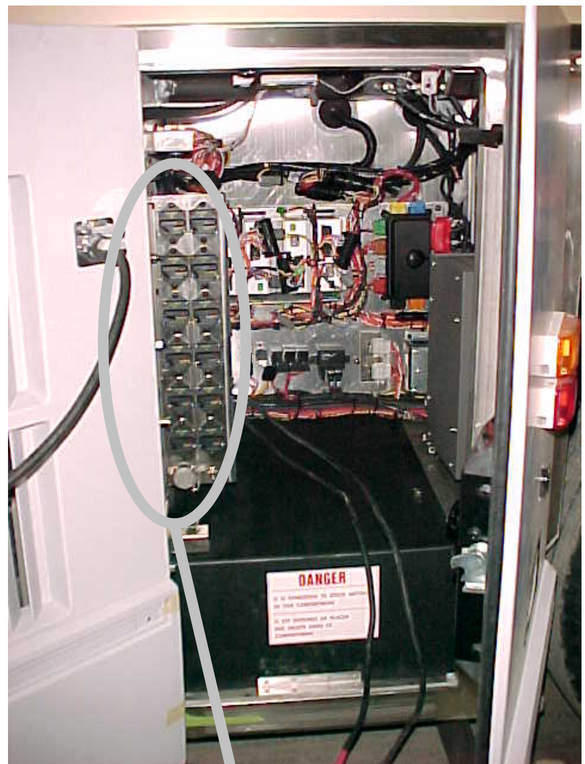
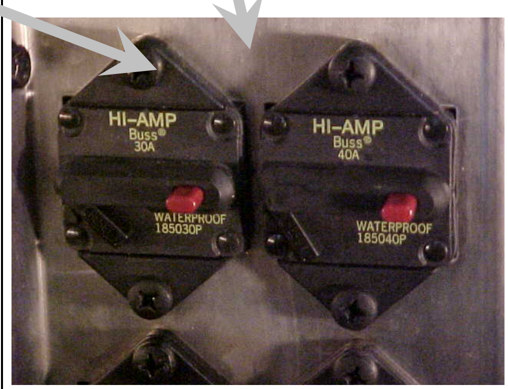
Equipment(s) :
Phillips-head screwdriver
Ratchet handle
3/8" socket
Electric tape
Long nose pliers

Reference schematics: N/A

Safety rules :
- Wear safety goggles
- Set the battery master switch to the OFF position first

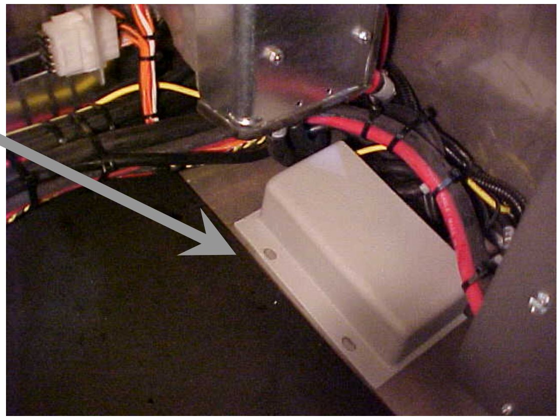
Recommendations: **This procedure should be performed by qualified personnel only.**

	Effective
Revision 0 : Issued with multiplex	
Revision 1 : Modified for Fire Protection System and also for VIP with multiplex	
Revision 2 : Step 5 modified for introduction of VIP with multiplex	**-0436**
Revision 3 : Step 1.15 added C397 **Addition of SECTION 2 for X3 Coaches** **Addition of SECTION 3 for XLII MTH**	

SECTION 1 H3 Coaches & VIP		
1.00	**Location: Main power compartment and dashboard** Set the battery master switch to the OFF position. Place the ignition switch to the OFF position.	 
1.05	**Location: Main power compartment** Trip circuit breakers CB2, CB4, CB6 Push the red button to open the circuit	 

1.10 **Location: Main power compartment**

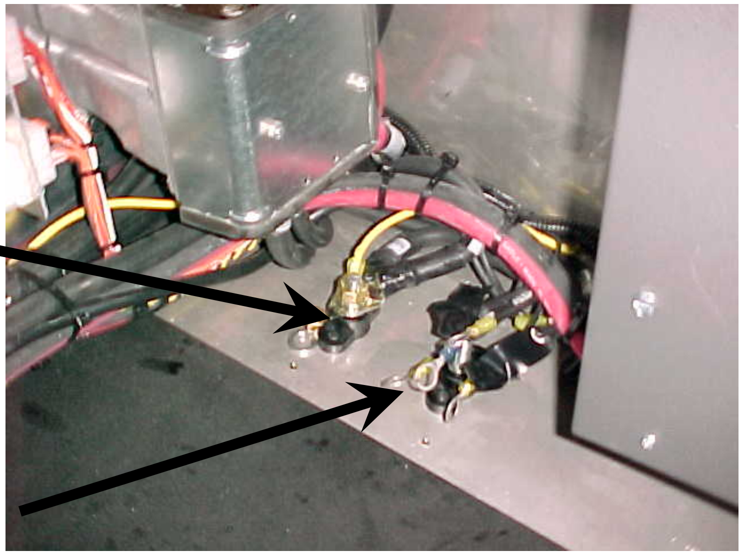
Remove the protective cover



⚠ WARNING ⚠

LIVE WIRE

This 12-volt terminal remains energized

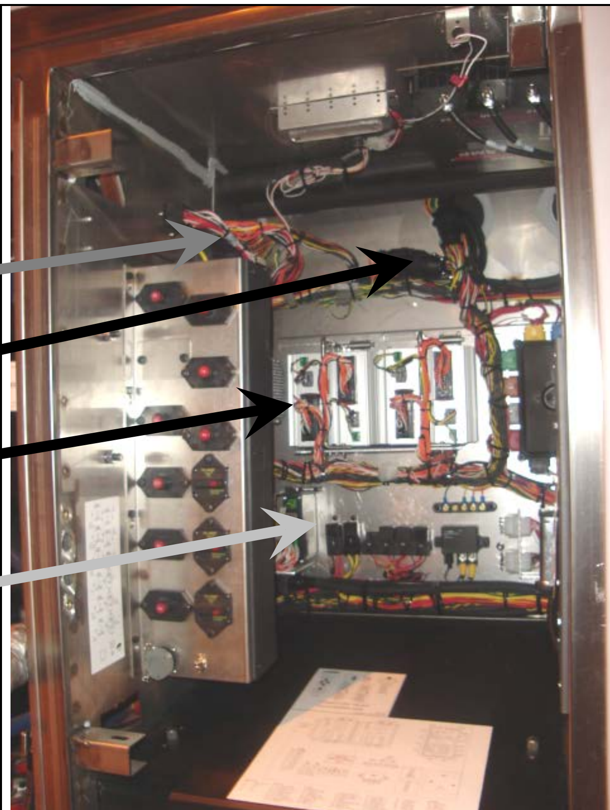
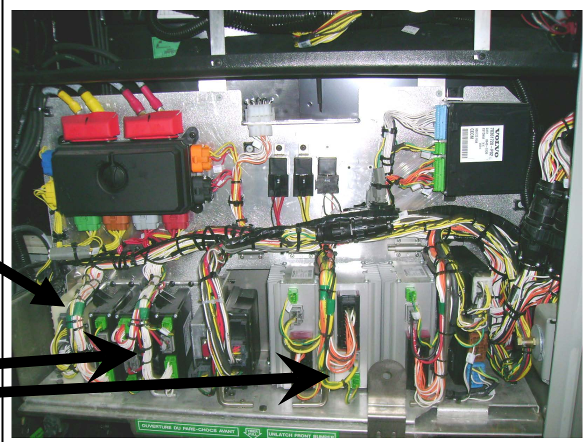
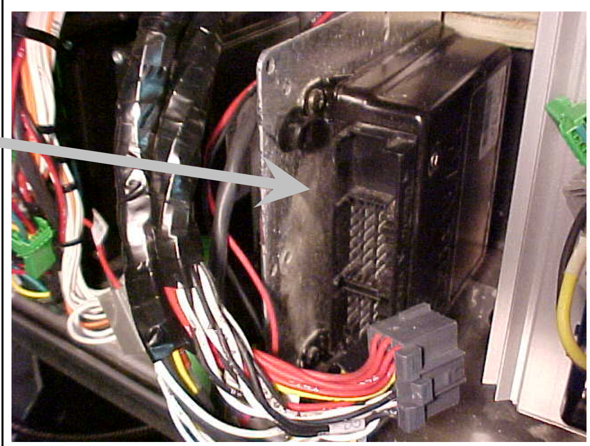


Disconnect the electronic ground terminals from the stud

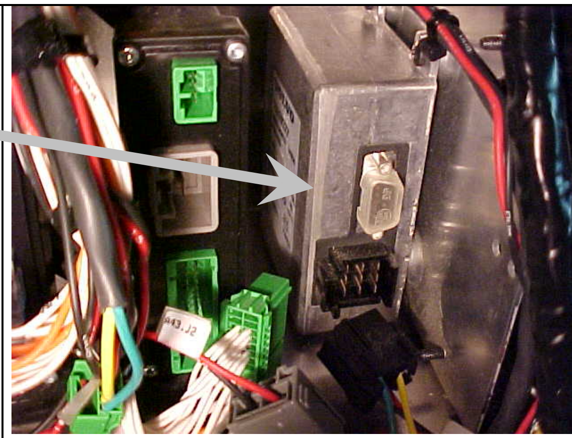
Using electric tape, insulate the 2 largest gage wires. Make sure the ring terminals do not touch each others and the vehicle body.

NOTE

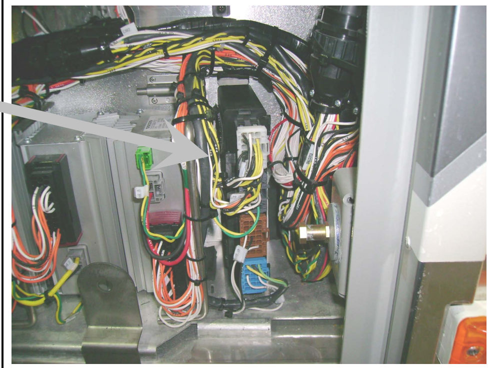
With disconnection of the electronic ground terminals, disconnecting the engine ECM, transmission TCM and the dashboard electronic components (telltale module, HVAC module, radio, control head, …) is not required.

1.15	**Location: Main power compartment** Disconnect the electronic modules : Disconnect the I/O A and I/O B modules Disconnect C397 Disconnect connector C717 Unplug 3 connectors per I/O B modules Unplug 3 connectors on the I/O A module	
1.20	**Location: Front electrical compartment** **VIP + COACH:** Disconnect the I/O A, I/O B, ABS, master ID, CECM and CPC modules. Unplug connector C92 **VIP:** Disconnect all keyless module connectors. Unplug 3 connectors per I/O B modules and 3 connectors per I/O A modules. Unplug 2 connectors from the ABS module	 

Unplug 1 connector from the master ID

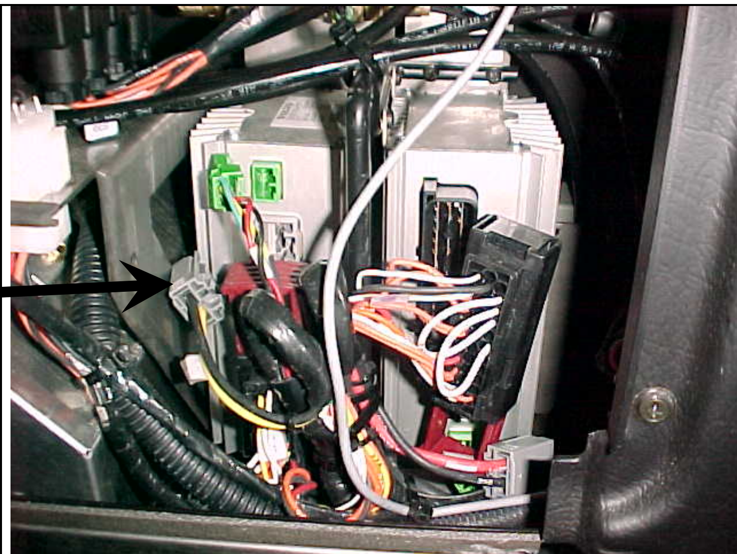
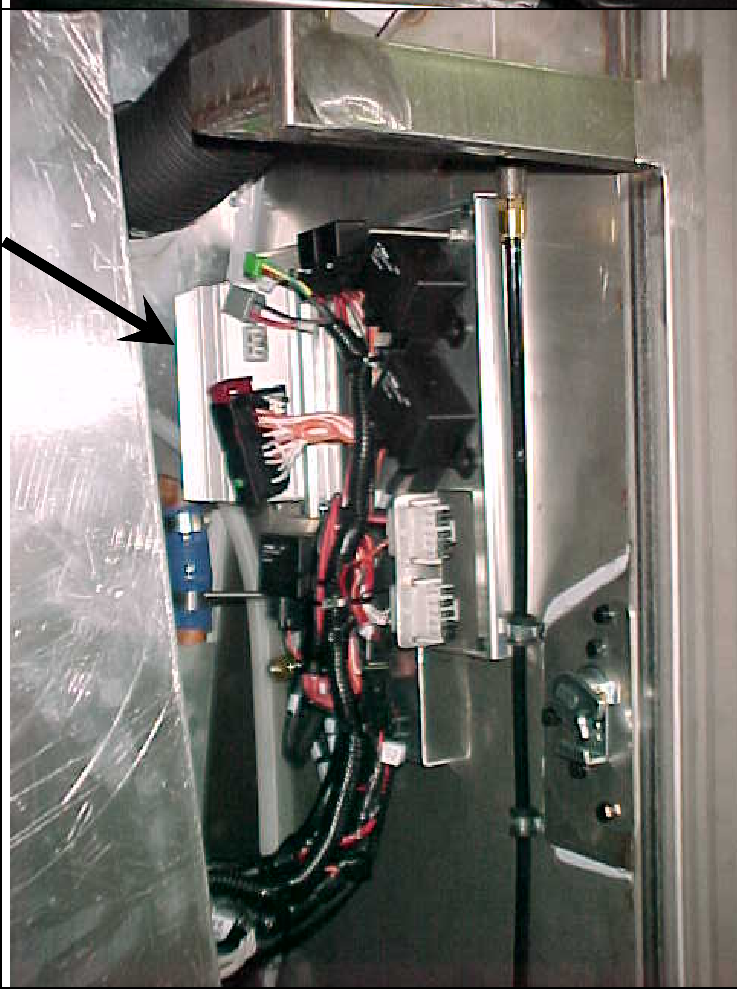


Disconnect CPC connectors



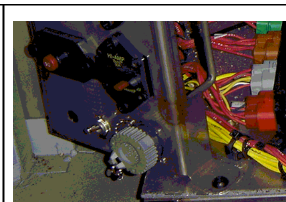
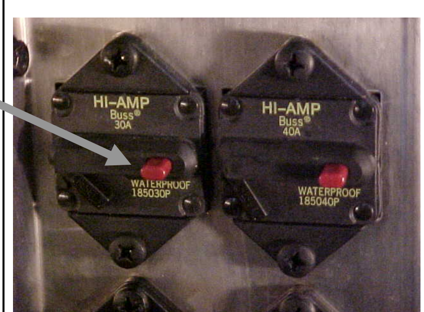
Unplug 3 connectors from the CECM

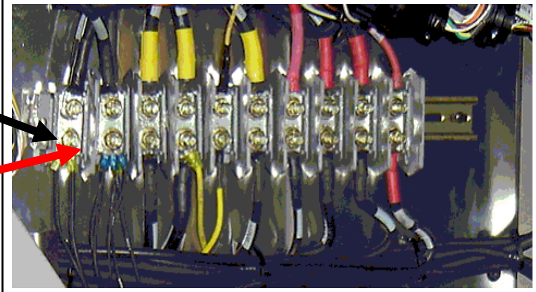
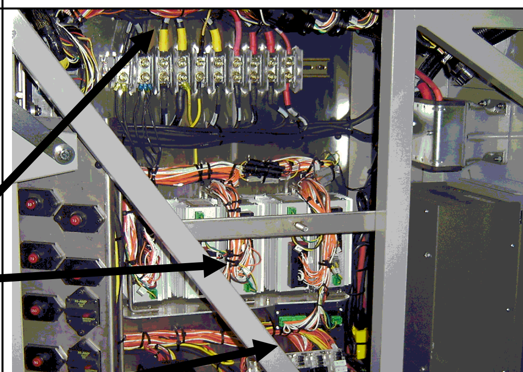
Unplug connector C92

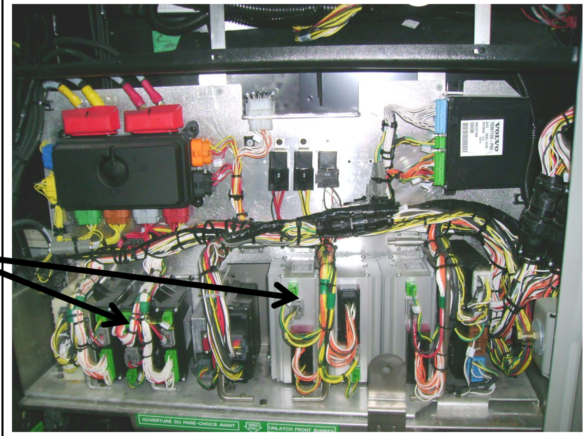
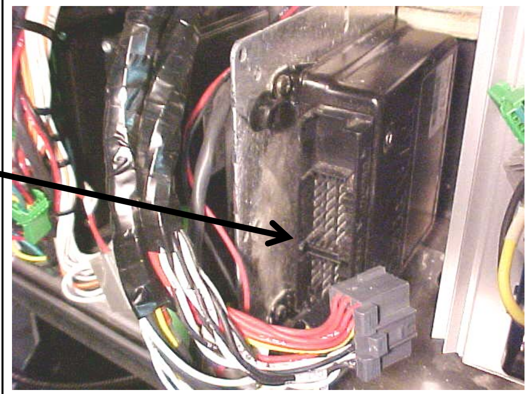
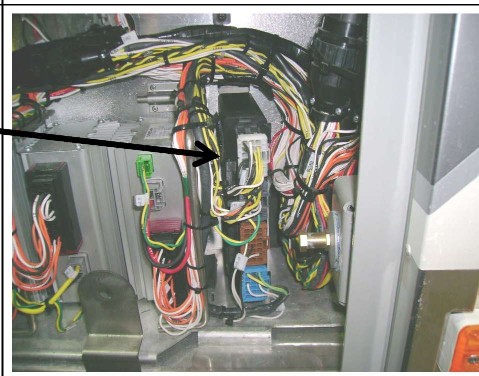
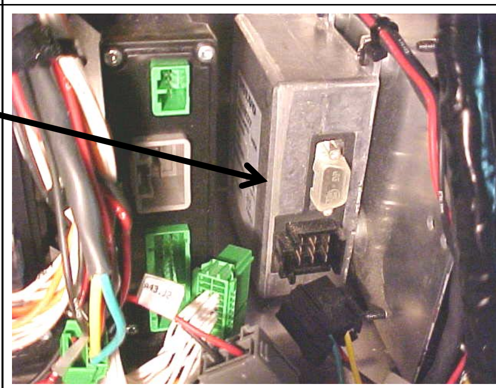
1.25	**Location: pneumatic accessory panel inside right console** Remove the access panel on the right console (R.H. side of dashboard) Disconnect both I/O B modules	
1.30	**Location: Evaporator compartment** Remove the protective cover and disconnect the I/O B module	

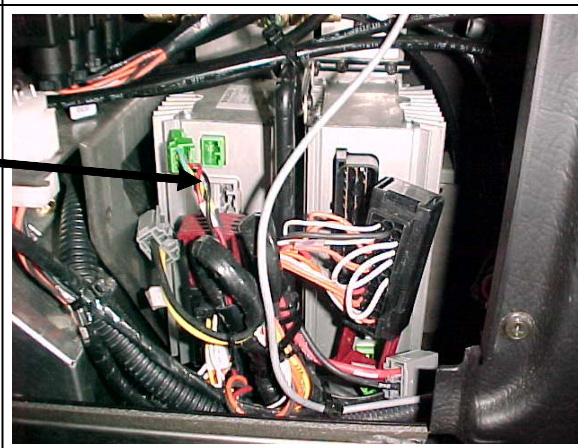
1.40	**Kidde Automatic Fire Detection and Suppression System (optional)** Disconnect C466 Kidde AFSS module is located on the lateral control panel.	
1.45	When all the previous steps are done, you can do welding on the vehicle	**ENSURE THAT THE WELDING GROUND RETURN CLAMP IS WELL SECURED AND MAKES A GOOD ELECTRICAL CONTACT WITH A LARGE METALLIC AREA OF THE CHASSIS LOCATED NEAR THE WELDING POINT AS MUCH AS POSSIBLE.**
1.50	**When welding is completed, reconnect all the modules.** Make sure that the connectors locking tab are well engaged	**BE CAREFUL TO MAKE THE PROPER CONNECTIONS, IF NOT, SOME SYSTEMS OR COMPONENTS MAY NOT BE USABLE**

SECTION 2 X3 Coaches

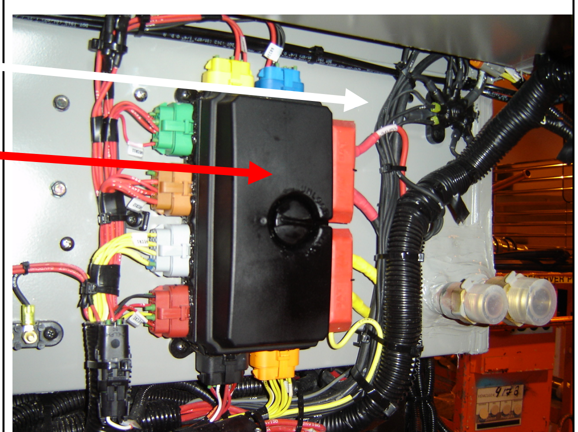
2.00	**Location: Rear electrical compartment and dashboard** Set the battery master switch to the OFF position. Place the ignition switch to the OFF position.	 
2.05	**Location: Rear electrical compartment** Trip circuit breakers CB2-CB4-CB6 located on rear junction panel Push the red button in to open the circuit	 

2.10	**Location: Rear electrical compartment** Disconnect the electronic ground terminals from this stud **Warning: The remaining terminals may still be energized** Use electric tape; make sure that cables do not touch each others and the vehicle body. *NOTE* ***With disconnection of the electronic ground terminals, disconnecting the engine ECM, transmission TCM and the dashboard electronic components (telltale module, HVAC module, radio, control head, …) is not required.***	
2.15	**Location: Rear electrical compartment** Disconnect the electronic modules: Disconnect all I/O A and I/O B modules Disconnect C397 and C717 Disconnect 3 connectors from each I/O B module Disconnect 3 connectors from each I/O A module	

2.20	**Location: front electrical compartment** Disconnect I/O A, I/O B, ABS, master ID, CECM and CPC modules and also disconnect connector C92 Disconnect the 3 connectors from the I/O B and I/O A modules	
	Disconnect the 2 connectors from the ABS module	
	Disconnect CPC connectors	
	Disconnect connector from master ID	

	Disconnect the 3 connectors from CECM	
	Disconnect connector C92	
2.25	**Location: Entrance door & wiper control panel** Remove windshield wiper motor access panel and disconnect both I/O B modules	
2.30	When all the previous steps are done, you can do welding on the vehicle	**ENSURE THAT THE WELDING GROUND RETURN CLAMP IS WELL SECURED AND MAKES A GOOD ELECTRICAL CONTACT WITH A LARGE METALLIC AREA OF THE CHASSIS LOCATED NEAR THE WELDING POINT AS MUCH AS POSSIBLE**
2.40	**When welding is completed, reconnect all the modules.** Make sure that the connectors locking tab are well engaged!	**BE CAREFUL TO MAKE THE PROPER CONNECTIONS, IF NOT, SOME SYSTEMS OR COMPONENTS MAY NOT BE USABLE**

SECTION 3 XLII MTH

2.00	**Location: Dashboard** Place the ignition switch to the OFF position.	
2.05	**Location: Engine compartment R. H. side area** Trip circuit breakers CB1-CB2 located on circuit breaker panel. Push the blue button in to open the circuit	
2.10	**Location: Rear Junction Box** Disconnect the electronic ground terminals from this stud. **Warning: The remaining terminals may still be energized.** Use electric tape; make sure that cables do not touch each others and the vehicle body. *NOTE* ***With disconnection of the electronic ground terminals, disconnecting the engine ECM, transmission TCM and the dashboard electronic components (telltale module, HVAC module, radio, control head, …) is not required.***	

2.15 **Location: Rear Junction Box**

Disconnect the electronic modules:

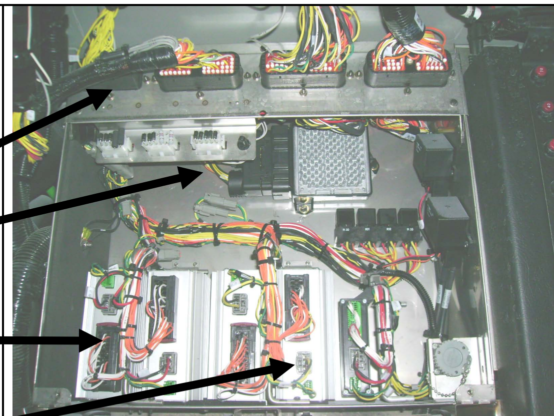
Disconnect all I/O A and I/O B modules

Disconnect C397

Disconnect transmission module (A1)

Disconnect 3 connectors from each I/O B

Disconnect 3 connectors from each I/O A

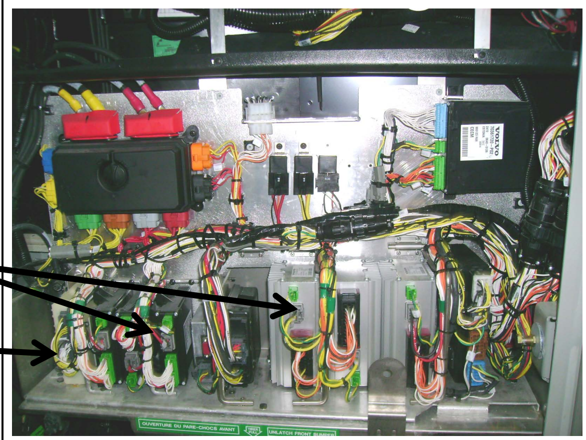


2.20 **Location: Front Electrical Compartment**

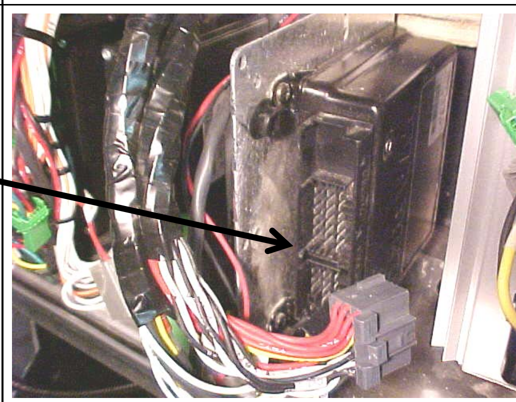
Disconnect I/O A, I/O B, ABS, master ID, CECM, CPC, keyless modules and also disconnect connector C92.

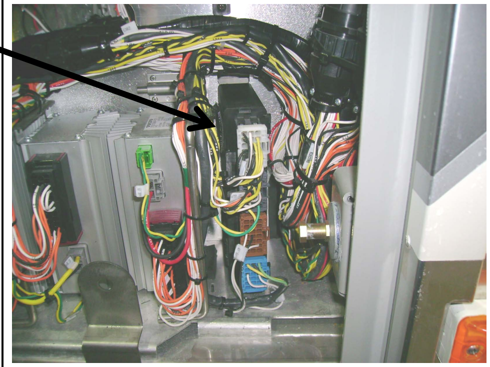
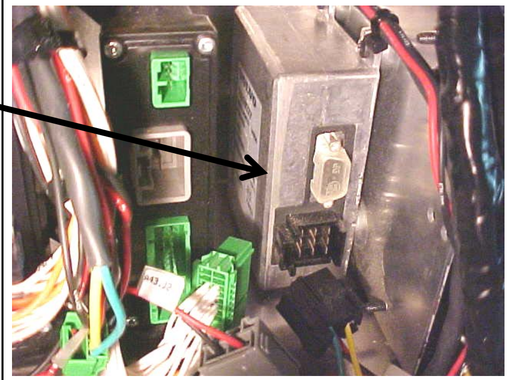
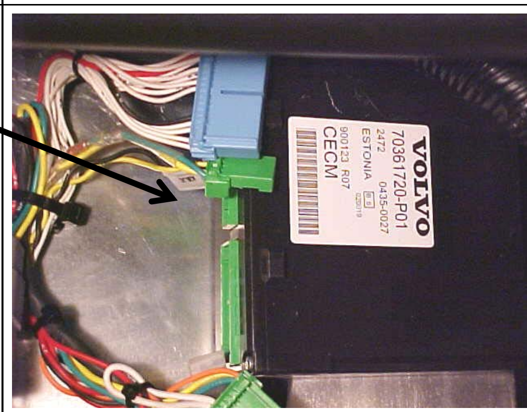
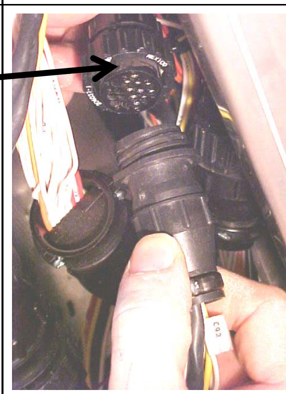
Disconnect 3 connectors from the I/O B and I/O A modules

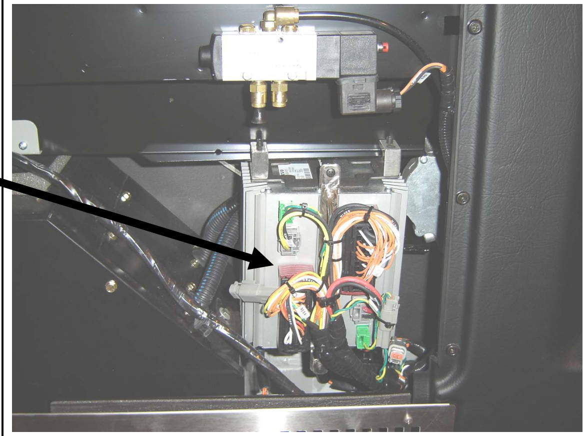
Disconnect connectors from Keyless module



Disconnect 2 connectors from ABS module



	Disconnect connectors from CPC	
	Disconnect connector from master ID	
	Disconnect 3 connectors from CECM	
	Disconnect connector C92	

	Location: Wiper Control Panel Remove windshield wiper motor access panel And disconnect I/O B modules	

2.30	When all the previous steps are done, you can do welding on the vehicle	**ENSURE THAT THE WELDING GROUND RETURN CLAMP IS WELL SECURED AND MAKES A GOOD ELECTRICAL CONTACT WITH A LARGE METALLIC AREA OF THE CHASSIS LOCATED NEAR THE WELDING POINT AS MUCH AS POSSIBLE**
2.35	**When welding is completed, reconnect all the modules.** Make sure that the connectors locking tab are well engaged!	**BE CAREFUL TO MAKE THE PROPER CONNECTIONS, IF NOT, SOME SYSTEMS OR COMPONENTS MAY NOT BE USABLE**

SECTION 03: FUEL SYSTEM

CONTENTS

ILLUTRATIONS

1. FUEL SYSTEM DESCRIPTION

Figure 1 shows a schematic of the fuel system. Fuel is drawn from the fuel tank through a manual shut-off valve, a primary fuel filter or a fuel filter/water separator (optional) before it enters the fuel pump. If the vehicle is equipped with the optional “Davco Fuel Pro 382”, it is designed to be the only fuel filter in the system, no secondary fuel filter is necessary. Leaving the pump under pressure, the fuel flows through a secondary fuel filter and a shut-off valve, then to the cylinder head. The fuel reaches the injectors in the cylinder head through passages within the head. Excess fuel exits at the rear of the head just above the inlet, through a restrictive return fitting which maintains fuel pressure in the system. Finally, the fuel flows through the check valve and the fuel cooler before it returns to the fuel tank. One preheater is available: 104 000 BTU. If the vehicle is equipped with the 104 000 BTU preheater, the fuel is drawn from the fuel tank through the fuel filter to the preheater. Excess fuel returns to the fuel tank.

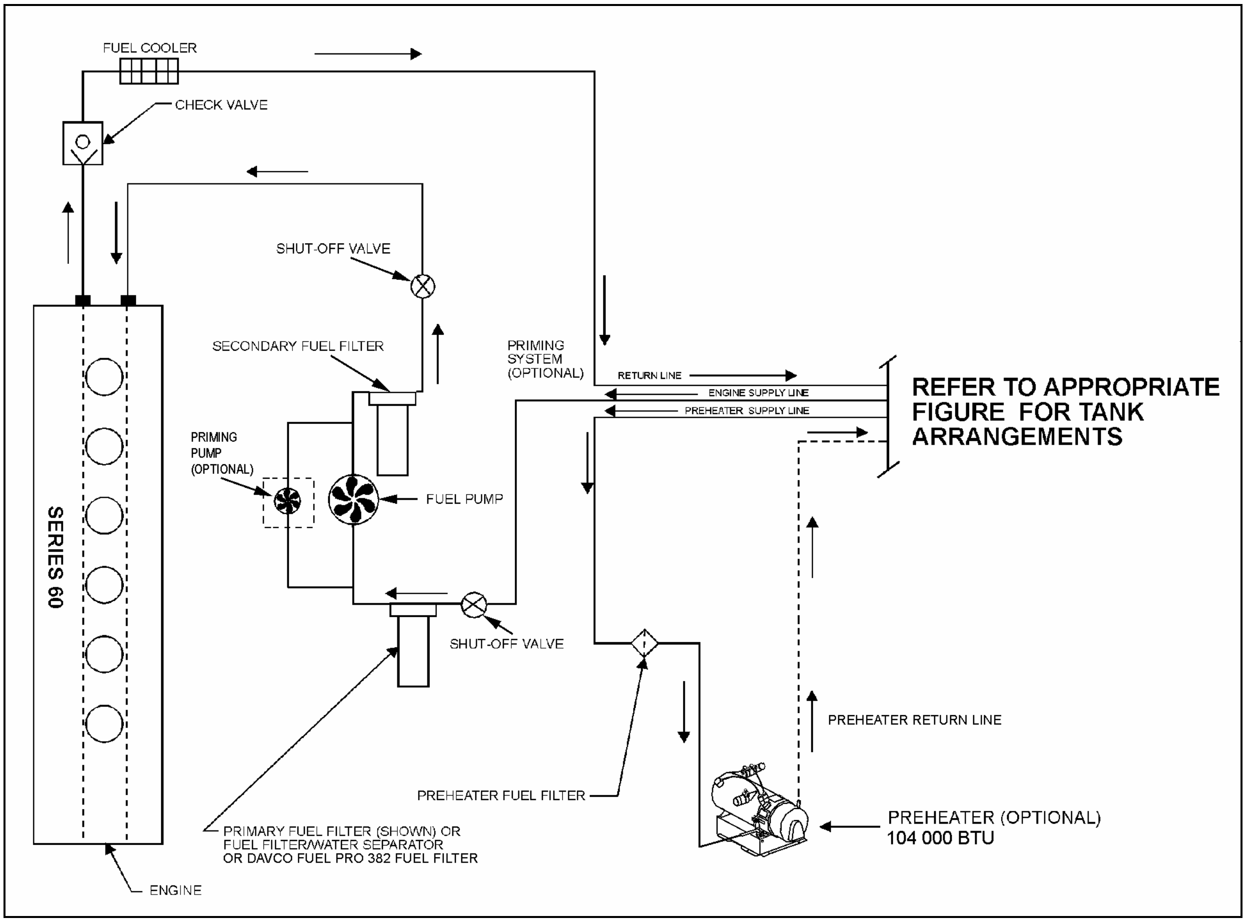


FIGURE 1: FUEL SYSTEM SCHEMATIC 03055

2. FUEL LINES AND FLEXIBLE HOSES

Make a visual check for fuel leaks at all engine-mounted fuel lines and connections and at the fuel tank suction and return lines. Since fuel tanks are susceptible to road hazards, leaks in this area may best be detected by checking for accumulation of fuel under the tank. Engine performance and auxiliary equipment is greatly dependent on the ability of flexible hoses to transfer lubricating oil, air, coolant and fuel oil. Diligent maintenance of hoses is an important step in ensuring efficient, economical and safe operation of engine and related equipment.

Check hoses daily as part of the pre-start-up inspection. Examine hoses for leaks and check all fittings, clamps and ties carefully. Make sure that the hoses are not resting on or touching shafts, couplings, and heated surfaces, including exhaust manifolds, any sharp edges or other obviously hazardous areas. Since all machinery vibrates and moves to a certain extent, clamps and ties can fatigue with age. To ensure continued proper support, inspect fasteners frequently and tighten or replace them as necessary. Refer to the schematic diagram of the fuel system (Fig. 1).

⚠ CAUTION ⚠
Oil level above the dipstick full mark or a decrease in lube oil consumption may indicate internal fuel leaks. Check oil level frequently.

3. FUEL VALVES

Manual shut-off valves on engine fuel-supply line are located on the R.H. side of engine compartment (Fig. 2). A manual shut-off valve is located at the inlet side of the primary fuel filter (fuel filter/water separator, if vehicle is so equipped) under the starter. Another manual shut-off valve is located at the outlet side of the secondary fuel filter, under the air compressor. No manual valve is required on preheater fuel-supply line, since the positive-displacement fuel pump (located close to the fuel tank) prevents fuel flow when not activated.

4. FILTERS AND WATER SEPARATOR

The fuel system is equipped with primary and secondary fuel filters for additional protection of the injectors. A fuel-filter/water-separator may be installed in primary fuel-filter location, to prevent water infiltration in engine fuel system (Fig. 2). It should be drained periodically, or when the water separator telltale light on the dashboard illuminates. To drain, loosen positive seal drain valve below separator, and tighten after water has been flushed out.

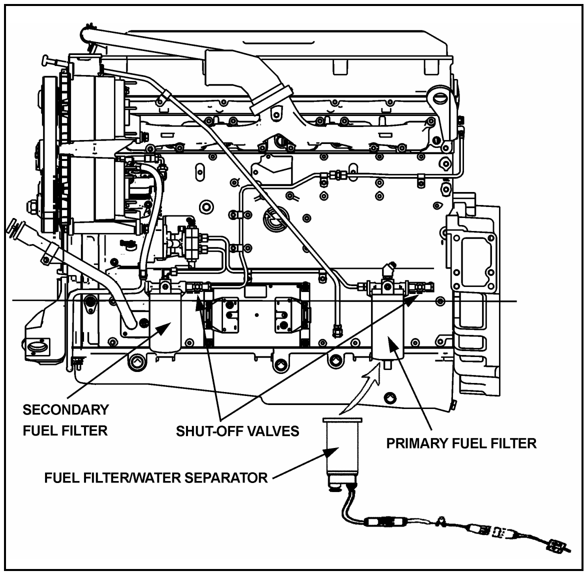


FIGURE 2: MANUAL SHUT-OFF VALVES 03060

NOTE
The operating conditions and cleanliness of type of fuel used determine the service intervals of the filter/water separator element and the secondary fuel filter cartridge.

4.1 FUEL FILTER/WATER SEPARATOR SERVICING

The fuel filter/water separator is located on the starter side of the engine, below the starter. The water separator must be drained periodically or when the telltale light on the dashboard illuminates.

Replace the water separator element as follows:

1. Drain the fuel filter/water separator as stated previously.
2. With engine "OFF" and engine fuel supply line valves closed; remove the filter element/bowl assembly from cover (for valve location, see *"3. FUEL VALVES"* in this section).

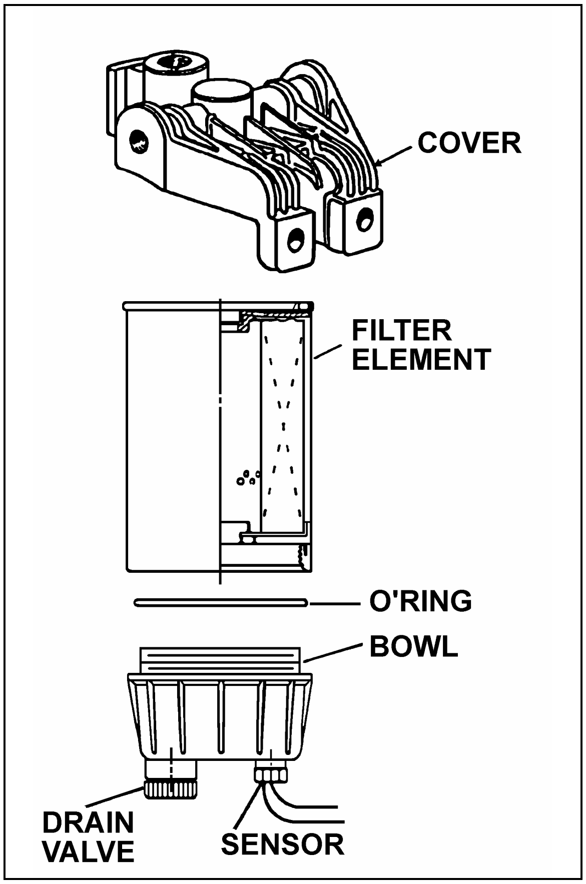


FIGURE 3: FUEL FILTER/WATER SEPARATOR 03025

3. Separate bowl from filter element. Clean bowl and O-ring groove.

NOTE
Bowl is reusable, do not discard.

4. Lubricate O-ring with clean diesel fuel or motor oil and place it in bowl groove.
5. Screw new filter element onto bowl snugly by hand.

⚠ CAUTION ⚠
Do not use tool to tighten. Tighten by hand only.

6. Lubricate filter seal with clean diesel fuel or motor oil.
7. Fill filter element/bowl assembly with clean diesel fuel and attach onto cover. Hand tighten an additional 1/3 to 1/2 turn after making full seal contact.
8. Open valves of the engine fuel supply line.
9. Run the engine and check for leaks.

⚠ CAUTION ⚠
If the water separator continuously requires draining, it is possible that water or sediment has accumulated in the fuel tank. To correct this situation, open the drain plug under the tank when the fuel gauge indicates tank is 1/4 full in order to drain any contaminant.

4.2 FUEL FILTER SERVICING (PRIMARY AND SECONDARY)

The primary and secondary fuel filters are located on the R.H. side of the engine. The primary filter is located below the starter, and the secondary fuel filter is below the air compressor. They are of a spin-on type and must be replaced every 12,500 miles (20 000 km) or once a year, whichever comes first. The primary fuel filter is equipped with a positive seal drain-valve to prevent water infiltration in engine fuel system. To drain, loosen positive seal drain-valve below filter and tighten after water has been flushed out.

A method of determining when filters are clogged to the extent that they should be changed is based on the fuel pressure at the cylinder head fuel inlet fitting and the inlet restriction at the fuel pump. In a clean system, the maximum pump-inlet restriction should not exceed 6 inches of mercury (20.3 kPa) and must not exceed 12 inches of mercury (41 kPa) with a dirty system.

At normal operating speeds and with the standard 0.080" restriction fittings, the fuel pressure at the cylinder head inlet is 50-75 psi (345-577 kPa). Change the fuel filters whenever the inlet restriction at the fuel pump reaches 12 inches of mercury (42 kPa) at normal operating speeds. Also, change whenever the fuel pressure at the cylinder head inlet fitting falls to the minimum fuel pressure given above.

Change the filter cartridge(s) as follows:

NOTE
Use a suitable band wrench or filter wrench, such as J22775, to remove the filters.

1. Stop engine, shut off the engine fuel supply line valves (for valve location, See *"3. FUEL VALVES")*. Unscrew and discard filters.
2. Fill new filter replacement cartridge(s) with clean fuel oil, about two thirds (2/3). Apply a thin coat of clean fuel oil on gasket.
3. Install new filters. Tighten until filter is snug against the gasket, with no side movement. Rotate an additional 1/2 turn by hand.
4. Open engine fuel supply line valves.

⚠ CAUTION ⚠

Mechanical tightening of the fuel filters is not recommended and may result in seal and/or cartridge damage. Tighten the fuel filters by hand only.

5. Start the engine and check for leaks.

NOTE

There is a fuel system shut-off valve on the discharge side of the secondary fuel filter. This check valve is designed to prevent fuel loss at time of filter replacement.

4.3 DAVCO FUEL PRO 382

The optional Fuel Pro 382 diesel fuel filter system consists of a permanently mounted fuel processor, a replaceable filter element, a filter element cover and collar and a fluid filter base assembly. This system is installed between the fuel tank and the fuel pump and is designed to be the only fuel filter in the fuel system. The filter serves as a water separator as well as a fuel filter (refer to figure 4).

When new, the fuel level as seen through the clear cover in the 382 filter is very low. It rises as dirt collects on the filter from the bottom up. Restriction remains consistently low because fuel always flows through clean, new media. Change filter when fuel level reaches the top of filter element (refer to figure 5).

Filter renewal:

1. Stop engine;
2. Drain fuel by opening the drain valve;
3. Untighten upper collar, remove cover;
4. Replace filter element;
5. Check O-Rings and components for wear;
6. Replace cover, hand tighten collar;
7. Pour fuel up to bottom of filter element through spin off cap located on top of cover.
8. Start engine, raise rpm for 2-3 minutes, hand tighten collar again.

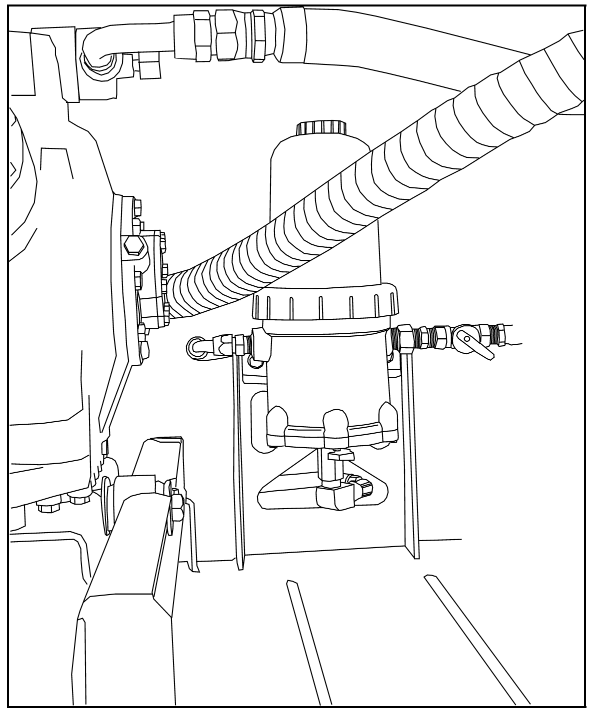


FIGURE 4: DAVCO FUEL PRO 382 FUEL FILTER 03062

NOTE

Fuel Pro 382 also accepts standard secondary spin-on fuel filters.

ENVIRONMENTAL NOTICE

Diesel fuel is an environmentally hazardous product. Dispose in an environmentally friendly manner.

4.4 PREHEATER FUEL FILTER

The preheater fuel filter is located near the preheater, on the R.H. side of the engine compartment. Replace the filter every 50,000 miles (80 000 km) or once a year, whichever comes first.

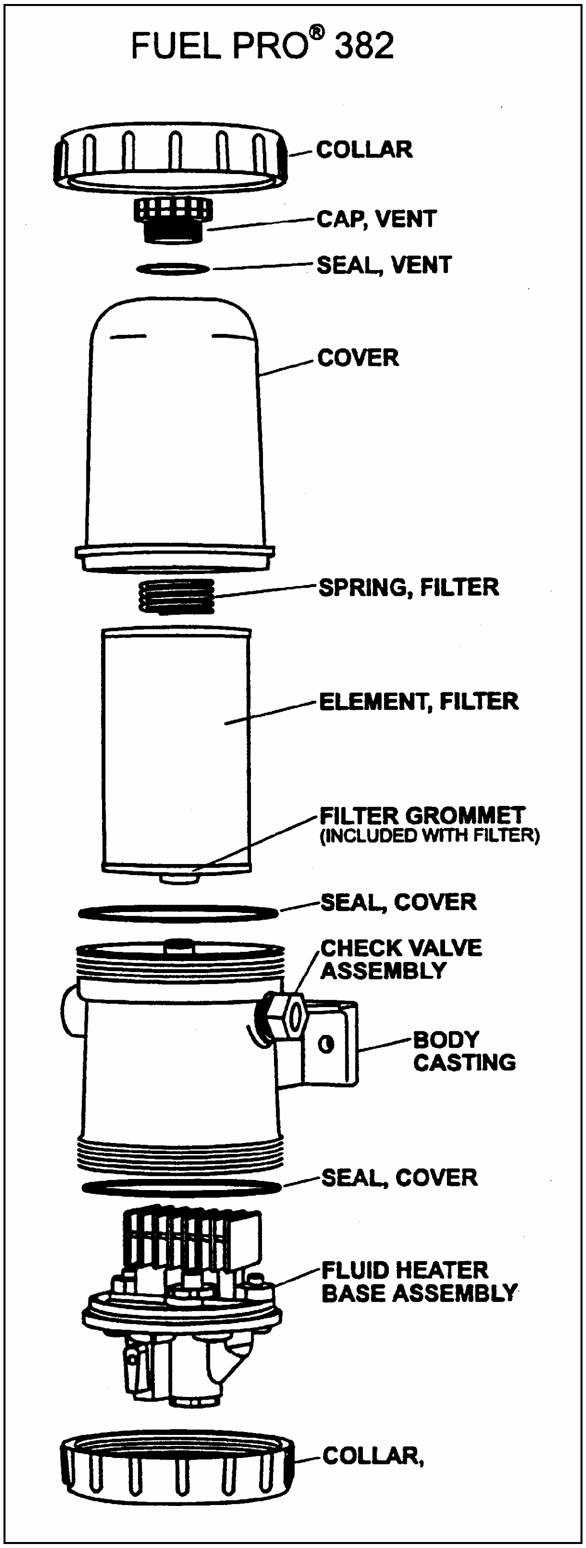


FIGURE 5: DAVCO FUEL PRO 382 EXPLODED VIEW 03034

5. FUEL TANK

X3-45 coaches are equipped with a high-density cross-link polyethylene fuel tank with a capacity of 208 US gallons (787 liters).

On all vehicles, fuel filling access doors on both sides of vehicle provide direct access to filler necks; offering the added advantage of refueling from either side of vehicle.

A pressure relief valve on the fuel tank connection-panel relieves high-pressure buildup and an overflow tube allows offset air in the tank to escape during filling. For 95% of the tank volume, 5% of tank inside space is kept filled with air with no exit opening, allowing for a fuel expansion safety margin. A drain plug, accessible from under the vehicle, is fitted at the bottom of the tank(s).

5.1 TANK REMOVAL

⚠ WARNING ⚠

Park vehicle safely, apply parking brake, stop engine and set battery master switch(es) to the OFF position prior to working on the vehicle.

Before working under an air-suspended vehicle, it is strongly recommended to support the body at the recommended jacking points.

NOTE

Before removal, the fuel tank should be completely drained by unscrewing the drain plug. Ensure that the container used has a capacity equal to the amount of fuel remaining in the tank.

1. Open the condenser door and remove the fuel tank access panel. The rear baggage compartment fuel tank access panel may also be removed to facilitate access to components.
2. If applicable, unscrew clamps retaining L.H. side filler tube to the fuel tank, then disconnect tube and remove it.
3. Unscrew clamps retaining R.H. side filler tube to fuel tank and filler neck. Disconnect tube and remove it.

4. If applicable, unscrew preheater supply line, preheater return line, auxiliary return line and/or auxiliary return line from fuel tank connection-panel.
5. Unscrew engine supply and return lines from fuel tank connection-panel, identify them for reinstallation.
6. Disconnect electrical wiring from tank on connection plate.

⚠ WARNING ⚠
Before removing the bolts securing the tank support to the frame, make sure the tank is supported adequately. Failure to do so could result in injury as well as damage to the tank.

7. From under the vehicle, on R.H. side, unscrew the 4 bolts (2 in front, 2 in back) retaining the tank support to the frame.
8. From under the vehicle, on the L.H. side, unscrew the 2 bolts (1 in front, 1 in back) retaining the tank support to the frame.
9. Carefully remove tank from under the vehicle.

5.2 TANK INSTALLATION

To install tank, simply reverse the *"Tank Removal"* procedure.

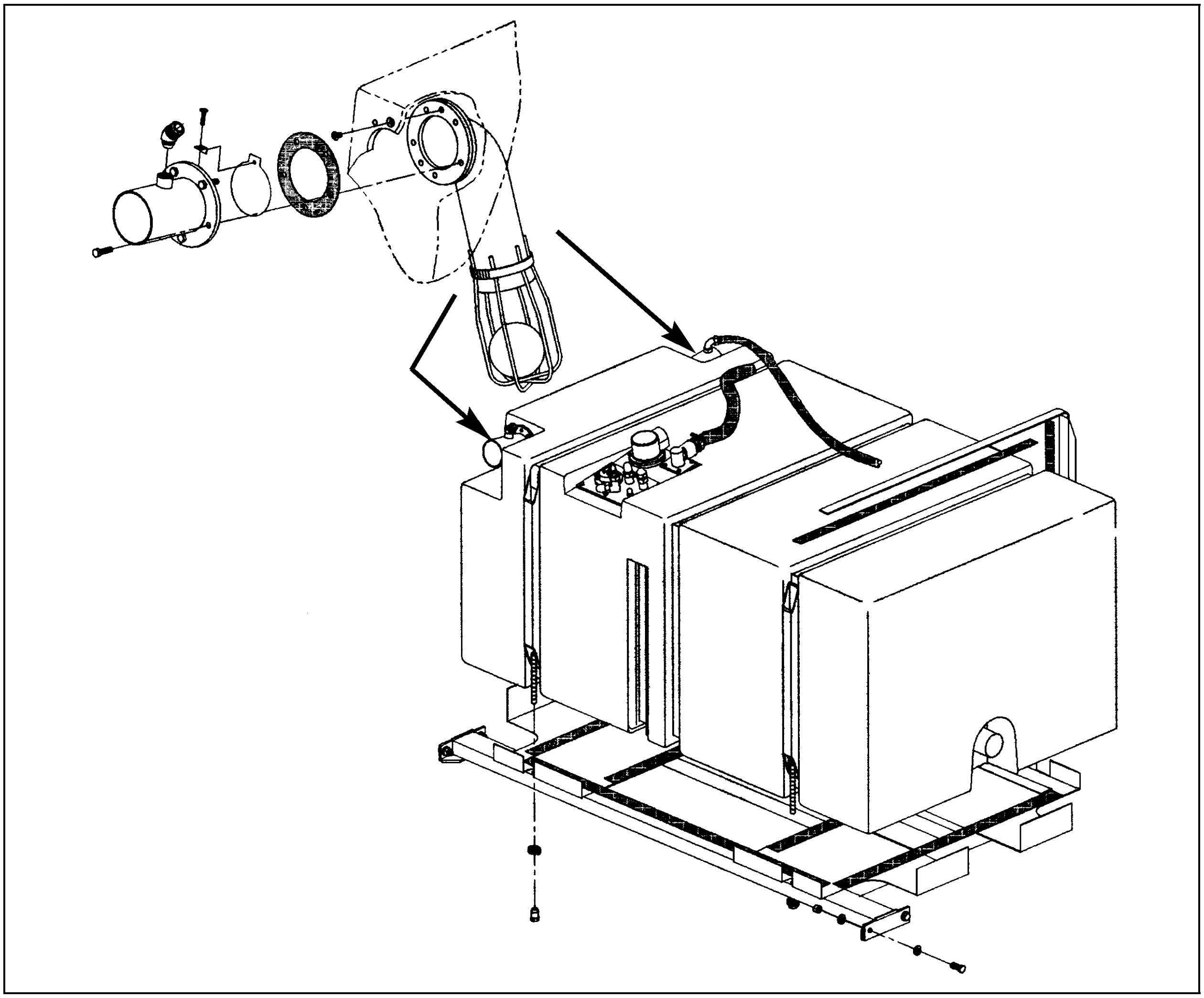


FIGURE 6: 208 US GAL. FUEL TANK 03063

5.3 FUEL TANK VERIFICATION

Inspect fuel tank from under vehicle for leaks or fuel traces. If a leak is detected, repair immediately as per "Polyethylene Fuel Tank Repair" in this section.

⚠ WARNING ⚠
Park vehicle safely, apply parking brake, stop engine and set battery master switch(es) to the OFF position prior to working on the vehicle.   **Before working under an air-suspended vehicle, it is strongly recommended to support the body at the recommended jacking points.**

5.4 POLYETHYLENE FUEL TANK REPAIR

NOTE
Fuel level must be lower than perforation to carry out this procedure.

⚠ WARNING ⚠
Park vehicle safely, apply parking brake, stop engine and set battery master switch(es) to the OFF position prior to working on the vehicle.

1. Locate perforation on fuel tank.
2. If necessary, remove fuel tank as per instructions in this section.
3. Drill perforation with a 23/64" bit. Make sure drill hole is perfectly round.
4. Insert a screw (Prevost #500196) and a washer (Prévost #5001244) into anchor nut (Prévost #500331).
5. Place assembly in drill hole. Tighten screw by 10 complete turns. Refer to Fig. 7.
6. Apply sealant on head plug (Prévost #507300) and seal hole with the head plug.

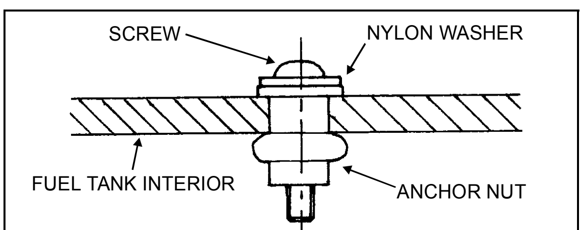


FIGURE 7: FUEL TANK REPAIR 03014

6. PRIMING FUEL SYSTEM

The problem with restarting a diesel engine that has run out of fuel, is that after the fuel is exhausted from the tank, it is pumped from the primary fuel filter or the fuel filter/water separator (if vehicle is so equipped), and sometimes partially removed from the secondary filter. This results in an insufficient fuel supply to sustain engine firing. The primary fuel filter or fuel filter/water separator and secondary filter must be free of air in order for the systems to provide adequate fuel for the injectors. When the engine runs out of fuel, the following operations must be performed before restarting:

Fill fuel tank with the recommended fuel oil. If only partial filling is possible, add a minimum of 10 gallons (38 liters) of fuel.

* If the vehicle is equipped with a Fuel Pro 382 fuel filter/water separation, pour fuel through spin on cap as per "4.3 DAVCO FUEL PRO 382".

* If the vehicle is equipped with an optional priming pump (see Figure 8).

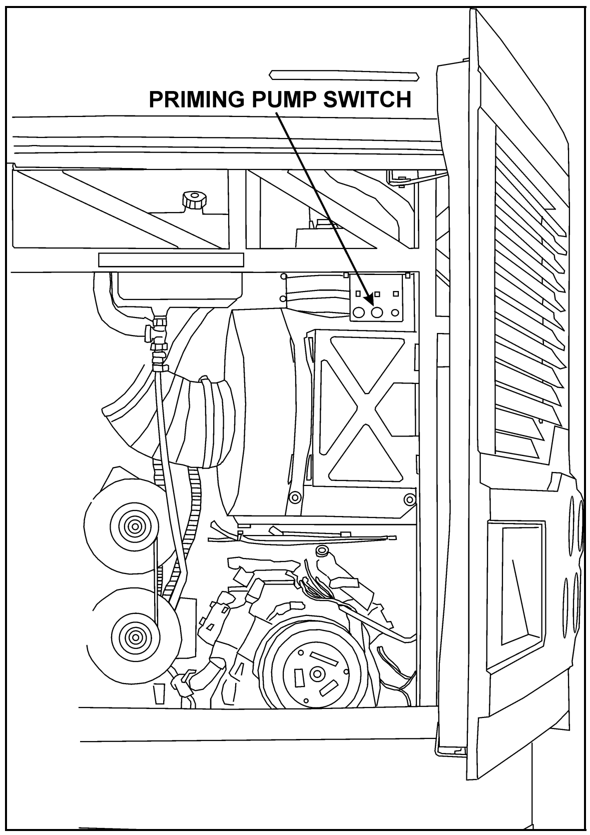


FIGURE 8: PRIMING PUMP SWITCH LOCATION 03064

Press the priming pump switch, located on the engine rear start panel just above the engine air filter. Start the engine and check for leaks.

If the vehicle is not equipped with a priming pump:

1. Unscrew the cap on the priming valve located on the secondary filter;
2. Direct fuel under pressure 25 psi (172 kPa) to the priming valve using a quick coupling;
3. Start the engine and check for leaks.

7. FUEL PUMP INSTALLATION

The fuel pump is driven off the rear of the air compressor.

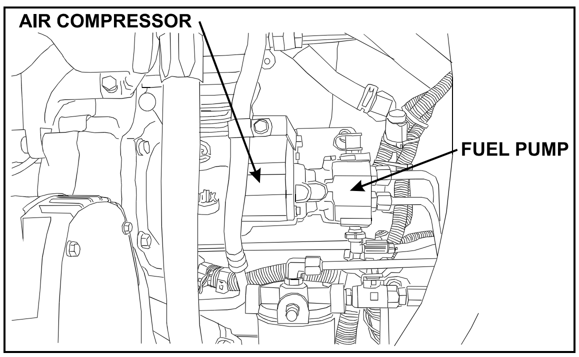


FIGURE 9: FUEL PUMP LOCATION 03053

1. If removed, install inlet and outlet fittings in the cover of the fuel pump.

NOTE

New fittings have sealant already applied. When reusing fittings, coat the threads lightly with Locktite Pipe Sealant, Detroit Diesel number J 26558-92, or equivalent, before installing. To prevent sealant from entering fuel system, do not apply to the first two threads of the fitting. Do not use Teflon tape or paste on the fittings.

2. Install drive coupling in drive hub of the fuel pump. Install a new gasket to the mounting flange of the pump.
3. Index the drive coupling with the drive hub on the end of the air compressor crankshaft and align the pump mounting bolt holes with those in the air-compressor rear cover.

NOTE

When correctly positioned, the outlet fitting on the pump should be in approximately an 8 o'clock position when viewed from the rear, and the drain opening in the pump body facing down.

4. Seat the fuel pump squarely against the air compressor. Pilot the flange on the pump body, in the opening in the rear cover of the compressor. Install three mounting bolts and tighten them to 22-28 Lbf-ft (30-38 Nm).
5. Connect the fuel inlet and outlet lines to the fuel pump and tighten.
6. Prime engine fuel system before starting engine to ensure pump seal lubrication and prompt engine starting.

8. FUEL OIL SPECIFICATIONS

The quality of fuel oil used for high-speed diesel engine operation is a very important factor in obtaining satisfactory engine performance, long engine life and acceptable exhaust emission levels. The fuel oil should meet ASTM designation D 975. Grade 1-D is recommended, however grade 2-D is acceptable.

NOTE

These fuel grades are very similar to grade DF-1 or DF-2 of Federal Specifications VV-F-800. For detailed fuel recommendations, refer to publication "Engine Requirements-Lubricating Oil, Fuel, and Filters" #7SE270 available from Detroit Diesel Distributors.

9. AIR CLEANER (DRY TYPE)

The vehicle is equipped with a dry-type replaceable element air cleaner, located in the engine compartment. Access the air cleaner through the engine R.H. side door. Engine air enters the air cleaner through (2) two intake ducts located just above engine side doors. It then flows through a pre-cleaner and finally through the air cleaner. The pre-cleaner removes dust and moisture by means of a discharge tube at the bottom of the element. It is in series with a replaceable impregnated paper filter element (air cleaner).

9.1 PRE-CLEANER SERVICING

The pre-cleaner is designed to be self-cleaning; however, it should be inspected and any accumulated foreign material removed during the periodic replacement of the impregnated paper filter element.

9.2 AIR CLEANER SERVICING

Stop the engine, open the R.H. side engine compartment door, and loosen the wing nut retaining the air cleaner element to the air cleaner. Remove the element by pulling on the handle in the center of the air cleaner element.

Install cleaner element as follows:

1. Inspect the gasket-sealing surface inside the air cleaner. It must be smooth, flat and clean;
2. Install the air cleaner element;
3. Make sure that the element seals securely;
4. Inspect element cover gasket and replace if necessary.

Whenever it becomes necessary to remove the air cleaner assembly (dry type) for maintenance or other repair in this area, great care should be taken when installing air cleaner assembly.

The pre-filter should be installed snugly in the air duct and clamped tightly to the air cleaner inlet to prevent any dust infiltration into the air cleaner.

9.3 GENERAL RECOMMENDATIONS

The following maintenance procedures will ensure efficient air cleaner operation:

1. Keep the air cleaner housing tight on the air intake pipe;
2. Make sure the correct filters are used for replacement;
3. Keep the air cleaner properly assembled so the joints are air-tight;
4. Immediately repair any damage to the air cleaner or related parts;
5. Inspect, clean or replace the air cleaner or elements as operating conditions warrant. Whenever an element has been removed from the air cleaner housing the inside surface of the housing must be cleaned with a soft clean cloth;
6. Periodically inspect the entire system. Dust-laden air can pass through an almost invisible crack or opening which may eventually cause damage to an engine;
7. Never operate the engine without an element in the air cleaner assembly;

⚠ CAUTION ⚠
Do not ignore the Warning given by the air restriction indicator. This could result in serious engine damage.

8. Store new elements in a closed area free from dust and possible damage.

9.4 AIR CLEANER RESTRICTION INDICATOR

A resettable restriction indicator may be installed on the engine air-intake duct, clearly visible from the rear engine compartment. The indicator monitors the vacuum level between the air filter and the engine. A red marker is displayed when the air filter is clogged and must be replaced. Reset by pressing on the indicator's extremity.

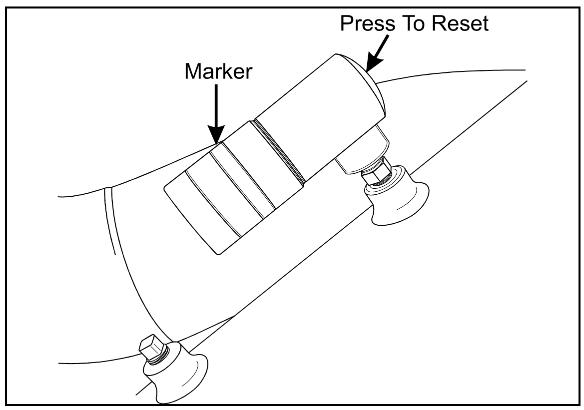


FIGURE 10: RESTRICTION INDICATOR 01052

10. FUEL COOLER

The fuel cooler serves to cool the surplus diesel fuel after it has exited the cylinder head, on its way back to the fuel tank. It is accessible through the engine radiator door, and is located between the charge air cooler (CAC) and the coolant radiator (Fig. 11 & 12).

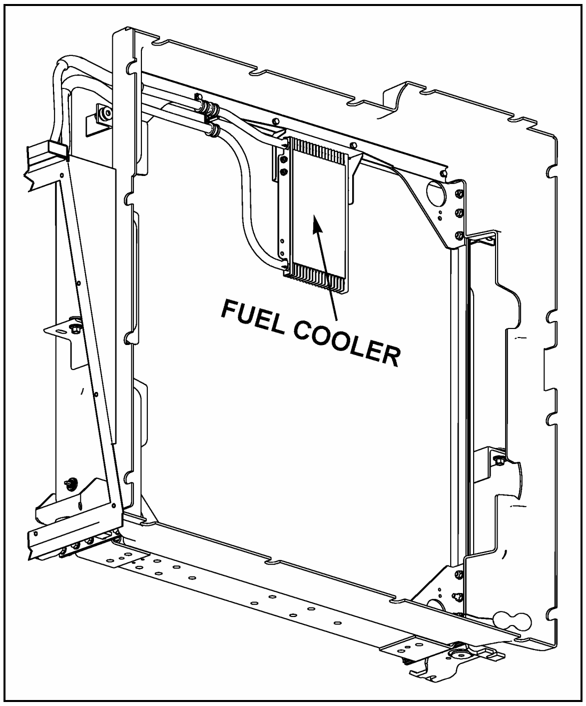


FIGURE 11: FUEL COOLER LOCATION 03065

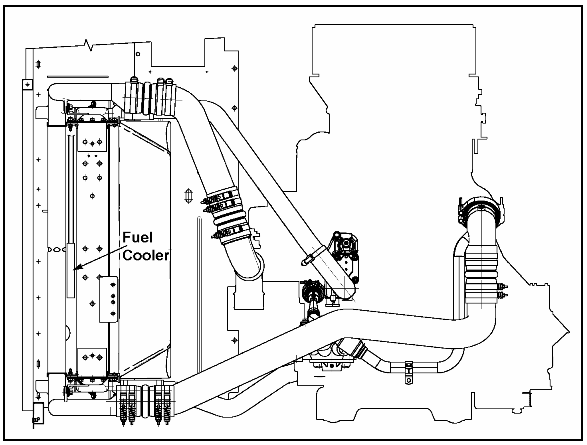


FIGURE 12: FUEL COOLER LOCATION 03066

11. FUEL PEDAL

The EFPA (Electronic Foot Pedal Assembly) connects the accelerator pedal to a potentiometer (a device that sends an electrical signal to the ECM, which varies in voltage, depending on how far down the pedal is depressed). The EFPA is installed in the space normally occupied by a mechanical foot pedal. It has maximum and minimum stops that are built into the unit during manufacturing.

11.1 FUEL PEDAL ADJUSTMENT

The EFPA contains a throttle position sensor that varies the electrical signal sent to the ECM. The sensor must be adjusted whenever an EFPA is serviced. In addition, the sensor should be adjusted any time codes 21 and 22 are flashed.

With the ignition "ON" and the proper diagnostic tool (DDR) (for information regarding the DDR, see *"01 ENGINE"* in this manual), check the throttle counts at idle and full throttle positions. Proper pedal output should be 20/30 counts at idle and 200/235 at full throttle. If adjustment is necessary, remove the potentiometer retaining screws and rotate the potentiometer clockwise to increase counts or counterclockwise to decrease. When correct output is confirmed, tighten retaining screws.

11.2 POTENTIOMETER REPLACEMENT

1. Disconnect cable harness connector.
2. Loosen the two screws and remove potentiometer. Retain for re-assembly.
3. Discard potentiometer (Fig. 13).

⚠ CAUTION ⚠
Note the routing and clamping locations of the cable before disassembly. Proper cable routing and fastening is critical to the operation of this system. Marking the foot pedal assembly to record cable routing is recommended.

4. Position new potentiometer. Press potentiometer onto the potentiometer shaft, matching cutouts in shaft to drive tangs of potentiometer. Apply hand pressure until potentiometer has bottomed out in housing. Reinstall screws (Fig. 13) and tighten just enough to secure potentiometer lightly. Tighten screws to 10 - 20 Lbf-in (1.13 - 2.26 Nm).
5. Reconnect electronic foot pedal assembly's cable harness to the ECM connector. If potentiometer calibration is necessary (see *"FUEL PEDAL ADJUSTMENT"* in this section).

CAUTION

Make sure the cable harness is routed correctly, and securely installed so that it does not become pinched, stretched, or otherwise damaged during vehicle operation.

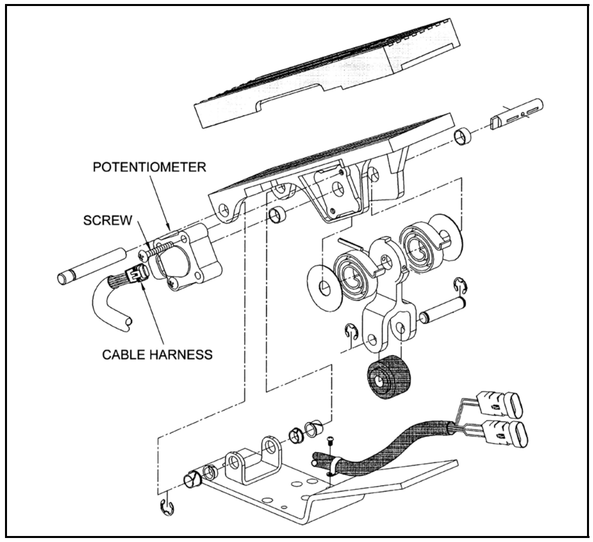


FIGURE 13: ELECTRONIC FOOT PEDAL ASSEMBLY 03035

12. SPECIFICATIONS

Davco FuelPro 382 Fuel Filter / Water Separator Element

Supplier number 23521528
Prévost number 531437

Primary Fuel Filter / Water Separator (optional)

(May be used instead of primary filter (never use with a primary filter).
Make ....Racor
Type ....Spin-on

ELEMENT
Supplier number ....S 3202
Prévost number 531390

BOWL
Supplier number RK30051
Prévost number 531389

DRAIN VALVE AND SEAL
Supplier number RK30058
Prévost number 531397

O-RING
Supplier number RK30076
Prévost number 531398

PROBE/WATER SENSOR
Supplier number RK21069
Prévost number 531391

Primary Fuel Filter

Make ....AC
Type ....Spin-on
Filter No. T-915D
Service Part No. 25014274
Prévost number 510137

OR
Service Part No (Type with Water Separator) 23512317
Prévost number 531407
Element torque .... 1/2 turn after gasket contact

Secondary Fuel Filter
Make .... AC
Type .... Spin-on
Filter No. T-916D
Service Part No. 25014342
Prévost number 510128
Element torque .... 1/2 turn after gasket contact

Fuel tank Capacity
Standard (X3-45) .... 208 US gallons (787 liters)

Air Cleaner
Make .... Nelson
Prevost Number 530206
Service Part No 7182 8N
Supplier number (element cartridge) 70337N
Prévost number (element cartridge) 530197

Air Cleaner Restriction Indicator
Make .... Donaldson
Model RBX00-2220
Indicates .... at 20" (508 mm) of water
Prévost number 530161

Preheater Fuel Filter
Make .... Webasto
Supplier number 603.359
Prévost number 871037

Fuel Cooler
Make .... Berendsen
Supplier number DB-1240
Prévost number 950109

SECTION 04: EXHAUST SYSTEM

CONTENTS

ILLUSTRATIONS

1. DESCRIPTION

The muffler is rubber mounted on the vehicle frame. This feature reduces the transmission of vibrations to the muffler thus resulting in extended life of muffler, brackets and other components.

2. MAINTENANCE

The exhaust system should be inspected periodically for restrictions and leaks. The exhaust system is shown on figure 1. Restrictions such as kinked or crimped pipes result in excessive back pressure that can lead to increased fuel consumption, power loss, and possible damage to engine combustion chamber components. Exhaust leaks are commonly the result of loose clamp bolts, corroded pipes, or a punctured muffler. In addition to objectionable noise, a leaking exhaust system could allow toxic gases to enter the vehicle. Inspect the exhaust system as follows:

* At vehicle inspection intervals ;
* Whenever a change is noticed in the sound of the exhaust system ; and
* Whenever the exhaust system is damaged.

Replace damaged or corroded exhaust system components without delay.

When operating the engine in a service garage or in a closed area, the exhaust must be vented to the outside. Place the shop vent hose over the exhaust outlet pipe.

⚠ WARNING ⚠
Avoid breathing exhaust gases since they contain carbon monoxide which is odorless and colorless but harmful. Carbon monoxide is a dangerous gas that can cause unconsciousness and can be lethal. If, at any time you suspect that exhaust fumes are entering the vehicle, locate and correct the cause(s) as soon as possible.

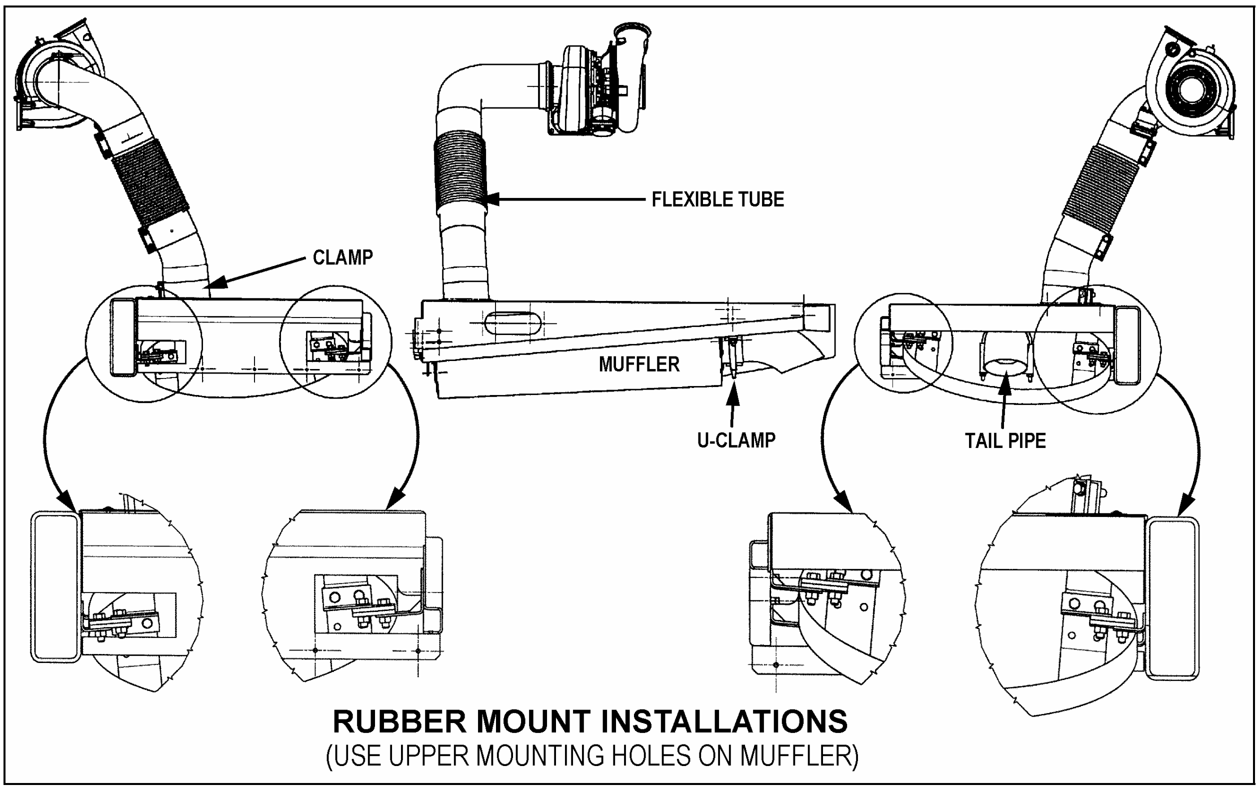


FIGURE 1: EXHAUST SYSTEM – X3-45 INSTALLATION 04011

3. MUFFLER REMOVAL & INSTALLATION

⚠ WARNING ⚠

Make sure that muffler and components are cold before handling.

1. Remove bolts and clamps securing exhaust pipe bellows to the muffler.
2. Support the muffler from underneath vehicle.
3. Remove U-clamp retaining the tail pipe to the muffler.
4. Remove bolt holding the tail pipe to the frame bracket.
5. Remove the tail pipe.
6. Remove the fasteners holding the four rubber mounts to the frame brackets.
7. Remove the fasteners securing the rubber mounts to the muffler brackets.
8. Remove rubber mounts then muffler from underneath vehicle.
9. Remove parts which are attached to the muffler such as brackets and collar.
10. Inspect and replace parts if necessary. Reinstall parts on the new muffler.

For installation, reverse the removal procedure.

⚠ WARNING ⚠

Check connections for tightness and fasteners for proper assembly.

4. FLEXIBLE TUBE INSTALLATION

The flexible exhaust tube contains an inside rigid pipe. To allow appropriate flexibility for assembly, make sure that the rigid pipe is concentric to the flexible part.

To maintain the pipe centered at the time of installation, cardboard spacers must be inserted at four places at equal distance around tubing (Fig. 2). These spacers may be left in place and will deteriorate over time.

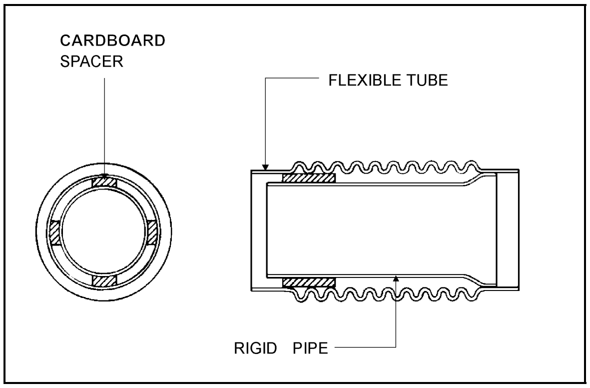


FIGURE 2: FLEXIBLE TUBE INSTALLATION 04003

CONTENTS

ILLUSTRATIONS

1. GENERAL DESCRIPTION

This vehicle uses a dual voltage system to obtain two different voltages (12 and 24 volts) for various electrical controls and accessories. The main power source incorporates four maintenance-free “Delco” model 1150 batteries connected in parallel-series. All batteries are kept uniformly charged by means of a 100 amp battery equalizer (standard), giving a maximum possible output supply of 100 amps on the 12 volt system. Both the 12 and 24 volt systems are controlled through individual main battery relays. Two 24 volt self-rectified alternators are belt driven from the engine, and can be reached through the engine compartment doors.

1.1 WIRING DIAGRAMS

A master wiring diagram of the electric circuits, covering standard and optional accessories and systems, is located in the technical publications box. Usually, a separate wiring diagram page is provided for each major function or system. In some cases, more than one circuit may appear on one wiring diagram page; when this occurs, each circuit covered in this page is listed in the wiring diagram index. Moreover, a circuit may appear on several pages; in such case, the number(s) at the extremity of the diagram title will indicate the sheet reference number. Refer to the *"Wiring Diagram Index"* to ensure that the correct diagram is being used to trace the circuit in question. In addition to the major functions page reference, the wiring diagram index contains the following information pages.

- The Multiplexed Device Index,
- The Arrangement-Harness drawing showing the harnesses arrangement and harness number on the vehicle,
- Glossary,
- Circuit number listing,
- Circuit breaker code,
- Connector code,
- Diode number code,
- Resistor number code,
- Fuse code.

1.1.1 Using Wiring Diagrams

Three methods are used to *"work"* with electric wiring diagrams.

Situation: You have identified the defective part (breaker, diode, relay, etc.), and you wish to locate its corresponding circuit.

Problem: Circuit breaker CB12 is released (open circuit) and you don't know which circuit is affected.

a) Refer to wiring diagram index, and look for *"Circuit breaker code"*, pages **F**.

b) At item CB12, you will find the location, the Prevost number, the breaker function, the breaker ampere rating and the page on which to find the corresponding diagram.

c) Refer to page 3.1.

d) When you have located CB12, follow the wiring up to the end and find the diagram page number and function on which the circuit continues.

Situation: You have a problem with a specific system and you want to find the corresponding diagram.

Problem: The last three (3) speakers on the R.H. side of vehicle are inoperative and you must trace the electric circuit.

d) Refer to wiring diagram index and look for *“Sound system”.*

e) You will find on page 35.1 & 35.2 the components as well as the electric wiring, thus providing you with a complete understanding of this circuit.

Situation: Using the message center display (MCD), you check on arrival if there are active errors in the vehicle electrical system. With the SYSTEM DIAGNOSTIC menu, highlight FAULT DIAGNOSTIC, highlight ELECTRICAL SYSTEM to request a diagnostic of the electrical system and then press the enter key. If applicable, the MCD shows the fault messages or fault codes recorded. When more than one fault is recorded, an arrow pointing down appears on the right of the display. Use the down to see all the fault messages.

Problem: MCD displays the fault "Elec. Horn SW61 SW62; shorted to ground" as being active.

a) Refer to wiring diagram index, and look for *"Multiplexed Device Index"*, pages B1-B8.

b) In first column DEVICE ID, look for device SW61, SW62.

c) At device SW61,SW62, find the fault message, the minimum condition to activate, other inputs involved in logic, the multiplex module related to switch 61 and switch 62, the connector and pin number on the module and the page on which to find the corresponding diagram.

d) Once the problem corrected, the MCD still shows the fault as being active. You have to leave the FAULT DIAGNOSTIC menu, wait approximately 20 to 30 seconds and then return to FAULT DIAGNOSTIC to request a new diagnostic of the ELECTRICAL SYSTEM from the CECM. The MCD should display the fault as being inactive.

1.1.2 Testing Circuits

A careful study of the wiring diagrams should be made to determine the source and flow of current through each circuit. When a circuit is thoroughly understood, a point-to-point check can be made with the aid of the applicable wiring diagrams. Any circuit can be tested for continuity or short circuits with a multimeter or a suitable voltmeter.

All electrical connections must always be kept clean and adequately tight. Loose or corroded connections can result in discharged batteries, difficult starting, dim lights and improper functioning of other electric circuits. Inspect all wiring connections at regular intervals. Make sure knurled nuts on all amphenol-type plugs are securely tightened. Knurled nuts on the plastic amphenol-type connectors will click into a detent when properly tightened. Line connectors, who have the side locking tabs, must have the locks latched in place to ensure a proper electrical connection.

1.2 WIRE SIZES AND COLORS

Each wire in the electrical system has a specific size as designated on the wiring diagram. When replacing a wire, the correct size must be used. Never replace a wire with one of a smaller size.
The vehicle electrical system is provided with different voltages. The insulation on each wire is distinctly colored in order to determine visually the wiring voltage and to assist in making connectors. The wires are color coded as follows:

Yellow	Multiplex modules communication CAN-H (twisted with green)
Green	Multiplex modules communication CAN-L (twisted with yellow)
Orange	Connected to multiplex outputs
White	Connected to multiplex inputs
Red	24 volt system
Yellow	12 volt system
Black	grounded wire
Blue	110 V ac system (live)
White	110 V ac system (neutral)
Green	110 V ac system (ground)
Orange	speakers (+)
Brown	speakers (-)
Grey	spare wire

NOTE

Wires are identified at each 2-4 inch (5-10 cm) intervals by a printed number.

Each wire on a diagram is patterned to assist in tracing and testing circuits. The wire number identifies the voltage rating, the wire identification number and the basic wire gauge as illustrated in figure 1.

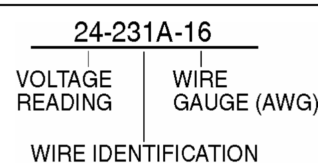


FIGURE 1: WIRE IDENTIFICATION 06048

1.3 SPARE WIRES

When the vehicle leaves the factory, and even in the case of a fully-equipped vehicle, an important number of unconnected spare wires are routed between the junction boxes. Consequently, for any connection of an additional accessory, refer to page D *"Spare wires"* in master wiring diagram to determine the number, the gauge and location of these wires.

⚠ CAUTION ⚠

Wire size is calibrated according to the breaker or fuse that protects it. When using a spare wire to replace a damaged wire, assure that the spare wire size is equal or larger than the wire being replaced. Using a wire too small for the breaker or fuse amperage might cause overheating of the wire.

NOTE
Spare wires are identified by a wire identification number and by the letters "SP", to designate "spare".

1.4 CLEANING CONNECTORS

When the pins and sockets of connectors become dirty, clean them with a good quality solvent containing HFC 134A refrigerant as its active ingredient. HFC 134A has two qualities that recommend it. First, it does not conduct electricity and therefore, will not cause shorting between connector pins and sockets. Second, it evaporates quickly, eliminating the possibility of condensation within the connectors.

Always shake out or gently blow out any excess HFC 134A before assembling a connector to its mating connector or hardware. HFC 134A trapped in the connector can affect the connector seal.

⚠ WARNING ⚠
HFC 134A is toxic. HFC 134A bases compounds should always be used in a well-ventilated area, never in a confined space. Use outdoor whenever possible.

1.5 CIRCUIT BREAKERS

Most electric circuits are protected by circuit breakers of the "Manual Reset" type. The main circuit breakers, as well as those protecting the A/C system, are located on the rear electrical junction panel in the rear electrical compartment, on L.H. side of the vehicle.

This type of circuit breaker deenergizes the circuit without disconnecting any wire. Simply press down the red tab on breaker to open the circuit, repair defective circuit, and afterwards depress black button in center of breaker to close the circuit.

Smaller circuit breakers may be located in the VECF of the front service compartment.

CIRCUIT BREAKERS			
CB1	Front distribution	24 VI	90 amps
CB2	Distribution	12 VD	90 amps
CB3	HVAC - evaporator	24 VI	90 amps
CB4	Sound system	12 VD	30 amps
CB5	Rear distribution	24 VI	150 amps
CB6	Distribution	24 VD	70 amps
CB7	HVAC - condenser	24 VI	70 amps
CB8	Rear distribution	12 VI	40 amps
CB9	WCL or other option	24VD	50 amps
CB10	Front distribution	12 VI	70 amps
CB11	Sound system	24 VD	50 amps
CB13	Galley or other option	24 VI	90 amps

VD= volts direct. The electrical components connected to these circuit breakers are direct-connected to the battery.

VI= volts indirect. Electrical power is supplied via master relay R1 which engages when ignition key is in the ON or ACC position and battery master switch (master cut-out) is set to ON.

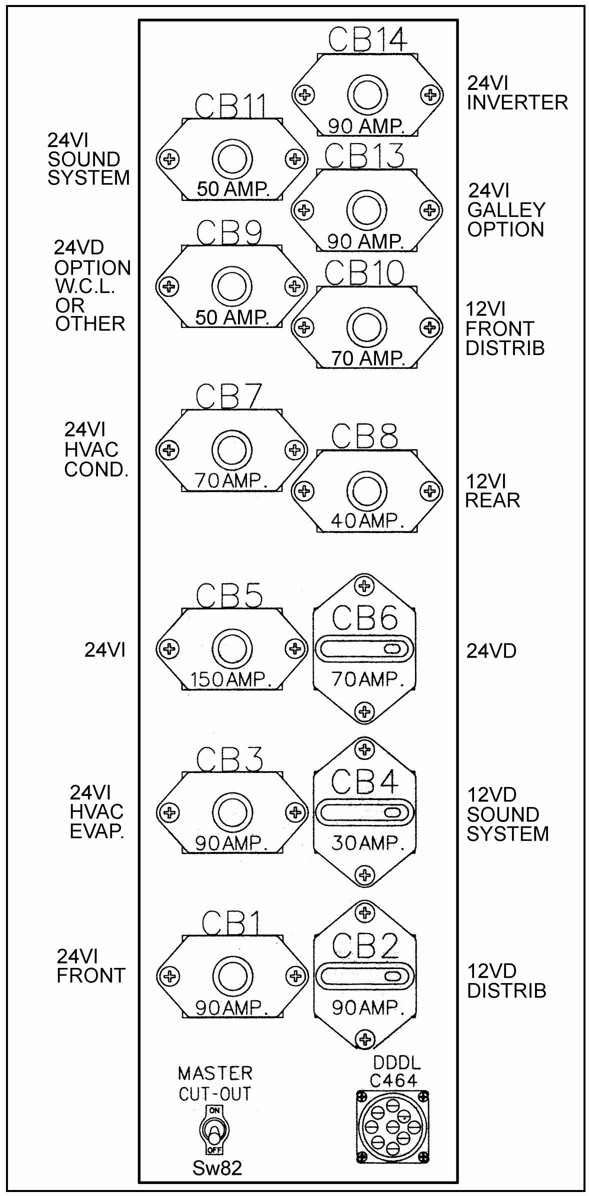


FIGURE 2: REAR ELECTRICAL JUNCTION PANEL 06621

1.6 MULTIPLEX FUSES

The multiplex outputs are protected in current by an internal "soft-fuse". Each output has programmed specific maximum amperage. When an output is shorted, the current gets above the limit and the soft-fuse intervenes to turn the output OFF. The output stays OFF until the "soft-fuse" is reset.

Turn the ignition key to the OFF position and turn to the ON position again. This resets all "soft-fuses".

There is also hardware fuses used to protect the incoming power to the multiplex modules. These fuses are located inside the VECF (Vehicle Electrical Center Front) and VECR (Vehicle Electrical Center Rear).

1.7 RELAYS

Relays are used to automatically energize or deenergize a circuit from a remote location. The relay draws a very low current to energize its coil. Once the coil is energized, it develops a magnetic field that pulls a switch arm closed or open, to either energize or deenergize a given component. As the control current required for the coil is very low, the relay allows a remote station to control a high energy circuit without running great lengths of costly high capacity cable, and also eliminates the need for high amperage switches and heavy connectors.

NOTE

Each relay is identified with "12V" or "24V" printed on its casing in order to identify the coil operating voltage.

CAUTION

The Multiplex vehicle uses a VF4 relay designed specially for Volvo that has different internal characteristics than the current VF4 relay. It is important to use only the new part marked Volvo as a replacement in Multiplex vehicles. Regular relays have an inadequate lifespan for Multiplex vehicles.

1.8 PRECAUTIONS

WARNING

Prior to working on a system inside vehicle, make sure to cut electrical power and air supply. A component could be supplied with electricity even if the ignition switch is set to the OFF position and/or a component could be pressurized even if air tanks are emptied. Always refer to the appropriate wiring and pneumatic diagrams prior to working on electrical and/or pneumatic systems.

NOTE

When the ignition switch is set to the OFF position, the electrical components are not energized except for the CECM (Chassis Electronic Control Module), engine ECM, transmission ECU, instrument cluster module, the battery equalizer, the preheater system, the wheelchair lift system and some Multiplex modules which are energized during 15 minutes after the ignition has been set to the OFF position. Prior to working on one of these electrical components, set the master cut-out switch in the rear electrical compartment to the OFF position. If the vehicle will not be operated for a long period (more than 2 weeks), it is recommended, in order to prevent the batteries from discharging, to trip main circuit breakers (2, 4 and 6) located in the rear electrical compartment to stop the small current drawn by the radio preset station memory, the CECM memory and the instrument cluster clock. Note that the radio station presets will be erased, same thing for the diagnostic codes history and the instrument cluster clock will have to be reset.

CAUTION

Prior to arc welding on the vehicle, refer to "Multiplex Modules Disconnection Procedure Prior To Welding" in section 00 GENERAL of this manual to avoid serious damage to the vehicle components.

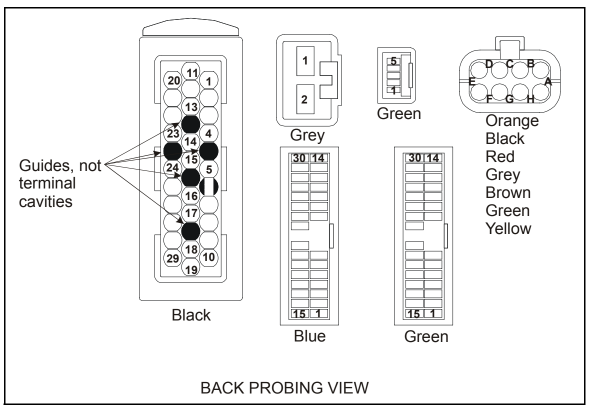
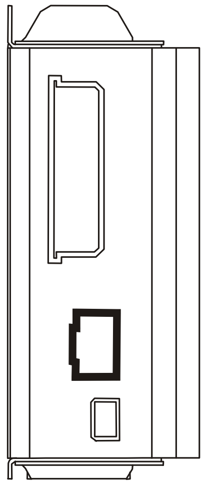
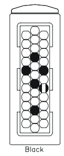
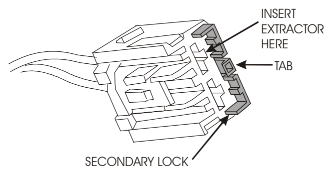
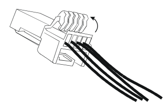
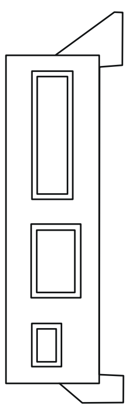
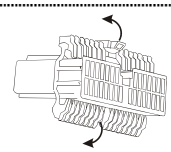


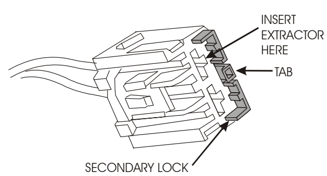
FIGURE 3: MULTIPLEX MODULE CONNECTORS PIN-OUT 06624

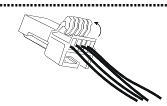
<table>
<tr><th>Multiplex modules</th><th>Connector type</th><th>Terminal removal</th></tr>
<tr><td rowspan="3">
IO-B
06625</td><td>
AMP 06628</td><td>EXTRACTOR/TOOL: Prevost #683594

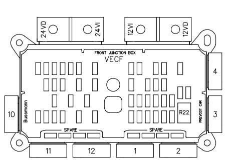
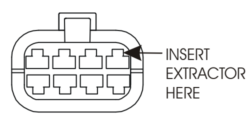
Insert the extractor on the front of the connector. Remove the terminal by disengaging the flexible lock tabs on the terminal. Gently remove the terminal from the connector by pulling on the wire.</td></tr>
<tr><td>
grey 06629
YAZAKI</td><td>EXTRACTOR/TOOL: Packard #12094430

Using a small flat blade screwdriver, open the hinged secondary lock. Insert the extractor on the front of the connector, over the terminal cavity. Remove the terminal by disengaging the flexible lock tab on the terminal. Gently remove the terminal from the connector by pulling on the wire.</td></tr>
<tr><td>
green 06630
JAE</td><td>EXTRACTOR/TOOL: Prevost #683766

Using a small flat blade screwdriver, open the hinged secondary lock. Insert the extractor on the front of the connector, over the terminal cavity. Remove the terminal by disengaging the flexible lock tab on the terminal. Gently remove the terminal from the connector by pulling on the wire.</td></tr>
<tr><td rowspan="3">
IO-A
06626</td><td>
green, blue (CECM)
JAE 06631</td><td>EXTRACTOR/TOOL: Prevost #683766

Using a small flat blade screwdriver, open both hinged secondary locks. Insert the extractor on the front of the connector, over the terminal cavity. Remove the terminal by disengaging the flexible lock tab on the terminal. Gently remove the terminal from the connector by pulling on the wire.</td></tr>
<tr><td>
grey 06629
YAZAKI</td><td>EXTRACTOR/TOOL: Packard #12094430

Using a small flat blade screwdriver, open the hinged secondary lock. Insert the extractor on the front of the connector, over the terminal cavity. Remove the terminal by disengaging the flexible lock tab on the terminal. Gently remove the terminal from the connector by pulling on the wire.</td></tr>
<tr><td>
green 06630
JAE</td><td>EXTRACTOR/TOOL: Prevost #683766

Using a small flat blade screwdriver, open the hinged secondary lock. Insert the extractor on the front of the connector, over the terminal cavity. Remove the terminal by disengaging the flexible lock tab on the terminal. Gently remove the terminal from the connector by pulling on the wire.</td></tr>
<tr><td>
VECF
06627</td><td>
Orange
Black
Red
Grey
Brown
Green
Yellow
06632
BUSSMAN</td><td>EXTRACTOR/TOOL: Prevost #682256 (Packard 12094429)

Remove the terminal by disengaging the flexible lock tab on the terminal. Gently remove the terminal from the connector by pulling on the wire.</td></tr>
</table>

2. X3 COACHES ELECTRICAL COMPARTMENTS

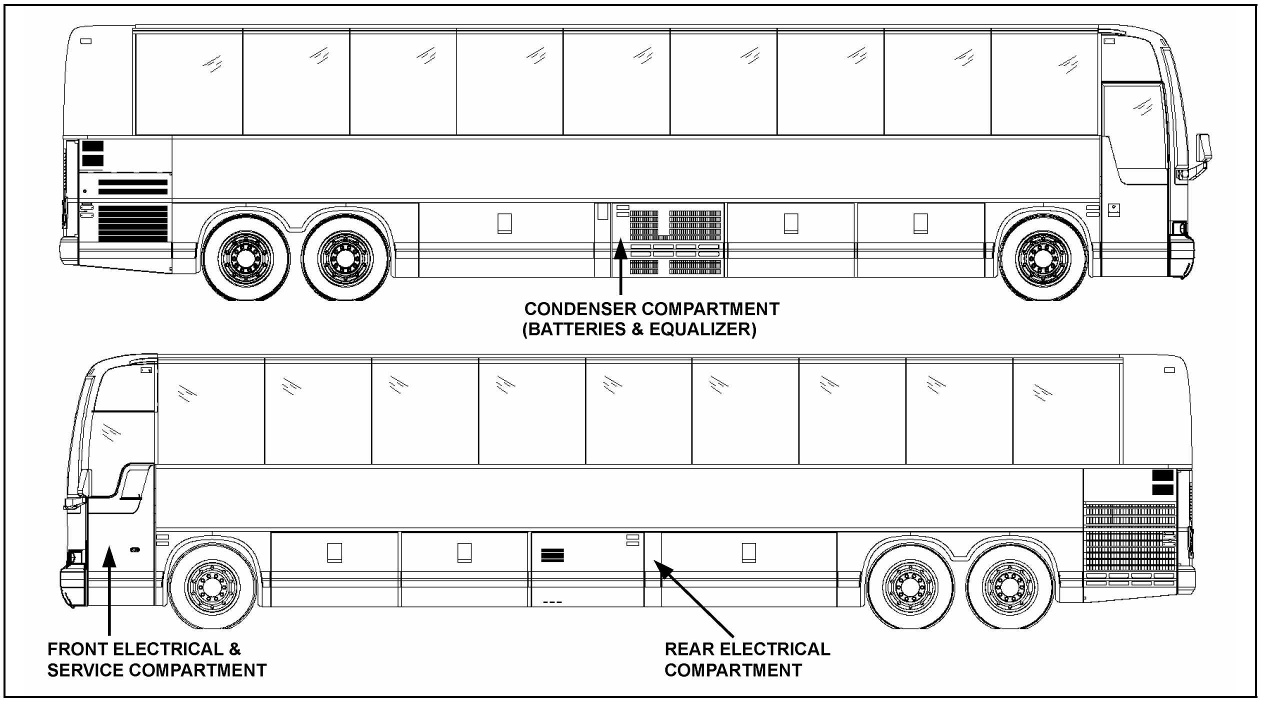


FIGURE 4: ELECTRICAL COMPARTMENTS (X3-45 COACH) 06633

2.1 MAINTENANCE

A Cortec VCI-238 corrosion inhibitor has been sprayed in all electrical compartments to protect components from corrosion. The life expectancy of this product is five years, so it is recommended to reapply it every five years. It is also recommended to spray it on new components when added or replaced.

⚠ CAUTION ⚠

Never put grease, Cortec VCI-238 or other product on the multiplex module connector terminals.

⚠ WARNING ⚠

Use VCI-238 in a well ventilated area. Do not smoke. Avoid prolonged contact with skin and breathing of spray mist. Harmful or fatal if swallowed. Do not induce vomiting. Call physician immediately.

2.2 REAR ELECTRICAL COMPARTMENT

The rear electrical compartment is located in the space between the evaporator compartment and the last baggage compartment (Super bay) on the driver side of the vehicle. The compartment is accessible from the last baggage compartment by removing a plastic access cover. The rear electrical compartment provides access to the following:

- Rear junction panel;
- Rear terminal block;
- Multiplex modules;
- Vehicle Electrical Center Rear (VECR)
- Battery charger;
- Relays and fuses;
- Transmission ECU;
- Battery master switch (Master cut-out);
- Diagnostic Data Reader (DDR) receptacle, (refer to “Other Features” chapter).

Rear Electrical Compartment			
Multiplex Modules			
A49	I/O-A	A52	I/O-B
A50	I/O-B	A53	I/O-B
A51	I/O-B	A54	I/O-B
		Spare	I/O-B

Relays			
R1	Master relay	R15	Aisle & Emerg. Lts
R2	ZF Trans.	R17	12V Rr wake-up
R3	12V IGN & A/C	R20	Water Pump Relay
R5	Preheat / Charger	R26	Water Pre-heater Realy
R6	Direct lights	R21	Emergency cut-out
R8	Service brakes	R30	Luggage Door Lock
R10	Condenser Fan Sp. 2	R31	Luggage Door Lock
R11	ZF Trans. Ign.	R32	Luggage Door Unlock
R12	Evaporator Fan	R33	Luggage Door Unlock
R13	Indirect lights	Rxx	Spare
R14	Reading lights		

Fuses			
F50	Engine Pre-heating	F69	Overhead storage compartment lighting RH & LH
F51	Engine Pre-heating	F70	Customer (24VI)
F52	ZF Trans.	F71	Spare fuse
F53	Power Mux A54	F72	Power Mux A50
F54	Customer (24VD)	F73	Spare fuse
F55	Aisle & emergency lights	F74	ECM engine IGN
F56	Indirect lights	F75	ECU trans IGN
F57	Indirect lights	F76	Customer (12VI)
F58	Direct lights	F77	ECU transmission wake-up
F59	Direct lights	F78	ECM engine wake-up
F60	Reading Lamp RH	F79	ECM engine wake-up
F61	Reading Lamp LH	F80	Power Mux A51
F62	Lavatory night light	F81	Alternators excitation resistor
F63	Engine Pre-heater	F85	ZF Trans.
F64	Spare	F86	Spare fuse
F65	Power Mux Module RJB	F87	Spare fuse
F66	Radiator Fan Clutch	F88	Spare fuse
F67	Power Mux A54	F89	Spare fuse
F68	Power Mux A54		

Resistors			
RES13	Excit. res. ALT-1	RES16	Rear marker lights
RES14	Excit. res. ALT-2	RES17	Rear marker lights

Diodes			
D6	Master relay	D29	Unloader RH
D9	Water Pre-Heater	D31	Main A/C Clutch
D10	Water Pre-Heater	D33	Toilet flush pump
D11	Pass. Liq. Valve	D36	Fan Clutch 2
D15	Wake-up mode	D37	Fan Clutch 1
D17	Luggage 4-Cmpt	D49	Parcel Rack
D19	Luggage 2-Cmpt	D67	Rear Lights
D20	Luggage 1-Cmpt	D68	Rear Lights
D23	Condenser fans	D69	Rear Lights
D24	Condenser fans	D70	Rear Lights
D28	Unloader LH	DXX	Not used

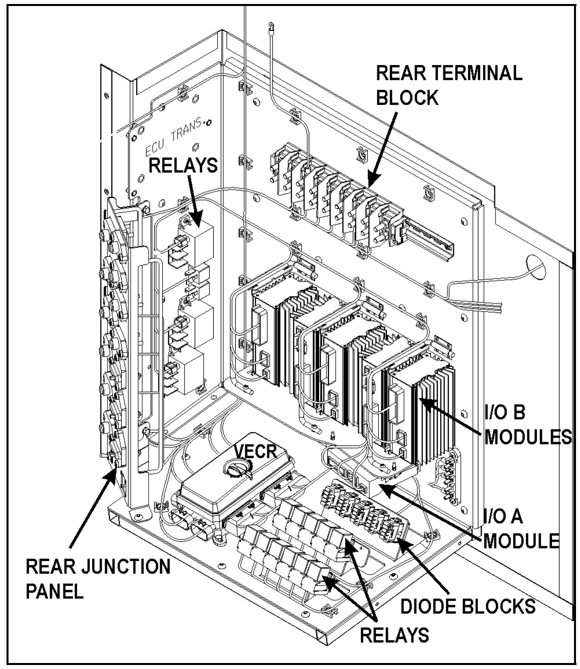


FIGURE 5: REAR ELECTRICAL COMPARTMENT 06634

2.3 FRONT ELECTRICAL AND SERVICE COMPARTMENT

The front electrical and service compartment is located on L.H. side of vehicle, under the driver's window. It contains the following components (Fig. 6):

- Front terminal block;
- CECM;
- Vehicle Electrical Center Front (VECF) and Multiplex Modules;
- Relays and fuses;
- ABS Electronic Control Unit (ECU);

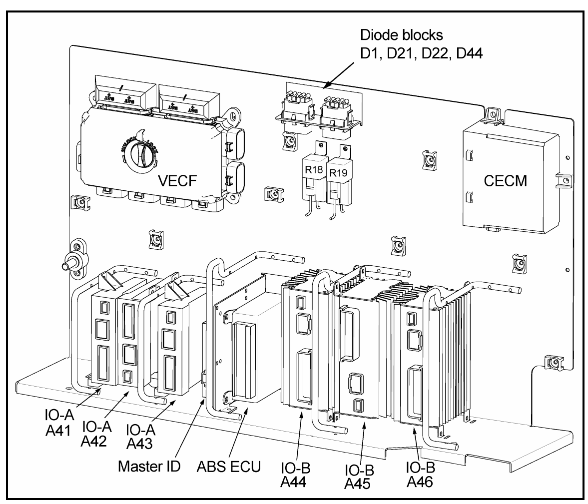


FIGURE 6: FRONT ELECTRICAL COMPARTMENT 06617

Front Electrical & Service Compartment			
Multiplex Modules			
VECF	Vehicle Electrical Center Front	A42	I/O-A
A9	ABS-ECU	A43	I/O-A
A13	MASTER ID	A44	I/O-B
A36	CECM	A45	I/O-B
A41	I/O-A	A46	I/O-B
Relays			
R18	Wake-up 24V	R22	Engine brake
R19	Wake-up 12V	A27	Steering Control soft module
Fuses			
F1	CECM Power	F23	ABS
F2	Front start main switch	F24	Mirror
F3	Pre-heating & driver liquid solenoid valve	F25	Back-up camera
F4	Wireless microphone	F26	Spare fuse
F5	Wake-up mode 24V	F27	Customer
F6	Free/customer	F28	Driver's power window
F7	ABS & pre-heat control	F29	Instrument cluster & data reader
F8	Air horn	F30	Cigarette lighter & 12-volt accessory outlet
F9	Spare fuse	F31	Keyless entry module
F10	Spare fuse	F32	Spare fuse
F11	Sun visor	F33	Wake-up mode 12VD
F12	Power multiplex A41	F34	Wake-up mode 12VD
F13	Power multiplex A41	F35	12-volt accessory outlet
F14	Customer	F36	HVAC & telltale panel
F15	R22	F37	Spare fuse
F16	Defroster unit	F38	Digital Clock
F17	Spare	F39	Spare fuse
F18	Upper Defroster	F40	Spare fuse
F19	Pro Driver	F41	Spare fuse
F20	Witness red LED	F82	Lower wipers
F21	Power Mux A44	F83	Sound system
F22	ZF Steering Control	F84	Customer
Diodes			
D1	Accessories	D22	Service brake
D2	Driver Liq Sol Vlve	D44	Ignition
D12	Engine Brake	Dxx	Not used
D13	ABS		

2.4 ENGINE REAR START PANEL

This control panel is located in the R.H. side of engine compartment above the engine air filter. This control panel includes the engine starter selector switch, the rear start push button switch to start engine from engine compartment as well as the engine compartment lights switch.

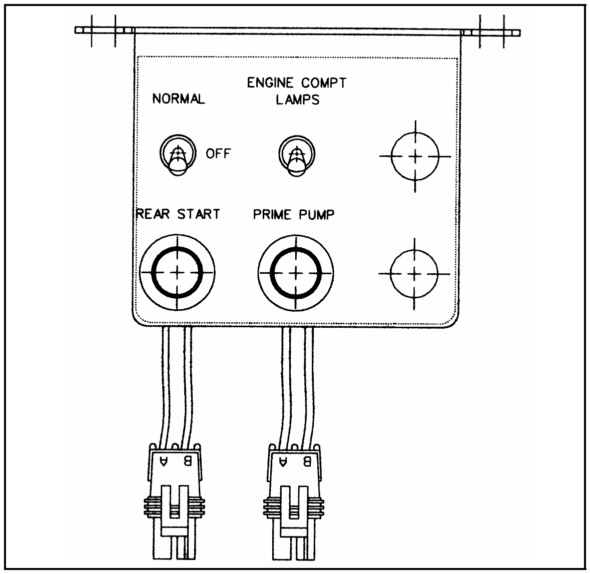


FIGURE 7: REAR START PANEL 06622

NOTE
When the ignition key switch is set to the "OFF" position, the electrical supply from the batteries is cut off, with the exception of the Fire Detection System, the Engine & Transmission Electronic Controls, the Auxiliary Heating System, the Battery Equalizers and the Digital Clock.

2.5 CONDENSER COMPARTMENT

The batteries are located inside the condenser compartment on the X3-45 coach.

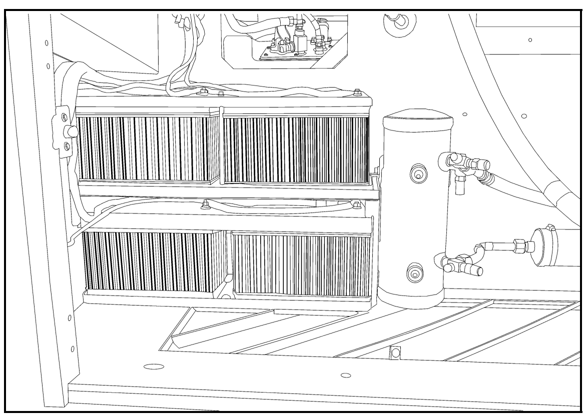


FIGURE 8: LOCATION OF BATTERIES IN CONDENSER COMPARTMENT 22300

2.5.1 Battery equalizer

On X3-45 coaches the battery equalizer is located on the L.H. side of the condenser compartment (Fig. 9).

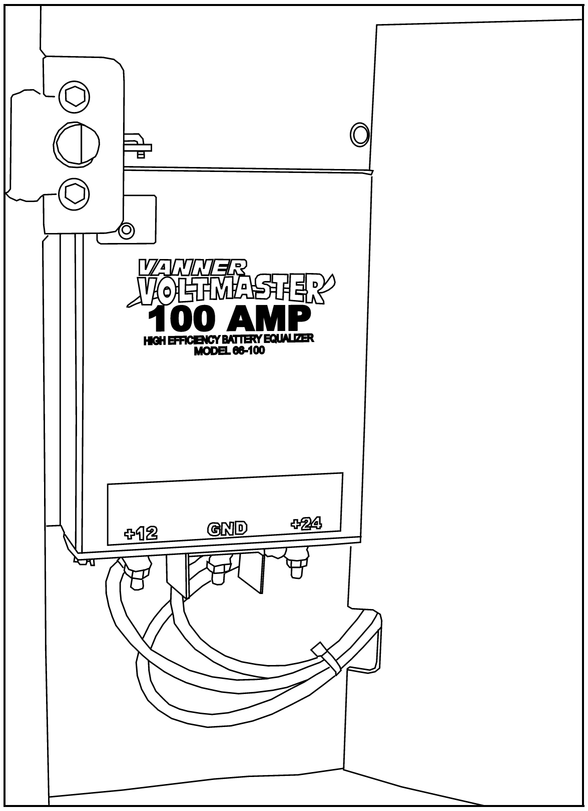


FIGURE 9: BATTERY EQUALIZER 06635

2.6 ENTRANCE DOOR & WIPER CONTROL PANEL

To access the entrance door & wiper control panel of the right console, remove the panel under the larger utility compartment at the base of the windshield.

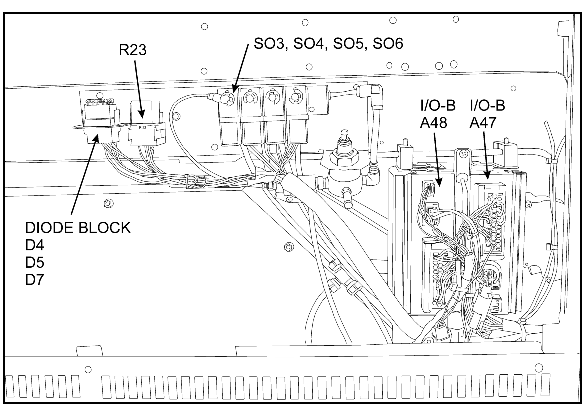


FIGURE 10: ENTRANCE DOOR & WIPER CONTROL PANEL 06619

Entrance Door & Wiper Control Panel			
Multiplex Modules			
A47	I/O-B	A48	I/O-B
Relays			
R23	Windshield wipers		
Solenoids			
SO3	Door unlock solenoid valve	SO5	Door opening solenoid valve
SO4	Door unlock solenoid valve	SO6	Door closing solenoid valve
Diodes			
D4	Windshield wipers speed 2	D7	Entrance door
D5	Windshield wipers speed 1		

3. BATTERIES

The vehicle is provided with four (4) maintenance-free 12 volt heavy-duty batteries connected in series-parallel (Fig. 8 & 11). The top-mounted negative and positive terminals are tightly sealed to prevent leaks. Water never needs to be added to this type of battery. There are no filler caps in the cover. The battery is sealed, except for small vent holes in the cover. The vents must not be restricted as they allow small amounts of gases produced in the battery to escape. The special chemical composition inside the battery reduces gassing to a very small amount at normal charging voltages. Besides reducing gassing, the special chemistry greatly reduces the possibility of overcharge damage.

The vents require keeping the battery in an upright position to prevent electrolyte leakage. Tipping the battery beyond a 45° angle in any direction can allow a small amount of electrolyte to leak out of the vent holes.

WARNING

DO NOT tip battery by more than 45° when carrying or installing the battery.

NOTE

Evidence of electrolyte leakage does not necessarily mean the battery is defective.

With special cables properly attached to batteries, the metal surfaces that carry the current are completely sealed from the atmosphere. This prevents terminal oxidation and corrosion that may cause starting and charging problems. If new cables are required, sealed terminal cable replacements should be used to retain the reliability of the original maintenance-free connections.

⚠ WARNING ⚠

All lead-acid batteries generate hydrogen gas, which is highly flammable. If ignited by a spark or flame, the gas may explode violently, causing spraying of acid, fragmentation of the battery, which may result in severe personal injuries. Wear safety glasses and do not smoke when working near batteries. In case of contact with acid, flush immediately with water.

The battery has four (4) major functions:

1. Providing a source of current for starting the engine;
2. Stabilizing the voltage in the electrical system;
3. Supplying current for a limited time, when electrical demands of the equipment exceed the power output of the alternator;
4. Providing a limited source of power for connected accessories, when the engine is not running.

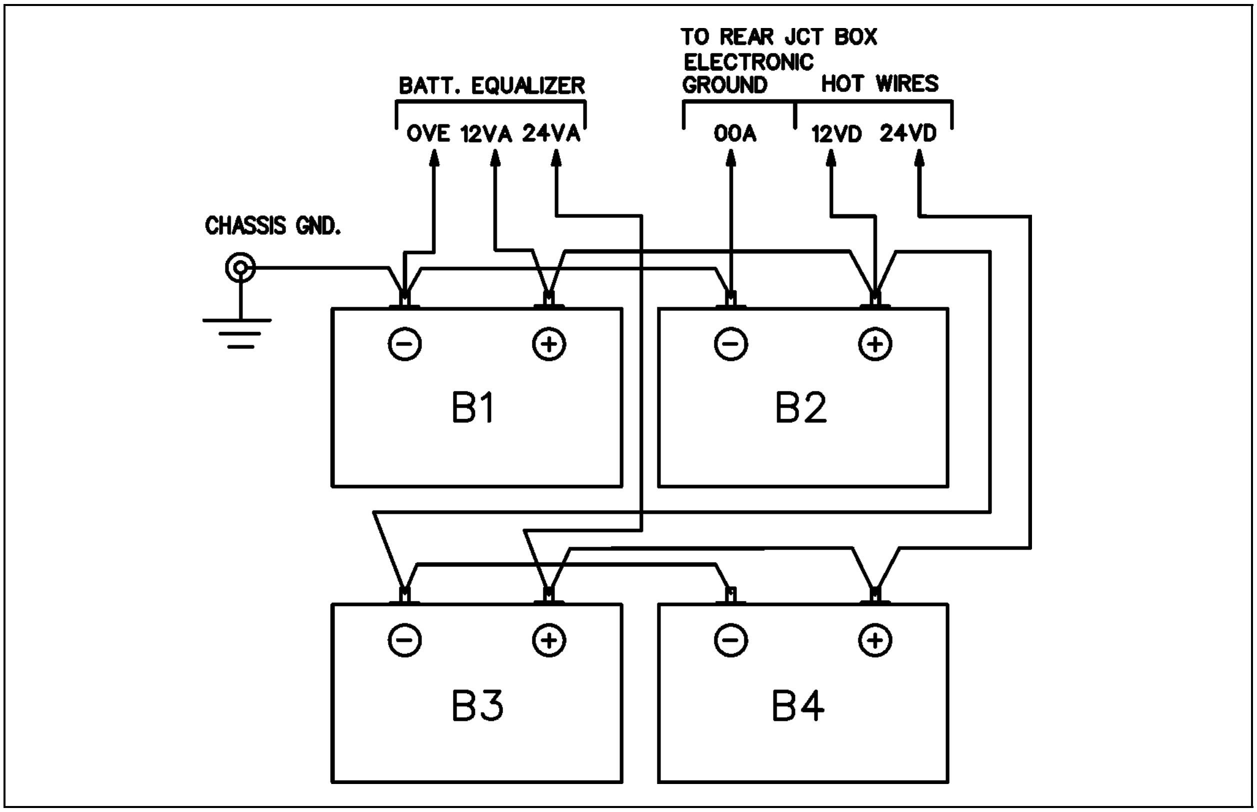


FIGURE 11: BATTERY CONNECTIONS 06636

3.1 BATTERY DISCHARGE PROTECTION

To prevent discharge of the batteries when the engine in not running, some functions are automatically switched off if the batteries voltage drops below 24.4 volts for more than 30 seconds. The "BAT" telltale light blinks while this protection mode is active. Set the ignition key to the OFF position and then turn the ignition key to the ON position to reactivate the functions for a period of 30 seconds before they switch off again. If a prolonged use of the functions with the engine not running is necessary, connect the battery to a charger.

3.2 MAIN BATTERY RELAYS

Main battery (master) relays (12V and 24V) are provided for this vehicle. The relays are located in the rear electrical compartment. The 24-volt battery relay (R1) engages when ignition key is in the ON or ACC position and battery master switch (master cut-out) is flipped ON.

When the main battery relays (R1 & R3) are turned to the *OFF* position, all electrical supply from the batteries is cut off, with the exception of the following items.

- Battery equalizer check module;

- ECM;
- ECU power (World transmission);
- Preheater electronic timer;
- Preheater and water recirculating pump;
- Sedan entrance door;
- Radio memory;
- CECM;
- Cluster memory.

3.3 BATTERY REMOVAL AND INSTALLATION

The batteries are located in the condenser compartment.

1. Remove the two quarter turn nuts to remove the protective cover (Fig. 8)

WARNING

To prevent possible electric shocks or sparking, the battery master switches should be in the "Off" position before disconnecting cables from the batteries (see paragraph "3.8 Battery safety switches").

2. Remove the supports, and unscrew terminal nuts of each defective battery.
3. Remove battery cables from the batteries.
4. Remove batteries.
5. Installation is the reverse of removal.

NOTE

When the battery cables have been removed from the batteries, wrap the battery terminals and cable ends with electric tape to prevent accidental grounding. The ground cables should always be disconnected first and replaced last.

NOTE

In replacing batteries, only batteries of the same specification should be used. Refer to "Specifications" at the end of this section for further details.

CAUTION

Ensure that connections are not reversed when reinstalling batteries, since damage to electrical system components will result.

NOTE

When reinstalling batteries, battery connections must be tightened to 13-15 lbf-ft (18-20) Nm). A torque wrench is required to ensure an accurate tightening torque.

WARNING

To prevent possible electric shock or sparking, the battery master switch must be set to the "Off" position before tightening an electrical connection.

NOTE

A protective silicone free, coating should be applied on all terminals that have been disconnected. We recommend the use of Cortec VCI-238 (Prévost #682460) on all electrical connections.

3.4 BATTERY RATING

Each of the 12 volt batteries used on the vehicle has the following rating:

- Reserve capacity: 195 minutes
- Cold cranking (amps): 950 @ 0°F (-18°C)
- Cold cranking (amps): 745 @ -20°F (-29°C)
- Weight (filled): 59 lb (26,7 kg)

The reserve capacity is defined as the number of minutes a new, fully charged battery at 80°F (26,6°C) can be discharged at 25 amperes and maintain a minimum of 1.75 volts per cell (10.5 volts total for one 12 volts battery). This rating can be used as a basis for determining how long a vehicle might run after an alternator failure. The cold cranking rating is defined as the minimum discharge current a battery will deliver in amperes for 30 seconds at 0°F (-18°C) while maintaining a minimum of 1.2 volts per cell (7.2 volts total for one 12 volts battery). This rating can be used as a basis for comparing starting performance.

3.5 BATTERY TESTING

The maintenance-free battery has a strong ability to withstand the damaging effects of overcharge. The test indicator in the cover is used only to determine if the battery can be tested in case of a cranking problem.

The test indicator in the battery cover is to be used with accepted diagnostic procedures only. It must not be used to determine if the battery is good or bad, charged or discharged. The test indicator is a built-in hydrometer in one cell that provides visual information for battery testing (Fig. 12).

It is important when observing the test indicator, that the battery be relatively level and has a clean indicator top to see the correct indication. Some lighting may be required in poorly lit areas. Under normal operation, two indications can be observed.

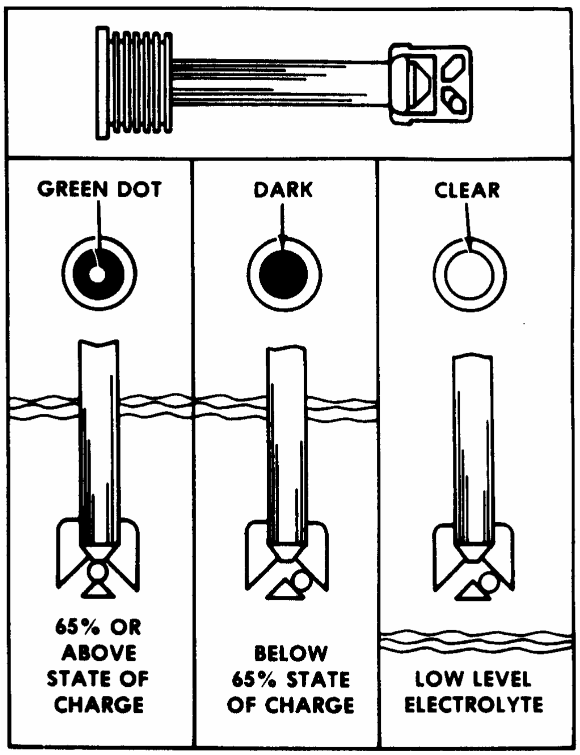


FIGURE 12: TEST INDICATOR 06096

Green Dot Visible

Any green appearance is interpreted as a *"green dot"*, and the battery is ready for testing. On rare occasions, following prolonged cranking, the green dot may still be visible when the battery is obviously discharged. Should this occur, charge the battery as described under *"Charging Procedure"* in *"Battery Charging"* later in this section.

Dark - Green Dot Not Visible

If there is difficulty cranking the engine, the battery should be tested as described in this section. On rare occasions, the test indicator may turn light yellow. In this case, the integral charging system should be checked. Normally, the battery is capable of further service; however, if difficult start has been reported, replace the battery. **DO NOT CHARGE, TEST, OR JUMP-START.**

3.5.1 Visual Inspection

1. Check the outside of the battery for a broken or cracked cover or case that could permit loss of electrolyte. If obvious physical damage is noted, replace the battery.
2. Check for loose terminal posts, cable connections, damaged cables, and for evidence of corrosion. Correct conditions as required before proceeding with tests.

3.5.2 Removing Surface Charge

Disconnect cables from the battery and attach alligator clamps to the contact lead pad on the battery as shown in figure 16. Connect a 300 ampere load across the terminal for 15 seconds to remove surface charge from the battery.

3.5.3 Load Test

This test is one means of checking the battery to determine its ability to function as required in the vehicle.
To make this test, use test equipment that will withstand a heavy electrical load from the battery, such as a carbon pile resistor or other suitable means.

1. Connect a voltmeter, ammeter, and a variable load resistance as illustrated in figure 13.

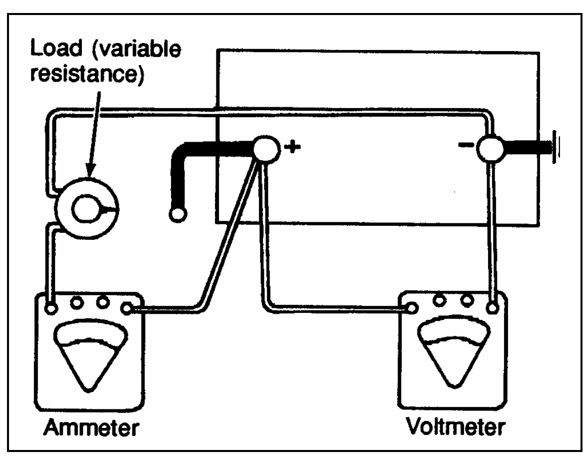


FIGURE 13: LOAD TEST 06064

⚠ CAUTION ⚠

Observe polarity of the meters and the battery when making connections, and select the correct meter range.

2. Apply a 290 amperes load to the battery for 15 seconds.
3. With an ammeter reading specified load, read voltage. The voltage should be at least 9.6 volts. Disconnect the load. If the voltmeter indicates 9.6 volts or more, the battery is good. If the voltmeter reading is less than 9.6 volts, replace the battery. This voltage is to be used for battery ambient temperatures of 70ºF (21ºC) and above. For temperatures below 70ºF (21ºC), refer to the following *"Voltage and Temperature Chart"*.

Voltage and Temperature Chart

Ambient Temperature	Minimum Voltage
70ºF (21ºC) and above	9.6
60ºF (16ºC)	9.5
50ºF (10ºC)	9.4
40ºF (4ºC)	9.3
30ºF (-1ºC)	9.1
20ºF (-7ºC)	8.9
10ºF (-12ºC)	8.7
0ºF (-18ºC)	8.5

NOTE

The accuracy of this test procedure is dependent upon close adherence to the proper load, time and temperature specifications.

3.5.4 Testing Battery Cables

Check all cable ring terminals and connections to determine if they are in good condition. Excessive resistance, generally caused by poor connections, produces an abnormal voltage drop which may lower voltage at the starter to such a low value that normal operation of the starter will not be obtained. An abnormal voltage drop can be detected with a low-reading voltmeter as follows:

⚠ WARNING ⚠

To prevent the engine from starting during these tests, remove fuses F78 and F79 located in the VECR of the rear electrical compartment. Once the tests are completed, reinstall F78 and F79.

1. Check voltage drop between grounded (negative) battery terminal and vehicle frame by placing one prod of the voltmeter on the battery terminal and the other on a good ground (unpainted surface) on the vehicle. With the starter cranking the engine at a temperature of 70ºF (21ºC), voltage reading should be less than 0.3 volt. If the voltage reading exceeds 0.3 volt, there is excessive resistance in this circuit.
2. Check voltage drop between the positive battery terminal and the starter positive terminal stud while the motor is operated. If the reading is more than 2.5 volts, there is excessive resistance in this circuit.

NOTE

If it is necessary to extend the voltmeter lead for this test, use a #16 (AWG) or larger wire.

3. Check voltage drop between the starter housing and a good ground on the vehicle. The reading should be less than 0.2 volt.

⚠ WARNING ⚠

Any procedure other than the following could cause personal injury or damages to the charging system resulting from battery explosion or electrical burns.

Wear adequate eye protection when working on or near the batteries. Ensure that metal tools or jumper cables do not contact the positive battery terminal (or a metal surface in contact with it) as a short circuit will result. Do not attempt to jump start a vehicle suspected of having a frozen battery because the battery may rupture or explode. Both the booster and discharged batteries must be treated carefully when using jumper cables. Follow exactly the procedure outlined later in this section, being careful not to cause sparks.

3.6 BATTERY CHARGING

The batteries used on this vehicle can be charged either on or off the vehicle; however, when they are removed from the vehicle, it is recommended that an adapter kit, which is available from any "A/C DELCO" dealer, be used in charging sealed-terminal batteries. Use the booster block to charge the batteries when they are left on vehicle and **make sure that the main battery disconnect switch is set to the *"On"* position.**

⚠ WARNING ⚠

During charging of the batteries, an explosive gas mixture forms in each cell. Part of this gas escapes through the vent holes and may form an explosive atmosphere around the battery itself if ventilation is poor. This explosive gas may remain in or around the battery for several hours after it has been charged. Sparks or flames can ignite this gas causing an internal explosion, which may shatter the battery.

1. **Do not smoke near a battery which is being charged or which has been recently charged.**
2. **Do not break live circuits at battery terminals because a spark usually occurs at the point where a live circuit is broken. Care must always be taken when connecting or disconnecting booster leads or cable clamps on chargers. Poor connections are a common cause of electric arcs, which cause explosions.**
3. **The electrical system on this vehicle is negative ground. Installing the batteries with the positive terminals grounded or incorrect use of the booster battery and jumper cables will result in serious damage to the alternator, batteries and battery cables.**

The alligator clamps of the tester or charger must be placed between the terminal nuts and the lead pads of the terminal studs (Fig. 14) after the vehicle cables are detached. The alligator clamps should make firm contact with the lead pads.

NOTE

If this connection cannot be made because of the alligator clamp design, the load value for testing must be reduced from 290 to 260 amperes.

On rare occasions, such as those that occur following prolonged cranking, the green dot in the test indicator may still be visible when the battery is obviously discharged. Should this occur, a boost charge of 20 amperes-hour is recommended. Under normal operating conditions, do not charge battery if the green dot is visible. The battery should never be charged if the test indicator (hydrometer) is clear or light yellow. If this occurs, replace the battery.

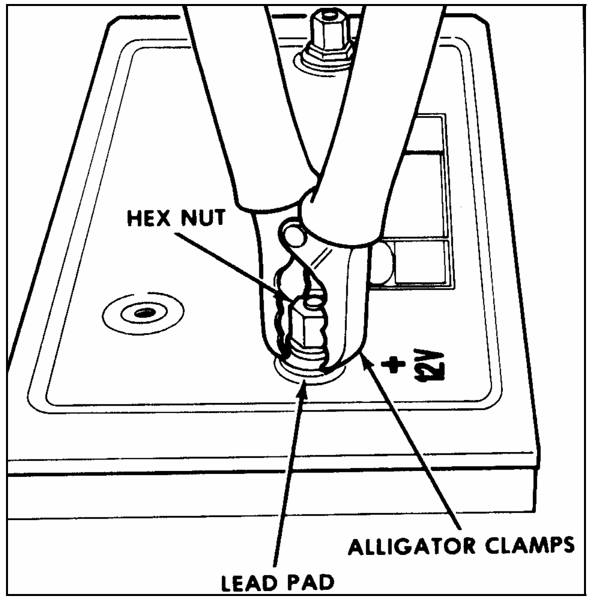


FIGURE 14: ALLIGATOR CLAMPS AND BATTERY 06065

A charge rate between 3 and 50 amperes is generally satisfactory for any maintenance-free battery as long as spewing of electrolyte does not occur or the battery does not feel excessively hot (over 125ºF (52ºC)). If spewing or violent gassing of electrolyte occurs or battery temperature exceeds 125ºF (52ºC), the charging rate must be reduced or temporarily stopped to allow cooling and to avoid damaging the battery. Battery temperature can be estimated by touching or feeling the battery case. The battery is sufficiently charged when the green dot in the built-in hydrometer is visible. No further charging is required. Shake or tilt the battery at hourly intervals during charging to mix the electrolyte and see if the green dot appears.

⚠ WARNING ⚠

Always turn off the charger before connecting or disconnecting to a battery.

NOTE

The charge rate must be doubled when the batteries are charged by the booster block, because of the series-parallel circuit.

Battery charging consists of a charge current in amperes for a period of time in hours. Thus, a 25 ampere charging rate for 2 hours would be a 50 ampere-hour charge to the battery. Most batteries, whose load test values are greater than 200 amperes, will have the green dot visible after at least a 75 ampere-hour charge. In the event that the green dot does not appear, replace the battery.

3.6.1 Battery Charging Guide

Fast Charging Rate

20 amps @ 3-¾ hours
30 amps @ 2-½ hours
40 amps @ 2 hours
50 amps @ 1-½ hours

Slow Charging Rate

5 amps @ 15 hours
10 amps @ 7-½ hours
The time required for a charge will vary according to the following factors:

Size of Battery

For example, a completely discharged large heavy-duty battery requires more than twice the recharging time of a completely discharged small passenger car battery.

Temperature

For example, a longer time will be needed to charge any battery at 0^{o}F (-18^{o}C) than at 80^{o}F (27^{o}C). When a fast charger is connected to a cold battery, the current accepted by the battery will be very low at first, and then in time, the battery will accept a higher rate as it warms.

State of Charge

For example, a completely discharged battery requires more than twice as much charge than a half-charged battery. Since the electrolyte is nearly pure water and a poor conductor in a completely discharged battery, the current accepted is very low at first. Later, as the charging current causes the electrolyte acid content to increase, the charging current will likewise increase.

Charger Capacity

For example, a charger which can supply only 5 amperes will require a much longer period of charging than a charger that can supply 30 amperes or more.

3.6.2 Emergency Jump Starting With Auxiliary (Booster) Battery.

⚠ WARNING ⚠

Off-board battery charger with a start boost facility must not be used to jump start the vehicle. This could damage the electrical system. Do not jump start vehicles equipped with maintenance-free batteries if the test indicator is light yellow.

Booster Block

On X3-45 coaches, booster block is located near the preheater in the engine compartment on the R.H. side and is accessible through engine R.H. side door (Fig. 15).

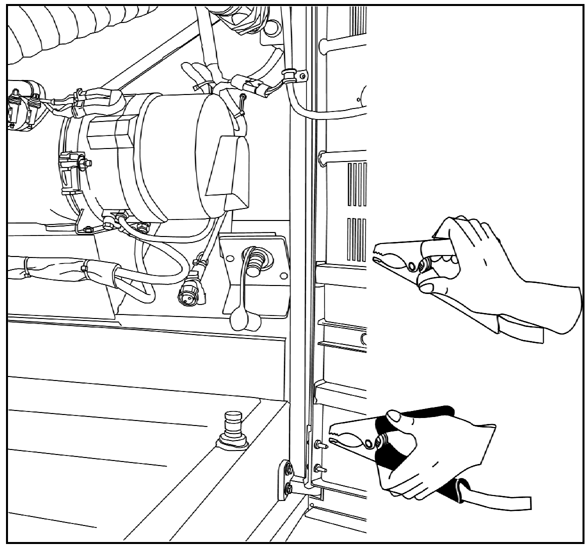


FIGURE 15: BOOSTER BLOCK 06623

Both booster and discharged batteries should be treated carefully when using jumper cables. A vehicle with a discharged battery may be started by using energy from a booster battery or the battery from another vehicle.

⚠ WARNING ⚠

Jump starting may be dangerous and should be attempted only if the following conditions are met:

The booster battery or the battery in the other vehicle must be of the same voltage as the battery in the vehicle being started, and must be negative grounded.

If the booster battery is a sealed-type battery without filler openings or caps, its test indicator must be dark or a green dot must be visible. Do not attempt jump starting if the test indicator of the booster battery or the discharged battery has a light or bright center.

⚠ WARNING ⚠

Follow the procedure exactly as outlined hereafter. Avoid making sparks.

Wear eye protection and remove rings, watches with metal bands and other metal jewelry.

Apply parking brake and place the transmission shift lever or push-button pads in Neutral (N) position in both vehicles. Turn off lights, heater and other electrical loads. Observe the charge indicator. If the indicator in the discharged battery is illuminated, replace the battery. **Do not** attempt jump starting when indicator is illuminated. If the test indicator is dark and has a green dot in the center, failure to start is not due to a discharged battery and the cranking system should be checked. If charge indicator is dark but the green dot does not appear in center, proceed as follows:

1. Connect one end of one red jumper cable to the positive (+) terminal of the booster power source and the other end to the positive (+) post of the booster power block, located on the R.H. side of the engine compartment (refer to fig. 4).
2. Connect one end of the remaining negative jumper cable (black) to the negative (-) terminal of the booster power source, and the other end of the black jumper cable to the negative (-) post of the booster power block.
3. Make sure the clips from one cable do not inadvertently touch the clips on the other cable. Do not lean over the battery when making connections. The ground connection must provide good electrical conductivity and current carrying capacity.
4. Start the engine in the vehicle that is providing the jump start. Let the engine run for a few minutes, then start the engine in the vehicle that has the discharged batteries.
5. When removing the jumper cables, perform the above procedure exactly in reverse order, and replace protective caps on booster block terminals.

WARNING

Any procedure other than the above could result in personal injury, property damage due to battery explosion, or damage to the charging system of the booster vehicle or of the boosted vehicle.

NOTE

Jumper cables must withstand 500 cranking amperes. If cable length is 20 feet (6m) or less, use 2/0 (AWG) gauge wires. If cable length is between 20-30 feet (6-9m), use 3/0 (AWG) wires.

3.7 CLEANING AND INSPECTION

The external condition of the battery and the battery cables should be checked periodically. The top of the battery should be kept clean and the battery hold-down clamp bolts should be kept properly tightened. For best results when cleaning the battery, wash first with a diluted solution of ammonia or soda to neutralize any acid present then wash out with clean water. The battery hold-down bolts should be kept tight enough to prevent the batteries from moving, but they should not be tightened to the point that excessive strain is placed on the battery hold-down cover (proper tightening torque: 45-55 lbf-in (5-6 Nm).

To insure good contact, the battery cable ring terminals should be tight on the battery posts. If the posts or cable ring terminals are corroded, the cables should be disconnected and the posts and clamps cleaned separately with a soda solution and a wire brush. Install cable ring terminals on battery posts and tighten to a torque of 10-15 lbf-ft (13-20 Nm). Replace protective caps to prevent corrosion and sparks.

3.8 COMMON CAUSES OF BATTERY FAILURE

When a battery fails, the cause of failure may be related to something other than the battery. For this reason, when a battery failure occurs, do not be satisfied with merely recharging or replacing the battery. Locate and correct the cause of the failure to prevent recurrence. Some common external causes of battery failure are as follows:

1. A defect in charging system such as high resistance or a faulty alternator or regulator.
2. A malfunction within the 12 volts system (equalizer).
3. Overloads caused by a defective starter or excessive use of accessories.
4. Dirt and electrolyte on top of the batteries causing a constant drain.
5. Hardened battery plates, due to battery being in a low state of charge over a long period of time.
6. Shorted cells, loss of active material from plates.
7. Driving conditions or requirements under which the vehicle is driven for short periods of time.

8. A constant drain caused by a shorted circuit such as an exposed wire or water infiltration in junction boxes causing ground fault.
9. Extended operation of preheating system with engine not running.
10. Failing to close disconnect switches during the night.

3.9 TROUBLESHOOTING

If a battery is known to be good and then has not performed satisfactorily in service for no apparent reason, the following factors may reveal the cause of trouble:

1. Vehicle accessories and disconnect switches inadvertently left on overnight.
2. Defects in the charging system, such as high wiring resistance, faulty alternator, regulator or battery equalizer.
3. A vehicle electrical load exceeding the alternator (or battery equalizer) capacity, with the addition of electrical devices, such as CB radio equipment, a cellular phone or additional lighting systems.
4. Defects in the electrical system, such as shorted or pinched wires.
5. Extended driving at a slow speed while using many accessories.
6. Loose or poor battery cable-to-post connections, previous improper charging of a run-down battery, or loose hold-down clamp bolts.
7. High-resistance connections or defects in the cranking system.

3.10 "BAT" BATTERY VOLTAGE INCORRECT TELLTALE LIGHT

If the "BAT" (battery voltage incorrect) telltale light is illuminated, check the 24-volt voltmeter to determine if the battery voltage is too high or too low.

NOTE
According to the battery charging condition, it is normal that "BAT" telltale light illuminates upon starting the engine and stays illuminated for a few seconds. This is caused by the normal voltage drop of the battery during starting.

3.10.1 "Bat" Telltale Light Definitions

Voltmeter drops below 24.4 volts dc

Check alternator output.

Check voltage regulator.

Check battery connections.

Check battery cells.

- Check battery equalizer connections.

Voltmeter exceeds 30 volts dc

- Check alternator output.
- Check voltage regulator.
- Check battery connections.

Battery Balance

NOTE
Allow at least 15 minutes to balance batteries after any corrective measure has been taken.

1. Batteries out of balance (difference greater than 1.5 volts between the two battery banks).

- Check battery equalizer connections.
- Check equalizer cables for proper gauge.
- Check battery connections.

2. Demand for 12-volt power exceeding rated amperage output of battery equalizers causing batteries to go out of balance.

- Reduce 12-volt load or install additional battery equalizer(s).

4. TROUBLESHOOTING AND TESTING THE MULTIPLEX VEHICLES

4.1 ELECTRICAL SYSTEM DIAGNOSTIC

Using the message center display (MCD), check if there are active errors in the vehicle electrical system. With the SYSTEM DIAGNOSTIC menu, highlight FAULT DIAGNOSTIC and then highlight ELECTRICAL SYSTEM to request a diagnostic of the electrical system from the CECM. Press the enter key. If applicable, the MCD shows the multiplex device ID, the fault messages or fault codes recorded. When more than one fault is recorded, an arrow pointing down appears on the right of the display. Use the down arrow to see all the fault messages.

Once the problem corrected, the MCD still shows the fault as being active. You have to leave the FAULT DIAGNOSTIC menu, wait approximately 20 to 30 seconds and then return to FAULT DIAGNOSTIC to request a new diagnostic of the ELECTRICAL SYSTEM from the CECM. The MCD should display the fault as being inactive. The CECM can store up to 20 faults, i.e. the first 10 and the last 10. Middle faults will be erased. If the breakers are tripped, the fault history will be erased from the CECM memory.

NOTE
It is of the utmost importance to have a MCD (message center display) in working condition because it is the most important tool to achieve troubleshooting on a multiplex vehicle.

4.2 PROBING VOLTAGE ON THE MULTIPLEX CIRCUITS

Some Multiplex modules are supplied by 12 volts while others are supplied by 24 volts. The 12-volt or 24-volt information is found on the modules symbol in the wiring diagram. Before taking voltage readings to track the source of a problem, first verify if the module is supplied by 12V or 24V, if not, residual voltage on the module inputs/outputs can draw an erroneous conclusion.

Inactive Multiplex output = Residual voltage of 18% to 33% of supply voltage.

Inactive Multiplex input = Residual voltage of 50% of supply voltage.

NOTE
o *Verify on the wiring diagram whether the voltage is 12V or 24V,* o *For a 12V module: an active voltage would be 12V or 0V but not in between. If you measure the intermediate tensions (ex. 6V, 2V, or 4V) this must be interpreted as if the input or the output is inactive.* o *For a 24V module: an active voltage would be 24V or 0V but not in between. If you measure the intermediate tensions (ex. 12V, 4V, or 8V) this must be interpreted as if the input or the output is inactive.*

4.3 CAN NETWORK

The CAN network wiring is separated in sections and uses connectors that are not shared with other circuits. This allows sections of the network to be isolated to help locate short-circuit on the CAN.

In case of a short-circuit on the CAN network, this affects all the modules and they all act as “No response” in the error messages of the “ELECTRICAL SYSTEM” menu. To locate a short-circuit, proceed by disconnecting one module zone at a time while verifying if this makes inactive the errors in the modules still connected. Connector C1 (front electrical & service compartment) disconnects all the modules at the rear of the vehicle from the network. Connector C5 (front electrical & service compartment) disconnects all the modules from the entrance door & wiper control panel. Connector C3 (rear electrical compartment) disconnects all the modules at the rear of the vehicle from the network.

Example: Disconnect C5 and C1 and then verify the status of the errors. If the front modules (A41 to A46) now give inactive errors, which means short-circuit is elsewhere than in the front electrical & service compartment.

4.3.1 Can Connection On The Telltale Panel And The Hvac Control Unit

The telltale panel module and HVAC module are linked to the CECM by a CAN connection. In case of a CAN connection default, the telltale panel LCD display shows "CAN", and on the HVAC control unit, the temperature display indicates "---". To confirm a CAN connection default, check that the fan speed on the driver's section HVAC control unit cannot be adjusted.

Moreover, specific error messages from these 2 modules can be read in the ELECTRICAL SYSTEM menu.

NOTE
While downloading a new vehicle program in the CECM from a computer, the CAN network is temporarily interrupted and therefore a CAN reference appears in the telltale panel LCD display.

4.3.2 Spare Can

A spare CAN network is installed between the front and the rear of the vehicle. It has connectors installed at each end to facilitate swapping from the regular CAN network to the spare CAN network. Refer to the vehicle wiring diagram and the section 4.6 for more information.

4.4 TEST MODE FOR SWITCHES AND SENSORS

The switch/sensor test mode provides useful information to diagnose problems complimentary to the electrical system diagnosis.

To enter this mode, activate the dashboard "Telltale Light Test" switch 3 times within 4 seconds. To exit the switch/sensor test mode, reactivate the test switch 1 time or turn OFF the ignition.

4.4.1 Information Available And Impact On The Functions In Switch/Sensor Test Mode

Telltale panel audible alarm emits a *beep* each time an OFF/ON transition is detected on a multiplex input. This allows quick verifying if the switches and sensors are detected or seen by the multiplex modules. When the vehicle is parked, the back-up alarm also emits a sound that allows verification of the sensors at the rear of the vehicle.

Certain inputs are doubled (ex. turn signal switch on multi-function lever, door operating buttons) and also other inputs activate at the same time (ex. kneeling switch and Kneeling proximity sensor switch). For these inputs, 2 *beeps* are emitted. If only one *beep* is heard, one of the inputs is defective.

SWITCHES AND SENSORS SUPPORTED BY THE SWITCH/SENSOR TEST MODE
HVAC control unit driver's section ON/OFF
A/C door ajar open sensor
HVAC control unit driver recirculate switch
HVAC overhead compartment fan switch
HVAC control unit passenger's section ON/OFF
Engine ether start switch
Radiator fan clutch switch
Engine front start enable switch
Engine rear start enable switch
Engine ignition front switch
Engine ignition rear switch
Entrance door inside closing switch
Entrance door outside opening /closing switch
Entrance door electric window down switch
Entrance door electric window up switch
Electric horn button
Kneeling down switch
Kneeling up switch
Lavatory emergency switch
Interior lighting switch, 2 positions
Driver's area lighting switch
Reading lights switch
Multi-function lever LH turn signal
Multi-function lever RH turn signal
Fog lights switch
Hazard warning flashers switch
Multi-function lever courtesy blinkers switch
Headlights switch, 2 positions
Multi-function lever headlights beam toggle switch
Baggage compartment door lock/unlock switch
Tag axle signal
Wheelchair lift activation switch
Windshield lower wiper
Multi-function lever windshield wipers intermit.
Multi-function lever windshield wipers speed 1,2
Windshield wipers backup switch
Windshield washer switch

The following inputs, either certain options or sensors which are difficult to activate, are not supported by the switch/sensor test:

- Low-Buoy switch,
- Starter Sensor,
- ABS Warning input,
- WCL switch,
- Driver's Power Window Switch (up & down),
- Fog Lights Switch,
- Alternator Sensors 1 & 2,
- Retarder Active Signal,
- Radiator fan speed 1 & 2 signals.

When in switch/sensor test mode, the A/C compressor HI and LO pressure values are displayed one after the other instead of the outside temperature in the telltale panel LCD display. This feature can be used when the vehicle is traveling to check the A/C compressor pressure values, but no *beep* can be heard.

In test mode, with the parking brake applied and the passenger set point set to a value higher than 64°F (18°C), the circulator pump is not set to OFF as it would normally do when the outside temperature gets above 50°F (10°C). This feature allows verification of the pump when inside a garage. This is also useful when working on the heating system to remove air pockets trapped in the system.

When performing an A/C cooling test and having the water pump shut off in switch/sensor test mode is required, just set the passenger set point temperature to the minimum 64°F (18°C) to shut off the pump.

4.5 TEST MODE FOR ELECTRIC MOTORS

The test mode allows testing the motors and electric contactors without the need to have the engine running. Note that while in test mode, the engine cannot be started.

Prerequisite conditions for the motor test mode:

A. The battery charger must be connected to a 110-120 volt power supply. If not, the test will be interrupted when the voltage drops below 24.4 volts,

B. Engine not running,

C. Parking brake applied,

⚠ WARNING ⚠
Before starting the test sequence, make sure nobody is working in the evaporator or condenser compartment.

NOTE
A delay of 15 seconds during which the back-up alarm will sound is introduced prior the test start to advise people that may be working on the vehicle.

To enter this mode:

- Activate the dashboard Telltale Light Test switch 3 times within 4 seconds;
- Push the ON/OFF button on the driver's side HVAC control unit 5 times (that makes 3 transitions from OFF to ON),
- A *beep* can be heard indicating the motor test mode has started.

Using the test mode:

- During the entire test, the telltale panel audible alarm gives a signal each second to remind that the motor test mode is underway.

4.5.1 Test Sequence

Go to the condenser compartment.

- The condenser fans runs for 3 seconds at speed 1.
- 1 second delay.
- Speed 2 activates for 3 seconds.
- 3 seconds delay.
- Passenger's unit refrigerant solenoid valve activates 3 times at 1 second interval.

Then 5 *beeps* can be heard from the back-up alarm to indicate to go to the engine compartment (15 SECONDS DELAY).

In the engine compartment, the sequence is as follows:

- Toilet fan motor runs for 3 seconds.
- 1 second delay.
- A/C compressor clutch activates 3 times at 1 second interval.
- 1 second delay.
- Left compressor unloader activates 3 times at 1 second interval.
- 1 second delay.
- Right compressor unloader activates 3 times at 1 second interval.

5 *beeps* from the back-up alarm indicate to go to the engine radiator fan (5 SECONDS DELAY).

- Fan clutch is disengaged for 3 seconds (fan can be turned freely by hand).
- Fan clutch engages for 3 seconds in speed 1 (fan can be turned by hand but with a certain resistance).
- 3 seconds delay.
- Fan clutch engages for 3 seconds in speed 2 (cannot be turned but hand).
- 10 seconds delay.
- Auxiliary A/C clutch (parcel rack cooling system) activates 3 times at 1 second interval.

5 *beeps* from the back-up alarm indicate to go to the evaporator compartment (10 SECONDS DELAY).

In the evaporator compartment:

- Evaporator fan motor runs at speed 1 for 3 seconds then runs at speed 2 for 3 seconds.
- Hot water pump starts running for 5 seconds and hot water pneumatic valve activates 3 times at 1 second interval.

5 *beeps* from the back-up alarm indicate to go to the spare wheel compartment (20 SECONDS DELAY).

Inside the compartment:

- Driver's refrigerant solenoid valve activates 3 times at 1 second interval.
- 1 second delay.
- Driver's water solenoid valve activates 3 times at 1 second interval.

5 *beeps* from the back-up alarm indicate to go to inside the vehicle (10 SECONDS DELAY).

Inside the vehicle:

- Upper section defroster fan motor runs for 5 seconds.
- 10 seconds delay.
- Left and right overhead compartment fans start running one after the other for 5 seconds.
- 1 second delay.
- Overhead storage compartment refrigerant solenoid valve activates 3 times at 1 second interval.

This ends the test. Activate the dashboard Telltale Light Test switch one time to leave the motor test mode.

4.6 CAN NETWORK LAYOUT AND TROUBLESHOOTING

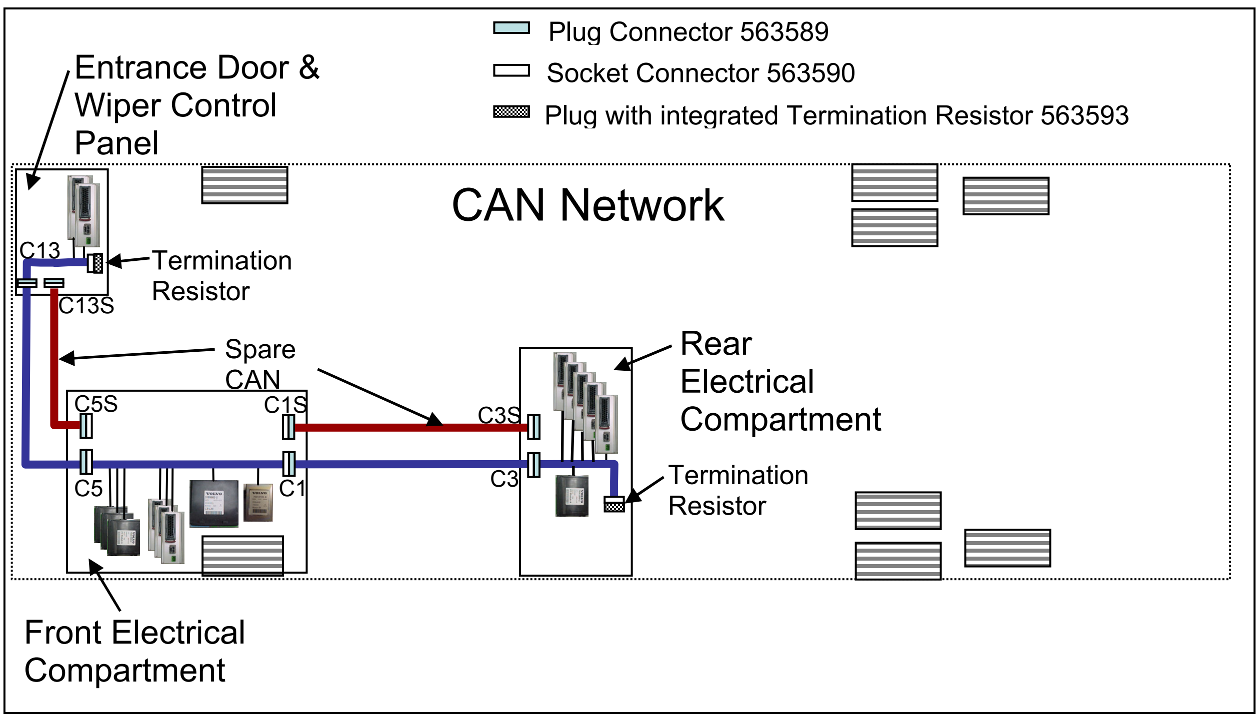


FIGURE 16: X3-45 COACHES CAN NETWORK LAYOUT 06637

4.7 TROUBLESHOOTING

Problem/Symptom	Probable Causes	Actions
Vehicle does not Start	Rear Start selector switch is not in the NORMAL position Master cut-out switch in the rear electrical compartment is in the OFF position (down)	1. Check that the rear start selector switch is flipped up to NORMAL start position and master cut-out switch is flipped up to ON and retry cranking 2. Flip the rear start selector switch to “Rear Start” and start the vehicle from the rear
	CAN network problem (Multiplex) Module A53 not powered or is defective Engine ECM does not receive the ignition signal Engine ECM is not powered	If the vehicle does not start from the rear: 1. Verify that module A53 is powered: a) Check the SYSTEM DIAGNOSTIC menu of the message center display (MCD). Select FAULT DIAGNOSTIC and ELECTRICAL SYSTEM. The message “No Response ModA53, Active”, indicates a power problem on the module or a CAN network problem. b) Check / reset circuit breaker CB5 c) Check / replace fuse F65 d) Probe gray connector on module to see if it is powered. 2. Verify that the engine ECM is powered and get the ignition signal a) Check / reset circuit breaker CB8 Check / replace fuse F74 b) Check / reset circuit breaker CB2 Check / replace fuse F78
None of the Multiplexed functions are operating, including the basic limp-home functions (door opening, flashers, wipers in speed 1) Three dashes “---“ appear in the telltale panel instead of the outside temperature *Note: The sunshades are still functioning since these are not multiplexed*	The program version in the CECM is different than the program in the I/O modules and the CECM is forcing all I/O modules to stay inactive	1. Engage the auto-programming of the I/O modules: Turn the ignition key to the OFF position, flip the master cut-out switch in the rear electrical compartment to OFF and ON and then turn the ignition key ON. The letters CAN will appear in the telltale LCD panel for about 3 minutes Everything shall get back to normal once the letters CAN are replaced with outside temperature display 2. Try disconnecting the green connector on the CECM and reconnect 3. If step 1 and 2 are ineffective, try disconnecting the Master ID module completely and repeat step 1

Problem/Symptom	Probable Causes	Actions
		4. Try disconnecting the CECM completely, leave it disconnected and see if the limp-home functions (start of the vehicle from the engine compartment, wipers speed 1, flashers, etc) are functioning
Many secondary functions (not essential for driving) not functioning (interior lighting, driver's area lighting, wiper speed 2 and intermittent). Outside temperature display in the telltale LCD panel displays three dashes "---" Marker lights and clearance lights are turned ON when setting ignition to the ON position.	The CECM module does not receive 24 V power. The CAN network is not working. It could be caused by a short on the network, an open circuit, a problem with the CECM or the CECM being disconnected from the network.	1. Check / reset circuit breaker CB6 (3rd from the bottom on the right side column) Check / replace fuse F1 2. Operate in limp-home mode by starting the vehicle from the engine compartment (REAR START). All functions essential to drive are available To close and lock the door, pull the door manually up to its closed position and it will lock by itself. The door opening button is still functioning
No temperature control in the passenger area Passenger temperature display indicates two dashes "--"	Problem with the temperature sensor located in the evaporator compartment air intake or the sensor wiring	Instruct the driver to manually control the temperature by playing with the passenger set point. Set above 22°C (72°F) to heat and below 22° C (72°F) to cool
Entrance door does not open nor close using the control buttons Defroster fan not functioning Windshield wipers not functioning in speed 1 or intermittent	Module A47 is not powered or is faulty	1. Check the SYSTEM DIAGNOSTIC menu of the message center display (MCD). Select FAULT DIAGNOSTIC and ELECTRICAL SYSTEM. The message “No Response ModA47, Active” indicates a power problem on the module. (A CAN network problem would show the same message but doesn't produce these symptoms). 2. Check / reset circuit breaker CB6 3. Check / replace fuse F5 4. Probe gray connector on module to see if it is powered. 5. Use the air release valves near the entrance door and in the front service compartment to lock / unlock the door
Windshield wipers not functioning in speed 1 or intermittent	No power on R23	Check / replace fuse F82

Problem/Symptom	Probable Causes	Actions
HVAC condenser fans not functioning in speed 1	Circuit breaker CB7 was manually tripped and not reset	Check / reset circuit breaker CB7
HVAC condenser fans not functioning in speed 2	Circuit breaker CB7 was manually tripped and not reset	Check / reset circuit breaker CB7
Windshield washer not functioning Windshield upper section de-icing system not functioning Defroster fan is functioning but no heat or cooling available in the driver area.	Module A46 is not powered or is faulty	1. Check the SYSTEM DIAGNOSTIC menu of the message center display (MCD). Select FAULT DIAGNOSTIC and ELECTRICAL SYSTEM. The message “No Response ModA46, Active” indicates a power problem on the module. (A CAN network problem would show the same message but doesn't produce these symptoms). 2. Check / reset circuit breaker CB1 3. Check / replace fuse F12 or F13 4. Probe gray connector on module to see if it is powered.
Low beam headlights and front flasher on left side not functioning Electric horn not functioning	Module A45 is not powered or is faulty	1. Check the SYSTEM DIAGNOSTIC menu of the message center display (MCD). Select FAULT DIAGNOSTIC and ELECTRICAL SYSTEM. The message “No Response ModA45, Active” indicates a power problem on the module. (A CAN network problem would show the same message but doesn't produce these symptoms). 2. Check / reset circuit breaker CB2 3. Check / replace fuse F33 and F34 4. Probe gray connector on module to see if it is powered.
Low beam headlights and flasher on right side not functioning	Module A48 is not powered or is faulty	1. Check the SYSTEM DIAGNOSTIC menu of the message center display (MCD). Select FAULT DIAGNOSTIC and ELECTRICAL SYSTEM. The message “No Response ModA48, Active” indicates a power problem on the module. (A CAN network problem would show the same message but doesn't produce these symptoms). 2. Check / reset circuit breaker CB2 3. Check / replace fuse F33 and F34 4. Probe gray connector on module to see if it is powered.

Problem/Symptom	Probable Causes	Actions
Rear flashers not functioning Stoplights and center stoplights not functioning	Module A51 is not powered or is faulty	1. Check the SYSTEM DIAGNOSTIC menu of the message center display (MCD). Select FAULT DIAGNOSTIC and ELECTRICAL SYSTEM. The message "No Response ModA51, Active" indicates a power problem on the module. (A CAN network problem would show the same message but doesn't produce this symptom). 2. Check / reset circuit breaker CB2 3. Check / replace fuse F80 4. Probe gray connector on module to see if it is powered.
Engine is overheating and radiator fan clutch does not engage The A/C compressor clutch does not engage	Module A52 is not powered or is faulty	1. Check the SYSTEM DIAGNOSTIC menu of the message center display (MCD). Select FAULT DIAGNOSTIC and ELECTRICAL SYSTEM. The message "No Response ModA52, Active" indicates a power problem on the module. (A CAN network problem would show the same message but doesn't produce this symptom). 2. Check / reset circuit breaker CB5 3. Check / replace fuse F65 4. Probe gray connector on module to see if it is powered.
Evaporator fan not functioning	Circuit breaker CB3 tripped Module A54 is not powered or is faulty	1. Check / reset circuit breaker CB3 2. Check the SYSTEM DIAGNOSTIC menu of the message center display (MCD). Select FAULT DIAGNOSTIC and ELECTRICAL SYSTEM. The message "No Response ModA54, Active" indicates a power problem on the module. (A CAN network problem would show the same message but doesn't produce this symptom). 3. Check / reset circuit breaker CB5 4. Check / replace fuse F67 , F68 5. Probe gray connector on module to see if it is powered.
HVAC condenser fans not functioning in speed 1	Module A54 is not powered or is faulty	1. Check the SYSTEM DIAGNOSTIC menu of the message center display (MCD). Select FAULT DIAGNOSTIC and ELECTRICAL SYSTEM. The message "No Response ModA54,

Problem/Symptom	Probable Causes	Actions
		Active" indicates a power problem on the module. (A CAN network problem would show the same message but doesn't produce this symptom). 2. Check / reset circuit breaker CB5 3. Check / replace fuse F67 , F68 4. Probe gray connector on module to see if it is powered.
Sound system not functioning	Circuit breaker CB4 or CB11 was manually tripped and not reset	Check / reset circuit breaker CB4 or CB11
Fire alarm telltale light and audible alarm always ON and there is no fire or high temperature in the engine compartment	Short-circuited fire sensor or defective sensor	Prior to start the vehicle, cycle the ignition key to the ON position, OFF position and then ON position again and then start the vehicle. This will deactivate the fire alarm function. This has to be repeated each time the vehicle is re-started
The vehicle is parked and the electrical horn is acti-vated to indicate a fire in the engine compartment but there is no fire	Short-circuited fire sensor or defective sensor	Cycle the ignition key between the ON and OFF position twice within 3 seconds. This will deactivate the fire alarm function. This has to be repeated each time the vehicle is parked
A single light, a group of LED lights or another function of the vehicle is not functioning	The multiplex outputs are protected in current by an internal "soft-fuse". When an output is shorted, it turns OFF and stays OFF until the "soft-fuse" is reset	Turn the ignition key to the OFF position and turn to the ON position again. This resets all "soft –fuses"
No backlighting in the instrument cluster	Circuit breaker CB10 is tripped or fuse F20 blown	Check / reset circuit breaker CB10 Check / replace fuse F20
The radiator fan clutch does not function and the engine is overheating		1. Set the ignition key to the ON position. 2. Activate the dashboard Telltale Light Test switch 3 times within 4 seconds. 3. In the engine compartment, set the starter selector switch to REAR START and then start the engine from the rear. While in this mode, the rear start push-button can be used to manually engage the fan clutch. The Multiplex system knows when the engine is already running, and it will not activate the starter.

Problem/Symptom	Probable Causes	Actions
		4. Press the push-button one time to engage the clutch in 1st speed, press a second time to engage in 2nd speed, press a third time to stop the fan, press once again to return to 1st speed. If the fan clutch does not engage using this procedure then the clutch is faulty or the wiring between the multiplex module and the clutch is faulty. Mechanically lock the fan clutch as described in section 05: COOLING SYSTEM of the maintenance manual.

4.8 ESSENTIAL FUNCTIONS TO OPERATE THE VEHICLE

Even with a defective CECM (Chassis Electronic Control Module) or a CAN network problem, essential base functions are maintained to rear start the vehicle from the engine compartment and drive in a secure manner.

However, many secondary functions are lost. In this case, the following directives must be followed.

- Never connect a battery charger when the ignition is at the ON position on a vehicle with a CAN defective or certain functions will start up by themselves,
- Disconnect the charger before starting the vehicle, if not the default functions will not activate,
- If the default mode does not activate, try to turn the ignition OFF while ensuring that no charger is connected and then restart the vehicle.

4.8.1 Available Functions

- Startup: Turn on the ignition in the driver's area and rear start the vehicle from the engine compartment,
- Opening the door: Functions normally,
- Closing the door: Manually pull on the door and it will lock automatically,
- Windshield wipers: Wipers functions at 1st speed only,
- Headlights: Low beams only,
- Directional signals: Rear and front only,
- Stoplights: 2 upper stoplights + high-mounted stoplight are functional,
- HVAC: Functional with set point fixed at 70°F (22°C), evaporator and condenser fixed at speed 1, defroster fixed at speed 4.

4.9 LOWER PRIORITY MODULES FOR BREAKDOWN SERVICE

Modules A43 (IO-A) and A44 (IO-B) affect lower priority functions. These modules can therefore be used as spare parts for breakdown service while on the road.

Functions lost if A43 is removed and used as spare part:

- High beams,
- Ability to turn on the parking lights only,
- « Watch your step » sign,
- Driver's area lighting,
- Tag axle activation,
- Courtesy lights.

Functions lost if A44 is removed and used as spare part:

- Fresh air damper mix trap control,
- Driver's area and entrance overhead light,
- Front clearance lights.

4.10 MULTIPLEX MODULES

4.10.1 CECM

The CECM plays the role of interface between the engine ECM, the transmission ECU, the telltale panel module and other IO-A, IO-B modules. When a multiplex module is being replaced, the CECM will inform the new module of its role and function accordingly to the vehicle options.

4.10.2 MASTER ID

The Master ID works in conjunction with the CECM. It keeps the specific back-up program of the vehicle. So, a specific Master ID cannot be removed from a vehicle and installed on another vehicle.

4.10.3 IO-A

IO-A modules receive inputs and control outputs. IO-A's are used for all outputs of 1 amp or less.

4.10.4 IO-B

IO-B modules receive inputs and control outputs. IO-B's are used for outputs up to 30 amps.

4.11 MULTIPLEX MODULES REPLACEMENT

IO-A, IO-B and CECM multiplex modules can be replaced and reprogrammed without having to connect a computer to the vehicle.

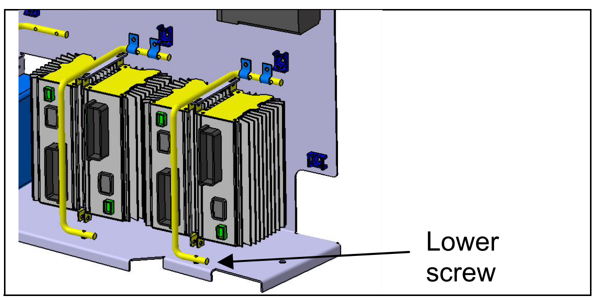


FIGURE 17: IO-B MODULE REMOVAL 06638

4.11.1 Replacing IO-A Or IO-B Modules

- Set the ignition key to the ON position and leave it in that position at all time while performing this procedure.
- Inside rear electrical compartment, trip circuit breaker CB6.
- Replace the module (for IO-B modules, disconnect the green connector first, then the grey one and finish with the black connector.

  To disconnect the black connector, slide downwards the red latch. Remove the lower screw that holds the cable attachment rod onto the floor portion of the panel and flip the rod up, this will relieve the IO-B module, (see Fig. 17).
- Reset circuit breaker CB6. This engages the automatic reprogramming.
- The telltale panel LCD display indicates "CAN" until the reprogramming is complete. Once completed, "CAN" disappears and the temperature reappears.
- Check the SYSTEM DIAGNOSTIC menu of the message center display (MCD). Select FAULT DIAGNOSTIC and ELECTRICAL SYSTEM. Verify the fault message to be certain the module is reprogrammed. If the module is not reprogrammed, the message « Axx Not Responding » appears where Axx is the module number (Ex: A41, A42…etc).

4.11.2 Replacing The CECM Module

- Set the ignition key to the ON position and leave it in that position at all time while performing this procedure.
- Inside rear electrical compartment, trip circuit breaker CB6.
- Replace the module.
- Reset circuit breaker CB6. This engages the program transfer from the Master ID to the CECM module (the back-up program is inside the Master ID. The Master ID will identify the CECM as being new and will send the correct program to it). The telltale panel LCD display indicates "CAN" during 3 minutes approximately. "CAN" disappears and "---" is displayed alternately with "CAN" (during that sequence, "---" will be displayed up to 6 times and the audible alarm will ring). Wait until "CAN" is replaced by "---" that remains for more than 10 seconds. At this point the MasterID module has finished loading the program in the CECM.
- Go to the rear electrical compartment and trip circuit breaker CB6 once again. Wait 1 second and reset it. This engages I/O's modules automatic reprogramming.
- The telltale panel LCD display indicates "CAN" until the reprogramming is completed. Once completed, "CAN" disappears and the temperature reappears. Check the SYSTEM

DIAGNOSTIC menu of the message center display (MCD). Select FAULT DIAGNOSTIC and ELECTRICAL SYSTEM. Check the error messages. All modules appear in error but are not active. If an active error appears for a module, this one was not reprogrammed. In this case, trip CB6 once again. Wait 1 second and reset CB6. Re-verify the error messages when "CAN" disappears from the telltale panel LCD display.

- Do an error reset to remove all errors (requires Password) from non-active modules, leave the SYSTEM DIAGNOSTIC menu and reopen to verify there are no more errors.

5. BOSCH ALTERNATOR

Two 24 volt 140A, self regulated, belt driven, air-cooled BOSCH alternators are used in the 24 volt electrical system.

Change the brushes and voltage regulator as per “Repair and Testing Instructions for T1 Alternator 0120 69 552” every 100,000 miles (160 000 fm) or once every two years, whichever comes first.

Replace bearings as per “Repair and Testing Instructions for T1 Alternator 0120 69 552” every 200,000 miles (320 000 fm) or once every four years, whichever comes first.

NOTE
Use Polyrex EM grease (684922) when repacking the bearings. Grease comes in 14.1 oz (400gr) cartridges.

Refer to Bosh T1 Alternator Maintenance Manual Annexed at the end of this section.

5.1 TWIN BOSCH ALTERNATORS INSTALLATION

If the alternators needed to be removed, reinstall as follows. Refer to figure 18 for installation and to figure 19 for tightening specifications:

1. Install alternator mounting bracket (1, figure 18) to the gear case. Use the four flanged phosphor alloy bolts on the pulley end of the bracket and the flanged nuts at the transmission end of the bracket;
2. Bolt the alternators to the bracket using the three inch bolt at the top of the upper alternator (2, fig 18) and flanged bolts at the other mounting bosses (3 and 4, figure 18). Tighten the bolts in the sliding sleeves (4, figure 18) last as they will adjust to prevent breaking the alternator mounting bosses upon final tightening. Repeat for the second alternator;
3. On the drive shafts of both alternators, install key, pulley, spring washer and nut. Tighten to 220 Lbf-ft (300 Nm);

NOTE
Final tightening of the pulleys can be performed once the belt is installed. This will help keep the pulley from turning when tightening.

4. Install the snubber bracket (5, fig. 18) using three flanged bolts. Do not tighten the adjustment bolts on the snubber until after final tightening;
5. Install the compressor belt idler pulley (6, fig. 18) as shown. A stud inserts into one of the mounting holes of the pulley assembly. Fasten this one using a nut and bolts for the other two.

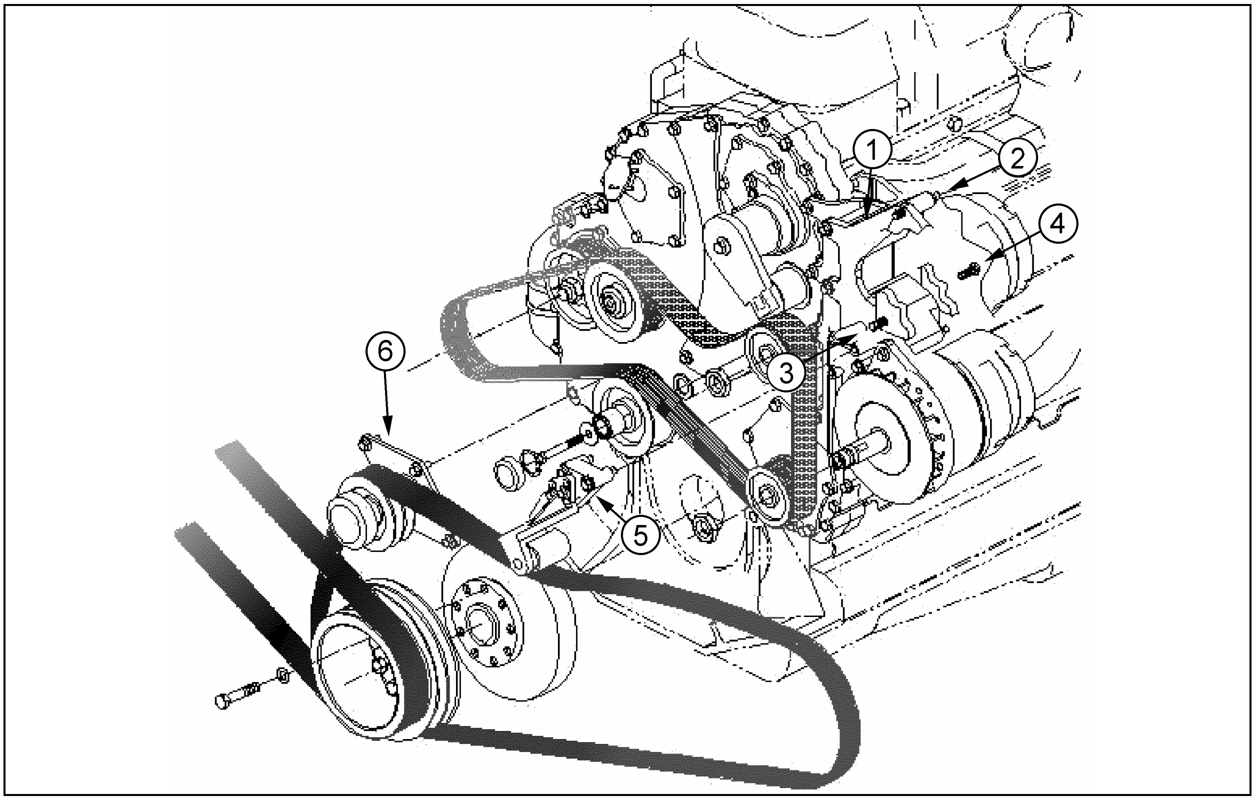


FIGURE 18: TWIN BOSCH ALTERNATORS INSTALLATION 01077

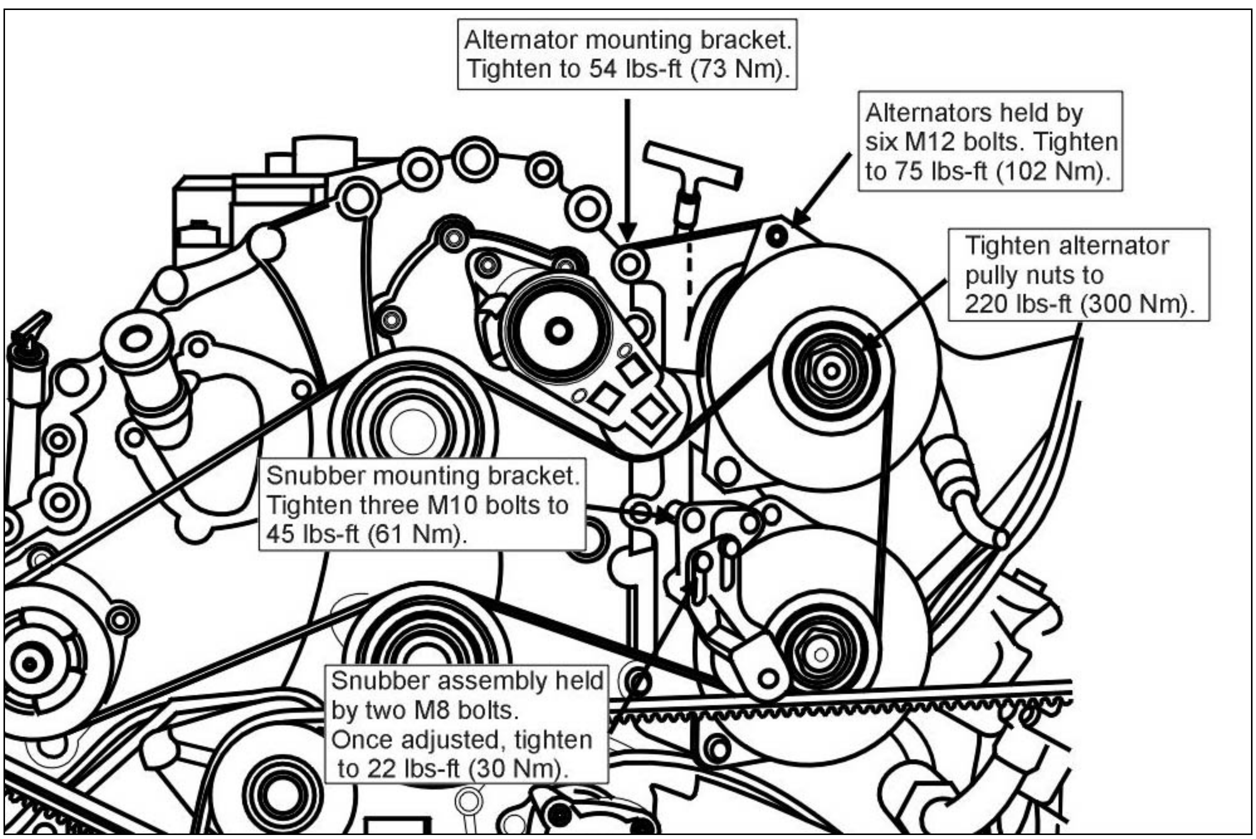


FIGURE 19: ALTERNATORS AND ACCESSORIES MOUNTING TORQUES 01094

5.2 ALTERNATOR DRIVE BELT

Removal

1. Insert a ¾'' socket drive into the tensioning arm opening (Fig. 20).
2. Twist the tensioning arm to slacken belt.
3. Remove belt.

Installation

Installation of the alternator drive belt is the reverse of removal.

5.2.1 Adjustment

Correct belt tension is required to maximize belt life. The tensioning arm maintains proper belt tension, no adjustment is required.

Check for wear and proper tension every 6,250 miles (10 000 km) or twice a year, whichever comes first.

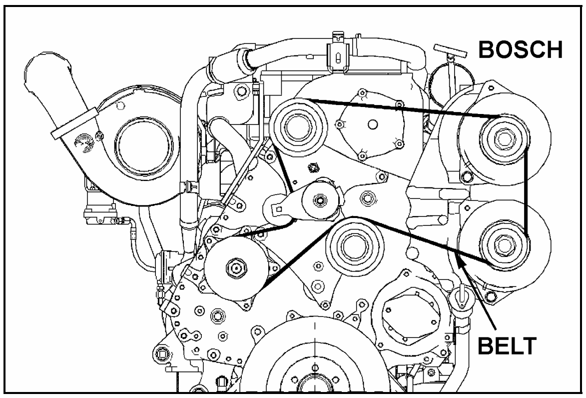


FIGURE 20: ALTERNATOR DRIVE BELT 06509

6. BATTERY EQUALIZER

VoltMaster Battery Equalizer Owner's Manual (100 amps) is annexed at the end of this section.

Refer to "Electrical Compartments" in this section, for location.

7. STARTER

Refer to Mitsubishi Electric Corporation (MELCO) Service bulletin ME003-P annexed at the end of this section for information and maintenance instruction on MELCO 105P70 starter.

⚠ CAUTION ⚠

Prior to the installation of the Mitsubishi starter, the Flywheel Ring Gear must be examined for excess wear or damage. Service Bulletin A1-M1N-1729EN included at the end of Section 06 shows acceptable levels of wear, and illustrates the proper measuring procedure. Maximum wear is 0.5mm. Ring Gears with more than 0.5mm of wear or damage must be replaced before installing the new starter to prevent engagement and/or disengagement problems. Failure to do so will render the Warranty null and void.

⚠ CAUTION ⚠

Do not engage starter for more than 15 seconds at a time. If engine does not start within 15 seconds, release ignition key and let starter cool for one minute before attempting to restart.

8. ENGINE BLOCK HEATER

The vehicle may be equipped with an engine immersion-type electric block heater to assist cold weather starting. The heater male electric plug is easily accessible through the engine compartment R.H. side door (Fig. 21). To use it, connect the female plug of an electrical extension cord to the heater plug. The extension cord must be plugged into a 110-120 V AC power source only. The engine block heater should be used whenever the vehicle is parked for an extended period of time in cold weather and a suitable power source is available.

8.1 MAINTENANCE

This heater is non-serviceable except for the cord, and if faulty, must be replaced as a unit.

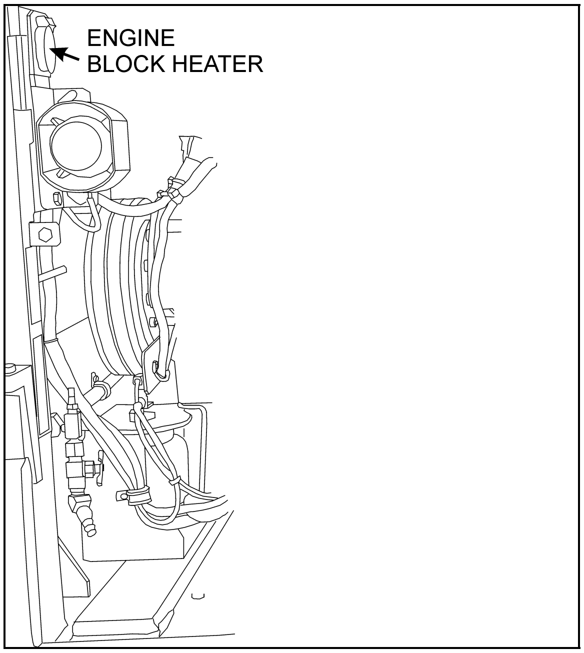


FIGURE 21: ELECTRIC HEATER PLUG LOCATION 06639

9. EXTERIOR LIGHTING

The circuit for exterior lights, as well as their control switches, relays and circuit breakers are shown on the applicable wiring diagrams. Wiring diagrams are located in the technical publication box.

9.1 HEADLIGHTS

Each headlight assembly consists of two headlamp module 90 mm (3½ inch) equipped with a 12-volt halogen bulb and one 100 mm (4 inch) 12-volt LED turn/signal lamp. Outer lamps have a double function (both low and high beam). Inner lamps are used for high beam or daytime running light. The inner or outer lamp uses the same single filament halogen bulb part number.

NOTE
If vehicle is equipped with optional Xenon headlamps, refer to paragraph 9.1.6.

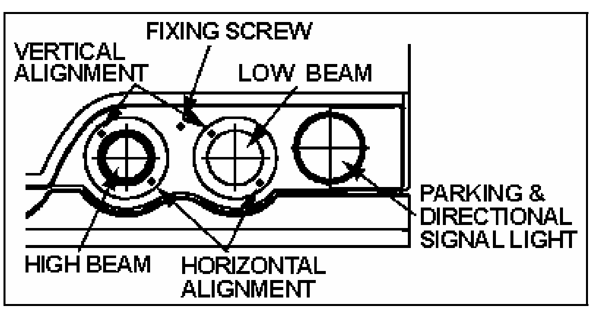


FIGURE 22: HEADLIGHT ASSEMBLY 06546

9.1.1 Headlight Beam Toggle Switch

The multifunction lever located on the steering column is used to select proper lighting. High beams or low beams can be selected by pulling the lever rearward. A high beam indicator on the central dashboard panel is illuminated when the high beam circuit is energized.

NOTE
Pulling the lever rearward while the lights are off will flash the headlights.

9.1.2 Maintenance

Clean headlights with soap and water and a good glass cleaner whenever dirty. For maximum illumination, headlight connections must be coated with a dielectric grease to prevent oxidation and proper voltage must be maintained. Low battery voltage, loose or dirty contacts in wiring system and poor ground contribute to a decrease in voltage. Check wiring and connections regularly and keep battery properly charged. When a headlight burns out, a new bulb must be installed. Headlights must be properly aimed to provide maximum allowable road illumination. When using mechanical aiming devices, follow manufacturer's instructions.

Headlight aim should be checked after installing a new bulb. Aiming can be performed without opening headlight assembly. Horizontal and vertical aiming of each module is provided by two adjusting screws that pivot the module in the housing for proper alignment (fig. 22). There is no adjustment for focus since the module is set for proper focus during manufacturing assembly.

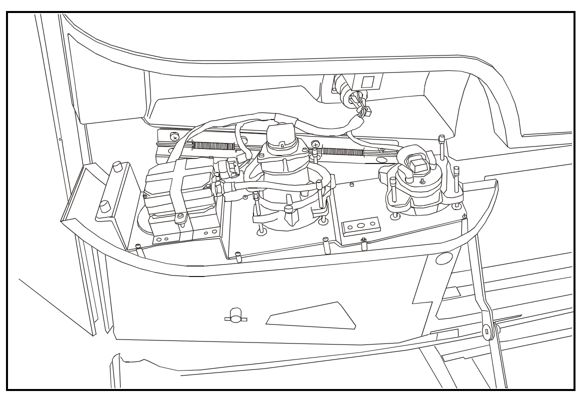


FIGURE 23: OPENING HEADLIGHT ASSEMBLY 06547

NOTE
Make sure headlight assembly is properly positioned into its housing before securing using fixing screw.

⚠ CAUTION ⚠

Use a soft cloth to clean the parking and front turn signal lamp.

9.1.3 Headlight Adjustment

The following is a general procedure for headlight adjustment using mechanical equipment, such as a *"Hoopy 100" Aligner.* If your mechanical equipment is different, refer to the manufacturer's instruction manual.

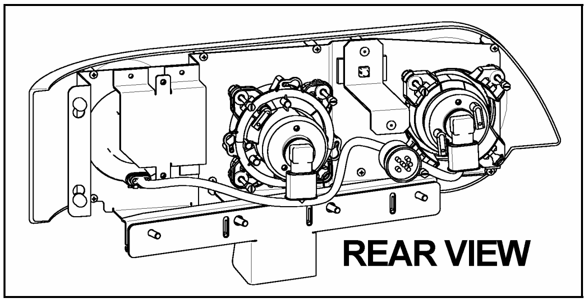


FIGURE 24: HEADLIGHT ASSEMBLY REAR VIEW 06548

Setting aligner according to slope

1. Park vehicle on a level floor.
2. Set the support rail (Prévost #29261) down (Fig. 25). Using shims, adjust its level to stabilize it.

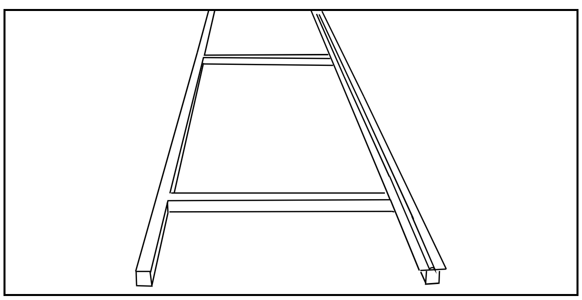


FIGURE 25: SUPPORT RAIL INSTALLATION 06501

3. Install jigs #29263 and #29262 onto the support rail. Position the support rail so that both stops are centered between the two beams (Fig. 26). Mark the position for future reference.
4. Remove the jigs.
5. Install *"Hoopy 100" Aligner* onto support rail (Fig. 27).
6. Using an Allen key on the front wheel, level Hoopy 100 aligner until spirit level bubble is centered (Fig. 28 and 29).

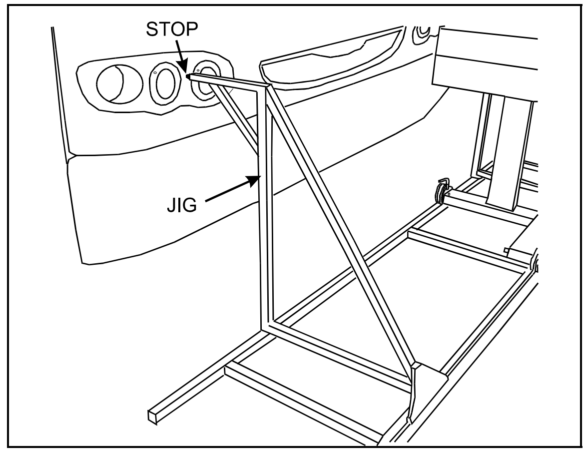


FIGURE 26: INSTALLATION OF JIGS 06499

NOTE

The stops will position the support rail between 16-24 inches of vehicle.

7. Install a calibration fixture in the axis of front axle wheel and one in the axis of rear axle wheel (Fig.30).
8. Adjust mirrors so that lines are perfectly aligned.
9. Record reading.

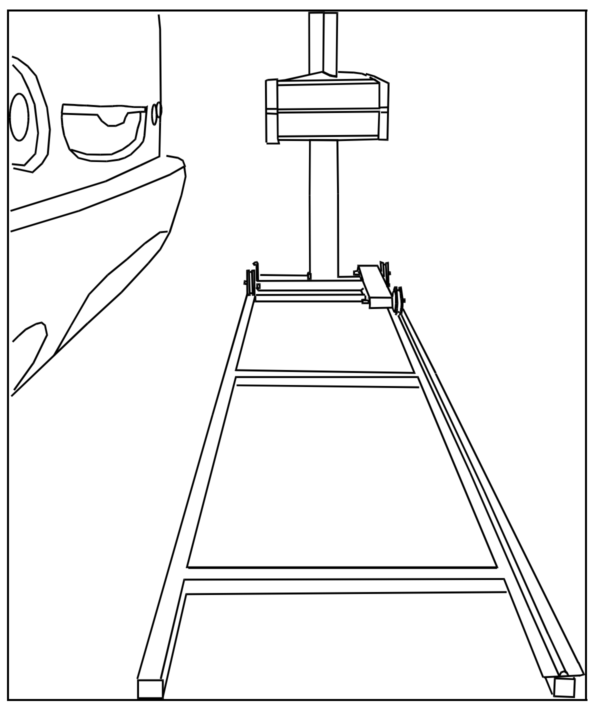


FIGURE 27: INSTALLATION OF HOOPY 100 ALIGNER 06496

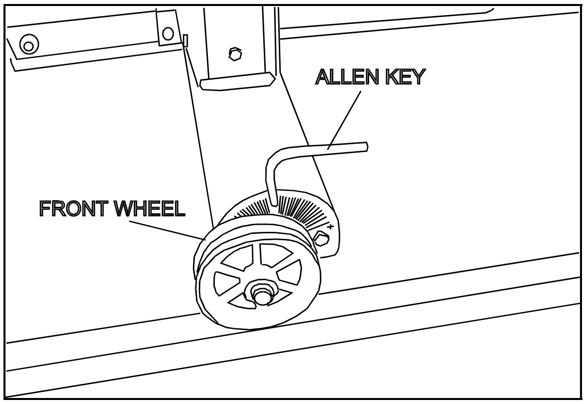


FIGURE 28: ADJUSTING HOOPY 100 LEVEL 06498

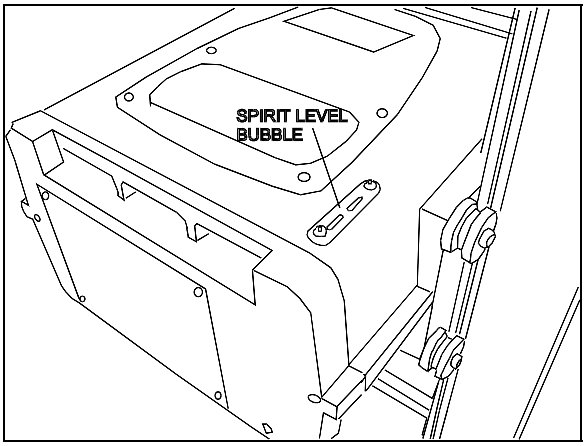


FIGURE 29: SPIRIT LEVEL 06500

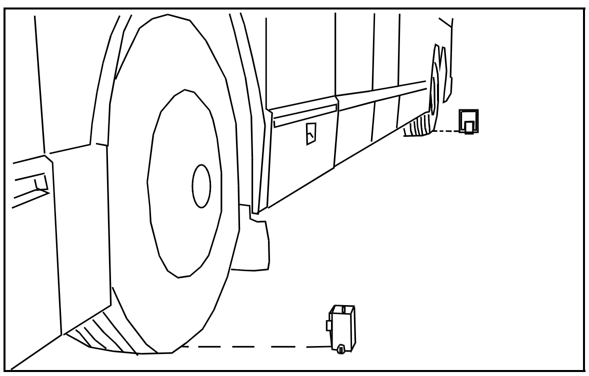


FIGURE 30: INSTALLING CALIBRATION FIXTURES 06497

NOTE
The floor level reading must be added to the aligner reading to ensure a precise alignment.

10. Transfer positive (+) or negative (-) reading of calibration fixtures to the front wheel of Hoopy 100 aligner. Add this reading to Hoopy 100 aligner level reading.
    * eg – level: 0.2, mirrors: 0.1 = 0.3
    * eg – level: -0.2, mirrors: 0.1 = 0.1

NOTE
If vehicle remains stationary during the headlight alignment procedure, it is not necessary to check floor slope each time.

Headlight Alignment

⚠ CAUTION ⚠
This mechanical equipment must be calibrated by metrology before initial set-up or after major overhaul. Calibration must be performed annually.

1. Set the support rail (Prévost #29261) down (Fig. 25). Using shims, adjust its level to stabilize it. Use previous reference marks to ensure proper positioning.
2. Make sure that headlight assembly fixing screw is properly fastened (Fig.22).

NOTE
Make sure that the vehicle is at proper height (suspension) and that air pressure is above 90 psi.

3. Install *“Hoopy 100” Aligner* onto support rail (Fig. 27). Turn aligner ON.

⚠ CAUTION ⚠
Vehicle must be parked at the same location each time. If location is changed for any reason, floor slope alignment and aligner leveling must be redone. Refer to “Setting aligner according to slope”.

NOTE
If aligner indicates LOW BATT, battery must be charged for 12 hours.

Low Beam Adjustment

1. Turn ON low beam lights.
2. Press ALIGN TO LAMP and move aligner in front of first beam.

NOTE
If beam is offset, a LOW CANDLES message will appear. Using vertical and horizontal alignment screws, adjust beam as needed (fig. 22).

3. Adjust aligner height (move aligner sideways if needed) so that XX appears in the aligner sight. Lock aligner side handle.

4. Open Hoopy 100 aligner door.
5. Press AIM LAMP down; press a second time so that LOW ADJUST appears in the sight. Arrows indicate in which direction to adjust the beam using the vertical and horizontal adjustment screws. Perform this adjustment until XX appears in the sight.
6. Aligner will reset after 5 minutes.
7. Repeat for other low beam light.

High Beam Adjustment

1. Turn ON high beam lights.
2. Press ALIGN TO LAMP and move aligner in front of first beam.
3. Adjust aligner height (move aligner sideways if needed) so that XX appears in the aligner sight. Lock aligner side handle.
4. Open Hoopy 100 aligner door.
5. Press AIM LAMP down; press a second time so that HIGH ADJUST appears in the sight. Arrows indicate in which direction to adjust the beam using the vertical and horizontal adjustment screws. Perform this adjustment until XX appears in the sight.
6. Aligner will reset after 5 minutes.
7. Repeat for other high beam light.
8. Store equipment away in a safe place.

If proper mechanical equipment is not available, perform adjustments as described hereafter:

1. Headlight aiming and inspection can be accomplished by visual means. This is done on a screen located at a distance of 25 feet (7,6 m) of the headlights. It should be of adequate size with a matte-white surface well shaded from extraneous light and properly adjusted to the floor area on which the vehicle stands. Provisions should be made for moving the screen or its vertical centerline so that it can be aligned with the vehicle axis. In addition to the vertical centerline, the screen should be provided with four laterally adjustable vertical tapes and two vertically adjustable horizontal tapes.
2. The four movable vertical tapes should be located on the screen at the left and right limits called for in the specification with reference to centerlines ahead of each headlight assembly.
3. The headlight centerlines shall be spaced either side of the fixed centerline on the screen by ½ the lateral distance between the light source centers of the pertinent headlights. The horizontal tapes should be located on the screen at the upper and lower limits called for in the specification with reference to the height of beam centers and the plane on which the vehicle rests, not the floor on which the screen rests (Fig. 31).
4. The nominal vertical aim position on lower beam headlights shall be adjusted based on the headlight mounting height, from the ground to the light source center of the headlight, according to table1.

TABLE 1 – VERTICAL BEAM AIM GUIDELINES

Headlight (centerline) Mounting Height	Nominal Vertical Aim	Aim Inspection Limits for Vertical Aim
56 to 90 cm (22 to 36 inch)	0 Vertical	10 cm (4 inch) up to 10 cm (4 inch) down
90 to 120 cm (36 to 48 inch)	5 cm (2 inch) down	5 cm (2 inch) up to 15 cm (6 inch) down
120 to 140 cm (48 to 54 inch)	6.4 cm (4 inch) down	4 cm (1.5 inch) up to 16.5 cm (6.5 inch) down

5. High beam headlights are aimed so that the center of the high-intensity zone is located at the horizontal and straight ahead vertically (Fig. 32).
6. Low beam headlights are aimed so that the top edge (the cutoff) of the high-intensity zone is at the vertical location as per Table 1 and the left edge of the high-intensity zone is at the vertical centerline of the headlight (Fig. 33).
7. The inspection limits for high-beam headlights shall be with the center of the high-intensity zone from 10 cm (4 in) up to 10 cm (4 in) down; and, from 10 cm (4 in) left to 10 cm (4 in) right on a screen at 7.6 m (25 ft) (Fig. 34).

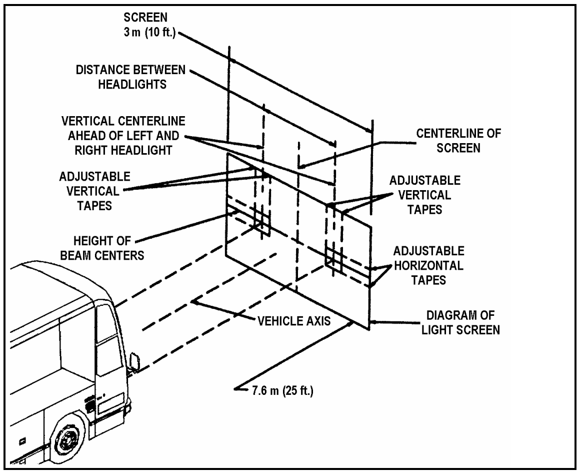


FIGURE 31: ALIGNMENT OF HEADLIGHT AIMING SCREEN 06502

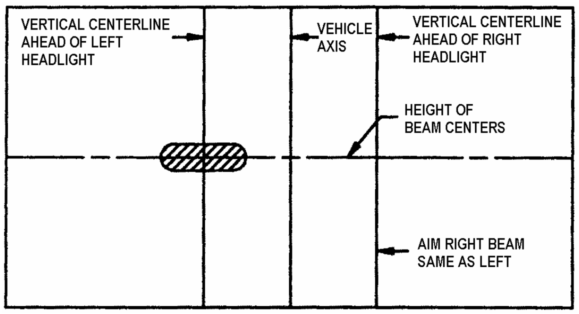


FIGURE 32: HIGH-INTENSITY ZONE (SHADED AREA) OF A PROPERLY AIMED UPPER BEAM ON THE AIMING SCREEN 7.6 M (25FT) IN FRONT OF VEHICLE 06503

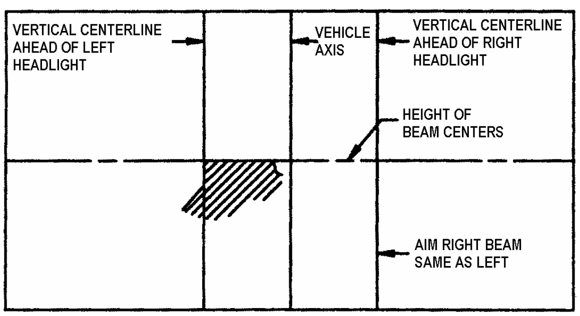


FIGURE 33: HIGH-INTENSITY ZONE (SHADED AREA) OF A PROPERLY AIMED LOWER BEAM ON THE AIMING SCREEN 7.6 M (25FT) IN FRONT OF VEHICLE 06504

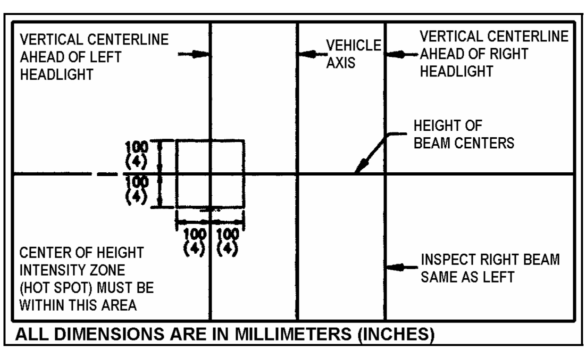


FIGURE 34: AIM INSPECTION LIMITS FOR UPPER-BEAM HEADLIGHTS 06505

7. The inspection limits in the vertical direction for low-beam headlights or the low beam of a dual-beam headlight, shall be as described in Table 1. In the horizontal direction, the left edge of the high-intensity zone shall be located from 10 cm (4 in) left to 10 cm (4 in) right of the vertical centerline of the beam. The viewing screen shall be located 7.6 m (25 ft) in front of the vehicle (Fig. 35).

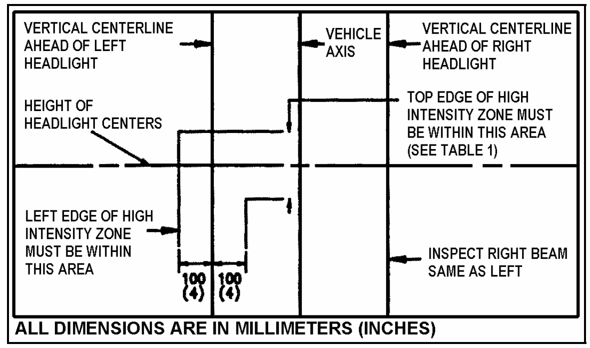


FIGURE 35: AIM INSPECTION LIMITS FOR LOWER-BEAM HEADLIGHTS 06506

9.1.4 Sealed-Beam Unit

Bulb Removal and Replacement

1. Pull the release handle located inside the front service compartment to tilt down the entire bumper assembly.
2. Remove the headlight screw fixing the headlight assembly, then tilt headlight assembly down (Fig. 22 and 23).
3. Remove connector from headlight bulb.
4. Remove the bulb by pushing and rotating it out of the socket.
5. Install the new bulb by reversing the previous procedure.

⚠ CAUTION ⚠
During this step, avoid contacting the bulb with the fingers not to alter the bulb life.

NOTE
Do not disrupt headlight adjustment screws.

Module Replacement

1. Pull the release handle located inside the front service compartment to tilt down the entire bumper assembly.

2. Remove the headlight screw fixing the headlight assembly, then tilt headlight assembly down (Fig. 22 and 23).
3. Remove connector from headlight bulb.
4. Unfasten three metal clips attaching headlight unit to support.
5. Install new module and fasten metal clips.
6. Install wiring connector on back of new sealed beam unit.
7. Tilt headlight assembly up into its housing then secure using fixing screw.

NOTE
Make sure headlight assembly is properly positioned into its housing before securing using fixing screw.

8. Perform alignment procedure.

NOTE
The headlight aim must be checked and adjusted even if it was properly adjusted before the sealed beam unit was replaced.

9.1.5 Front Turn Signal

The front turn signal is part of the front headlight assembly. The turn signal is a sealed unit (LED) located on each front corner and should be replaced as an assembly. Turn signal is visible from both front and side.

Removal and Replacement

1. Pull the release handle located inside the front service compartment to tilt down the entire bumper assembly.
2. Remove the headlight screw fixing the headlight assembly, then tilt headlight assembly down (Fig. 22 and 23).
3. Partially unfasten back plate fixing screws, then remove signal lamp.
4. Remove socket from signal lamp.
5. Install wiring connector on back of new signal lamp then install signal lamp.
6. Fasten back plate fixing screws then tilt headlight assembly up into its housing then secure using fixing screw.

NOTE
Make sure headlight assembly is properly positioned into its housing before securing using fixing screw.

9.1.6 Optional Xenon Headlamp

The outer lamps of each headlight assembly may be equipped with the optional Xenon lamps. These lamps improve visibility and provide better lifespan.

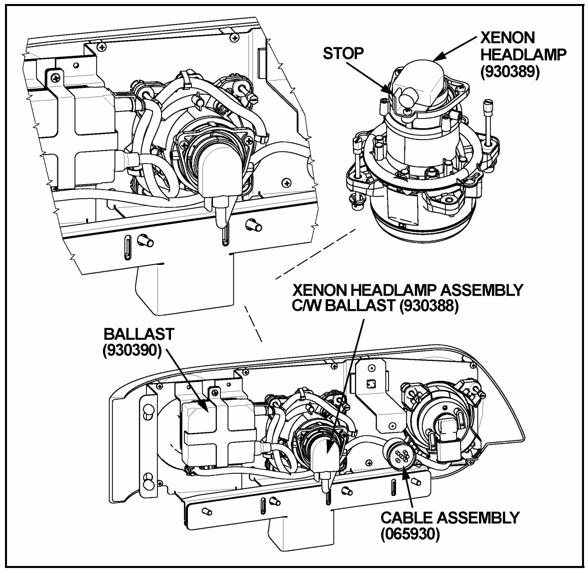


FIGURE 36: XENON HEADLAMP LOCATION 06549

Bulb Removal and Replacement

1. Pull the release handle located inside the front service compartment to tilt down the entire bumper assembly.
2. Remove the headlight screw fixing the headlight assembly, then tilt headlight assembly down (Fig. 22 and 23).
3. Remove main cable connector (066011).
4. Remove connector from headlamp bulb by turning counterclockwise.
5. Unscrew the three Phillips head screws, pull the retainer and bulb out.

⚠ CAUTION ⚠
To avoid breaking the bulb, make sure the socket is in proper position against the stop.

6. Install the new bulb by reversing the previous procedure.

⚠ CAUTION ⚠

During this step, avoid contacting the bulb with the fingers not to alter the bulb life.

NOTE

Do not disrupt headlight adjustment screws.

⚠ CAUTION ⚠

Never connect a voltmeter or V.O.M. to measure bulb voltage as instrument will be destroyed.

Troubleshooting and Safety

When switching on the Xenon headlamp using the rocker switch, a lamp short-circuit test is performed.

Current is detected in the lamp circuit before the ignition time and ignition prevented. Connection of the "hot" lamp to the body mass also prevents ignition. In both cases, the system is cut off within < 0.2 s and can only be restarted via the rocker switch.

In general, the maximum ignition time is < 0.2 s, which period is followed by cutoff. This would happen if a lamp was defected.

Lamp missing: system is cut off after < 0.2 s.

If lamp components or cables are damaged by force (accident) so that contact with hazardous parts is possible, the current in these lines is earthed by the vehicle body and - as with a defective household appliance - switched off when 30 mA are reached within < 0.2 s. the cutoff time is shortened by a more powerful defect current.

To protect the ballast, a counter in the electronic safety system ensures that a defective lamp can only be switched off 7 times consecutively after a successful ignition, after which the device is cut off. This prevents flutter and flashing. This counter is put out of action when the lamp cutoff time repetition interval is longer than 1.3 s so that temporary non-defect disturbances that result in immediate invisible re-ignition do not cause lamp cutoff.

A warning notice on the lamp plug makes you aware of the fact that the lamp is operated in this system on a higher voltage (you should therefore switch off the lamp before working on this part).

After taking out the lamp, the contact pins are in a practically idle state (< 34 Volt) after < 0.5 seconds so that there is no immediate danger of electric shock even if the warning is disregarded.

With this safety concept there is no danger to check the ballast with a new bulb. There is a very high probability that the ballast is OK if the ballast can ignite the bulb.

One simple test to check the ballast would be to measure the Nominal current of 1.58 A after one minute for the 24V ballast.

9.2 STOP, TAIL, DIRECTIONAL, BACK-UP, AND HAZARD WARNING LIGHTS

A combination stoplight, taillight, directional signal light and back-up light assembly is mounted at the rear, on each side of the vehicle. Furthermore, when braking, two center stoplights (LED) and a cyclops light (LED) will illuminate simultaneously with the stoplights on the sides for increased safety. The L.H. and R.H. side center stop lights are also used as directional signal and marker lights.

The stop, tail, directional signal and back-up lights consist of individual LED lights mounted on the engine rear door, and each light is serviced individually as a complete unit. The back-up light uses a regular tungsten bulb.

The hazard warning flashing system uses the front, side and rear directional lights simultaneously. This system is energized by a switch on the L.H. dashboard.

9.2.1 Lamp Removal and Replacement

1. Open engine compartment rear door.
2. Remove the lamp support retaining screws (2), and then from the outside, remove the lamp and its support.
3. From the outside, install the new lamp with its support then fasten the retaining screws.

9.2.2 Center Stoplights and Cyclops Light Removal and Replacement

These (LED) lights are sealed unit and should be replaced as an assembly in accordance with the following procedure:

1. Unscrew both “Phillips” light screws then remove the light assembly.

2. Install new light assembly and secure using screws.

9.3 LICENSE PLATE LIGHT

Two LED units are mounted above the rear license plate(s) of vehicle. In case of burn out, the LED unit must be changed according to the following procedure.

1. Pry out the rubber seal with a small screwdriver. Pull on the LED unit and disconnect it.
2. Reconnect new LED unit, place rubber seal, and press on it until it is seated in position.

9.4 CLEARANCE, IDENTIFICATION AND MARKER LIGHTS

The vehicle is equipped with marker, identification and clearance lights (LED). The clearance lights are mounted at each corner of the coach near the top and the identification lights are in the upper center of rear and front sections.

The rear clearance and identification lights are red and the front ones are amber.
The amber marker lights are mounted along the sides of vehicle.

9.4.1 **THE SIDE MARKER LIGHT IS A SEALED UNIT (LED) AND** should be replaced as an assembly in accordance with the following procedure:

1. Unscrew both *"Phillips"* light screws, and then remove the light assembly.
2. Position the new light assembly and install the "Phillips" screws.

9.4.2 Clearance and Identification Light Removal and Replacement

The clearance and identification light are sealed units (LED) and can be replaced in accordance with the following procedure:

1. Unscrew both "Phillips" light screws, and then remove the light assembly.
2. Position the new light assembly, and then install the "Phillips" screws.

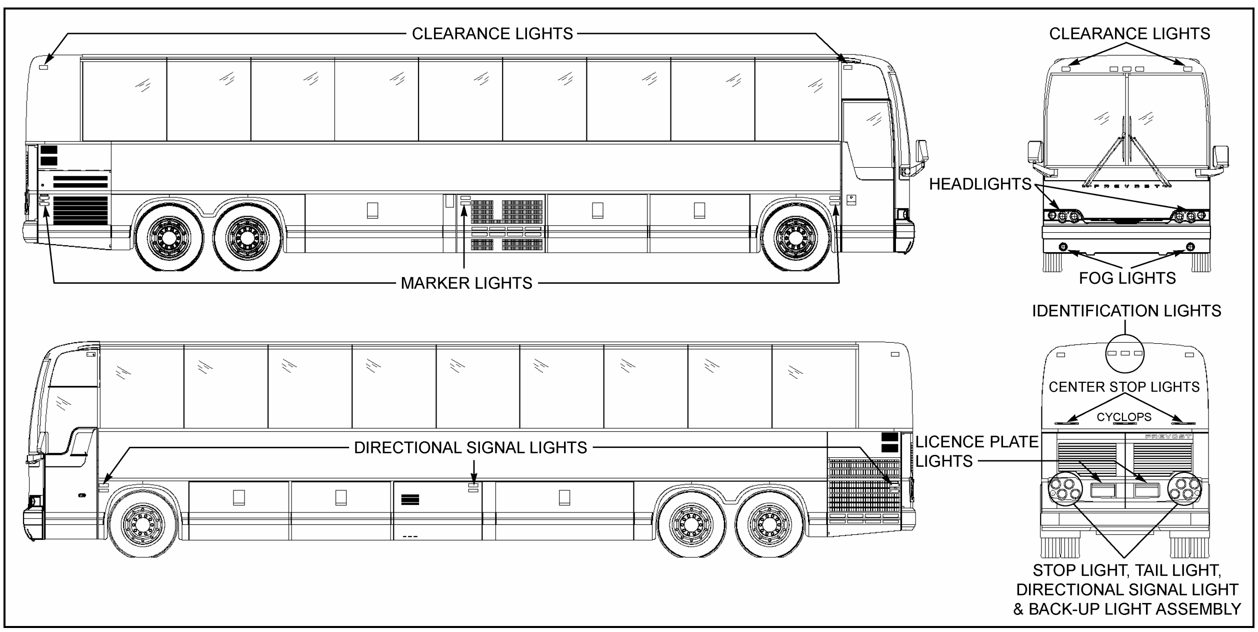


FIGURE 37: VARIOUS LIGHTS LOCATION 06640

9.5 FOG LIGHTS

Optional halogen fog lights can be mounted on this vehicle to give the driver better visibility in foggy weather, or to improve the range of vision just ahead of the coach.

9.5.1 Bulb Removal and Replacement

1. Pull on the release handle located in the front service compartment, near the door lower hinge. The bumper will lower gradually.
2. Unscrew the wing nut and pivot assembly upwards.
3. Unscrew the outer ring. Disconnect the light unit connection and remove the bulb.
4. Install the new bulb, reconnect the light unit and replace in its proper position.

⚠ CAUTION ⚠
During this step, avoid contacting the bulb with your fingers. This could alter the bulb life.

5. Reinstall the outer ring, pivot the assembly downwards.
6. Fasten the wing nut and securely close the bumper.

10. INTERIOR LIGHTING EQUIPEMENT

10.1 CONTROL PANEL LIGHTING

The instrument gauges and switches mounted on all control panels are energized whenever the exterior light switch is pushed to the first position. A control dimmer located on the dashboard is used to vary the brightness of the panel gauges, switches and indicator lights.
The gauge lights, panel lights, switch lights and indicator lights have a different bulb arrangement. Thus, the procedure to change a defective bulb can vary according to the application.

10.1.1 Switch Lighting

1. Slightly pull the switch with a defective LED away from the control panel.
2. Disconnect the electric cable from the switch.
3. To install a new switch, reverse the procedure (Fig. 38).

NOTE
Switches are lighted by the use of LED. When lighting on a switch fails, replace defective switch as a unit.

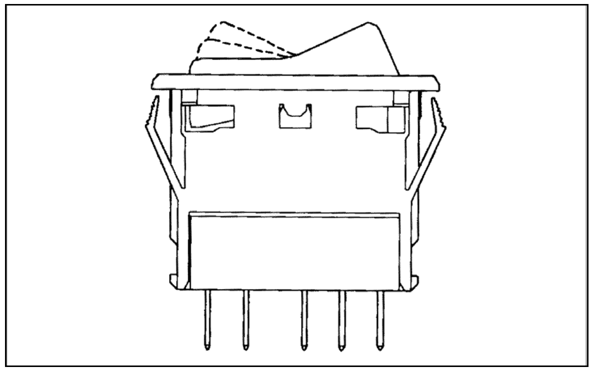


FIGURE 38: SWITCH 06321

10.1.2 Telltale Light Replacement

Telltale module is non-serviceable and must be replaced as a unit.

1. Unscrew and remove the top dashboard panel.
2. Remove the telltale back wire electric connectors.
3. Unscrew and remove the telltale module.
4. To replace the telltale module, reverse the procedure.

10.1.3 Gauge Light Bulb Replacement

1. For any gauge light bulb replacement, the dashboard panel must be removed in order to have access to the rear of gauges.
2. Remove bulb socket from the gauge, turn the defective bulb counterclockwise and pull it out of the gauge.
3. Push a new bulb and socket ASM and turn clockwise to lock in place.
4. Replace the rear dashboard housing.

10.2 STEPWELL LIGHTS

Two Stepwell lights are illuminated when the door opening system is activated.

10.2.1 Bulb Removal and Replacement

Proceed as follows to replace a defective bulb:

1. Unscrew the two Phillips-head screws retaining the lens to the wall, and remove it.
2. With the light lens removed, pull bulb from the lamp while applying lateral pressure.
3. Install the new bulb into the lamp.
4. Position the light lens and install it.

10.3 LAVATORY NIGHT-LIGHT

The lavatory night-light is illuminated as soon as the ignition switch is set to the *"ON"* position.

10.3.1 Bulb Removal and Replacement

1. Unscrew the two Phillips-head screws retaining the lens to the wall, and remove it.
2. With the light lens removed, pull bulb from the lamp while applying lateral pressure.
3. Install the new bulb into the lamp.
4. Position the light lens and install it

10.4 DRIVER'S AREA LIGHTS

Two halogen ceiling lights are installed over the stepwell and the driver's area. These lights are frequently used for night-time operation when passengers board or leave coach.

10.4.1 Bulb Removal and Replacement

1. Unsnap the lamp with a flat head screwdriver and remove it.
2. Pull the defective bulb out of the socket.
3. Install the new bulb by pushing it in position.
4. Replace the lamp by snapping it back in place.

⚠ CAUTION ⚠

Do not touch halogen bulbs with bare hands as natural oils on skin will shorten bulb life span.

10.5 PASSENGER SECTION LIGHTING

The passenger section of coach is lit by two types of fluorescent tube lamps installed on the parcel racks. The aisle or indirect lights are located on front of parcel racks, and provide soft, indirect cabin lighting and parcel rack interior lighting. More powerful lighting for general and in-station applications is provided by fluorescent tubes located under the parcel racks, close to the windows. A dual power system is available for this lighting either from the 24 volt vehicle power supply or from a 110 volt outlet supply. In order to save batteries during extended periods of in-station lighting, no current is drawn from the batteries as soon as the 110 volt circuit is connected.

Moreover, adjustable reading lamps are installed under the parcel racks for passenger accommodation.

10.5.1 Fluorescent Tube Replacement

Indirect Fluorescent Light

1. Open the parcel rack access door, if so equipped, unscrew the two Phillips screws (one each end). Let the hinged cover down.
2. Remove fluorescent tube from light socket.
3. Install a new fluorescent tube.
4. Lift the hinged cover and replace the two retaining screws (Fig. 39).

Parcel Rack Interior Lighting

1. Open the parcel rack access door, if so equipped, unscrew the two Phillips screws (one each end). Pull the hinged cover down.
2. Push on the bulb, turn and then, pull it from the socket.
3. Install a new bulb.
4. Lift the hinged cover and replace the two retaining screws.

10.5.2 Removal and Replacement of In-Station Fluorescent Tubes

1. Start by pulling out the corner of the lens then delicately peeling it out of its seat.

⚠ CAUTION ⚠

The lens is fragile. Be very careful when removing and handling.

2. Rotate and pull the fluorescent tube from its sockets.
3. Install a new fluorescent tube, rotating the tube to secure it in the sockets.
4. Replace the screen lens by first inserting one side in the seat, then push the other side in and snap it in place by running it in from one corner to the next.

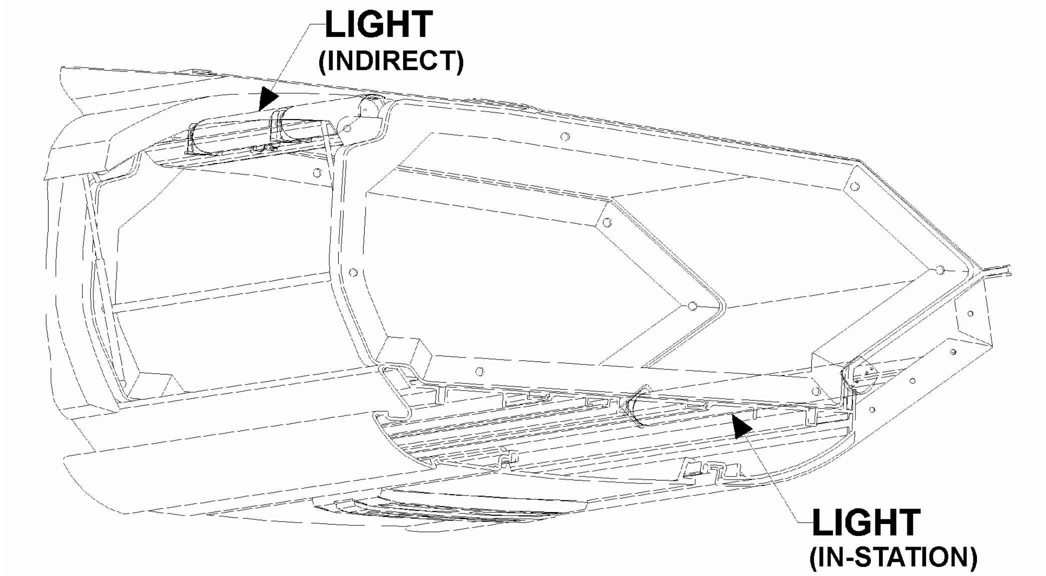


FIGURE 39: PARCEL RACK LIGHTING 06419

10.5.3 Removal and Replacement of Reading Lamp Bulb

1. Engage the tool (#830164) over the lamp and turn one quarter turn counterclockwise. Then, remove the tool slowly.
2. Pull the bulb socket off the reading lamp unit.
3. Push and turn bulb counterclockwise, then pull it out of the socket.
4. Install new bulb in the socket, then push and turn clockwise to lock bulb in position.
5. Push the bulb socket in the reading lamp unit.
6. Position the reading lamp with the tool (#830164), turn one quarter turn clockwise.

10.6 ENGINE COMPARTMENT LIGHTING

A switch located on R.H. side of rear junction box can be used to actuate the two oval engine compartment lights.

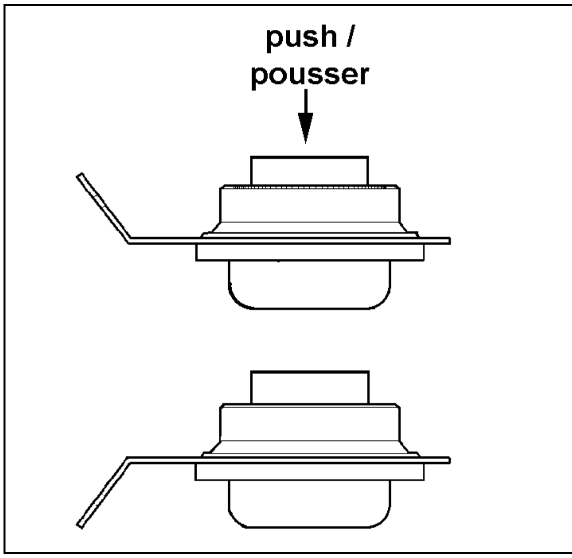


FIGURE 40: ENGINE COMPARTMENT LIGHT

Each light is sealed and can be replaced as follows:

1. Disconnect the light unit connection.
2. Remove the lamp.
3. Position new lamp.
4. Connect the light unit.
5. Make sure the retaining ring is installed properly.

10.7 LAVATORY LIGHT

The halogen lavatory light is installed on ceiling. A microswitch, mounted in the door exterior frame, is activated by the door lock mechanism upon locking to energize the circuit. This switch is readily serviced by removing the two Phillips-head screws securing the mounting plate to the door exterior frame.

Bulb removal and replacement:

1. Unsnap the lamp with a flat head screwdriver and remove it.
2. Pull the defective bulb out of the socket.
3. Install the new bulb by pushing it into position.
4. Replace the lamp by snapping it back in place.

⚠ CAUTION ⚠
Do not touch halogen bulbs with bare hands as natural oils on skin will shorten bulb life span.

11. LIGHT BULB DATA

When replacing a light bulb, special attention must be paid to the voltage rating (refer to light bulb data hereafter).

LIGHT BULB DATA					
APPLICATION	**PREVOST PART NO.**	**TRADE OR SAE NUMBER**	**WATTS OR CANDLE POWER**	**VOLTS**	**QTY**
EXTERIOR LIGHTING					
Hi/Lo-beam	930291	9004	65/45 W	12	2
Lo-Beam Xenon (optional)	930388	D2S	35 W	12	2
Docking & cornering	930319	9415	37.5W	12	4
Fog	930361	H3	55 W	12	2
License plate (sealed)	930266	TL 15206	---	12	2
Marker Light (red)	930340	Grote 47072-3	---	12	2
Marker Light (amber)	930341	Grote 47073	---	12	10
Identification (red)	930334	TL 25420R	---	12	3
Clearance (red)	930334	TL 25420R	---	12	4
Identification (amber)	930337	TL 25450Y	---	12	3
Clearance (amber)	930337	TL 25450Y	---	12	4

LIGHT BULB DATA					
APPLICATION	**PREVOST PART NO.**	**TRADE OR SAE NUMBER**	**WATTS OR CANDLE POWER**	**VOLTS**	**QTY**
EXTERIOR LIGHTING					
Front directional (hazard & marker)	562135	3057	32/3W	12	2
Rear directional	560589	1156	32 W	12	4
Stop	560589	1156	32 W	12	8
Back-up	560589	1156	32 W	12	4
Center stop	930330	HELLA 96208	---	12	2
Cyclops	930330	HELLA 96208	---	12	1
Tail	560123	67	4 W	12	4
Exterior compartment (except engine)	562278	6429	10 W	24	12
Engine compartment	930383	SEALED	25 W	12	2

LIGHT BULB DATA					
APPLICATION	**PREVOST PART NO.**	**TRADE OR SAE NUMBER**	**WATTS OR CANDLE POWER**	**VOLTS**	**QTY**
INTERIOR LIGHTING					
Instrument cluster lights	562838	2721 MFX	---	12	---
Telltale panel assy.	563333	---	---	---	1
Step light	562278	6429	10 W	24	2
Lavatory	830176	Q20MR16	20 W	12	1
Parcel rack	560144	1820	1.6 W	12	A R
Driver’s area	830176	Q20MR16	20 W	12	2
“EMERGENCY EXIT” decal	560601	456	2 W	24	A R
“LAVATORY OCCUPIED”	563108	168	3 W	12	1
“WATCH YOUR STEP”	561166	1820	1.6 cp	24	2
Aisle	560141	1251	3 W	24	A R
Reading	563349	303	6 W	24	A R
Fluorescent (In-Station)	830153	F32T8/SP41	32 W	---	A R
Destination sign fluorescent	830120	F30T8CW4	30 W	---	1
Fluorescent (Indirect)	830152	F13T5/CW	13 W	---	A R
Baggage Compartment	562411	#6424	5 W	24VDC	AR

12. SPECIFICATIONS

Battery

Make..Volvo
Model..20359831
Type..Maintenance-free
Terminal type..Top Stud
Group size..31
Volts..12
Load test amperage..290
Reserve capacity (minutes)..195

Cold cranking (in amps)
-At 0°F (-18°C)..950 (each battery)

Maximum dimensions (inches/mm)
-Length (including flange)..13.0/330,2
-Width..6.7/169,3
-Height (including top posts)..9.3/237,0
-Approximate weight (lbs/kg)..59/26,7

* *Battery tester cable clamps should be between terminal nuts and lead pads of terminals. If not possible, load value should be 210 amperes.*

Torque specifications

Battery cable to post..10-15 Ft-lbs (13-20 Nm)
Battery cover..45-50 Ft-lbs (5-6 Nm)

Alternator

Make..BOSCH
Model Number..0120689552
Series..T1

Hot output

-Amperes..140 at 25°C (AMBIENT)
-Volts..28
-Approximate rpm..6000
Ground..negative
Prevost Number..562752

Battery equalizer

Make..Vanner
Model..66-100
Amperes..100 amps
Prévost Number..563334

Starter

Make..Mitsubishi Electric Corporation (MELCO)
Model Number..M009T82479
Type..105P70
Voltage..24
Prévost Number..510752

No-load test
-Volts..23.5
-Max. current draw..125 amperes
-Min. rpm..3000 rpm

Starter solenoid

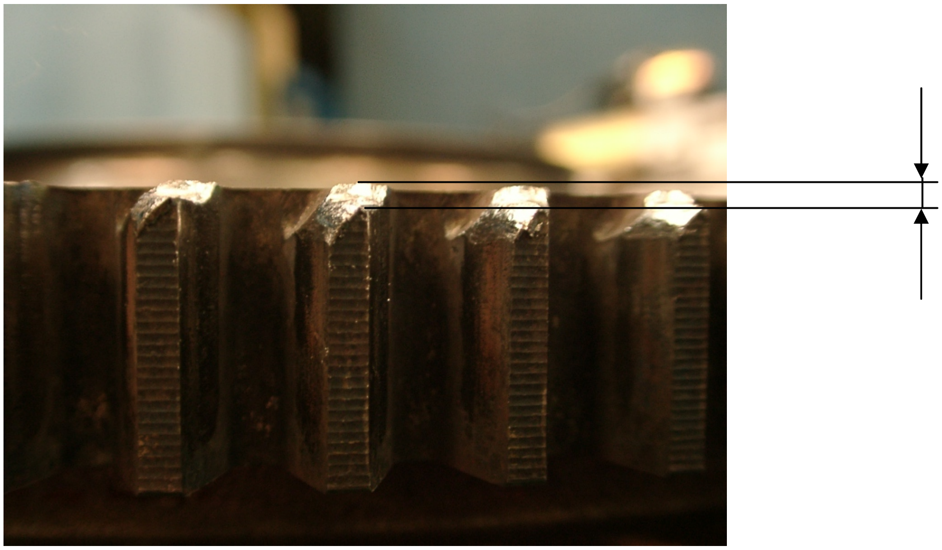
Make..Mitsubishi Electric Corporation (MELCO)
Model Number.. 1115557
Pull In Voltage ....16 volts max.

Service Bulletin A1-M1N-1729EN - Flywheel Ring Gear Wear / Damage

(Sample of Maximum Ring Gear Wear /Damaged)

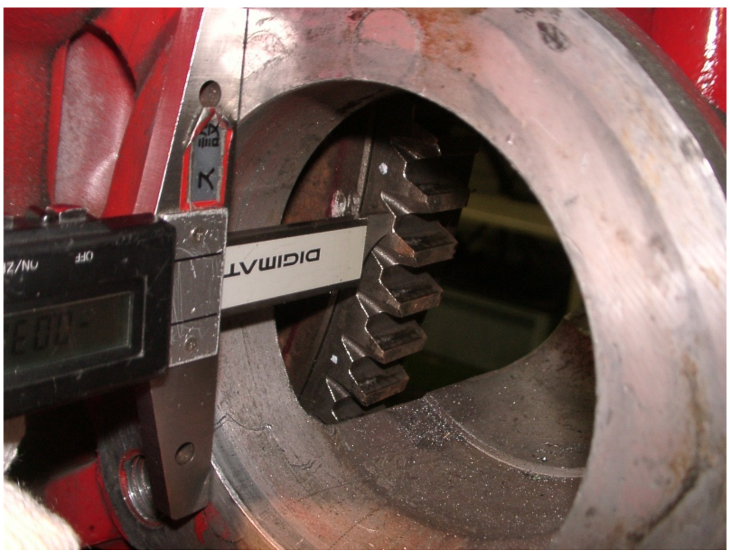
Please refer to the above photos and please replace the ring gear which has similar level of damage as these. See the next page for the method to measure the depth of the damage.

(Depth of wear / damage on ring gear)

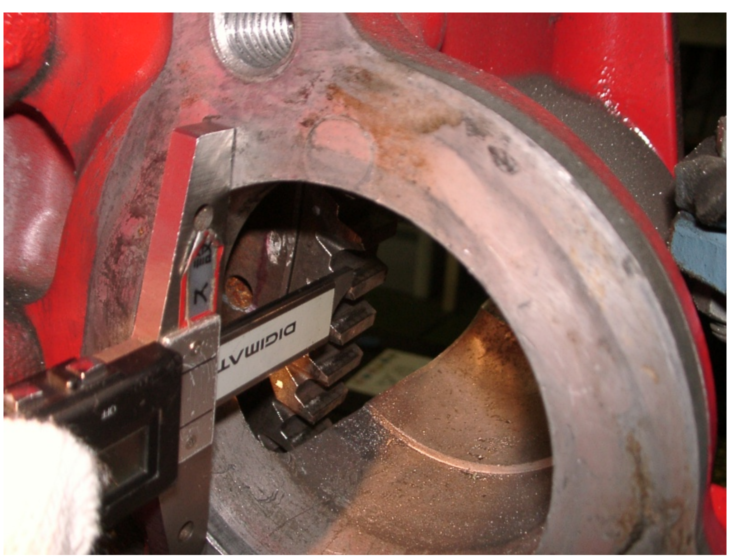


Less than 0.5mm

(Measurement method)



Dimension between the mounting surface and the end surface of ring gear



Dimension between the mounting surface and the damage depth portion of ring gear

SECTION 09: PROPELLER SHAFT

CONTENTS

ILLUSTRATIONS

1. PROPELLER SHAFT

1.1 DESCRIPTION

The propeller shaft transmits power from the transmission to the differential (Fig. 1). Refer to paragraph *"6. SPECIFICATIONS"* at the end of this section for propeller shaft length. The propeller shaft is "Dana 1810" type with tubular shafts. It is provided with two heavy-duty universal joints (Fig. 1).

The propeller shaft has a full round end yoke at one end and a half round end yoke at the other end. The tube yoke is connected to the differential by a full round end yoke with four needle bearings.

The other extremity (slip yoke assembly) is connected to the transmission by a half round end yoke with two needle bearings.

Furthermore, a slip joint on the propeller shaft compensates for variations in distance between the transmission and the differential, or between the output retarder (optional on the automatic transmission) and differential. The rise and fall of the drive axle bring about these variations as the vehicle passes over uneven surfaces. The slip joint also eases removal of the transmission or the drive axle.

2. REMOVAL, DISASSEMBLY, REASSEMBLY AND INSTALLATION

Refer to *"SPICER UNIVERSAL JOINTS AND DRIVESHAFTS"* annexed to this section, under headings *"Heavy Duty - removal, disassembly, reassembly and installation".*

Where applicable:

- Remove or install propeller shaft safety guard.
- Screw bolts to the specified torque (Fig. 1).

NOTE
Disregard the procedure on "Lock straps" mentioned in the "Spicer Universal Joints and Driveshafts Manual".

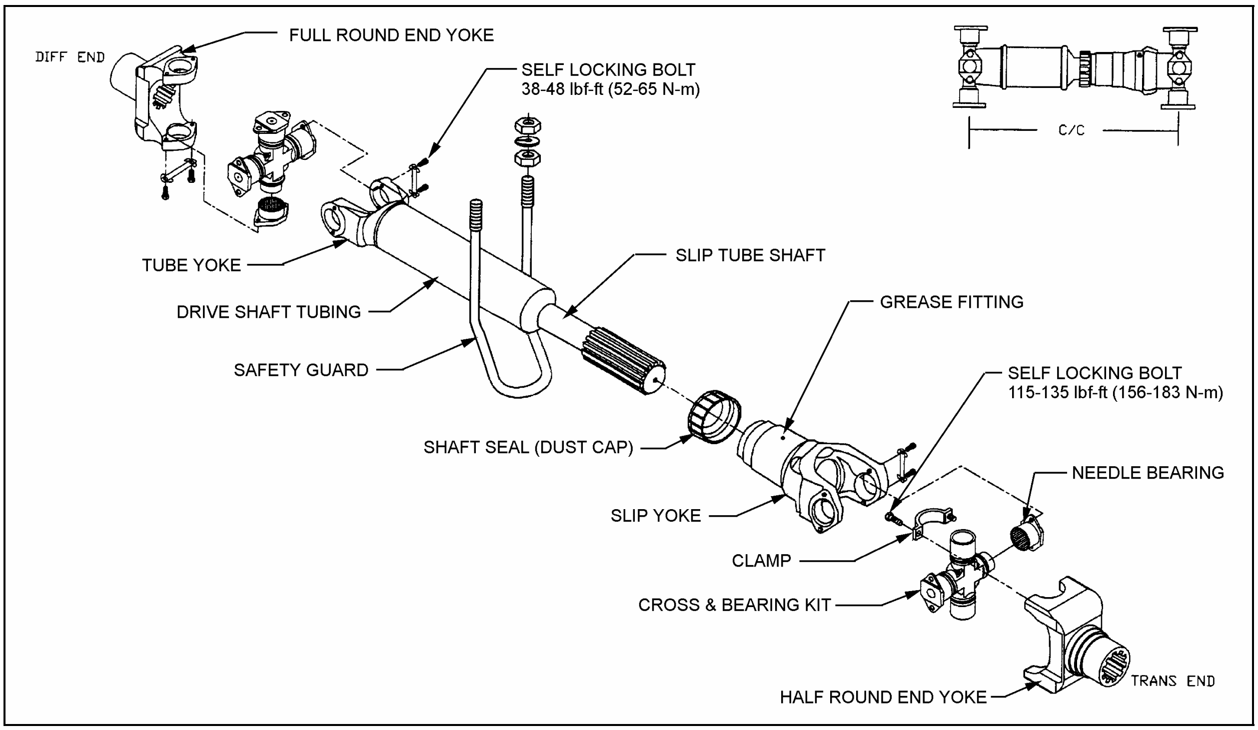


FIGURE 1: PROPELLER SHAFT ASSEMBLY 09002

3. CLEANING, INSPECTION AND LUBRICATION

3.1 CLEANING AND INSPECTION

Thoroughly clean grease from bearings, journal, lubricating grease fittings and other parts. Needle bearing assemblies may be soaked in a cleaning solution to soften hard grease particles. It is extremely important that bearing assemblies be absolutely clean and blown out with compressed air, since small particles of dirt or grit can cause rapid bearing wear. Do not attempt to disassemble needle bearings.

Bearing journal areas should be inspected for roughness or grooving. If light honing does not remove roughness, the entire bearing assembly should be replaced. Excessive wear of the needle bearing is indicated if the needles drop out of the retainer, or if marks are present on the journal bearing surface. In such case, replace bearing assembly. Finally, inspect yokes for cracks, wear or distortion.

NOTE
Repair kits are available for overhaul of the propeller shaft assembly. Refer to the paragraph "6. Specifications" of this section.

3.2 LUBRICATION

Lubricate propeller shaft universal joints and slip yoke periodically, every 6,250 miles (10 000 km) or twice a year, whichever comes first. Apply grease gun pressure to the lube fitting. Use a good quality lithium-base grease such as: NLGI No.2 (suitable for most temperatures) or NLGI No.1 (suitable for extremely low temperatures). Refer to "Spicer Universal Joints and Driveshafts, Service Manual", under heading, "Inspection and Lubrication". See lubrication procedures for U-joints and lubrication for slip splines.

NOTE
Do not assume that bearing cavities have been filled with new grease unless it has expelled around all seals.

4. EXPLANATION OF COMMON DAMAGES

1. Cracks: Stress lines due to metal fatigue. Severe and numerous cracks will weaken the metal until it breaks.

2. Galling: Scraping off of metal or metal displacement due to friction between surfaces. This is commonly found on trunnion ends.

3. Spalling (surface fatigue): Breaking off of chips, scales, or flakes of metal due to fatigue rather than wear. It is usually found on splines and U-joint bearings.

4. Pitting: Small pits or craters in metal surfaces due to corrosion. If excessive, pitting can lead to surface wear and eventual failure.

5. Brinelling: Surface wear failure due to the wearing of grooves in metal. It is often caused by improper installation procedures. Do not confuse the polishing of a surface (false brinelling), where no structural damage occurs, with actual brinelling.

6. Structural Overloading: Failure caused by a load greater than the component can stand. A structural overload may cause propeller shaft tubing to twist under strain or it may cause cracks or breaks in U-joints and spline plugs.

5. TROUBLESHOOTING

Refer to *"Spicer Service Manual - Universal Joints and Driveshafts"* under heading *"Troubleshooting".*

6. SPECIFICATIONS

PROPELLER SHAFT

X3-45 COACHES EQUIPPED WITH ALLISON WORLD TRANSMISSION

Make .... Hayes-Dana Inc.
Series 1810
Supplier number 819299-1
Prevost number 580075

X3-45 COACHES EQUIPPED WITH ZF TRANSMISSION

Make .... Hayes-Dana Inc.
Series 1810
Supplier number (Traction) 17937CCF
Prevost number 580083

Repair kits

Make .... Hayes-Dana Inc.
U-joint kit (tube yoke), Supplier number 5-281X
U-joint kit (tube yoke), Prevost number 580043
U-joint kit (slip yoke), Supplier number 5-510X
U-joint kit (slip yoke), Prevost number 580062
Cap and bolt kit, bolt torque 115-135 lbf•ft (156-183 N•m), Supplier number 6.5-70-18X
Cap and bolt kit, bolt torque 115-135 lbf•ft (156-183 N•m), Prevost number 580063
Bolts kit, bolt torque 38-48 lbf•ft (52-65 N•m), Supplier number 6-73-209
Bolts kit, bolt torque 38-48 lbf•ft (52-65 N•m), Prevost number 580071

Half Round End Yoke

Make .... Covington Detroit Diesel
Supplier number 29511516

NOTE
U-joint kits will come equipped with the serrated bolt and lock patch and will no longer contain a lock strap.

SECTION 10: FRONT AXLE

CONTENTS

ILLUSTRATIONS

1. FRONT AXLE

1.1 DESCRIPTION

This front axle is of the ''Reverse Elliot'' type manufactured by Dana Spicer Europe. The front axle consists of a girder section axle bed or beam with stub axles. Each stub axle is carried on a taper kingpin, with a plain phosphor bronze bushing at the top and at the bottom. The unitized hub bearings used on the NDS range of axles, are non-serviceable items. Bearings are pre-adjusted, lubricated and have seals fitted as part of the manufacturing process. The bearings are greased for life and there is no need or facility for re-lubrication. Brakes are manufactured by KNORR-BREMSE. Steering ball joints with hardened balls and rubbing pads incorporate compression springs which automatically take up any wear.

The tie rod simplifies toe-in adjustment. The maximum turning angle is set through stop screws installed on the inner side of the knuckle.

Steering stabilizer (damper) and steering drag link which are mounted on the front axle are described in Section 14; *''Steering''* of this manual.

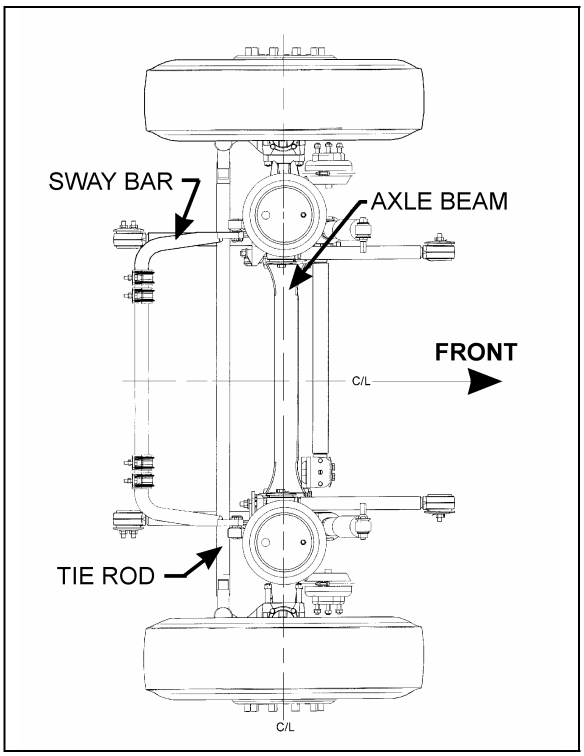


FIGURE 1: FRONT AXLE ASSEMBLY 10026

2. LUBRICATION

Pressure lubricate axle every 6 months or 30,000 miles (48 000 km) whichever comes first (Fig. 2). Tie rod ends and knuckle pins are provided with grease fittings for pressure lubrication. These grease fittings should be serviced every 6,250 miles (10 000 km) or twice a year whichever comes first. Good quality lithium-base roller bearing grease NLGI No.1 and 2 are recommended.

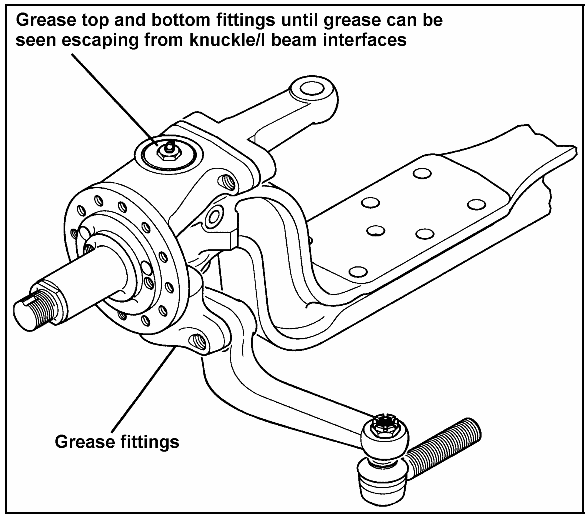


FIGURE 2: FRONT AXLE GREASING POINTS 10031

3. MAINTENANCE

A periodic inspection of the front axle assembly should be made to check that all bolts are tight, and that no damage and distortion have taken place. Suspension support stud nuts, U-bolt nuts, tie rod arms, steering arm nuts and stop screws should be checked and tightened, as required, to the torque specifications given at the end of this section. Also check the condition of the steering knuckle pins and bushings. In case of excessive looseness, the bushings and pins should be replaced.

Any looseness in the steering linkage, under normal steering loads, is sufficient cause to immediately check all pivot points for wear, regardless of accumulated mileage. Steering linkage pivot points should be checked each time the front axle assembly is lubricated. Any looseness can be visually detected while rotating the steering wheel in both directions.

Steering knuckles, knuckle pins and bushings can be overhauled or replaced without removing the axle from the vehicle. However, if extensive overhaul work is necessary, the axle assembly should be removed.

⚠ CAUTION ⚠

Should removal of a locking device be required when undergoing repairs, disassembly or adjustments, always replace with a new one.

3.1 TIE ROD END PLAY ADJUSTMENT

If end play exceeds 0.047" (1.2 mm), readjustment is necessary.

Remove protective cap, using a suitable tool ie: a 1" x 1/8" x 9" long flat bar, tighten adjuster piece fully home (SOLID) locating thrust cup onto ball pin.

Still with tool located on adjuster piece, back off carefully (LEAST AMOUNT) until adjuster piece cotter pin is allowed to pass through body, then remove tool.

Reinstall protective cap.

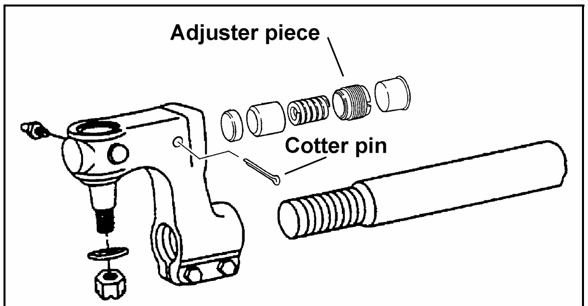


FIGURE 3: TIE ROD END PLAY ADJUSTMENT 10029

4. REMOVAL AND REPLACEMENT

The following procedure deals with the removal of the front axle assembly. The method used to support the axle assembly and suspension components during removal and disassembly depends upon local conditions and available equipment.

4.1 REMOVAL

1. Raise the vehicle by its jacking points on the body (see Section 18, *"Body"* under heading 16; Vehicle Jacking Points) until vehicle body is approximately 30 inches (760 mm) from the floor. Place jack stands under frame. Remove the wheels (if required, refer to Section 13, *"Wheels, Hubs and Tires"*).

⚠ CAUTION ⚠

Use only the recommended jacking points as outlined in section 18 "Body".

2. Exhaust compressed air from the air supply system by opening the drain valve of each reservoir.
3. Install jacks under axle jacking points to support the axle weight.

⚠ WARNING ⚠

To help prevent injury caused by the axle rolling off the jacks, these should be equipped with U-adapters, or similar precautions must be taken

4. Disconnect the steering drag link from the steering arm.
5. Remove the ABS sensors from their location in hubs (if applicable).
6. Disconnect the height control valve link from its support on the axle.
7. Disconnect air lines from front brake chambers, and cover line ends and fittings to prevent the entry of foreign matter.

⚠ CAUTION ⚠

Position the air lines and electric wires so they will not be damaged while removing the front axle assembly.

8. Proceed with steps a, b and c, while referring to Section 16: *"Suspension"*.
   a) Disconnect sway bar links from axle brackets.
   b) Remove shock absorbers.
   c) Disconnect five radius rods: one transversal and two longitudinal from subframe, and two upper rods from axle.
9. Remove the bolts and nuts fixing the axle to the left-hand and right-hand side air bellows mounting supports.
10. Using the jacks, slowly lower the axle assembly, and carefully pull away from underneath vehicle.

4.2 REPLACEMENT

Reverse front axle "*Removal*" procedure. Ensure cleanliness of air bellows support mounting plates.

NOTE
Refer to Section 16, ''Suspension'', Section 14, ''Steering'' and to paragraph 8 ''Specifications'' at the end of this section for applicable checks and recommended tightening torques.

5. SERVICE INSTRUCTIONS FOR STEER AXLE

Refer to "DANA SPICER Maintenance Manual Model NDS and Maintenance Manual NDS Axles" annexed at the end of this section.

6. FRONT WHEEL ALIGNMENT

Correct front wheel alignment must be maintained for steering comfort and satisfactory tire life. Road shocks and vibrations, as well as normal stress and strains on the front-end system can, under normal operating conditions, result in loss of front wheel alignment.

Check the front wheel alignment when the following occurs:

1. Every 200,000 miles (320 000 km) or 24 months (normal maintenance);
2. When the vehicle does not steer correctly; or
3. To correct a tire wear condition.

There are two types of front wheel alignment: **minor alignment** and **major alignment**.

6.1 MINOR FRONT WHEEL ALIGNMENT

Perform a minor front wheel alignment for all normal maintenance conditions.

Perform the minor front wheel alignment in the following sequence :

1. Inspect all the systems that affect the wheel alignment. See paragraph 6.3, *''Inspection Before Alignment''* in this section.
2. Check the hub bearings. See section 13, *''Wheels, hubs and Tires''* under heading 8: Front and Tag Axle Wheel Hubs.
3. Check and adjust the toe-in.

6.2 MAJOR FRONT WHEEL ALIGNMENT

Perform a major front wheel alignment to correct steering and tire wear conditions.

Perform the major front wheel alignment in the following sequence:

1. Inspect all systems affecting the wheel alignment. See paragraph 6.3, *''Inspection Before Alignment''* in this section.
2. Check the hub bearings. See section 13, *''Wheels, hubs and Tires''* under heading 8: Front and Tag Axle Wheel Hubs.

NOTE
If steering angle stoppers are changed, a special procedure is required for readjusting gearbox steering limiter. See paragraph 6.5 ''Hydraulic Stop'' in this section.

3. Check and adjust the turning angle adjustment.
4. Check the camber angle.
5. Check and adjust the caster angle.
6. Check and adjust the toe-in.

6.3 INSPECTION BEFORE ALIGNMENT

Check the following before doing a front wheel alignment:

1. Ensure that the vehicle is at normal riding height. See Section 16, *''Suspension''* under heading 7: *''Suspension Height Adjustment''*.
2. Ensure that front wheels are not the cause of the problem. See Section 13, *''Wheels, Hubs and Tires''*. Inspect the tires for wear patterns indicating suspension damage or misalignment.
    a. Make sure the tires are inflated to the specified pressure.
    b. Make sure the front tires are the same size and type.
    c. Make sure the wheels are balanced.
    d. Check wheel installation and straightness.
3. Check the wheel bearing adjustment.

4. Check steering linkage for bending and pivot points for looseness.
5. Check knuckle pins for evidence of excessive wear.
6. Check radius rods for bending and rubber bushings for evidence of excessive wear.
7. Make sure all fasteners are tightened to the specified torque. Use a torque wrench for verification. As soon as the fastener starts to move, record the torque. Correct if necessary. Replace any worn or damaged fasteners.

6.4 TURNING ANGLE ADJUSTMENT

The maximum turning angle is set through the two steering stop screws installed on the axle center. The turning angle is factory adjusted to accommodate the chassis design, and therefore, does not require adjustment on new vehicles. However, it should be checked and adjusted any time any component of the steering system is repaired, disassembled or adjusted.

Check if front tires rub against the frame or if the steering gear has been serviced.

Proceed with the following method to check the steering maximum turning angle :

6.4.1 R.H. Turn Adjustment

> ⚠ **CAUTION** ⚠
>
> **To prevent the steering damper from interfering with the adjustment of turning angles, make sure its fixing bracket is at the correct location on the axle center (refer to section 14 “Steering”).**

1. Turn steering wheel to the right until the boss on the axle center touches the right stop screw.
2. Verify the nearest point of contact of the ball socket body with the air bellows support assembly. Measure the distance between those two points.
3. The distance between these two points should be approximately 1/8 inch (3 mm). If not, the steering stop screws must be readjusted.
4. Verify the nearest point of contact of the drag link with the tire. Measure the distance between those two points.
5. The distance should be 1 inch (25 mm) or more. If not, the steering stop screws must be readjusted.
6. This must be done for a full right turn.
7. If readjustment is required:
   a. Remove the swivel stop screw.
   b. Add to the stop screw the required number of washers to obtain the proper measure, tighten the stop screw afterwards. Two washers of different thickness are available: 1/16 inch and 3/16 inch.

6.4.2 L.H. Turn Adjustment

1. Turn steering wheel to the left until the boss on the axle center touches the left stop screw.
2. Verify the nearest point of contact of the ball socket body with the air bellows support assembly. Measure the distance between those two points.
3. The distance between these two points should be approximately 1/8 inch (3 mm). If not, the steering stop screws must be readjusted.
4. Check the stroke of the steering stabilizer cylinder (damper). It should not exceed 12.59 inches (320 mm).
5. This must be done for a full left turn.
6. If readjustment is required:
   a. Remove the swivel stop screw.
   b. Add to the stop screw the required number of washers to obtain the proper measure, tighten the stop screw afterwards. Two washers of different thickness are available: 1/16 inch and 3/16 inch.

> **NOTE**
>
> *If steering angle stoppers are changed, a special procedure is required for readjusting gearbox steering limiter. See paragraph 6.5 ‘’Hydraulic Stop” in this section.*

6.5 HYDRAULIC STOP

> **NOTE**
>
> *Before steering limiter readjustment, verify vehicle wheel alignment and ensure that oil level is checked and that air bleeding is done.*

Refer to *"ZF-Servocom Repair Manual"* annexed at the end of Section 14 *"Steering"* under heading *'Setting and Functional Test.*

6.6 FRONT WHEEL CAMBER

Wheel camber is the number of degrees the top of the wheel tilts outward (positive) or inward (negative) from a vertical angle (Fig. 4).

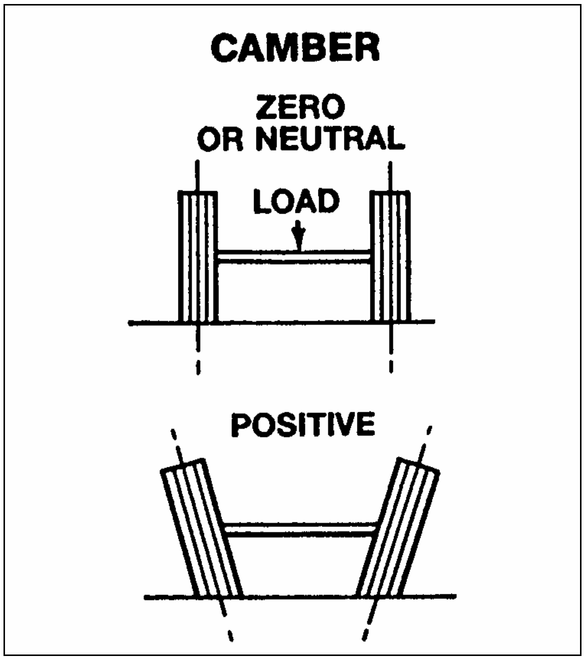


FIGURE 4: CAMBER 10006

The camber angle is not adjustable. Camber variations may be caused by wear at the wheel bearings, steering knuckle pins or by a bent knuckle or sagging axle center. Steering effort is affected by improper camber, and uneven tire wear will result. Excessive positive camber causes an irregular wear of tire at the outer shoulder and excessive negative camber causes wear at the inner shoulder.

6.6.1 Camber Check

For camber specifications, refer to paragraph 8: ''Specifications'' in this section

1. Use an alignment machine to check the camber angle.
2. If camber reading is not in the specifications, check the wheel bearings and repeat the check. If the reading is still not within specifications, verify the steering knuckle pins and axle center.

   See instructions in "DANA SPICER Maintenance Manual Model NDS and Maintenance Manual NDS Axles" annexed at the end of this section.
3. Check the wheel lateral distortion as instructed in Section 13, *"Wheels, Hubs and Tires"* under heading, *"Checking for Distorted Wheel on Vehicle"*. If distortion is excessive, straighten or replace wheel(s).

6.7 FRONT AXLE CASTER

For caster specifications, refer to paragraph 8: ''Specifications'' in this section.

Positive caster is the rearward tilt from the vertical axis of the knuckle pin. Negative caster is the forward tilt from the vertical axis of the knuckle pin (Fig. 5). This vehicle is designed with a positive caster. The purpose of the caster angle is to give a trailing effect. This results in stabilized steering and a tendency for the wheels to return to the straight-ahead position after taking a turn.

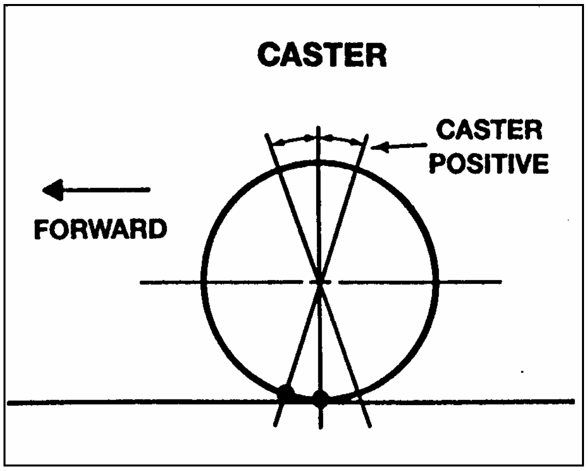


FIGURE 5: CASTER 10007

Excessive caster results in hard steering around corners. A shimmy may also develop when returning to the straight ahead position (pulling out of curves).

Insufficient caster will cause wandering and steering instability. Caster variations may be caused by a bent axle, tilting or distortion of the side suspension supports, damaged radius rod bushings, or unequal tightening of the front and rear suspension support bolts. Incorrect caster must be corrected by replacing the damaged suspension parts. A precision instrument should be used to measure the caster.

NOTE

The caster of this vehicle is factory set and is not adjustable. However, if after replacing damaged parts or in case of improper caster due to irregular setting, the front axle caster needs adjustment; it can be adjusted by means of shims (Prévost #110663) on the left-hand side upper radius rod support in order to obtain minor adjustment.

6.8 FRONT WHEEL TOE-IN

Wheel toe-in is the degree (usually expressed in fractions of an inch) to which the forward part of the vehicle front wheels are closer together than the rear part, measured at wheel centerline height with the wheels in the normal ''straight-ahead'' position of the steering gear.

Incorrect toe-in results in excessive tire wear caused by side slippage and also steering instability with a tendency to wander. Toe-in may be measured from the center of tire tread or from the inside of the tires. Take measurements at both front and rear of axle (see ''A and ''B'' in fig. 6).

When setting toe-in adjustment, the front suspension must be neutralized; that is, all component parts must be in the same relative position when marking the adjustment as they will be when in operation.

To neutralize the suspension, the vehicle must be rolled forward, approximately ten feet.

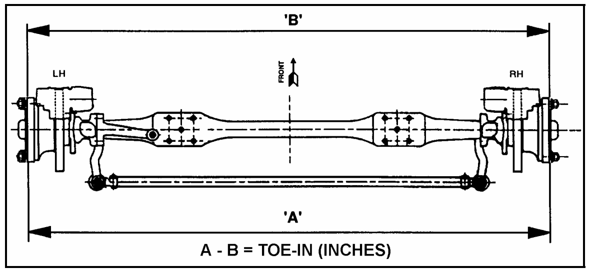


FIGURE 6: TOE-IN MEASUREMENTS 10032

For toe-in specifications, refer to paragraph 8 ''Specifications'' in this section.

By rolling the vehicle forward, all tolerances in the front suspension are taken up and the suspension is then in its normal operating position. Neutralizing the front suspension is extremely important, especially if the vehicle has been jacked up in order to mark the tires. Otherwise, the front wheels will not return to their normal operating position due to the tires gripping the floor surface when the vehicle jack is lowered.

NOTE

''Toe-in'' measurements must be taken at the horizontal axis of the wheel centerline.

6.8.1 Inspection and Adjustment

Before checking front wheel toe-in, first check the camber angles and make the necessary corrections.

1. Measure the toe-in.
2. If the toe-in measurement is not within the specified tolerance, carry out the following procedure :
   a. Loosen the pinch bolt nuts and bolts on each tie rod end.
   b. Turn the tie rod until the specified toe-in measurement is obtained.
   c. Tighten the pinch bolt nuts alternately and progressively to 65-75 lbf-ft (88-102 Nm), thus securing all tie rod joints.

7. TROUBLESHOOTING

CONDITION	CAUSE	CORRECTION
Tires wear out quickly or have uneven tire tread wear.	1. Tires have incorrect air pressure. 2. Tires out-of-balance. 3. Incorrect tag axle alignment. 4. Incorrect toe-in setting. 5. Incorrect steering arm geometry.	1. Put specified air pressure in tires. 2. Balance or replace tires. 3. Align tag axle. 4. Adjust toe-in specified setting. 5. Service steering system as necessary.
Vehicle is hard to steer.	1. Low pressure in the power steering system. 2. Steering gear not assembled correctly. 3. Steering linkage needs lubrication. 4. King pins binding. 5. Incorrect steering arm geometry. 6. Caster improperly adjusted. 7. Tie rod ends hard to move. 8. Worn thrust bearing.	1. Repair power steering system. 2. Assemble steering gear correctly. 3. Lubricate steering linkage. 4. Replace king pins. 5. Service steering system as necessary. 6. Adjust caster as necessary. 7. Replace tie rod ends. 8. Replace thrust bearing.
Bent or broken steering arm, steering top lever or tie rod assembly.	1. Too much pressure in the power steering system. 2. Cut-off pressure of the power steering system improperly adjusted. 3. Vehicle not powered on correctly. 4. Power steering system not installed correctly.	1. Replace damaged part(s), adjust power steering system to specified pressure. 2. Make sure vehicle is powered on correctly. 3. Correctly install the power steering system. 4. Correctly install the power steering system.
Worn or broken steering ball stud.	1. Drag link fasteners tightened past specified torque. 2. Lack of lubrication or incorrect lubricant. 3. Power steering stops improperly adjusted.	1. Replace damaged part(s), tighten drag link fasteners to specified torque. 2. Lubricate linkage with specified lubricant. 3. Adjust stops to specified dimension.
Worn king pins and knuckle bushings.	1. Worn or missing seals and gaskets. 2. Incorrect lubricant. 3. Axle not lubricated at scheduled frequency. 4. Incorrect lubrication procedures. 5. Lubrication schedule does not match operating conditions.	1. Replace damaged part(s), replace seals and gaskets. 2. Lubricate axle with specified lubricant. 3. Lubricate axle at scheduled frequency. 4. Use correct lubrication schedule to match operating conditions. 5. Change lubrication schedule to match operating conditions.
Vibration or shimmy of front axle during operation.	1. Caster not adjusted properly. 2. Wheels and/or tires out-of balance. 3. Worn steering stabilizer cylinder.	1. Adjust caster. 2. Balance or replace wheels and/or tires. 3. Replace steering stabilizer cylinder.

8. SPECIFICATIONS

Front Axle

Make .... DANA SPICER EUROPE

Model .... NDS

Front Track .... 84.4 inches (2 145 mm)

Rated load capacity .... 16,500 lbs (7 500 kg)

Torque specifications

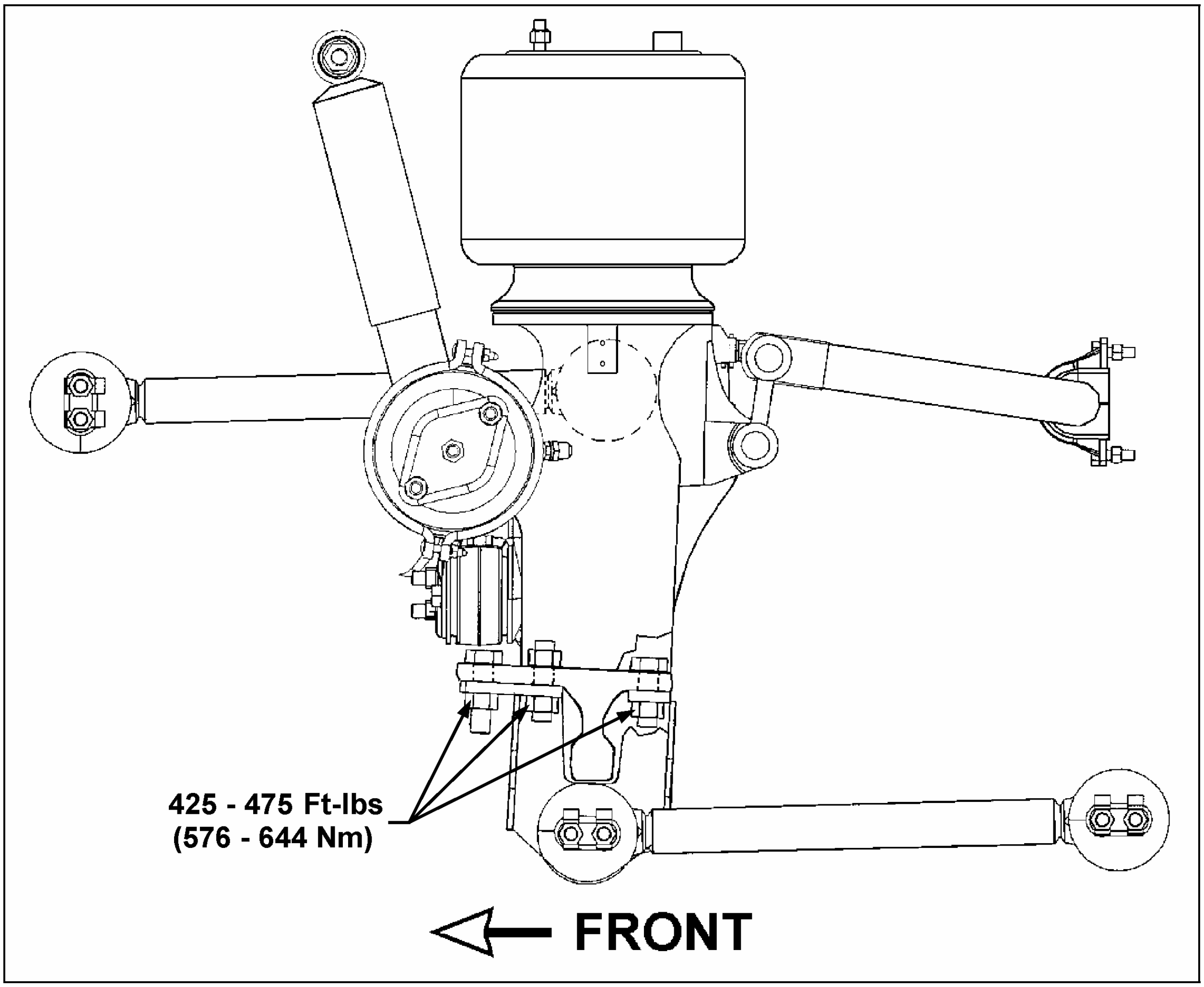


FIGURE 7: AIR BELLOWS MOUNTING SUPPORT AND AXLE 10030

For more torque specifications, see 'Dana Spicer Maintenance Manual NDS Axles and Maintenance Manual Model NDS'' annexed at the end of this section.

FRONT WHEEL ALIGNMENT SPECIFICATIONS			
Front Wheel Alignment	**Minimal**	**Nominal**	**Maximal**
Camber, (degrees) R.H. and L.H. *	-0.250	0.125	0.375
Caster, (degrees) R.H. and L.H.	2	2.75	3.5
Toe-in (A minus B), (degrees)	0.08	0.13	0.17

NOTE
Camber angle changes with loading. The given numbers are for an empty vehicle.

SECTION 12: BRAKE AND AIR SYSTEM

CONTENTS

ILLUSTRATIONS

1. AIR SYSTEM

The basic air system consists of an air compressor, reservoirs, valves, filters and interconnecting lines and hoses. It provides a means for braking; operating controls and accessories, and suspension (refer to Section 16, *"Suspension"*, for complete information on suspension description and maintenance). An air system schematic diagram is annexed in the technical publications box provided with the vehicle for better understanding of the system.

2. BRAKES

This vehicle uses both the service brake and emergency/parking brake. The service brake air system is divided into two independent circuits to isolate front brakes from rear brakes, thus providing safe braking in the event that one circuit fails. Front axle brakes operate from the secondary air system, while brakes on both the drive axle and tag axle operate from the primary air system.

NOTE
The tag axle service brake operates only when the axle is in normal ride position (loaded and down).

Furthermore, the brake application or release, which is speed up by a pneumatic relay valve (R-12), will start with the rear axles and will be followed by the front axle, thus providing uniform braking on a slippery road. The vehicle is also equipped with an Anti-Lock Braking System (ABS), which is detailed later in this section.

The drive and tag axles are provided with spring-loaded emergency/parking brakes, which are applied automatically whenever the control valve supply pressure drops below 40 psi (275 kPa).

3. AIR RESERVOIRS

The air coming from the air dryer is first forwarded to the wet air tank, then to the primary (for the primary brake system), secondary (for the secondary brake system), and accessory (for the pneumatic accessories) air tanks (Fig. 1 & 2).

Two additional air reservoirs may be installed on the vehicle: the kneeling air tank and ZF transmission air tank.

3.1 MAINTENANCE

Ensure that the wet (main) air tank is purged during pre-starting inspection. In addition, it is good practice to purge this reservoir at the end of every working day. The remaining reservoirs must be purged at every 12,500 miles (or 20 000 km) or once every year, whichever comes first.

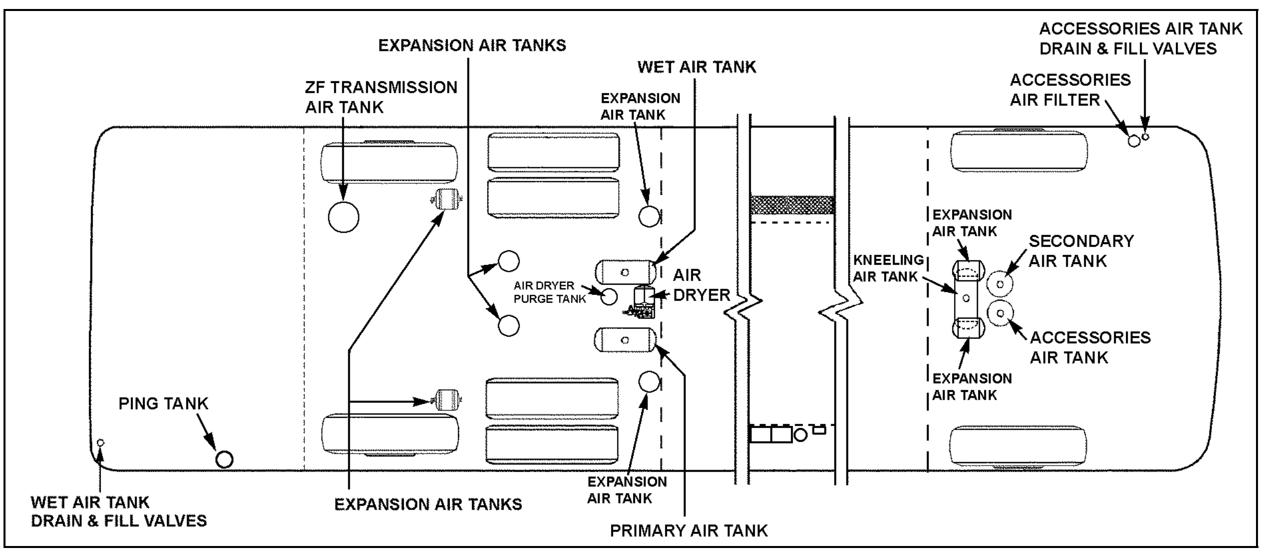


FIGURE 1: IFS AIR RESERVOIRS LOCATION 12212

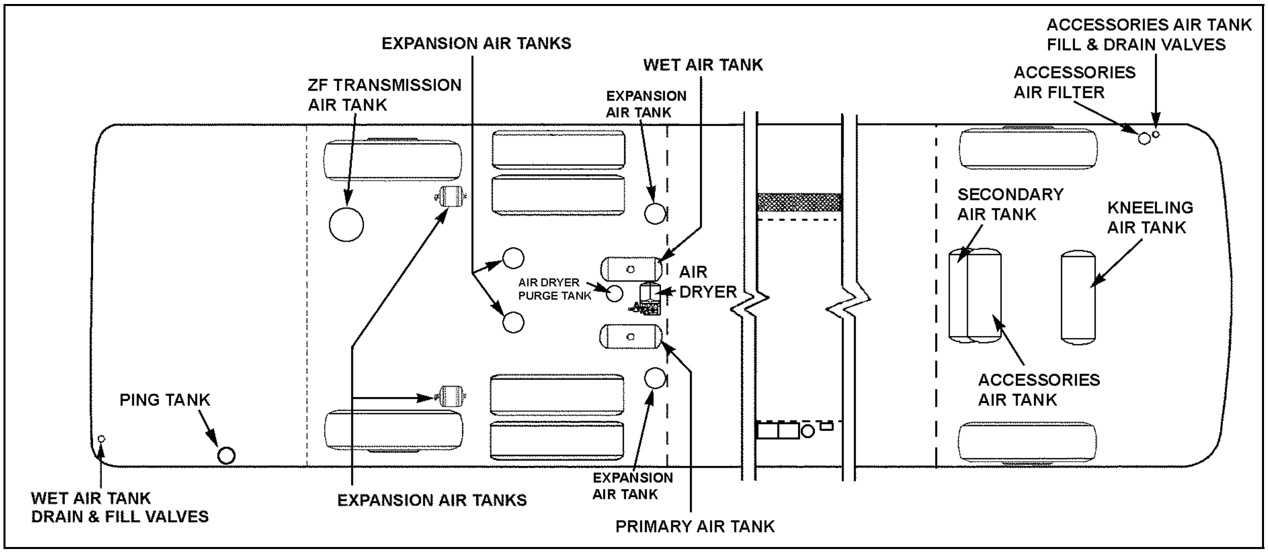


FIGURE 2: I-BEAM FRONT SUSPENSION AIR RESERVOIRS LOCATION 12213

3.1.1 Wet (Main) Air Tank

This reservoir, located above the L.H. wheel of drive axle in the rear wheelhousing, is provided with a bottom drain valve. A recommended purge using the bottom drain valve should be done every 12,500 miles (20 000 km), or once a year, whichever comes first.

3.1.2 Primary Air Tank

This reservoir is located above the R.H. wheel of the drive axle and is provided with a bottom drain valve (Fig. 1 & 2). It is recommended to purge the primary air tank every 12,500 miles (20 000 km) or once a year, whichever comes first.

3.1.3 Accessory Air Tank

The accessory air tank is installed close to the front axle and is provided with a bottom drain valve (Fig. 1 & 2).

Purge the reservoir by it's drain valve every 12,500 miles (20 000 km) or once a year, whichever comes first.

3.1.4 ZF transmission Air Tank

Installed on vehicles equipped with this option, this reservoir is located in the rear wheelhousing, beside the transmission on the L.H. side of the vehicle (Fig. 1 & 2). It is provided with a bottom drain valve.

Purge this reservoir every 12,500 miles (20 000 km) or once a year, whichever comes first.

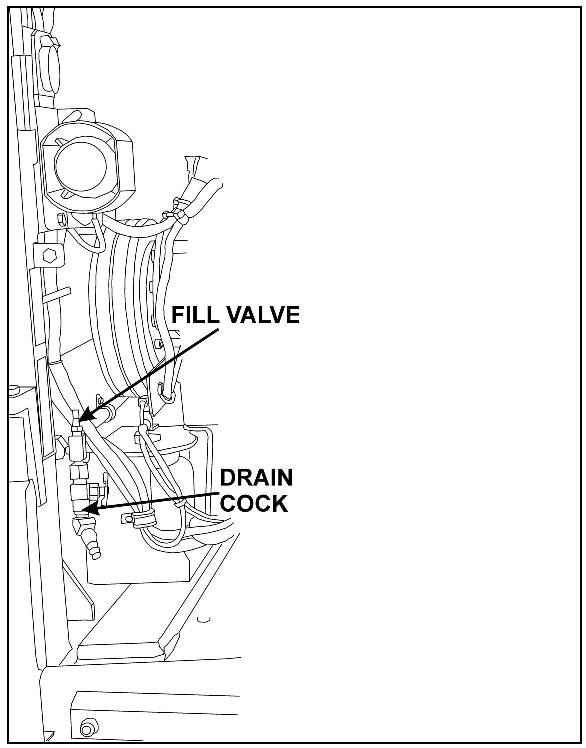


FIGURE 3: REAR VALVE LOCATION (TYPICAL) 12211

3.1.5 Secondary Air Tank

This tank is located in the front wheelhousing, behind the steering axle (Fig. 1 & 2). It is provided with a bottom drain valve.

Purge this reservoir every 12,500 miles (20 000 km) or once a year, whichever comes first.

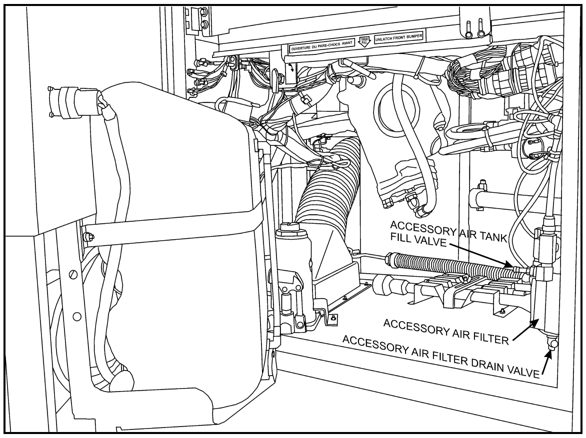


FIGURE 4: FRONT SERVICE COMPARTMENT 12210

3.1.6 Kneeling Air Tank

The kneeling air tank is installed on vehicles equipped with the Kneeling or Hi/Low-Buoy options. It is located in the front wheelhousing (Fig. 1 & 2), and is provided with a bottom drain valve.

3.2 PING TANK

The ping tank may be located behind the tag axle or in the engine compartment; in this case, it is accessible through the engine compartment R.H. side door. It is used to dissipate heat and to reduce noise produced by the air compressor cycling on and off.

4. AIR SYSTEM EMERGENCY FILL VALVES

All vehicles come equipped with two emergency fill valves that enable system pressurization by an external source such as an air compressor. The rear valve is located in the engine compartment and is accessible from engine R.H. side door (Fig 3). It is positioned close to the door opening.

⚠ **CAUTION** ⚠

Maximum allowable air pressure is 125 psi (860 kPa). Air filled through these two points will pass through the standard air filtering system provided by Prevost. Do not fill system by any point on the system.

The front valve is located in the front service compartment close to R.H. side of door frame (Fig. 4).

These two air system emergency fill valves are fitted with the same valve stems as standard tires, and can be filled by any standard external air supply line.

The rear air system emergency fill valve will supply air for all systems (brakes, suspension and accessories) while the front fill valve will supply air for accessories only.

5. ACCESSORY AIR FILTER

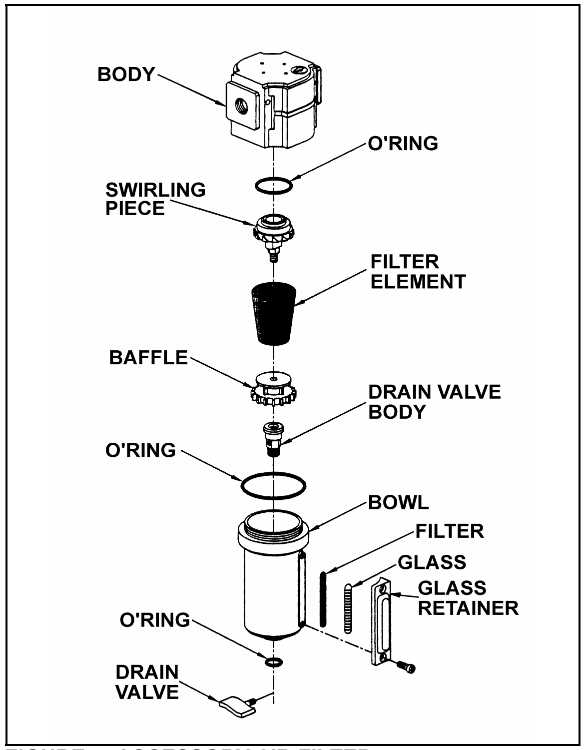


FIGURE 5: ACCESSORY AIR FILTER 12088

This filter is located inside the front service compartment (Fig. 4). Its main function consists in filtering the air supplied to the accessory air system, when connected to an external supply line. Ensure filter is purged whenever supplying the system with an external air line and at least every 12,500 miles (20 000 km). To purge, open drain valve (Fig. 4), let the moisture come out, then close the drain valve.

5.1 FILTER ELEMENT REPLACEMENT

Replace filter element whichever of the following occurs first: every 100,000 miles (160 000 km), every two years, or whenever differential pressure exceeds 15 psi (105 kPa) between filter inlet and outlet ports. Check condition of all three O’rings for damage. Replace when necessary (Fig. 5).

5.2 CLEANING

Clean filter body and bowl with a warm water and soap solution. Rinse thoroughly with clean water. Blow dry with compressed air making sure the air stream is moisture free and clean. Pay particular attention to the internal passages. Inspect all parts for damage and replace if necessary.

6. AIR GAUGES (PRIMARY, SECONDARY AND ACCESSORY)

The air pressure gauges, located on the dashboard (see *"Operator's Manual"*), are connected to the DC-4 double check valve, located on the pneumatic accessory panel in the front service compartment.

The latter is connected to the air lines running from the primary and secondary air tanks, as shown on the pneumatic system diagram provided in the technical publications box. The accessory air gauge is connected to the accessory air tank using the drain valve connector. The vehicle should never be set in motion until the buzzer alarm and warning lights turn off, i.e. when air pressure registers at least 66 psi (455 kPa). Moreover, if pressure drops below 66 psi (455 kPa), the *"Low air pressure"* warning lights will turn on, and the *"Low air pressure"* buzzer will sound. Stop the vehicle immediately, determine and correct the cause(s) of pressure loss. Check the gauges regularly with an accurate test gauge. Replace the gauge with a new unit if there is a difference of 4 psi (27 kPa) or more in the reading.

7. AIR FILTER/DRYER

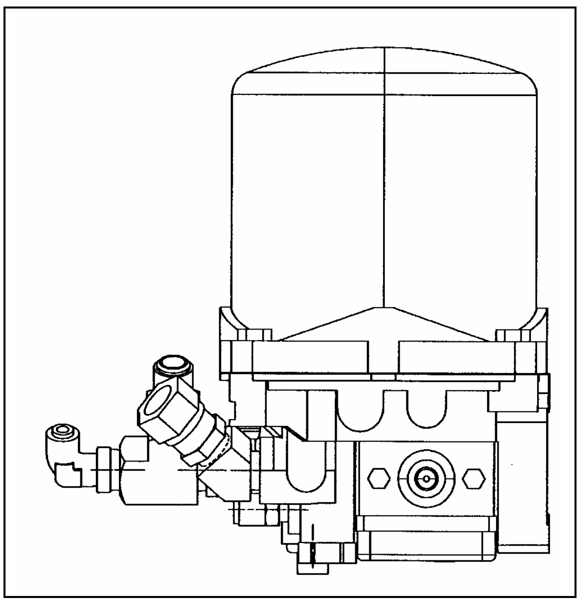


FIGURE 6: HALDEX AIR FILTER DRYER 12194

The air filter/dryer is located in front of rear wheelhousing above drive axle (Fig. 1, 2 & 6). Its purpose is to remove moisture that could damage the air system before the air enters the system reservoir. The air filter/dryer also filters the air to remove dirt, compressor oil, and other contaminants that can damage the system. Change cartridge every 100,000 miles (160 000 km) or once every two years, whichever comes first. The air dryer may be purged for maintenance purposes using the remote drain valve located in the engine compartment and accessible through the engine compartment R.H. side door. The valve is positioned close to the L.H. side of door opening (Fig. 3). The air filter/dryer has a built-in governor to maintain the system between 108 psig and 123 psig.

Maintenance and repair information is supplied in the maintenance information annexed to this section.

7.1 AIR FILTER/DRYER PURGE TANK

A tank is supplied to purge the air filter/dryer to remove moisture and contaminants.

8. AIR LINES

Copper piping, nylon-reinforced tubing, and flexible hoses are used to connect the units in the pneumatic system, including air brake system, suspension system and accessory systems such as the entrance door, fresh air damper cylinder, air horns, etc. Furthermore, the nylon tubing is color coded to ease identification. Refer to the following table for the complete color identification code. Service instructions for each type of air line are also provided under the applicable headings.

Color	Circuit
Red	Secondary
Green	Primary and Delivery
Yellow	Parking Brake
Blue	Suspension
Black	Accessory
Brown	Trailer Brake

8.1 COPPER PIPING

A heat dissipation copper piping assembly is used to dissipate the heat coming from the compressor before it enters the air filter/dryer.

Connections should be checked for leakage at least every 6,250 miles (10 000 km) or twice a year, whichever comes first. Tighten or replace when necessary. When replacing copper piping, the parts must be free of burrs, copper cuttings, and dirt. Blow out piping with compressed air. Any such particles will destroy sealing seats in air control units. Also, new piping must be the same size as the old one.

8.2 FLEXIBLE HOSES

A flexible hose is used normally where it is impractical to use copper or nylon tubing due to constant flexing during operation, such as brake chamber hoses. Hose connections should be tested for leakage at least every 6,250 miles (10 000 km) or twice a year, whichever comes first and tightened or replaced if necessary. Any hose which is chafed, worn or kinked should be replaced.

Teflon-braided stainless steel hoses used in the engine compartment must be replaced only with similar hoses.

8.3 NYLON TUBING

Nylon tubing is used for air lines in areas where usage of this material is suitable. Nylon tubing is flexible, durable, and weather resistant. When replacing an air line, use nylon tubing only where it has been used previously.

Nylon air lines must never be routed in areas where temperature could exceed 200°F (93°C).

⚠ CAUTION ⚠

Nylon air lines should be used to replace existing nylon lines only, and must comply with the color identification code to ease pneumatic system troubleshooting.

8.4 AIR LINE OPERATING TEST

If any trouble symptom such as slow brake application or slow brake release indicates a restricted or clogged air line, disconnect the suspected tube or hose at both ends and blow through it to clear the passage.

Inspect tubing and hose for partial restriction that may be caused by dents or kinks. If such a condition is found, the tubing or hose should be replaced.

8.5 AIR LINE LEAKAGE TEST

With air system fully charged and the brakes applied, coat all tubing and hose connections with a soapy solution to check for air leakage. No leakage is permitted. Leakage can sometimes be corrected by tightening the connection. If this fails to correct the leakage, new fittings, nylon tubing, copper tubing, teflon-braided stainless steel and flexible hoses must be installed as applicable.

8.6 MAINTENANCE

Inspect all lines for cuts, swelling, kinks or other damage or deterioration. Check for lines being pinched by other components. Retaining clips and ties must be in place.

Any support or bracket should be in good condition and mounted firmly in position. Hose spring guards should be in usable condition and not distorted. Particular attention should be given to long lines. Any supporting component (clips, ties, grommets, etc.) must be secured to prevent against unnecessary vibration and eventual loosening of connection. Any detected leak should be repaired. Be sure nylon lines are not near areas of intense heat. Check for any missing grommets or loose material where chafing or cutting may occur. Replace with new material as required. In general, lines should be securely located in position and free from any binding condition which would hinder air flow.

9. PRESSURE REGULATING VALVES

There is one pressure regulator for the belt tensioners, and an optional one installed on vehicles equipped with the World transmission output retarder.

The belt tensioner pressure regulating valve is located in the engine compartment above the doors and is used to limit the air pressure in belt tensioners to 50 ± 2 psi (345 ± 15 kPa) (Fig. 7).

The optional regulator is located near the Webasto in the engine compartment (accessible through the engine R.H. side door). It is used for transmission retarder and should be adjusted to 80 ± 3 psi (550 ± 20 kPa).

	Air Pressure (psi)	Air Pressure (kPa)
Belt Tensioner	**Series 60** 50	**Series 60** 345
Retarder	80 ± 3	550 ± 20

9.1 MAINTENANCE

Every 100,000 miles (160 000 km) or once every two years, whichever comes first, disassemble the regulating valve and wash all metal parts in a cleaning solvent (Fig. 7). Examine the diaphragm; if cracked, worn or damaged, replace with a new one. If the valve is excessively grooved or pitted, it should be replaced. Replace any other part that appears worn or damaged. After reassembly, adjust to the specified pressure setting and check for air leakage.

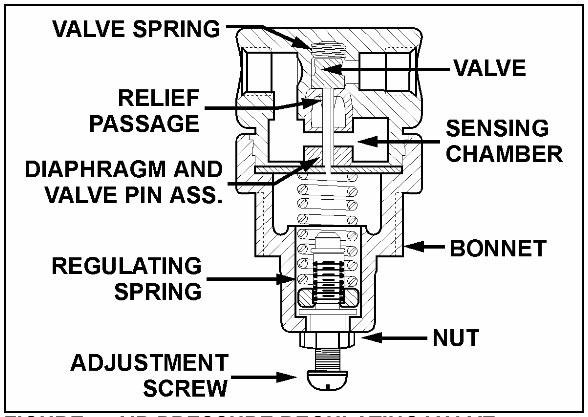


FIGURE 7: AIR PRESSURE REGULATING VALVE 12141B

9.2 PRESSURE SETTING PROCEDURE

Remove the dust cap from the pressure check valve (Fig. 8). Attach a pressure gauge at this port and check the pressure reading. If the pressure reading is incorrect, adjust as follows:

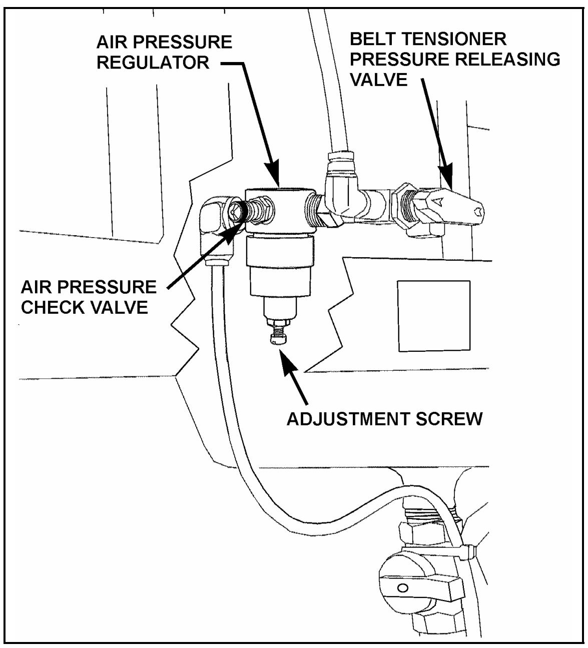


FIGURE 8: AIR PRESSURE REGULATOR 12200

1. Loosen the locking nut, turn the adjustment screw counterclockwise to decrease pressure by approximately 10 psi (70 kPa) below the required pressure.
2. Turn the adjustment screw clockwise to increase the pressure slowly until the required pressure setting is reached. Tighten the locking nut.
3. Remove pressure gauge and replace dust cap on the air pressure check valve.

10. AIR COMPRESSOR (BA-921)

The air compressor is located on starter side of the engine, on the rear of the engine gear case (Fig. 9). Its function is to provide and maintain air under pressure to operate devices in brake and air systems.

This air compressor also drives the engine fuel pump which is bolted to the rear end of the compressor. The compressor crankshaft is designed to accept a drive coupling which is placed between the compressor and fuel pump.

The compressor is driven by the bull gear, and is water cooled. Engine coolant is fed to the compressor through a flexible hose tapped into the block water jacket and connected to the rear of the compressor. Coolant returns from the top of the compressor (governor side) through a flexible hose to the engine pump.

The air is taken from the air intake manifold and entered in the top of the compressor. The compressed air is pushed into the discharge line located on side of the compressor, which sends air to the air dryer. Lubricating oil is supplied to the compressor by a line from the cylinder block oil gallery connected to the air compressor. Lubricating oil returns to the engine crankcase through the air compressor drive assembly.

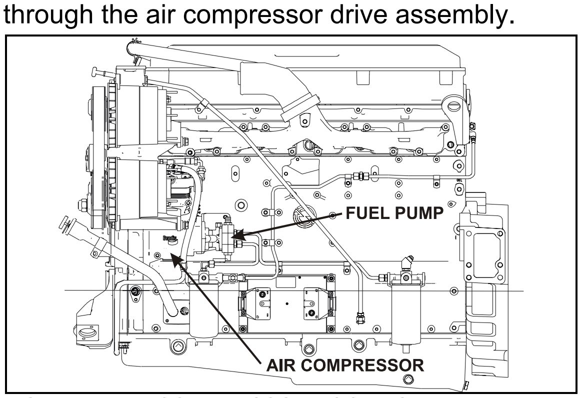


FIGURE 9: AIR COMPRESSOR LOCATION 03061

Maintenance and repair information on the Bendix BA-921 air compressor is supplied in the applicable booklet annexed to this section under reference number SD-01-676.

10.1 COMPRESSOR REMOVAL AND INSTALLATION

1. Exhaust compressed air from air system by opening the drain valve of each air tank.
2. Drain the engine cooling system. See Section 5: "*Cooling System*".
3. Identify and disconnect all air, coolant and oil lines from the compressor assembly.
4. Access the compressor by the engine R.H. side compartment. Remove the four compressor mounting bolts and the two fuel pump support bracket bolts.
5. Slide air compressor rearward to disengage the hub from coupling. Remove the air compressor.

Reverse removal procedure for installation.

11. EMERGENCY/PARKING BRAKE CONTROL VALVE (PP-1)

A push-pull control valve mounted on the L.H. lateral console is provided for parking brake application or release. The spring brakes are self-actuated whenever the control valve supply pressure drops below 40 psi (275 kPa). In the UP position, brakes are ON. In the DOWN position, brakes are RELEASED. A protective case around the knob prevents accidentally releasing the brakes.

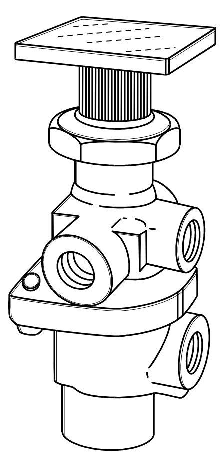


FIGURE 10: PP-1 12142

Maintenance and repair information on this valve is supplied in the applicable booklet annexed to this section under reference number SD-03-3611.

Remove the valve the following way:

1. Drain the air system.
2. Access this valve by tearing out the finishing panel, which holds the controls in place (Fig. 10).
3. Disconnect the air tubes.
4. Remove the retaining screws.
5. Service or replace the valve.
6. Installation is the reverse of removal.

12. EMERGENCY / PARKING BRAKE OVERRULE CONTROL VALVE (RD-3)

A RD-3 control valve is used with the optional parking brake overrule system. In the case of self-application of spring brakes due to a pressure drop, the brakes can be released by holding down this control valve. Maintenance and repair information on this valve is supplied in the applicable booklet annexed to this section under reference number SD-03-3611.

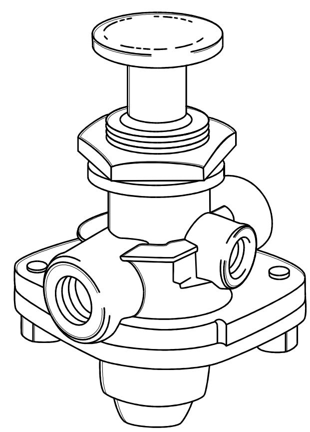


FIGURE 11: RD-3 12136

13. FLIP-FLOP CONTROL VALVE (TW-1)

A flip-flop control valve mounted on the L.H. lateral console is provided to unload tag axle air springs (and to lift tag axle if vehicle is so equipped). Another one controls the low-buoy system (coaches only). It is a manually operated "on-off" valve. Maintenance and repair information on this valve is supplied in the applicable booklet annexed to this section under reference number SD-03-3602.

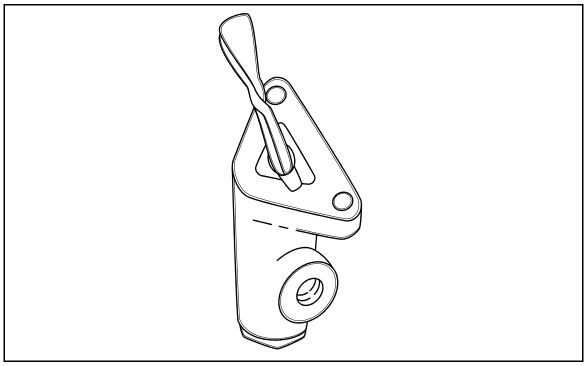


FIGURE 12: TW-1 12138

14. DUAL BRAKE APPLICATION VALVE (E-10P)

The E-10P dual brake valve is a floor mounted, foot-operated type brake valve with two separate supply and delivery circuits. This valve is located in the front service compartment (Fig. 13).

14.1 BRAKE PEDAL ADJUSTMENT

After brake pedal replacement or repair, adjust the pedal to its proper position according to the following procedure:

1. Replace the linkage, loosen threaded rod lock nuts and screw or unscrew the threaded adjustment rod in order to obtain a 45° brake pedal inclination (Fig. 13).
2. Tighten threaded rod lock nuts.

14.1.1 Maintenance

Maintenance and repair information on the E-10P dual brake application valve is supplied in the applicable booklet annexed to this section under reference number SD-03-830.

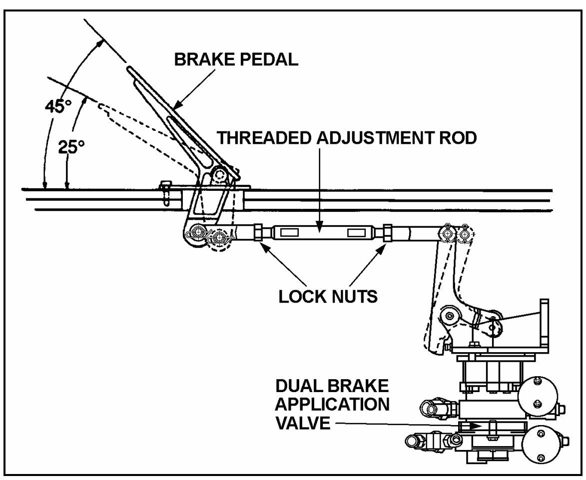


FIGURE 13: BRAKE PEDAL ADJUSTMENT 12208

15. STOPLIGHT SWITCHES

Two electro-pneumatic stoplight switches are mounted on the dual brake application valve (E-12). The upper one is used for the primary air circuit while the lower one is used for the secondary air circuit. Both switches are connected in parallel and have the same purpose, i.e. completing the electrical circuit and lighting the stoplights when a brake application is made. The upper switch (AC Delco) is designed to close its contact between 2 psi and 4 psi (14 kPa to 28 kPa) (Fig. 14), while the lower one (Bendix, SL-5) closes its contact at 4 psi (28 kPa) (Fig. 15). The switches are not serviceable items; if found defective, the complete unit must be replaced.

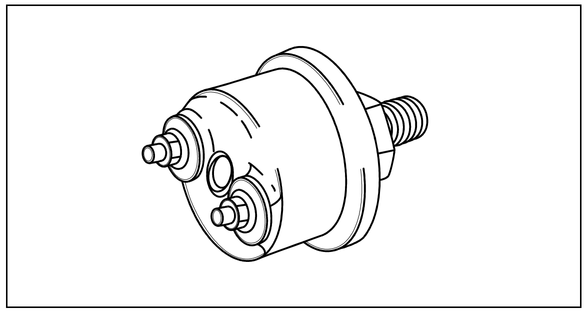


FIGURE 14: **DELCO SWITCH** 12139

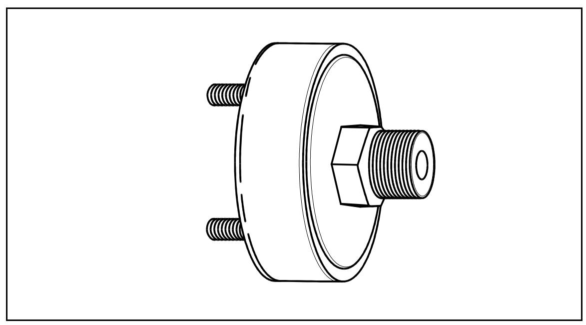


FIGURE 15: BENDIX SWITCH 12140

16. PARKING BRAKE ALARM SWITCH

Refer to the appropriate annexed booklet (Bendix, SL-5 Stop Light Switch; reference no. SD-06-2501).

The parking brake alarm uses the same switch as the stoplights. It is mounted on the spring brake valve and operates in conjunction with a NC relay to sound a warning alarm by completing the electrical circuit when the ignition key is turned OFF with parking brake released.

17. BRAKE RELAY VALVE (R-12 & R-14)

The primary air system includes three brake relay valves being supplied by the dual brake valve, and which function is to speed up the application and release of the service brakes.

One Wabco R-14 valve located in the rear underframe supplies the drive axle service brake air line, while the other two R-12 valves supply independently both the tag axle right and left service brake air line and act as interlock valves. These valves are accessible from under the vehicle at the level of the tag axle. Maintenance and repair information on these valves is supplied in the applicable booklet annexed to this section under reference number SD-03-1064.

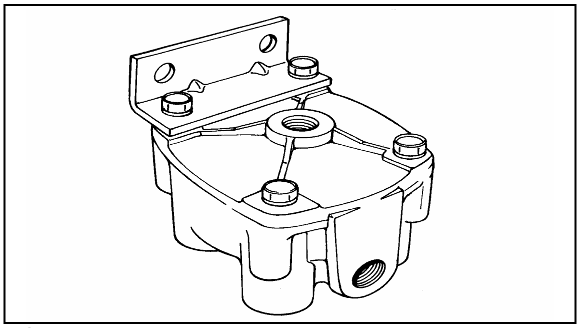


FIGURE 16: R-12 12074

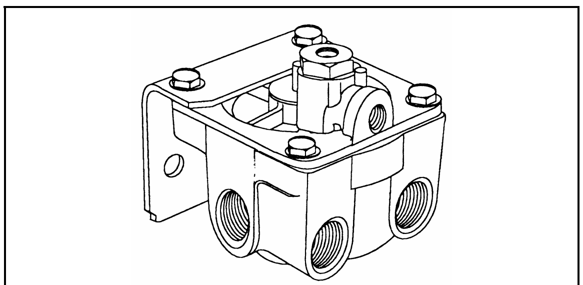


FIGURE 17: R-14 12207

18. QUICK RELEASE VALVES (QR-1)

The quick release valve is located on the front axle service brakes air line and permit rapid exhaust of air pressure from brakes, thus decreasing the brake release time.

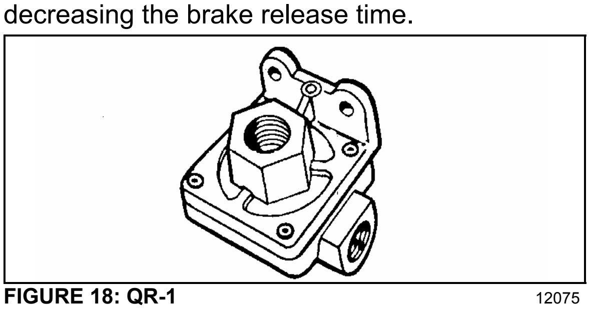


FIGURE 18: QR-1 12075

Maintenance and repair information on this valve is supplied in the applicable booklet annexed to this section under reference number SD-03-901.

19. SPRING BRAKE VALVE (SR-7)

The spring brake valve is located in the rear underframe. The SR-7 Modulating Valve is used in conjunction with a dual air brake system and spring brake actuator and performs the following functions:

- Provides a rapid application of the spring brake actuator when parking.
- Modulates the spring brake actuator application using the dual brake valve should a primary failure occur in the service brake system.
- Prevents compounding of service and spring forces.

Maintenance and repair information on the spring brake valve is supplied in the applicable booklet annexed to this section under reference number SD-03-9043.

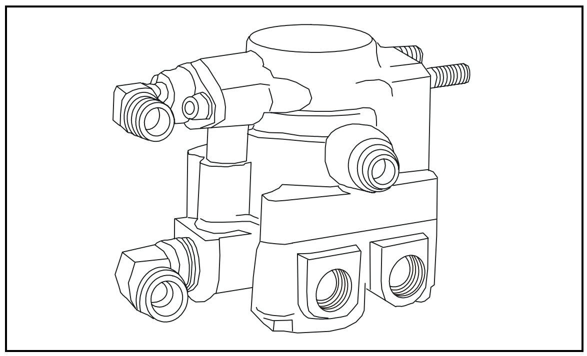


FIGURE 19: SR-7 12206

20. PRESSURE PROTECTION VALVE (PR-4)

Maintenance and repair information on the pressure protection valve is supplied in the applicable booklet annexed to this section under reference number SD-03-2010.

The air system includes two pressure protection valves (Fig. 20). One valve is installed on the manifold block, and insures at all times a minimum pressure of 70 psi (482 kPa) in the suspension air system in the event that a pressure drop occurs in either the suspension air system or accessory air system. This valve is located in the front service compartment beside the air filter.

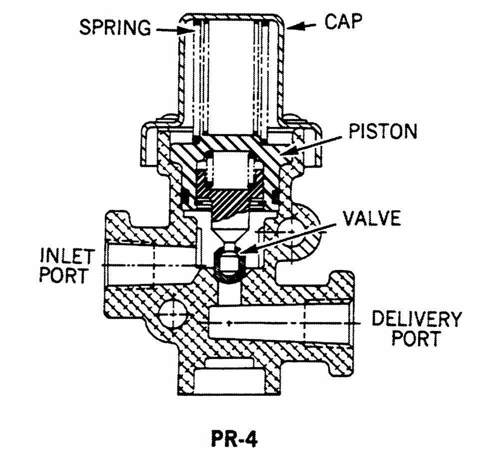


FIGURE 20: PR-4 12174

The other valve is installed on the accessory air tank, and insures a minimum pressure of 70 psi (482 kPa) in the accessory air system in the event that a pressure drop occurs in either the suspension air system or braking air system (refer to Fig. 1 & 2 for accessory air tank location).

21. LOW PRESSURE INDICATOR (LP-3)

Maintenance and repair information on the low pressure indicators is supplied in the applicable booklet annexed to this section under reference number SD-06-1600.

The air system includes two low pressure switches (Fig. 21), both located on the pneumatic accessory panel in the front service compartment. One serves for the parking brake signal, its pressure setting is 66 ± 6 psi (455 ± 40 kPa). The remaining pressure switch monitors the parking brake telltale panel indicator; its pressure setting is 30 psi (205 kPa).

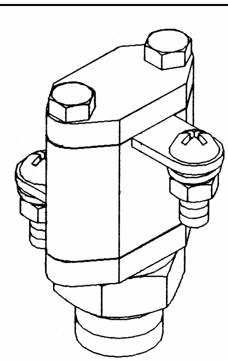


FIGURE 21: LP-3 12214

22. SHUTTLE-TYPE DOUBLE CHECK VALVE (DC-4)

Maintenance and repair information on the shuttle-type double check valve is supplied in the applicable booklet annexed to this section under reference number SD-03-2202.

The double check valve is located on the pneumatic accessory panel in the front service compartment. In the event of a pressure drop in either the primary or secondary system, this unit will protect the emergency /parking brake control valve and the intact portion of the air system from pressure loss.

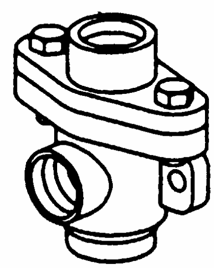


FIGURE 22: DC-4 12134

23. EMERGENCY DOOR OPENING VALVES

Two emergency door opening three-way valves are installed on coaches. One is in the front service compartment, readily accessible. The other one is on the R.H. side lateral console, close to the entrance door. When used, the valve releases pressure in the door locking cylinder, thus allowing the door to be manually opened.

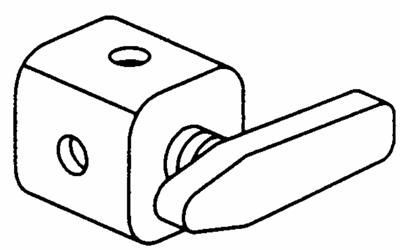


FIGURE 23: THREE-WAY VALVE 12186

24. AIR HORN VALVE

The air horn valve is located in the L.H. front service compartment. The air horn button is on the center of the steering wheel. Refer to section 23 “ACCESSORIES” for more information.

25. AIR SYSTEM TROUBLESHOOTING

The following list has been designed to help in troubleshooting some of the most common problems in the air system and main causes. For air brakes troubleshooting, refer to "*Air Brakes Troubleshooting*" in this section. For more troubleshooting information, refer to the manufacturer's brochures annexed to this section.

Air pressure doesn't rise to, or doesn't maintain, a normal setting:

- Defective air gauge (registering incorrectly).
- Excessive leaking in air system.
- Reservoir drain cock open.
- Governor poorly adjusted or defective.
- Defective compressor.
- Worn compressor or excessive wear on piston and/or ring.
- Air pressure rises to normal setting too slowly.

Excessive leaking in air system:

- Clogged engine air cleaner.
- Worn compressor or excessive wear on piston and/or ring.
- Engine speed too low.

Air pressure rises above a normal setting:

- Defective air gauge (registering incorrectly).
- Governor poorly adjusted or defective.
- Restriction in line between governor and compressor unloading mechanism.

Air pressure drops quickly when engine is stopped:

- Leaks in compressor discharge valve.
- Leaks in governor.
- Leaks in air lines.
- Leaks in air system valves.

26. BRAKE OPERATION

The vehicle braking system uses both service and parking air-operated brakes. The air system is divided into two independent circuits to isolate the front axle brakes and the rear axle brakes (drive and tag), thus providing safe brake operation in the event that one circuit of the system fails. The primary circuit is connected to the drive and tag axle brakes, while the secondary circuit is connected to the front axle brakes. The tag axle service brakes operate only when the axle is in the normal driving (loaded) position. The spring-type emergency brakes are mounted on the drive and tag axles, and will apply automatically if primary system pressure falls below 40 psi (276 kPa).

Furthermore, brake application or release, which is speed up by a pneumatic relay valve (R-12), will start with the rear axles and be followed by the front axle, thus providing uniform braking on a slippery surface. The vehicle is also equipped with an Anti-lock Brake System (ABS), detailed later in this section.

Brake and air system maintenance consists of periodic inspections. Check all parts for damage and brake adjustment (refer to subsequent headings in this section for more details). Ensure all fasteners are tight (refer to "*Specifications*" for recommended tightening torques).

27. AIR BRAKES

27.1 DISC BRAKES

Knorr-Bremse SB7000 disc brakes are used on all axles. The front and drive axle discs are actuated by 24 square inch effective area air brake chambers, while on tag axle, the brake chambers have a 16 square inch effective area for service brake and a 16 square inch effective area for emergency/parking brakes. The *Knorr-Bremse SB7000* brakes are supplied with automatic clearance (slack) adjusters as standard equipment for easier adjustment. For more information on disc brake components and maintenance, refer to the manufacturer's brochure at the end of this section.

27.1.1 Disc Brake Pads

Brake pads have to be checked on a regular basis depending on the vehicle operation. The remaining thickness of the pads should never be less than 3/32 in (2 mm). To check pad condition without removing the wheel, verify the position of guide bushing (6) relatively to guide sleeve (4) (see Fig. 24). When guide sleeve is in alignment with guide bushing, brake pad thickness has to be checked more precisely with the wheel removed. When replacing brake pads, all four pads on an axle have to be changed at the same time. There is no inner or outer pad, since all pads are the same. Once removed, worn pads should be replaced in their original position.

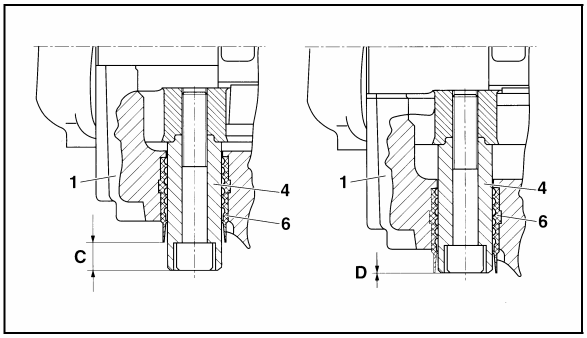


FIGURE 24: BRAKE PAD CHECK 12117

27.1.2 Caliper Maintenance

Use the following procedure for brake calipers servicing. The procedure must be followed in proper sequence to ensure that only needed repairs or replacements are performed on calipers. Problems such as hot brakes or cracked rotors may be effects of sticking calipers, too-small clearance between rotor and pad or possible trapped air pressure in the brake chamber. If any of these symptoms occur, perform this procedure before replacing the rotor to ensure the cause of the problem is properly solved.

1. Check for presence of residual pressure:

To check if there is any residual air pressure in the brake chamber, make four or five brake applications, then try to turn the wheel manually, if the wheel does not turn, use a wrench to crack the air line and listen for trapped air in the brake chamber then try to turn the wheel manually again. If you find trapped air in the brake booster, ensure that all pneumatic components in the braking system are functioning properly.

NOTE
A residual pressure of 2-3 PSI in the system is sufficient to prevent the brakes from releasing. Also the stop light switch can operate with as little as 1 PSI, therefore an illuminated brake light does not mean brakes are dragging.

2. Pad to rotor clearance inspection:

Remove clip and washer (26 & 45, Fig. 25), push down retainer bar (11), pull out pin (44) and remove retainer bar. Push caliper toward actuator (center of vehicle) for maximum clearance.

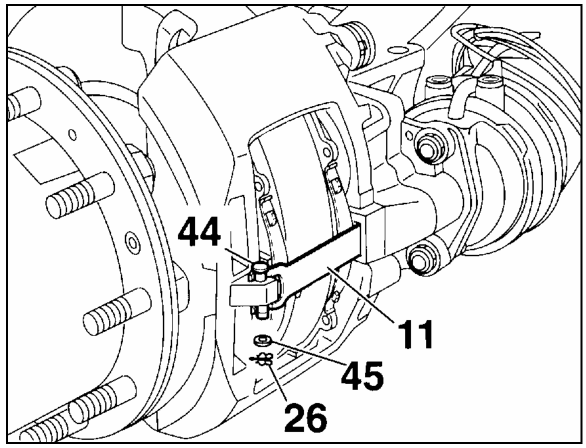


FIGURE 25: CLEARANCE INSPECTION 12119

3. Measure pad to rotor clearance:

Place a long feeler gauge (long enough to measure across entire tappet surface) between the tappet and the backing plate of the pad, measure clearance at both tappets. Clearance should range between 0.020 and 0.035 inch (0.5 mm and 0.9 mm), with a maximum difference between tappet measurements on same brake of 0.008 inch (0.2 mm).

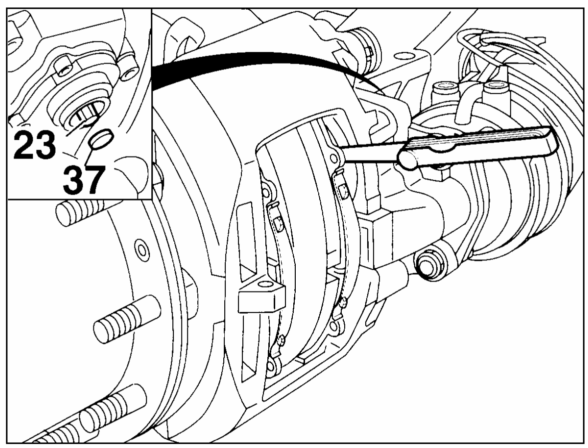


FIGURE 26: RUNNING CLEARANCE 12116

4. Checking the adjuster

⚠ WARNING ⚠
Use only a standard box wrench on the adjuster hexagonal pinion. Do not overtorque the pinion as overtorquing will damage the pinion.

a) Remove cap (37, Fig. 26).

b) Using a box wrench (8 mm), turn the adjuster pinion (23, Fig. 27) counterclockwise about 2 - 3 clicks to increase running clearance. By operating the braking system about 5 - 10 times (30 PSI or 2 bar), the wrench should turn clockwise in small increments if the adjuster is functioning correctly (Figs. 27 and 28).

NOTE
With increasing number of applications, the incremental adjustment will decrease.

c) In case of malfunction, i. e. the pinion or box wrench:

i) Does not turn.

ii) Turns only with the first application.

iii) Turns forwards then backwards with every application.

In any of the above cases, the automatic adjuster has failed and the caliper must be replaced. In such cases the brakes can be adjusted manually to run a short distance.

d) Take the box wrench off. Replace the cap and check for proper sealing.

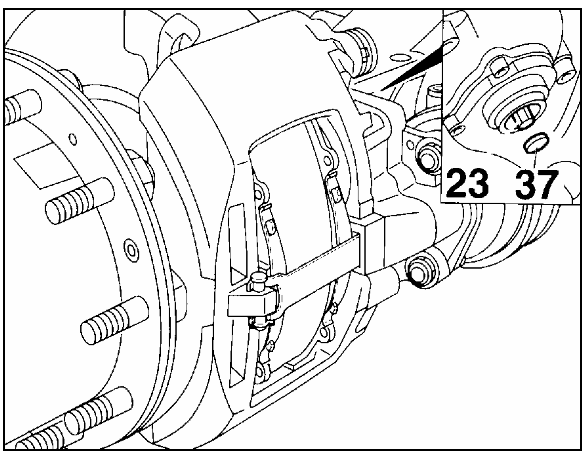


FIGURE 27: ADJUSTER PINION 12120

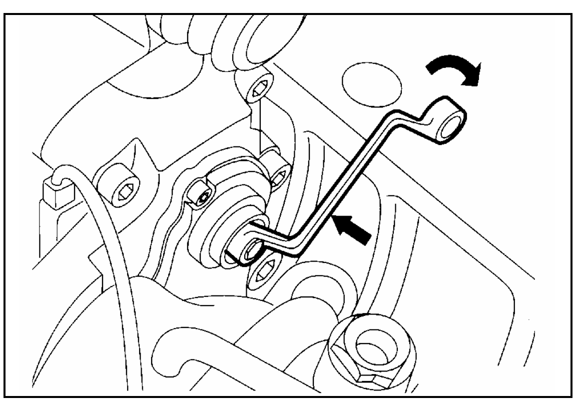


FIGURE 28: BOX WRENCH ON ADJUSTER PINION 12118

27.1.3 Roadside Inspection for Knorr/Bendix Air Disc Brakes

The coach is equipped with air disc brakes and therefore, cannot be inspected using the requirements for chamber stroke or visible lining clearance or lining thickness as specified for drum brakes. The roadside inspector should use the following instructions to determine that the air disc brakes are within proper adjustment and have sufficient pad wear thickness.

The Knorr/Bendix air disc brake is designed to move freely, with minimal force, in the axial direction on the two sliding pins as identified in figure 29. The movement in the axial direction should not exceed 2 mm (5/64").

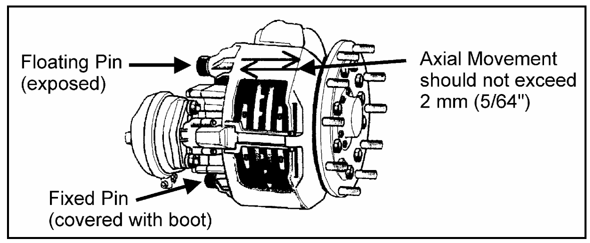


FIGURE 29: CALIPER AXIAL MOVEMENT 12132

The pad thickness can be seen but would require removal of the tire and rim. An indicator of the pad wear condition is available by inspecting the floating pin location in relation to the rubber bushing as shown in figure 30. When pads are in new thickness condition, the pin will be exposed (C) 19 mm (¾"). When the pads are worn to replacement conditions, the pin will be nearly flush to the bushing (D) or within 1 mm (3/64") of the edge of the rubber bushing.

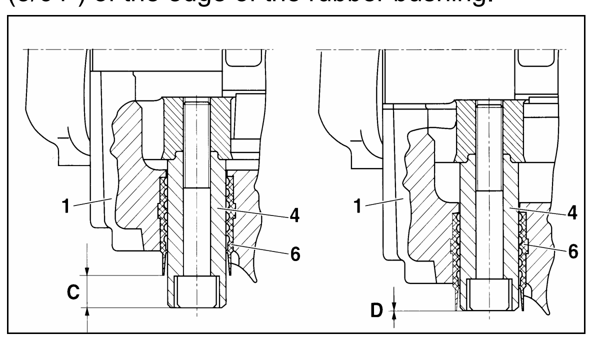


FIGURE 30: BRAKE PAD CHECK 12117

27.1.4 Pad Removal

Turn adjuster pinion (23) counterclockwise to increase pad to rotor clearance (a clicking noise will be heard). Push caliper toward actuator and remove pads (12).

⚠ CAUTION ⚠

Do not apply brakes while pads are removed as this could cause over stroke damage to the adjusting mechanism.

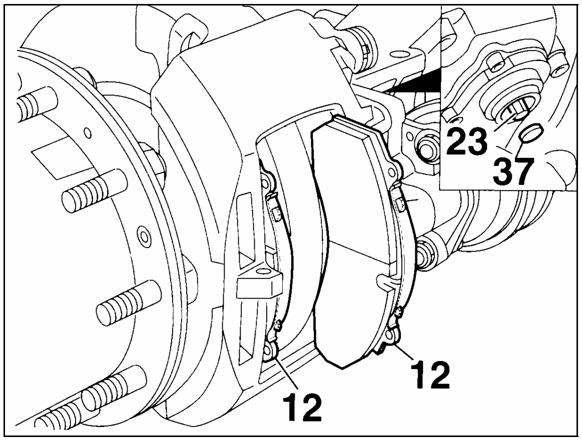


FIGURE 31: PAD REMOVAL 12111

27.1.5 Checking Pad Wear

Minimum friction material thickness is 2 mm (A, Fig. 32)

New friction material has a thickness of 21 mm (B, Fig. 32)

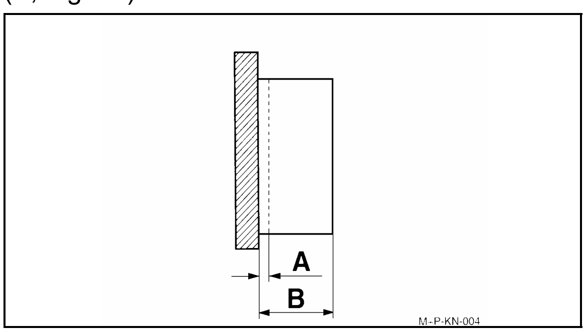


FIGURE 32: PAD WEAR 12112

27.1.6 Important Pad and Rotor Measurements

A = Rotor thickness (new): 45 mm;

B = Rotor thickness (worn): 37 mm, requires replacement;

C = Overall thickness of pad (new): 30 mm;

D = Backplate: 9 mm;

E = Minimum thickness of pad material: 2 mm;

F = Minimum allowed thickness of overall backplate and friction material: 11 mm. **Replacement necessary**.

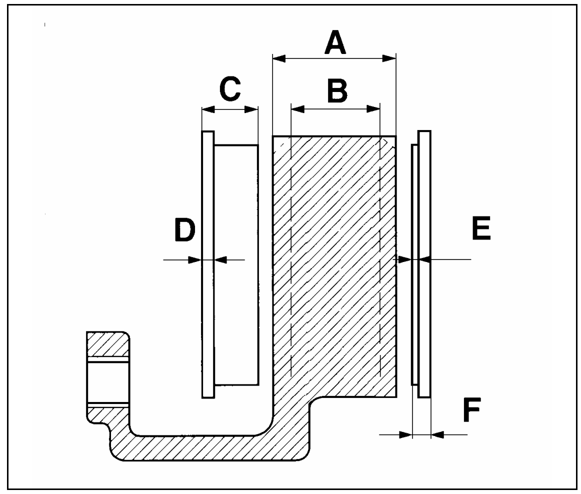


FIGURE 33: ROTOR AND PAD WEAR LIMITS 12113

27.1.7 Checking Caliper Guidance and Seal Condition

Perform sliding test. You must be able to slide the caliper easily at any time. Sliding test should be performed at least every three months or more often depending on the type of operation.

Sliding Test (Refer to Fig. 34):

a) Using hand pressure only, the caliper (1) must slide freely with its guide pin arrangements (4-7) across a distance of 1 3/16 inch (30 mm) when the pads are removed. The sleeve (5) is sealed using the boot (9) and the cap (10).

b) The rubber components (9 and 10) should show no damage. The positioning must be checked. If necessary the caliper has to be repaired using the guide kit (part #611168) or with the seal and guide kit (part #611199). When repairing a caliper with the above kits, make sure all parts in the kit are used. Use special green grease (Prévost #683344) to reassemble the slide pin into the bushing, white or yellow grease (Prévost #683345) may be used for all other lubrication needs.

c) Depending on caliper manufacturing date, black paint may be present on the unsealed pin (short pin). Paint on the slide pin can prevent the caliper from sliding properly especially when the pad starts to wear. If paint is present on the pin, separate the pin from the bushing, clean and reinstall the pin according to procedure.

NOTE
Do not attempt to use thinner or alcohol to clean the pin without removing it as it may damage the rubber bushing.

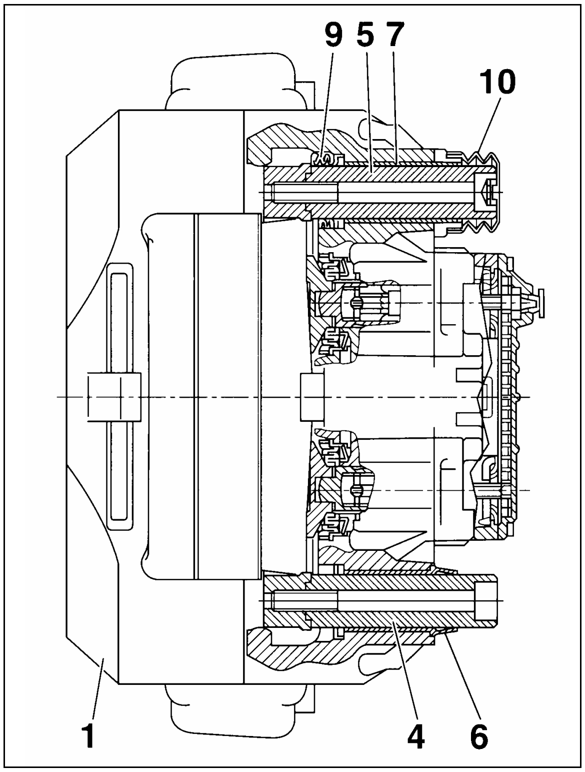


FIGURE 34: CALIPER GUIDANCE 12114

27.1.8 Checking the Tappet Boots

a) The rubber boots (13, Fig. 35) should show no damage, check the attachment.

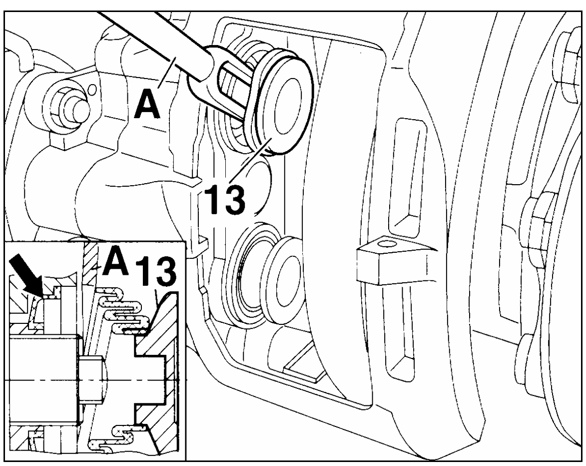


FIGURE 35: RUBBER BOOTS 12115

⚠ CAUTION ⚠
Any ingress of water and dirt will lead to corrosion and may affect the function of the actuation mechanism and adjuster unit.

b) If boots are damaged but show no corrosion, the boots and tappets should be replaced (Prévost #611177).

27.1.9 Pad Installation

Turn adjuster pinion (23, Fig. 36) counterclockwise until tappets are fully retracted and clean pad seat area. Slide caliper to full outboard position and install outside pad. Slide caliper to full inboard position and install inside pad.

⚠ WARNING ⚠
It is recommended to change all pads on an axle at the same time.

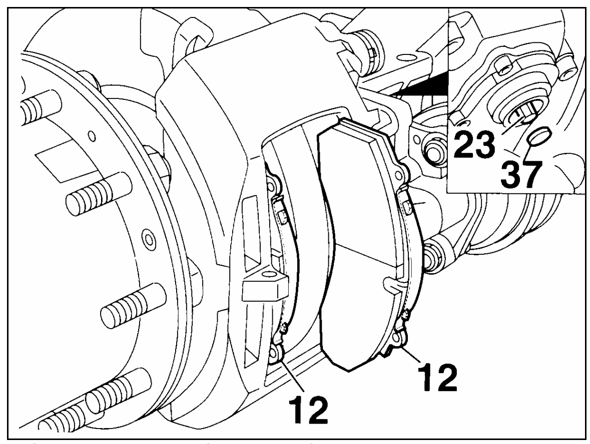


FIGURE 36: PAD INSTALLATION 12111

27.1.10 Adjusting the Running Clearance

a) Insert a feeler gauge 0.028 inch (0.7 mm thickness) between tappet and pad backplate (Fig. 37). Turn adjuster pinion clockwise until 0.028 inch (0.7 mm) clearance is achieved. Replace cap (37) (Prévost # 641313).

b) To ensure a constant running clearance between the rotor and pads, the brake is equipped with an automatic adjuster unit. When the pads and rotor wear, the running clearance between the pads and rotor increases. The adjuster (23, Fig. 37) and turning device turn the threaded tubes by the amount necessary to compensate the wear.

Total running clearance should be between 0.020 and 0.035 inch (0.5 and 0.9 mm). Smaller clearances may lead to overheating problems.

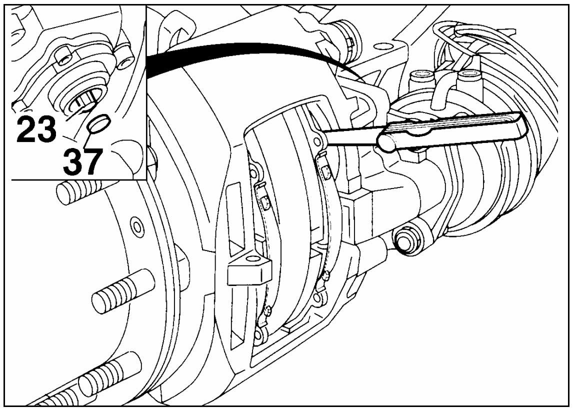


FIGURE 37: RUNNING CLEARANCE 12116

27.1.11 Brake Tools

Four brake tools are available from Prévost to facilitate disc brake maintenance:

a) #641321, Tappet with boot (item 13).
b) #641322, Caliper inner boot (item 9).
c) #641323, Caliper bushing (item 7).
d) #641435, Fork for boot tappet (item 13).

Maintenance tip

Using the following procedure, pad wear can be determined without removing the wheel.

27.1.12 Checking Brake Pads

Brake pads have to be checked on a regular basis depending on the vehicle operation. The remaining thickness of the pads should never be less than 3/32 inch (2 mm). To check pad condition without removing the wheel, verify the position of guide bushing (6) relatively to guide sleeve (4) (Fig. 38). When guide sleeve is in alignment with guide bushing, brake pad thickness must be checked more precisely with wheel removed. When replacing the brake pads, all four pads on an axle have to be changed at the same time. There is no inner or outer pad, since all pads are the same. Worn pads should be replaced in the same position.

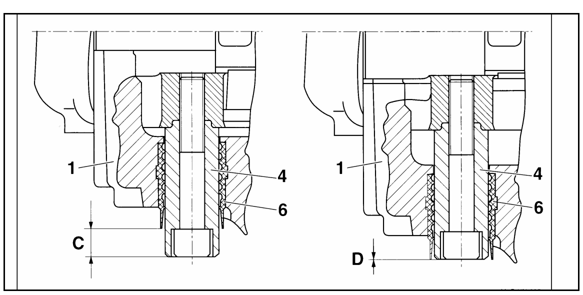


FIGURE 38: BRAKE PAD CHECK 12117

27.1.13 Torque specifications

For proper caliper maintenance, refer to the following figures.

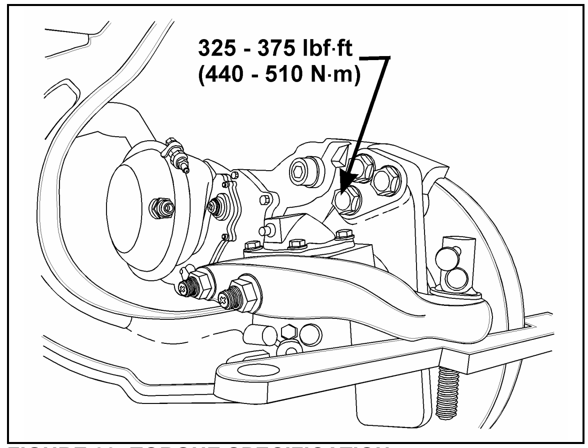


FIGURE 39: TORQUE SPECIFICATION 12145

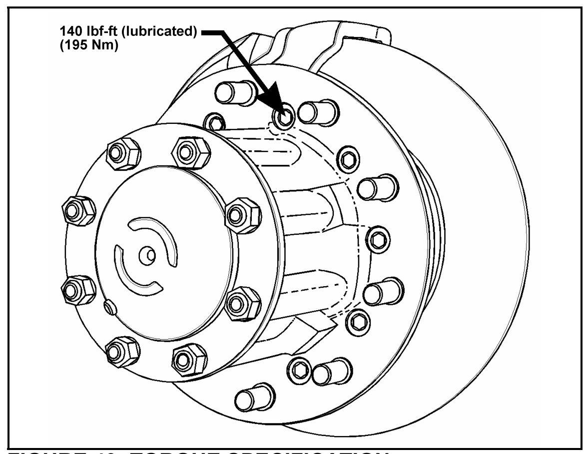


FIGURE 40: TORQUE SPECIFICATION 12149

28. SAFE SERVICE PROCEDURES

Most recently manufactured brake linings no longer contain asbestos fibers. Instead of asbestos, these linings contain a variety of ingredients, including glass fibers, mineral wool, aramid fibers, ceramic fibers, and carbon fibers. At present, OSHA (Occupational Safety and Health Administration) does not specifically regulate these non-asbestos fibers, except as nuisance dust. Medical experts do not agree about the potential long-term risks from working with and inhaling non-asbestos fibers. Nonetheless some experts think that long-term exposure to some non-asbestos fibers could cause diseases of the lung, including pneumoconiosis, fibrosis, and cancer. Therefore, lining suppliers recommend that workers use caution to avoid creating and breathing dust when working on brakes that contain non-asbestos fibers.

⚠ WARNING ⚠

Whenever possible, work on brakes in a separate area away from other operations.

Always wear a respirator approved by NIOSH (National Institute of Occupational Safety and Health) or MSHA (Mine Safety and Health Administration) during all brake service procedures. Wear the respirator from removal of the wheels through assembly.

NEVER use compressed air or dry brushing to clean brake parts or assemblies. OSHA recommends that you use cylinders that enclose the brake. These cylinders have vacuums with high efficiency (HEPA (Health and Environment Protection Agency)) filters and workmans' arm sleeves. But, if such equipment is not available, carefully clean parts and assemblies in the open air.

Clean brake parts and assemblies in the open air. During disassembly, carefully place all parts on the floor to avoid getting dust into the air. Use an industrial vacuum cleaner with a HEPA filter system to clean dust from the brake drums, backing plates and other brake parts. After using the vacuum, remove any remaining dust with a rag soaked in water and wrung until nearly dry.

If you must grind or machine brake linings, take additional precautions because contact with fiber dust is higher during these operations. In addition to wearing an approved respirator, do such work in an area with exhaust ventilation.

When cleaning the work area, NEVER use compressed air or dry sweeping to clean the work area. Use an industrial vacuum with a HEPA filter and rags soaked in water and wrung until nearly dry. Dispose of used rags with care to avoid getting dust into the air. Use an approved respirator when emptying vacuum cleaners and handling used rags.

Wash your hands before eating, drinking or smoking. Do not wear your work clothes home. Vacuum your work clothes after use and then launder them separately, without shaking, to prevent fiber dust from getting into the air.

Material safety data sheets on this product, as required by OSHA, are available from Rockwell and Knorr-Bremse.

29. AIR BRAKE TROUBLESHOOTING

The following tests and check lists have been designed to identify the cause(s) of a sluggish performance and/or leaks in the system. These tests require very little time to perform, and give you a general idea of the system condition. Each test is provided with a corresponding check list which will guide you to the most common causes of problems.

Before performing any test, check all air lines for kinks or dents, and hoses for signs of wear, drying out or overheating.

⚠ WARNING ⚠

When working on or around brake system and its related components, the following precautions should be observed:

Always block vehicle wheels. Stop engine when working under a vehicle. Keep hands away from chamber push rods and slack adjusters as they may apply when system pressure drops.

Never connect or disconnect a hose or line containing air pressure. It may whip as air escapes. Never remove a component or pipe plug unless you are sure all system pressure has been depleted.

Never exceed recommended air pressure and always wear safety glasses when working with air pressure. Never look into air jets or direct them at anyone.

Never attempt to disassemble a component until you have read and understood the recommended procedures. Some components contain powerful springs and injury can result if not properly disassembled. Use only proper tools and observe all precautions pertaining to the use of those tools.

Always clean connecting piping and/or fittings, and coat pipe threads with Teflon pipe sealant before installing any air brake system component.

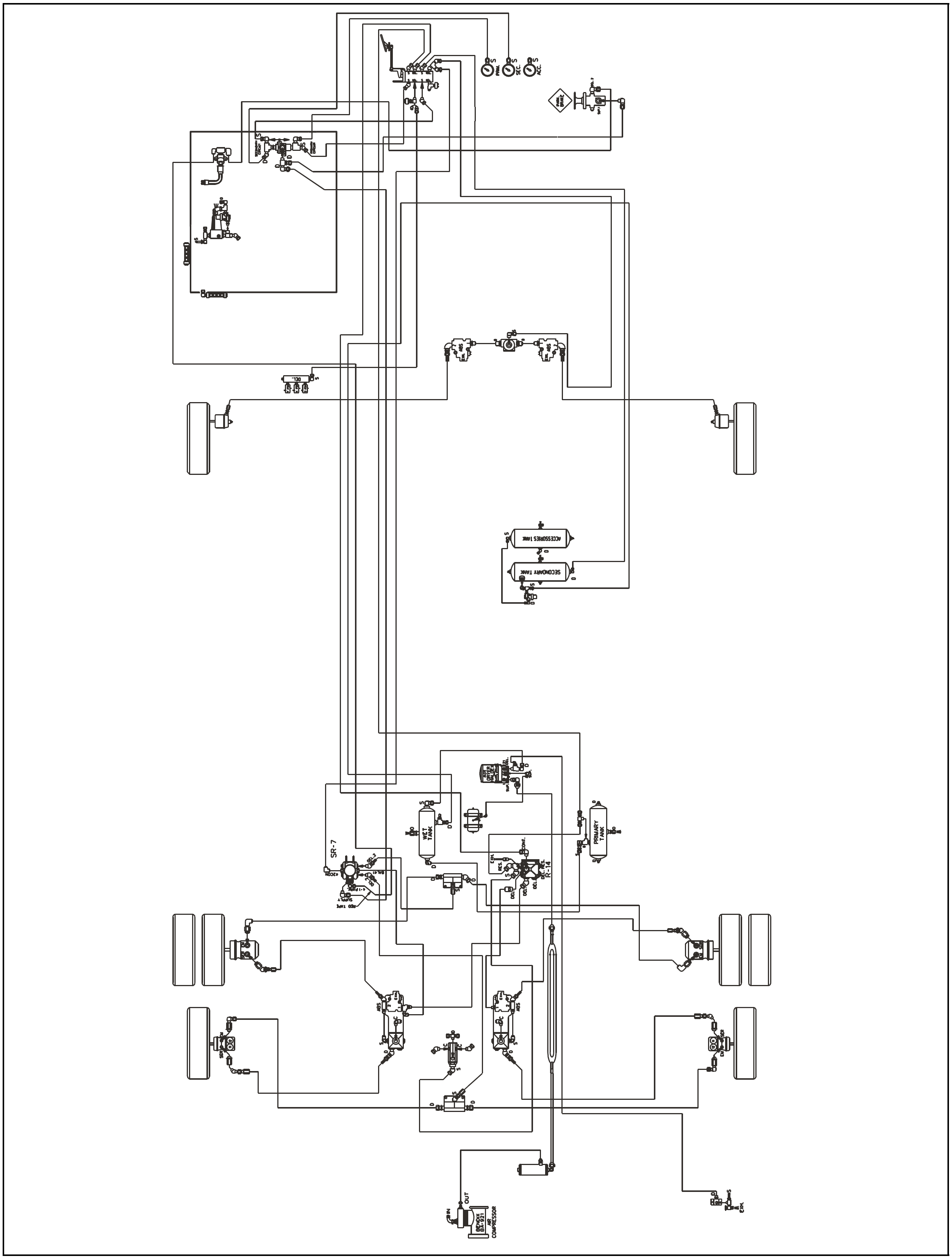


FIGURE 41: AIR-OPERATED BRAKING SYSTEM FOR X3 COACHES EQUIPPED WITH I-BEAM AXLE FRONT SUSPENSION 12215

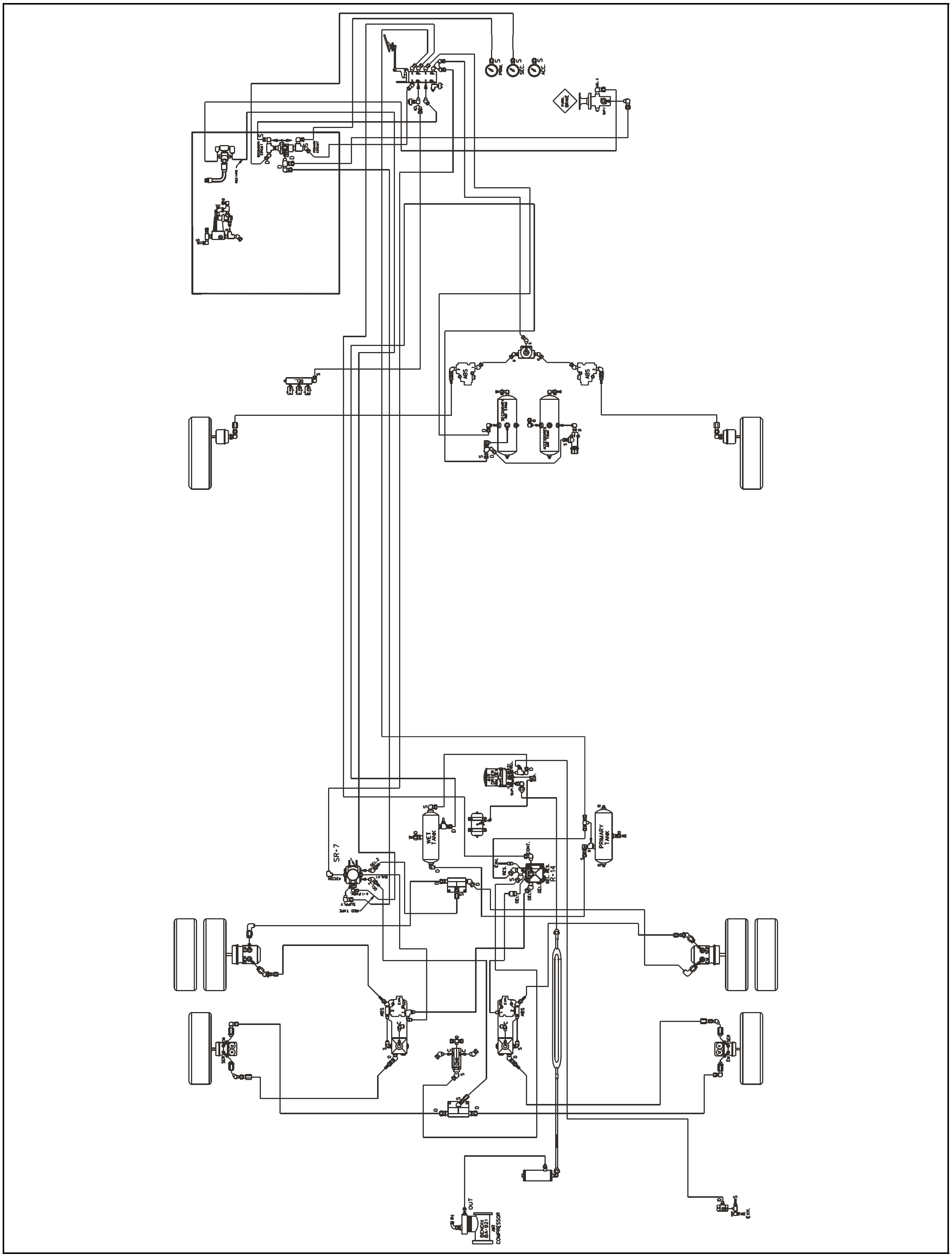


FIGURE 42: AIR-OPERATED BRAKING SYSTEM FOR X3 COACHES EQUIPPED WITH INDEPENDENT FRONT SUSPENSION 12216

Pressure Build-Up / Low Pressure Warning / Cutoff Point / Air Filter/Dryer Built-in Governor Cutout

CONDITION: Vehicle leveled, parking brake applied.

1. Completely drain wet, primary and secondary air reservoirs only.
2. Start engine and run at fast idle. Low pressure warning lights should be *"On"*.
3. Start checking pressure at 50 psi (344 kPa).
4. Low pressure warning lights and buzzer should go off at or above 60 psi (415 kPa).
5. At 85 psi (586 kPa), run engine at full rpm, then check that build up time to 100 psi (690 kPa) is 30 seconds or less.
6. Air filter/dryer built-in governor cut-out. Cuts out at the correct pressure of 123 psi ±3 (847±21 kPa).
7. Air filter/dryer built-in governor cut-in. Cuts in around 110 psi (758 kPa).

For common corrections, refer to the following check list:

High or Low Warning Cutoff Point

- Perform a telltale light and gauge test. Replace entire cluster if found defective.

High or Low Air Filter/Dryer Built-in Governor Cutout Point

- Perform a telltale light and gauge test. Replace entire cluster if found defective.

OR

- Repair or replace air filter/dryer as necessary after checking that compressor unloader mechanism operates correctly.

More than 30 seconds to build-up pressure from 85 to 100 psi (585 - 690 kPa) at full engine RPM

- Perform a telltale light and gauge test. Replace entire cluster if found defective.
- Check compressor strainer or inlet line. If restricted, clean or replace element or faulty line.
- Check compressor head or discharge line for carbonization or restriction. Clean or replace as necessary.
- If discharge valves leak, pull head and correct or replace cylinder head.
- If drive is slipping, replace gear.
- If inlet valves are stuck, open or leaking severely, replace unloader kit, inlet valves and/or seats as necessary.
- If drain cock is found open, close it.
- Listen for air leaks and repair.
- Redo list to check all items repaired or replaced.

Air Supply Reservoir Leakage

CONDITION: Full pressure, engine stopped, parking brake applied

1. Allow at least 1 minute for pressure to stabilize.
2. Stop engine, then check air pressure gauge for 2 minutes. Note any pressure drop.
3. Pressure should not drop by more than 3 psi (20 kPa) per minute.

For common corrections, refer to the following check list:

Excessive air loss:

- With the primary air system at normal operating pressure (95 - 125 psi (655 - 860 kPa)), coat all air line connections and pneumatic components with a water and soap solution. Bubbles will indicate an air leak, and none should be permissible. Repair or replace defective parts.
- Listen for leaks and correct as required.
- Redo test to check all items repaired or replaced.

Brake System Air Leakage

CONDITION: Full pressure, engine stopped, parking brake released.

1. Apply service (foot) brakes, allow at least 1 minute for pressure to stabilize.
2. Hold down foot valve for 2 minutes while observing air pressure gauge on the dashboard.
3. Pressure drop should not be more than 4 psi (27 kPa) per minute.

For common corrections, refer to the following check list.

Excessive leakage on brake service side:

- With the primary air system at normal operating pressure (95 - 125 psi (655 - 860 kPa)) and foot brake applied, coat all air line connections and brake pneumatic components with a water and soap solution. Bubbles will indicate an air leak, and none should be permissible. Repair or replace defective parts.
- Listen for leaks and correct as required.
- Redo test to check all items repaired or replaced.

IMPORTANT NOTE
To maintain your vehicle's air disc brakes at their original performance standard, we strongly recommend use of only genuine, approved service replacement parts on Bendix and Knorr-Bremse air disc brake systems. If non-approved friction materials or replacement components are used, neither Prévost Car nor Bendix Spicer Foundation Brake LLC will accept any air disc brake-related warranty returns or claims.   *For more information on this policy, refer to Bendix-Prévost product notification annexed at the end of Section 12 of Maintenance Manual.*

30. BRAKE AIR CHAMBER

If this vehicle is equipped with *Knorr-Bremse SB7000* disc brakes on all axles, it also uses "Knorr-Bremse" brake chambers. The tag and drive axle chambers consist of two separate air chambers, each having its own diaphragm and push rod. They are used as a service brake chamber, an emergency brake in case of air pressure loss and a spring-applied parking brake. Refer to figures 43 and 44.

The front axle brake air chambers are used only for service brake duty (Fig. 43).

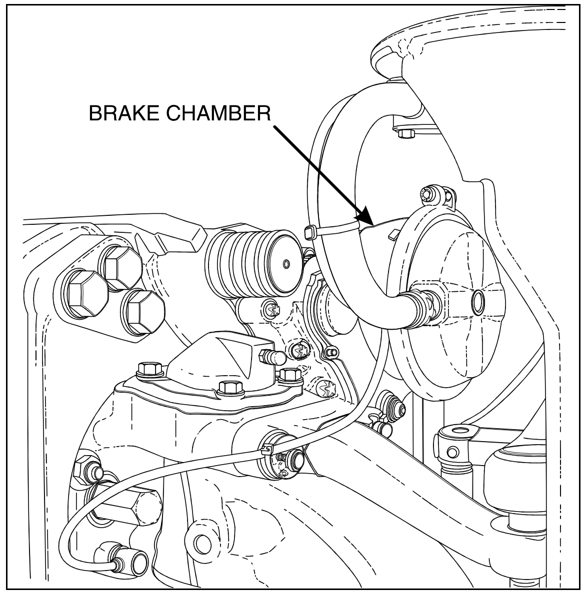


FIGURE 43: FRONT AXLE BRAKE AIR CHAMBER 12158

30.1 MAINTENANCE

Every 6,250 Miles (10 000 km) or twice a year, whichever comes first depending on type of operation:

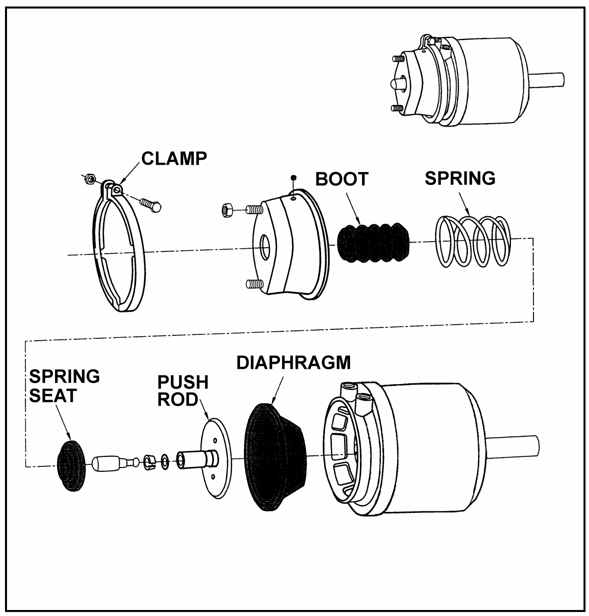


FIGURE 44: TAG AXLE BRAKE AIR CHAMBER 12126

Check all hoses and lines. They should be secure and in good condition.

Every 100,000 Miles (160 000 km) or once a year, whichever comes first depending on type of operation:

1. Disassemble and clean all parts.

2. Install new diaphragm or any other part if worn or deteriorated.

NOTE
When the diaphragm, spring, or both are replaced, they should be replaced in the corresponding chamber on the same axle.

3. Perform an airtighteness test:

a) Make and hold a full brake application.

b) Coat clamping ring(s) with a soapy solution. If leakage is detected, tighten clamping ring only enough to stop leakage. ***Do not overtighten*** as this can distort sealing surface or clamping ring. Coat area around push rod hole (loosen boot if necessary). No leakage is permitted. If leakage is detected, the diaphragm must be replaced.

30.2 EMERGENCY/PARKING BRAKE MANUAL RELEASE

⚠ WARNING ⚠
Never stand in the axis line of the spring brake chambers, especially when caging the spring.

Drive Axle

1. Block the wheels to prevent the vehicle from moving.
2. Remove the release stud tool from its storage place on drive axle brake air chamber.
3. Remove the access plug from the end of the spring chamber and then insert the release stud through the opening. Turn the release stud ¼ turn (clockwise) to anchor it into the spring plate. Install the flat washer and nut, then turn the nut clockwise to cage the spring. Repeat on the opposite side.

⚠ WARNING ⚠
Make sure the release stud is properly anchored in spring plate receptacle prior to caging the spring.

4. To manually reset the emergency/parking brake, turn the nut counterclockwise. Reinstall access plugs on the spring chambers, and release stud tools in their storage places.

Tag Axle

1. Block the wheels to prevent the vehicle from moving.
2. Turn the release bolt counterclockwise to cage the power spring (approx. 2.5 inches (6 cm)). Repeat on the opposite side.
3. To manually reset the emergency/parking brake, turn the bolt clockwise.

30.3 BRAKE CHAMBER REMOVAL

⚠ WARNING ⚠
To prevent personal injuries, brakes should be inoperative prior to working on any of their components. **To prevent personal injuries, brake chambers should be made inoperative by releasing spring tension prior to disposal.**

1. Block the wheels to prevent the vehicle from moving.
2. Safely support vehicle at the recommended body jacking points.
3. To gain access to a given brake air chamber, the corresponding wheel can be removed (refer to Section 13: *"Wheels, Hubs and Tires"*).
4. Exhaust compressed air from system by opening the drain valve of each reservoir.
5. For the drive and tag axles brake chambers, manually release spring brakes (refer to "*Emergency/Parking Brake, Manual Release"* procedure in this section).
6. Disconnect air line(s) from brake chamber.
7. Remove the cotter pin connecting brake chamber and slack adjuster (drive axle).
8. Unbolt and remove the brake chamber from vehicle.

30.4 BRAKE CHAMBER INSTALLATION

Reverse removal procedure and then check brake adjustment.

⚠ CAUTION ⚠
Always clean air lines and fittings, and coat pipe threads with teflon pipe sealant before reconnecting air lines.

30.5 BRAKE CHAMBER DISASSEMBLY

⚠ WARNING ⚠

Spring brake chambers, on drive and tag axles contain an extremely high compressive force spring, which can possibly cause serious injury if special precautions are not taken when working around this area.

To avoid such injury, the following recommendations must be applied:

- **Prévost recommends the installation of a new spring brake chamber if it is found to be defective.**
- **Spring brake chamber maintenance and/or repair must be performed by trained and qualified personnel only.**
- **Before manually releasing spring brakes, visually check spring brake for cracks and/or corrosion.**
- **On "MGM" brake chambers (drive axle), make sure the release stud is properly anchored in spring plate receptacle prior to caging the spring.**
- **Never stand in the axis line of the spring brake chambers, especially when caging the spring.**

⚠ WARNING ⚠

To prevent personal injuries, brakes should be inoperative prior to working on any of their components.

1. Block the wheels to prevent the vehicle from moving.
2. Safely support vehicle at the recommended body jacking points.

NOTE

To gain access to a given brake air chamber, the corresponding wheel can be removed (refer to Section 13: "Wheels, Hubs and Tires").

3. Exhaust compressed air from air system by opening the drain valve of each reservoir.
4. For the drive and tag axles brake chambers, manually release spring brakes (refer to "*Emergency/Parking Brake Manual Release"* procedure in this section).
5. Remove clamp ring, remove and discard the existing diaphragm. Install the new diaphragm squarely on body.
6. Reverse the procedure for assembly. Tap clamp ring to ensure proper seating. Check for proper operation before placing vehicle in service.

31. ANTI-LOCK BRAKING SYSTEM (ABS)

This device has been designed to ensure stability and permit steering control of vehicle during hard braking, and to minimize its stopping distance whatever the road conditions are. On slippery roads and generally in emergency situations, over-braking frequently induces wheel lock. The anti-lock braking system provides maximum braking performance while maintaining adequate steering control on slippery roads.

The ABS continuously monitors wheel behavior during braking. Sensors on each wheel of front and drive axles (tag axle is slave to drive axle) transmit data to a four channel electronic processor which senses when any wheel is about to lock. Modulator valves quickly adjust the brake pressure (up to 5 times per second) to prevent wheel locking. Each wheel is therefore controlled according to the grip available between its tire and the road.

With this device, the vehicle is brought to a halt in the shortest possible time, while remaining stable and under the driver's control.

Since the braking system has dual circuits, the ABS is also provided with a secondary system should a fault develop in the ABS. Anti-lock systems are a parallel system which does not hinder brake functioning in case of failure. Braking system functions in normal, non anti-lock controlled operation during ABS system failure.

The ABS system consists of two diagonally related circuits, only the half of the system which has sustained damage or other fault is switched off (i.e. wheels return to normal non-ABS braking). The other diagonal half remains under full ABS control.

NOTE

ABS is active on service brake, transmission retarder, Jake brake, but is inactive on emergency/parking brake.

NOTE

The ABS system is inoperative at speeds under 4 mph (6 Km/h). Illumination of ABS telltale indicator at these speeds is normal.

⚠ CAUTION ⚠

Disconnect the ECU or pull the ABS fuse before towing vehicle.

31.1 TROUBLESHOOTING AND TESTING

For troubleshooting and testing of the vehicle's anti-lock braking system, refer to Meritor Wabco Maintenance Manual MM-0112: *"Anti-Lock Braking System (ABS) for Trucks, Tractors and Buses"*, at the end of this section. Use dashboard Message Center Display (MCD) Diagnostic Mode for troubleshooting and repair.

31.2 ABS COMPONENTS

The main components of the ABS system are listed hereafter. Refer to each component for its specific function in the system and for proper maintenance.

31.2.1 Electronic Control Unit (ECU)

This control unit is located in the front electrical compartment, (refer to figure 45 for location). According to the data transmitted by the sensors (number of pulses/sec is proportional to the speed of each wheel), the electronic control unit determines which wheel is accelerating or decelerating. It then establishes a reference speed (average speed) from each wheel data, and compares the speed of each wheel with this reference speed to determine which wheel is accelerating or decelerating.

As soon as wheel deceleration or wheel slip threshold values are exceeded, the electronic control unit signals a solenoid control valve to limit the excessive brake pressure produced by the driver in the appropriate brake chamber.

Maintenance

No specific maintenance is required. The ECU is not serviceable. When found to be defective, replace.

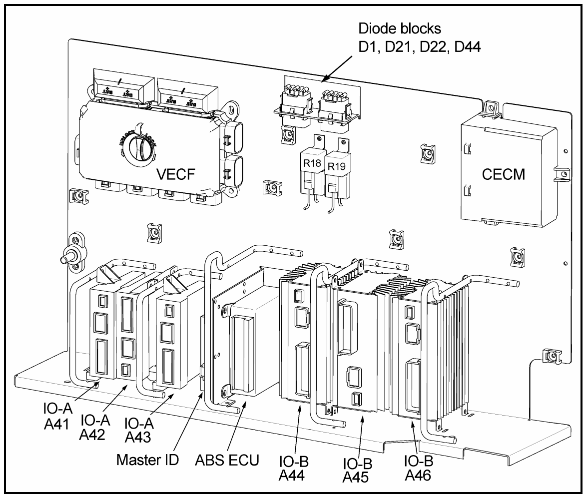


FIGURE 45: ABS ECU LOCATION 06617

⚠ CAUTION ⚠

In order to protect the ABS electronic control unit from voltage surges, always disconnect before performing any welding procedure on vehicle.

31.2.2 ABS Modulator Valve

This ABS system is equipped with four modulator valves, located between the brake chamber and the relay valve or quick release valve (Fig. 46). Note that there is only one solenoid valve controlling the drive and tag axle wheels on the same side (tag axle is slave to drive axle).

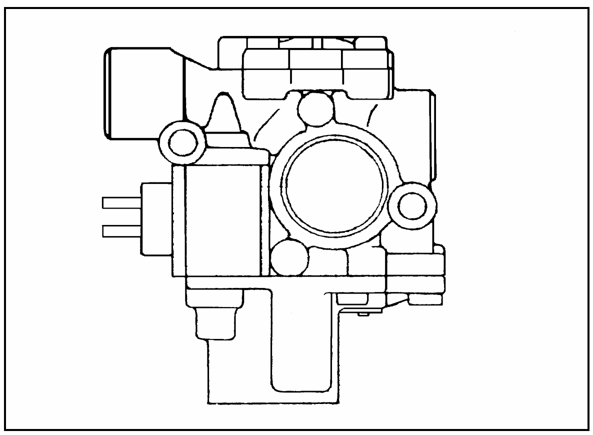


FIGURE 46: ABS MODULATOR VALVE 12084

This is an *"On/Off"* type valve, i.e., at brake application, the valve exhausts air from the brake chamber when the electronic unit senses that the corresponding wheel speed is decreasing in relation to the other wheels.

Maintenance

No specific maintenance is required for the solenoid control valve.

31.2.3 Sensors

The sensors are mounted on the front and drive axle wheel hubs (Fig. 47). The inductive sensors consist essentially of a permanent magnet with a round pole pin and a coil. The rotation of the toothed wheel alters the magnetic flux picked up by the coil, producing an alternating voltage, the frequency of which is proportional to wheel speed. When wheel speed decreases, magnetic flux decreases proportionately. Consequently, the electronic control unit will command the solenoid control valve to decrease the pressure at the corresponding brake chamber.

Maintenance

No specific maintenance is required for sensors, except if the sensors have to be removed for axle servicing. In such a case, sensors should be lubricated with special grease (Prévost #680460) before reinstallation. Refer to paragraph *"Sensor Installation"* for details.

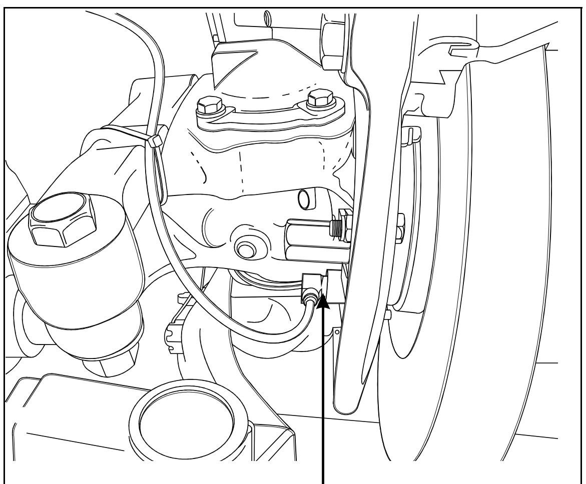


FIGURE 47: ABS SENSOR LOCATION 12153

NOTE
The resistance value, when sensors are checked as a unit, must be equal to 1,75 k ohms. To check the sensors for proper output voltage after the sensors and toothed wheels have been assembled to the axle, connect a suitable AC voltmeter across the output terminals. With the hubs rotating at 30 rpm, the output voltages should read from 50 to 1999 mV to be acceptable.

31.2.4 Sensor Installation

The following procedure deals with sensor installation on the axle wheel hubs. Read procedure carefully before reinstalling a sensor, as its installation must comply with operational tolerances and specifications.

1. Apply recommended lubricant (Prévost #680460) to spring clip and sensor.

⚠ CAUTION ⚠
Use only this type of grease on the sensors.

2. Insert spring clip in the holder on hub. Make sure the spring clip tabs are on the inboard side of the vehicle. Push in until the clip stops.
3. Push the sensor completely inside the spring clip until it is in contact with the tooth wheel. Ensure mounting is rigid, as it is an important criterion for adequate sensor operation.

NOTE
This installation should be of the "press fit" type.

31.2.5 Spring clip

The spring clip retains the sensor in its mounting bracket close to the toothed pulse wheel. The gap between the sensor end and teeth is set automatically by pushing the sensor in the clip hard up against the tooth wheel, and the latter knocks back the sensor to its adjusted position (Fig. 48).

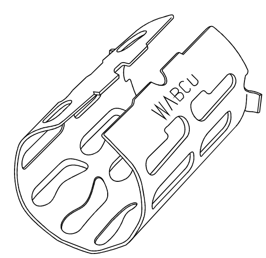


FIGURE 48: SPRING CLIP 12161

Maintenance

The spring clip requires no specific maintenance.

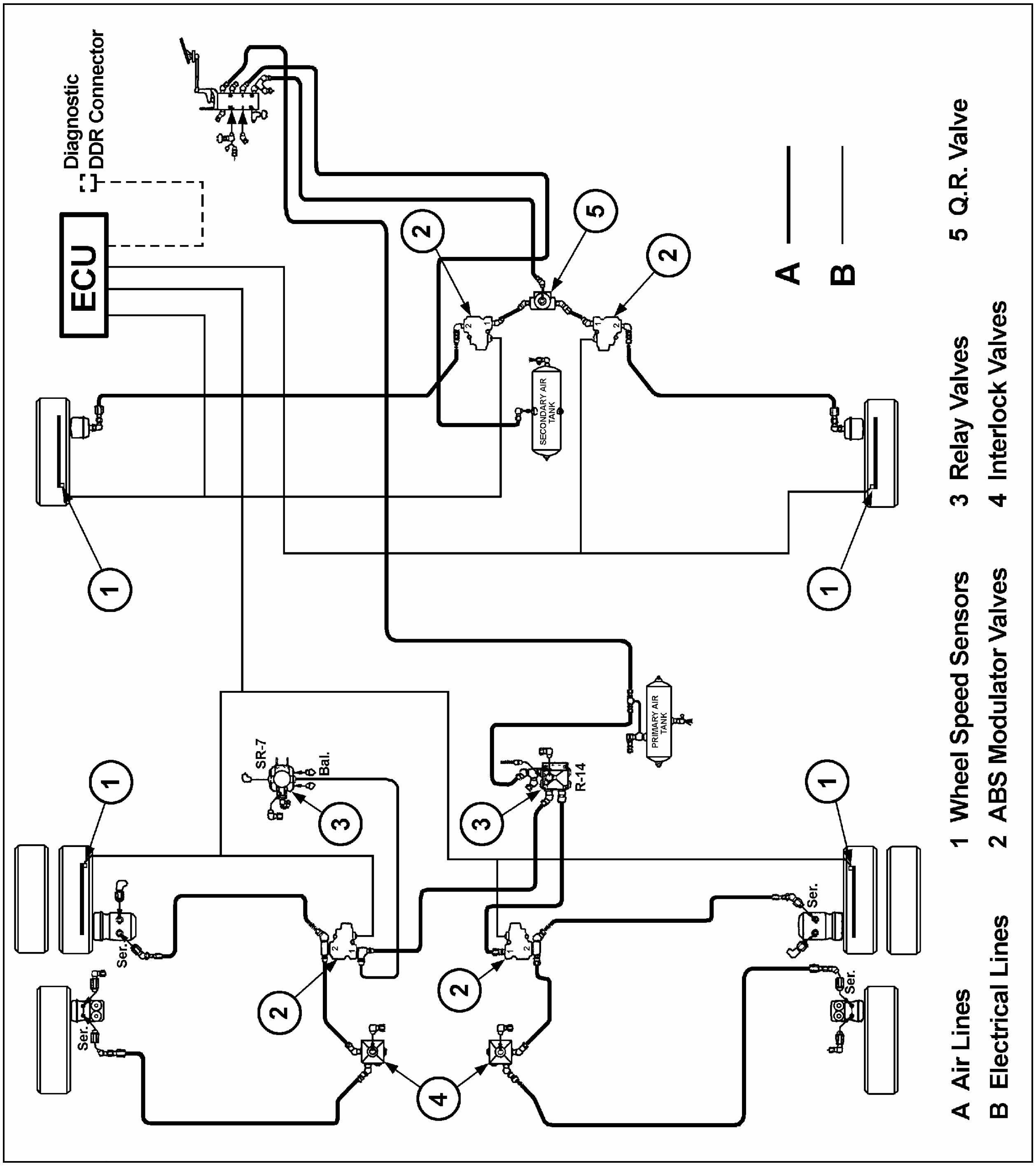


FIGURE 49: ABS 4S/4M CONFIGURATION

32. FITTING TIGHTENING TORQUES

45° Flare and Inverted Flare: Tighten assembly with a wrench until a solid feeling is encountered. From that point, tighten 1/6 turn (Fig. 50).

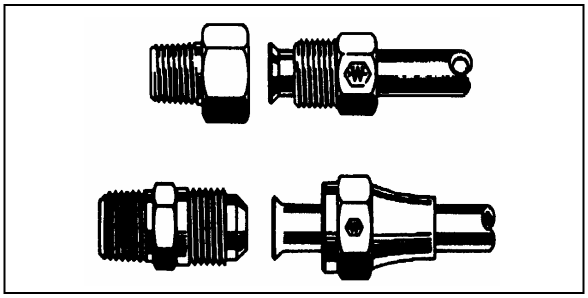


FIGURE 50: HOSE FITTINGS 12053

Compression: Tighten nut by hand (Fig. 51). From that point, tighten using a wrench the number of turns indicated in the chart hereafter.

Fitting size	Pipe diameter (inches)	Number of additional turns required following hand tightening
2	1/8	1 ¼
3	3/16	1 ¼
4	1/4	1 ¼
5	5/16	1 ¾
6	3/8	2 ¼
8	1/2	2 ¼
10	5/8	2 ¼
12	3/4	2 ¼
16	1	2 ¼

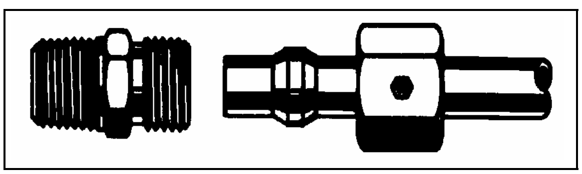


FIGURE 51: HOSE FITTING 12054

NTA-Type Plastic Tubing: Hand tighten nut (Fig. 52). From that point, tighten using a wrench the number of turns indicated in the following chart.

Tubing diameter (inches)	Number of additional turns required following hand tightening
1/4	3
3/8 to 1/2	4
5/8 to 3/4	3 ½

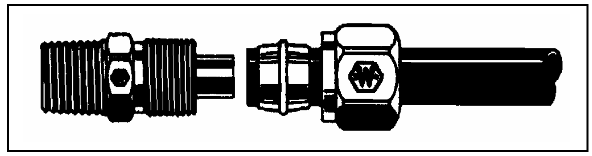


FIGURE 52: HOSE FITTING 12055

AB-Type Copper Piping: Hand tighten nut (Fig. 53). From that point, tighten with a wrench the number of turns indicated in the following chart.

Piping diameter (inches)	Number of additional turns required following hand tightening
1/4, 3/8, 1/2	2
5/8, 3/4	3

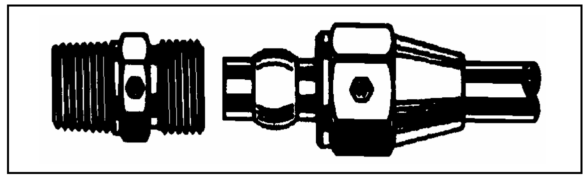


FIGURE 53: HOSE FITTING 12056

Pipe Tightening: All connections must be hand tightened. From that point, tighten a minimum of 2 ½ additional turns.

NOTE
Use Locktite (Prévost number 680098) pipe sealant to seal pipe thread.

33. SPECIFICATIONS

Air Compressor

Make..Bendix Westinghouse
Model..BA-921
Capacity (at 1250 rpm)..15.7 cfm (0,445 m^3/min.)
Supplier number..801287
Prévost number..641990

BA-921 Service Kits

ST-4 Safety Valve

Supplier number..800534
Prévost number..641989

Series 60 Seal Kit

Supplier number..5012371
Prévost number..641988

Compressor Seal Kit

Supplier number..5008559
Prévost number..641987

Cylinder Head Gasket Kit

Supplier number..5008558
Prévost number..641986

Air Dryer

Make..Haldex
Model..AT-87192
Supplier number..108229
Prévost number..70303498
Desiccant cartridge Prévost number..3097369

Flip-Flop Control Valve

Make..Bendix Westinghouse
Model..TW-1
Type..On-Off
Supplier number..229635
Prévost number..640136

Emergency/Parking Brake Control Valve

Make..Bendix Westinghouse
Model..PP-1
Automatic release pressure..40 psi (275 kPa) nominal
Supplier number..287325
Prévost number..641128

Dual Brake Application Valve

Make..Bendix Westinghouse
Model..E-10P
Supplier number..5006280
Prévost number..641856

Stoplight Switches

Make..Bendix Westinghouse
Model..SL-5
Contact close (ascending pressure)..4 psi and more (28 kPa)
Supplier number..286404
Prévost number..641462

Brake Relay Valves

Make..Bendix Westinghouse
Model..R-12
Supplier number..
Prévost number..

Brake Relay Valve

Make..Meritor Wabco
Model..R-14
Supplier number..
Prévost number..

Quick Release Valve

Make..Bendix Westinghouse
Model..QR-1
Supplier number..5001496
Prévost number..641429

Spring Brake Valve

Make..Bendix Westinghouse
Model..SR-7
Supplier number..
Prévost number..

Pressure Protection Valve

Make..Bendix Westinghouse
Model..PR-4
Nominal closing pressure..70 psi (482 kPa)
Supplier number..277226
Prévost number..641137

Shuttle-Type Double Check Valve

Make..Bendix Westinghouse
Model..DC-4
Supplier number..277988
Prévost number..641015

Low Pressure Indicators

Make..Bendix Westinghouse
Model..LP-3
Contact close..66 psi (455 kPa)
Supplier number..277227
Prévost number..640975

Air Pressure Regulator

Make..Norgren
Adjustable output range..0-80/85 psi (0-552/586 kPa)
Recommended pressure setting..75 psi (517 kPa)
Supplier number..R06-2G7 RNKA
Prévost number..641472

Air Filter Element

Make..Norgren
Type..With manual drain
Supplier number..F74G-345-004
Prévost number..641338

Front Axle Brake Chambers

Make....Knorr-Bremse
Type 24
Supplier number (R.H.) .... BS-3457 II 34671
Prévost number (R.H.) 641414
Supplier number (L.H.).... BS-3457 II 34670
Prévost number (L.H.).... 641413

Drive Axle Brake Chambers

Make....Knorr-Bremse
Type ....24 as service -24 as emergency
Supplier number.... II/35699/BS-9524
Prévost number.... 641432

Piggy Back (On Drive Brakes)

Make....Knorr-Bremse
Type .... 24 as emergency
Supplier number.... II/17567/0061
Prévost number.... 641433

Tag Axle Brake Chambers

Make....Knorr-Bremse
Type ....16 as service – 16 as emergency
Supplier number.... II/18224/V1-BS9396
Prévost number.... 641308

Piggy Back (On Tag Brakes)

Make....Knorr-Bremse
Type .... 16 as emergency
Supplier number.... II/18224/0061
Prévost number.... 641431

Brake Lining (All Axles)

Make....Knorr-Bremse
Supplier number.... II 33976
Prévost number.... 611049
Prévost number.... 641226

ABS ANTILOCK BRAKING SYSTEM (if applicable)

ABS MODULATOR VALVE

Make.... Rockwell Wabco
Voltage ....24 V
Supplier number.... 472 195 006 0
Prévost number.... 641097

Sensor, Front Axle

Supplier number....441 032-572-0
Prévost number.... 641288

Sensor, Drive Axle (In Wheel End)

Supplier number....441 032-576-0
Prévost number.... 641095

SECTION 16: SUSPENSION

CONTENTS

ILLUSTRATIONS

1. DESCRIPTION

The vehicle is provided with an air suspension system. The system consists of air springs, height control valves, radius rods, sway bars, tripod and shock absorbers (Fig. 1, 2, 11, 36, 37 and 38). The system operation is fully automatic and maintains a constant vehicle height regardless of load, or load distribution.

The vehicle can also be equipped with systems such as:

- Front Kneeling (w/ Front High-Buoy);
- Front Kneeling (w/ Full High-Buoy);
- Front Kneeling (w/ Front High-Buoy) and Low-Buoy Combination;
- Front Kneeling (w/ Full High-Buoy) and Low-Buoy Combination;

2. I-BEAM AXLE FRONT SUSPENSION

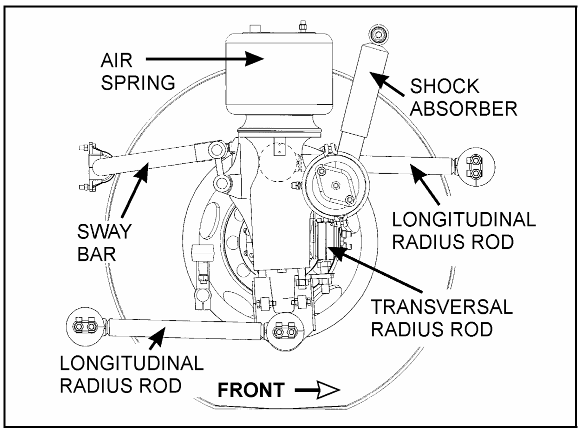


FIGURE 1: FRONT SUSPENSION COMPONENTS 16096

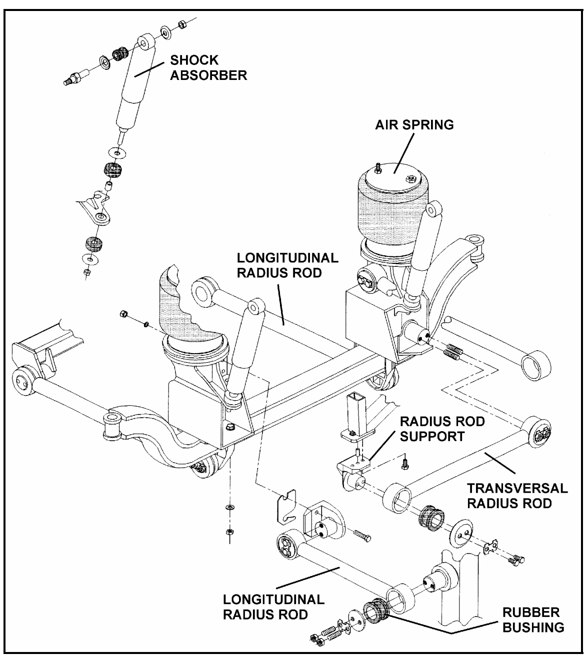


FIGURE 2: DETAILS OF FRONT SUSPENSION 16110

2.1 AIR SPRINGS

The air springs are made from a special compound rubber molded to the proper contour and dimensions. The entire vertical load of the vehicle is supported by these springs. The I-beam front axle is provided with air springs that are attached to the subframe and to the axle (Fig. 3).

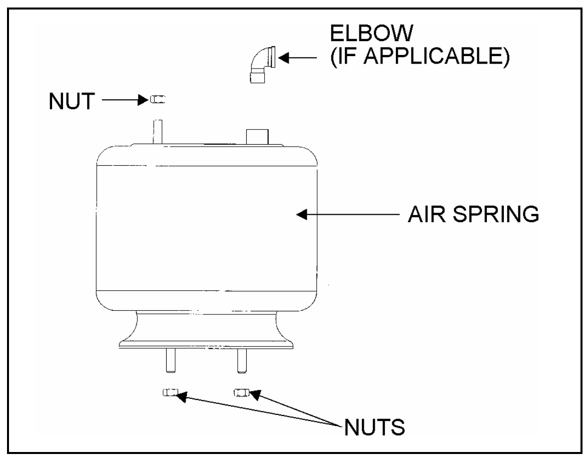


FIGURE 3: AIR SPRING 16052

2.1.1 Inspection

1. Check operation of bellows.
2. Visually inspect bellows for evidence of cracks, punctures, deterioration, or chafing. Replace the bellows if any damage is evident.
3. With the primary air system at normal operating pressure (95 - 125 psi (655 - 860 kPa)), coat all suspension air line connections and bellows mounting areas with a water and soap solution. Bubbles will indicate an air leak, and none is

permissible. Repair or replace defective parts.

NOTE
If air spring is removed from vehicle, bellows can be lightly inflated and submerged in water to detect any leakage. If any leakage is detected, replace bellows.

⚠ WARNING ⚠
To prevent personal injury, do not apply more than 10 psi (69 kPa) of air pressure to the uninstalled air spring.

2.1.2 Removal

NOTE
Front suspension air springs can be removed without removing the entire axle assembly.

1. Safely support vehicle at the recommended body jacking points. To gain access to a given air spring, the corresponding wheel can be removed as follows.
   a) Jack vehicle until the tire clears the ground, and place safety supports underneath body.

⚠ CAUTION ⚠
Only the recommended jacking points must be used as outlined in Section 18, "Body".

   b) Support the axle with a suitable hydraulic floor jack at the recommended jacking point.
   c) Remove wheel.
2. Exhaust compressed air from accessory air tank by opening drain cock under reservoir.
3. Disconnect the height control valve link and pull down the overtravel lever to ensure all air is exhausted from air springs.

NOTE
While performing this step, do not change the height control valve overtravel lever adjustment.

4. Disconnect air line from air spring, remove elbow (if applicable), and cover both the line end and fitting to prevent the entry of foreign matter.
5. Remove the air spring upper nut, and then the two lower nuts. Remove air spring.

2.1.3 Installation

1. Compress air spring as necessary, then aligning studs with their holes, position air spring between both the lower and upper supports. Thread the lower nuts and the small upper nut a few turns.

NOTE
To facilitate air spring installation, compress it manually then put a piece of tape over the air line threaded fitting. This prevents air from getting back into the bag and keeps it compressed, thus enabling to place the bag in between the mounting plates and greatly easing installation.

2. Tighten and torque the lower stud nuts, and then the upper one to 20 – 25 lbf-ft (27 – 34 Nm).
3. Thread the remaining upper nut (large nut) and tighten to 20 – 25 lbf-ft (27 – 34 Nm).
4. Install elbow (if applicable), then connect air line.
5. Connect the height control valve link.
6. Build up air pressure in system.

NOTE
To accelerate this operation, air reservoirs can be filled from an exterior air supply connected to the accessory tank fill valve or to the emergency fill valve.

7. Check operation of bellows, and with the primary air system at normal operating pressure (95 – 125 psi (655 – 860 kPa)), coat the air line connections and air spring mounting areas with a water and soap solution. Bubbles will indicate an air leak, and none is permissible. Repair or replace defective parts.
8. Reinstall wheel.
9. Remove the hydraulic floor jack from under the axle, then lower vehicle to ground.

2.2 SHOCK ABSORBERS

Double-action, telescoping-type shock absorbers ensure a smooth ride and enhance vehicle stability on the road. All shock absorbers are eye-type mountings. The front axle is provided with two shock absorbers (Fig. 1, 2, and 4).

Shock absorbers are non-adjustable and non-repairable. Maintenance requirements involve replacement of the rubber mounting bushings, and tightening of all shock absorber pins at the proper torque of 500 - 550 lbf-ft (680 - 750 Nm) when shock absorber replacement occurs. If a shock absorber becomes inoperative, complete unit must be replaced.

⚠ CAUTION ⚠

When a shock absorber is found defective, always replace with a new set on affected axle, except if there has been a recent replacement of one unit. The following method will help in determining if both shock absorbers on the same axle have to be replaced.

2.2.1 Inspection

Loosen lower mounting of both shocks, and then carefully attempt to raise and lower the bottom portion of each shock. Note the rate of effort for distance of travel. Replace both shocks if a definite differential rate is found.

The shock must be bench checked in an upright, vertical position. If checked in any other position, air will enter the cylinder tube and make the shock absorber appear defective.

Proceed as follows to check shock absorbers:

1. With the shock absorber in a vertical position (top end up), clamp the bottom mount in a vise.

⚠ CAUTION ⚠

Do not clamp the reservoir tube or the dust tube.

2. Rotate the dust tube. Notice any binding condition (may be compared with new unit). Binding condition indicates a scored rod. Units with scored rods should be replaced.
3. Fully extend shocks and check for leaks in the seal cover area. Shock fluid is a very thin hydraulic fluid that has a characteristic odor and dark brown tint. A slight trace of shock fluid around the seal cover area is not a cause for replacement. The shock seal is designed to permit a very slight seepage to lubricate the rod. Units that leak should be replaced.
4. Visually check shock for dents that could cause the shock to bind. Also, check for a bent rod.
5. Extend and collapse shock several times to determine that it has control (resistance) in both rebound and compression.
6. Visually inspect the shock mountings and vehicle mounting for:
   a. Broken mounts;
   b. Extreme bushing wear;
   c. Shifted bushing or sleeve;
   d. Deep cracks in bushing material (shallow surface cracks are normal);
   e. Loose shock absorber pins;
   f. Presence of convex washers, and their position relative to the rubber bushing.

2.2.2 Removal

1. Remove nuts and washers from shock absorbers on upper and lower mounting pins, taking care to identify the inner and outer washers to ease reinstallation. Refer to figure 4 for details.
2. Remove the shock absorber assembly from pins.
3. Remove the two inner bushings from the shock absorber and discard them.

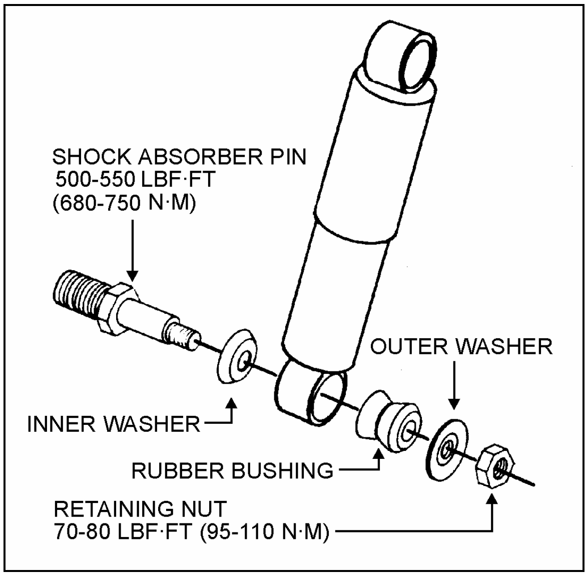


FIGURE 4: SHOCK ABSORBER

2.2.3 Installation

1. Ensure that the shock absorber mounting pins are tight and that the threads are not stripped.
2. Install new rubber mounting bushings on shock absorbers (upper and lower).
3. Place the inner washers (with washer convex side facing the shock absorber rubber bushing) on each shock absorber pin (Fig. 5).
4. Install the shock absorber eyes over the mounting pins, then the outer washers (with washer convex side facing the shock absorber rubber bushing) on each shock extremity.

NOTE
If shock absorber pins are removed, they must be reinstalled using "loctite" (see "Parts Specifications" in this section).

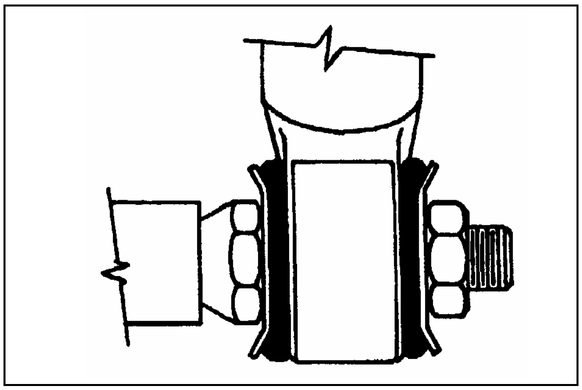


FIGURE 5: TYPICAL SHOCK ABSORBER SETUP 16009

5. Place the lower and upper mounting pin stud nuts and torque to 70 - 80 lbf-ft (95 – 110 Nm).

2.3 RADIUS RODS

Radius rods are used to secure the axles in the proper transversal and longitudinal positions. Four radius rods are provided on the front axle suspension (three longitudinal and one transversal). Refer to figures 1, 2 and 6 for details. These rods transmit both braking and driving forces from the axles to the vehicle body.

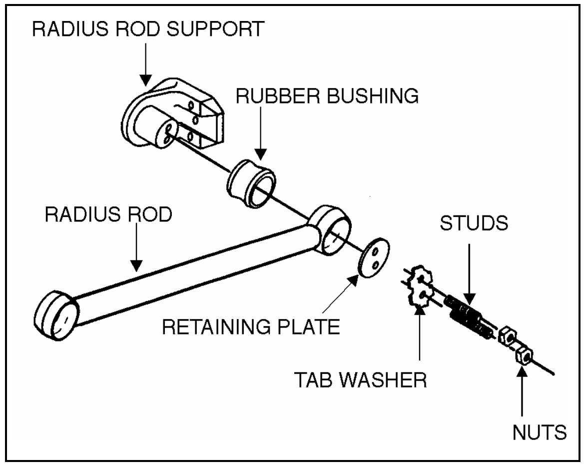


FIGURE 6: TYPICAL RADIUS ROD SETUP 16010

2.3.1 Inspection

The following instructions apply to all radius rods used on this vehicle:

1. Clean all parts thoroughly.
2. Inspect radius rods for distortion and cracks. We recommend the "Magnaflux" process to detect cracks in the radius rod. Any damaged part should be replaced with a new one.

NOTE
New bushings should be used when rods are replaced.

3. The radius rod bushings should be checked periodically for signs of shearing, deterioration, or damage. Any defective part should be replaced with a new one.

2.3.2 Removal

1. Flatten the tab washer which secures the two retaining nuts (or bolts), then unscrew the nuts (or bolts) at each extremity of the radius rod (Fig. 6).
2. Remove the tab washer and the retaining plates and radius rod ends from anchor pins, and then remove the radius rod.

2.3.3 Bushing removal

1. Safely support the radius rod as shown in figure 7.

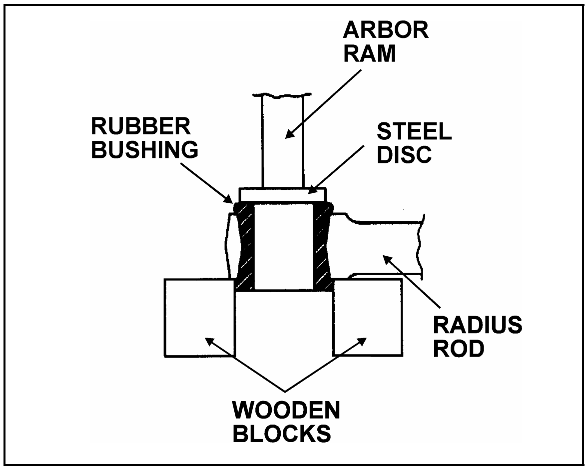


FIGURE 7: RADIUS ROD BUSHING REMOVAL 16011

2. Place a flat steel disc, slightly smaller than the outside diameter of the bushing (Fig. 7).
3. Using an arbor press or a suitable driving tool, press or drive the old bushing out of the rod and discard the bushing.

⚠ CAUTION ⚠

Make sure to prevent the steel disc from contacting the radius rod end.

2.3.4 Bushing installation

1. Lightly spray the inner and outer surfaces of radius rod bushing with water.

⚠ CAUTION ⚠

No lubricant whatsoever is to be used on the rubber bushing.

2. Safely support the radius rod, and place new bushing on top of the radius rod end (Fig. 8).
3. Place a block of wood on top of bushing and press on it manually.
4. If necessary, use an arbor press or a suitable driving tool. Press or drive the bushing into the radius rod end until it extends equally on both sides of the rod.
5. It is also possible to proceed differently. Place radius rod bushing on a plane surface. Spray a light coat of water on the inner and outer surfaces of radius rod bushing.
6. Take radius rod, align the bushing. Tap radius rod on bushing until latter is positioned correctly.

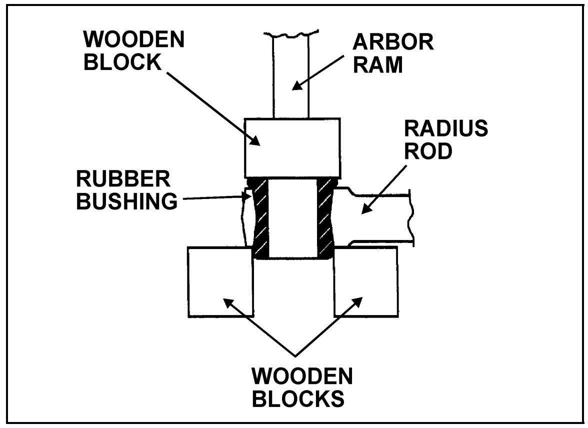


FIGURE 8: RADIUS ROD BUSHING INSTALLATION 16012

2.3.5 Installation

1. Lightly spray the radius rod support with water. Place the radius rod end over the radius rod support (Fig. 9).
2. Position the retaining plate. Install the tab washer and nuts (or bolts).

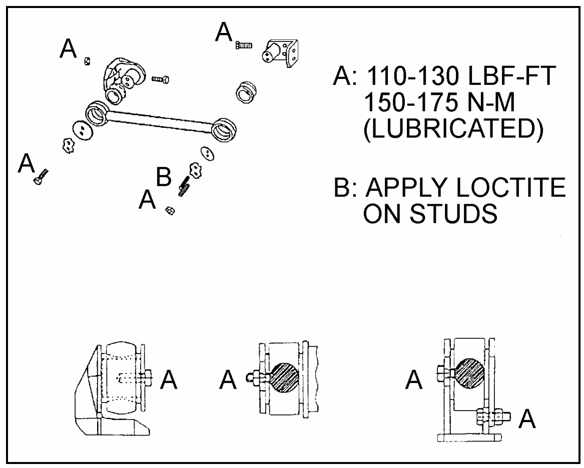


FIGURE 9: RADIUS ROD INSTALLATION 16028

⚠ CAUTION ⚠

Always use new tab washers at installation.

3. Tighten the nuts (or bolts) lightly, and repeat at the other end.
4. Refer to heading *"Suspension Height Adjustment"* later in this section, and set the vehicle to normal ride height.
5. With the vehicle at normal ride height, apply oil on threads and tighten all radius rod anchor pin nuts or bolts to 110 – 130 lbf-ft (150 – 175 Nm).

⚠ CAUTION ⚠
It is extremely important upon reconnection of the rods that the proper clearance height between the axle and body be maintained. Otherwise, the rubber bushings in radius rod ends will become preloaded, thus reducing their life span.

2.4 SWAY BAR

A sway bar is provided on the front axle to increase vehicle stability. It controls lateral motion (swaying movement) of the vehicle (Fig. 10).

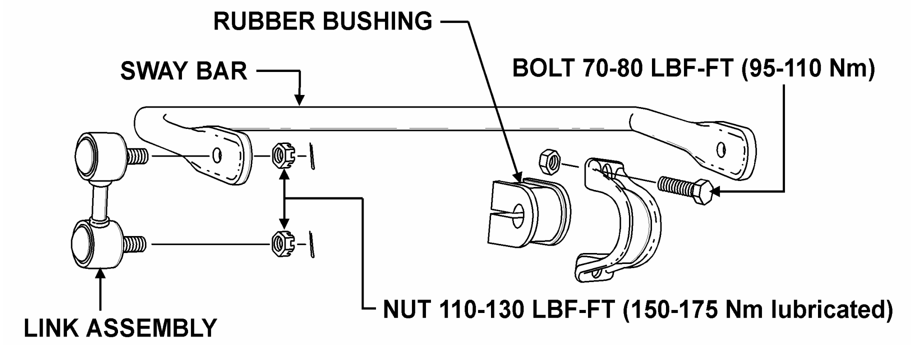


FIGURE 10: I-BEAM FRONT AXLE SWAY BAR 16099

2.4.1 Removal

1. Disconnect the two links from sway bar.
2. Safely support the sway bar. Unbolt the four bushing collars from subframe.
3. Remove sway bar.

NOTE
Sway bar bushings are slitted to ease their removal.

2.4.2 Installation

1. Loosely install the sway bar.
2. Tighten the eight bushing collar nuts to 70 - 80 lbf-ft (95 - 110 Nm) (Fig. 10).
3. Install two sway bar link upper and lower nuts and tighten to 100 - 130 lbf-ft (150 - 175 Nm) (Fig. 10).
4. Install a cotter pin on each nut and bend.

3. INDEPENDENT FRONT SUSPENSION (IFS)

3.1 STEERING LINKAGE

Turning motion of the steering wheel is transferred by the steering gear and steering linkage to the steering arms at the right and left front wheels. The steering linkage consists of tie rods connected to the bell crank and the steering arm at the left side of the coach, and to the idler arm and steering arm at the right side of the coach. The bell crank and idler arm are connected by a relay rod. A drag link connected to the bell crank and the pitman arm, which is mounted to the steering gear, transfers the turning motion of the steering wheel to the steering arms (Fig. 11).

Lower and upper A-arms are widely spaced. They are mounted on ball joints. Torque rods prevent rotation of the uprights around the lower and upper ball joints.

If the steering linkage is bent, twisted or worn, steering action of the coach will be seriously affected. Any time steering linkage components are replaced or adjusted, steering geometry and front wheel alignment must be checked as explained in this section.

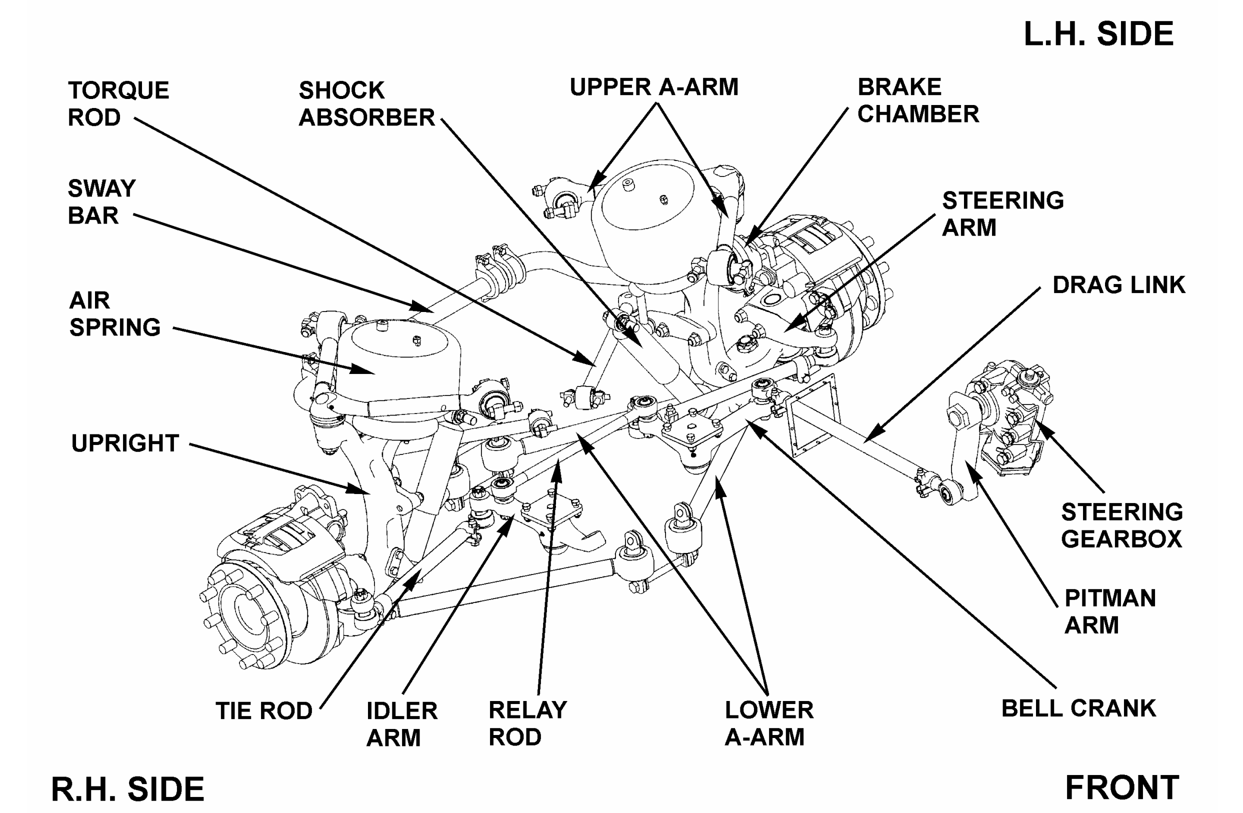


FIGURE 11: SUSPENSION AND STEERING LINKAGE 16125

Turning Angle

The maximum turning angle is set mechanically through the two steering stop screws installed on the swivel assembly. The turning angle (58° + 0° - 1°) mechanical stop is factory adjusted to accommodate the chassis design, and therefore, does not require adjustment on new vehicles.

However, turning angle should be checked and adjusted hydraulically, if necessary, any time a component of the steering system is repaired, disassembled or adjusted.

Before checking the turning angle, be sure the front end is properly aligned as described under paragraph "3.16 Front End Alignment" in this supplement.

To check steering maximum turning angle, proceed with the following method:

1. Check if front tires rub against the frame or if the steering gear has been serviced.

⚠ CAUTION ⚠
If clamps are not correctly installed, they can interfere with other parts.

2. For a full left and right turn, check clamps' position and for interfering parts. Refer to figures 12 to 16 for location and positioning of clamps. If readjustment is required, make the proper adjustment.

NOTE
Prior to steering limiter adjustment, verify vehicle wheel alignment, and ensure that oil level is adequate and that air bleeding is done.

3. If necessary readjust steering limiter. Refer to "ZF-SERVOCOM Repair Manual" annexed to Section 14 of Maintenance Manual, "Steering", under heading: "Setting and Functional Test".

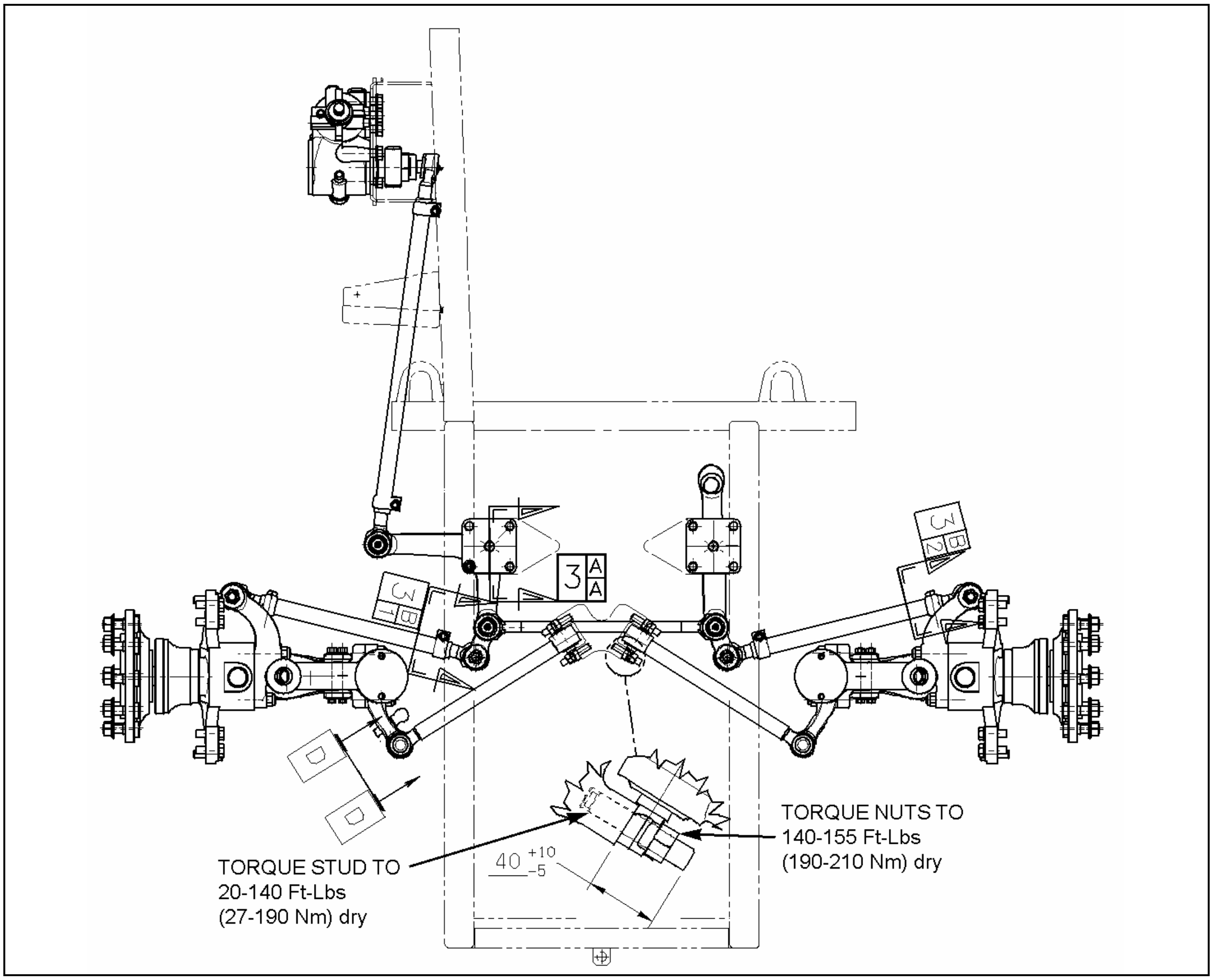


FIGURE 12: LOCATION OF CLAMPS 16168

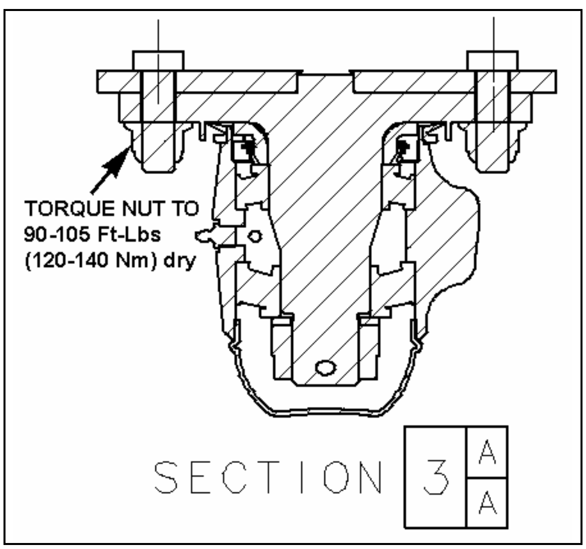


FIGURE 13: CLAMP POSITIONING 16169

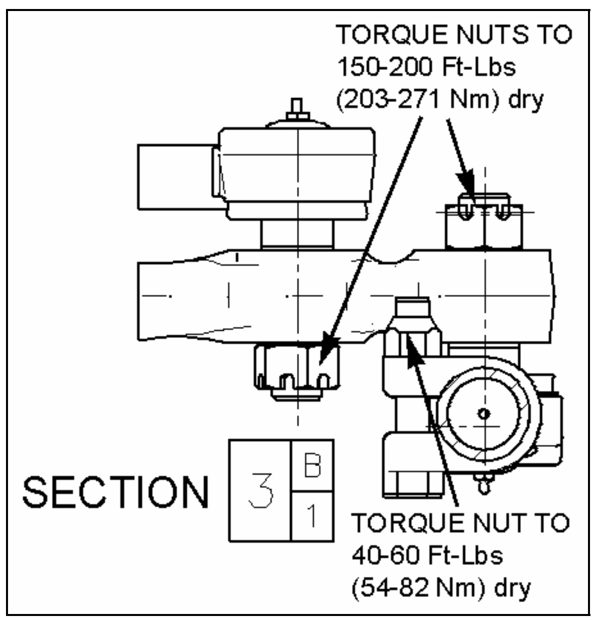


FIGURE 14: CLAMP POSITIONING 16170

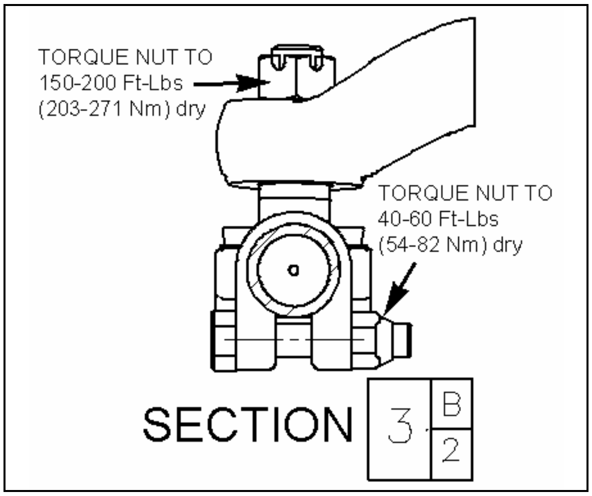


FIGURE 15: CLAMP POSITIONING 16171

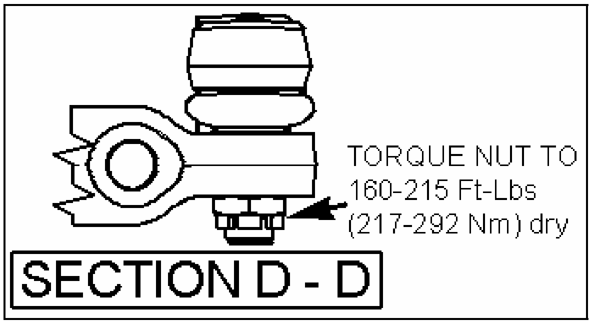


FIGURE 16: CLAMP POSITIONING 16172

3.2 POWER STEERING HYDRAULIC PUMP

Refer to the "TRW Power Steering Pump Service Manual" annexed at the end of Section 14.

3.3 STEERING LINKAGE ADJUSTMENT

NOTE

Whenever a steering linkage component has been removed and replaced, check steering geometry and front end alignment as directed in this Sectiont. Check to insure that all stud nuts and mounting bolts and nuts have been tightened to proper torques listed under "14. Torque Specifications" at the end of this section.

1. First, align input shaft marks.
2. Afterwards, the pitman arm should be adjusted with reference mark aligned or to an angle of 90° in relation with the horizontal axis (Fig. 17).
3. Locate centerline of vehicle then install relay rod in boss at steering bell crank and idler arm. Align center of relay rod with centerline of vehicle.

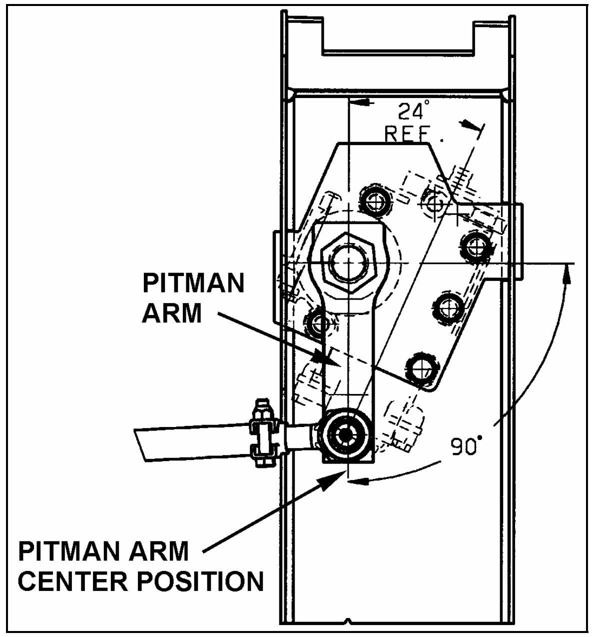


FIGURE 17: PITMAN ARM ALIGNMENT 14057

4. Install drag link to pitman arm and adjust opposite end of drag link to fit mounting stud hole in bell crank.
5. Install tie rods, and then adjust toe-in as per "Front End Alignment" in this Section.

3.4 PITMAN ARM REMOVAL

1. Remove cotter pin, nut and washer from drag link ball stud at pitman arm.
2. Disconnect drag link from pitman arm, using jaw style pullers (pressure screw type).

⚠ WARNING ⚠

Always wear approved eye protection when operating pullers.

⚠ CAUTION ⚠

Do not drive pitman arm on or off pitman shaft as this can damage the steering gear.

⚠ CAUTION ⚠

Heating of components to aid in disassembly is not allowed because it has a detrimental effect on axle components and steering linkages.

3. Remove pitman arm fixing nut.
4. Check the radial position of the pitman arm in relation to the sector shaft prior to removal of pitman arm.

5. Add reference marks to the arm and shaft if necessary to ensure correct alignment at reassembly.
6. Use a puller to remove pitman arm.

3.5 PITMAN ARM INSTALLATION

1. Position pitman arm on sector gear shaft with reference marks aligned.
2. Install fixing nut. Tighten nut to 400-450 lbf-ft (545-610 Nm).

NOTE
Use a new nut if the previously removed nut was punched.

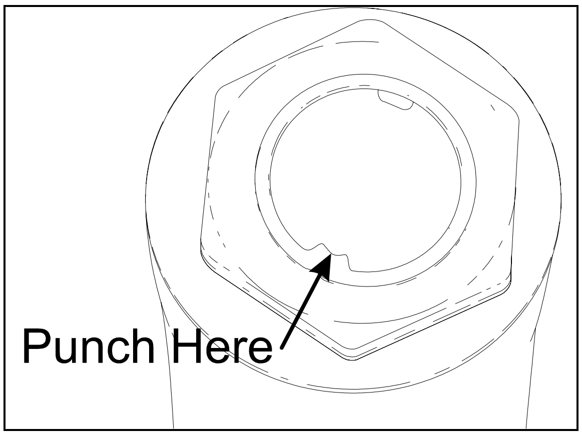


FIGURE 18: FIXING NUT PUNCH MARK 16098

⚠ CAUTION ⚠
Lock nut with sector shaft using a punch mark into the groove (Refer to figure 18).

3. Connect drag link to pitman arm. Install washers. Tighten nut to 160-215 lbf-ft (220-290 Nm). Advance nut to next alignment cotter pin slot and install a new cotter pin.

3.6 DRAG LINK

Drag link assembly consists of three parts; a drag link and two end assemblies. Both end assemblies are identical and they are retained on the drag link with a clamp bolt and nut.

Stud nuts at the pitman arm and bell crank ends of the drag link must be kept tight or hole at ball stud end of drag link and hole in pitman arm may become enlarged as a result of excessive looseness. Subsequent tightening of stud nuts may draw studs too far into holes and dust cover parts may become damaged which can result in component failure.

Drag link end sockets are equipped with lubrication fittings and should be lubricated as directed in "Lubrication Fittings" in this section.

3.6.1 Adjustment

It should not be necessary to alter the length of the drag link except when a new link is installed or when removable end assembly has been replaced. If drag link adjustment is necessary, proceed as follows:

1. Position front wheels in straight ahead position.
2. Center steering gear as previously explained in paragraph "3.3 Steering Linkage Adjustment".
3. Remove cotter pin and stud from drag link at bell crank. Locate centerline of vehicle and center of relay rod. With center of relay rod aligned with centerline of vehicle, loosen clamp bolt at socket end (bell crank end) of drag link and adjust length of socket end assembly to fit in boss of bell crank.

NOTE
Do not change position of pitman arm.

4. Install stud nut and torque to 160 lbf-ft (220 Nm). Align nut with cotter pin slot (tighten) and install a new cotter pin.
5. Torque mounting clamp bolt nut to 40-60 lbf-ft (55-80 Nm), then test the adjustment. Front wheels should turn from right to left extremities without noticeable binding at drag link ends.

3.7 BELL CRANK AND IDLER ARM

Bell crank and idler arm are equipped with one lubrication fitting and should be lubricated as directed in paragraph "3.11 Lubrication Fittings" of this Section.

3.7.1 Bell Crank and Idler Arm Removal

NOTE
Use a piece of wire to anchor loosen end of relay rod and tie rod in order to prevent placing an excessive load on opposite socket end.

Bell crank: Disconnect drag link, tie rod and relay rod from bell crank by removing cotter pins, stud nuts and washers from ball studs. Separate socket assemblies from the bell crank.

Idler arm: Remove cotter pins, nuts and washers from ball studs connecting relay rod and tie rod to idler arm. Separate socket assemblies from idler arm.

Remove nuts and washers from bolt attaching bell crank or idler arm mounting bracket to vehicle understructure. Remove bell crank or idler arm mounting bracket.

3.7.2 Bell crank or Idler Arm Ball Joint Disassembly

1. Remove adjacent link assemblies from bell crank or idler arm as previously described.
2. Remove the cap (Fig.21).
3. Remove the cotter pin, nut and tongue washer. Remove bearings, grease seal, bearing bushing and the bell crank or idler arm from its mounting bracket stud (Fig. 21).

3.7.3 Bell Crank or Idler Arm Ball Joint Reassembly

NOTE
For bearing installation use tool Prévost # 110684.

1. Install bearing bushing on bell crank or idler arm mounting bracket stud.
2. Install bearing and grease seal in bell crank or idler arm eye (Fig. 21).

NOTE
Install grease seal according to figure 21. Grease must be able to exit the bell crank or idler arm mechanism. For grease seal installation use tool Prévost # 110683.

3. Install bell crank or idler arm on its mounting bracket stud (Fig. 21).
4. Install bearing and nut.

NOTE
Apply grease on bearing before installation.

5. Firmly tighten nut (Fig. 19).
6. Unscrew nut until bell crank or idler arm starts to turn by the application of 1 to 3 pounds load (Fig. 20).

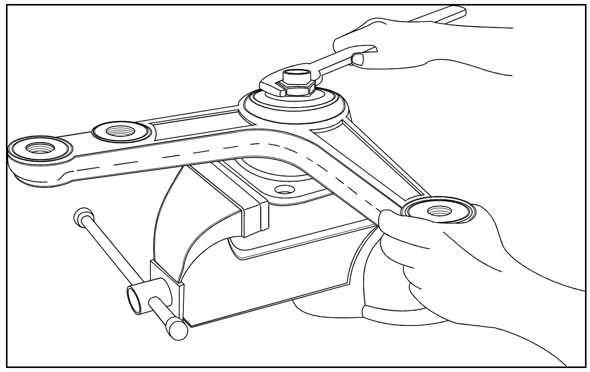


FIGURE 19: BELL CRANK 16044

7. Check for loose bearings by applying an up and down load on bell crank or idler lever (Fig. 20). The lever is not supposed to move in the vertical axis direction.

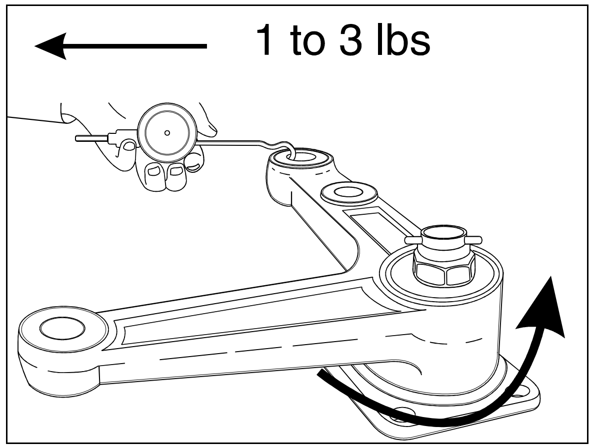


FIGURE 20: BELL CRANK 16045

8. Align nut with cotter pin slot (tighten) and install a new cotter pin.

NOTE
Bend cotter pin around the nut (Fig. 21). Do not bend the cotter pin in the direction of the cap, because it may interfere with the cap.

9. Install the cap.
10. **Bell crank:** Install drag link, tie rod and relay rod as directed herein under each specific subject.
11. **Idler arm:** Install tie rod and relay rod as directed herein under each specific subject.
12. Adjust turning angle as previously directed under paragraph "**Turning Angle**" and check front end alignment as specified in paragraph "3.16. Front End Alignment" of this section.

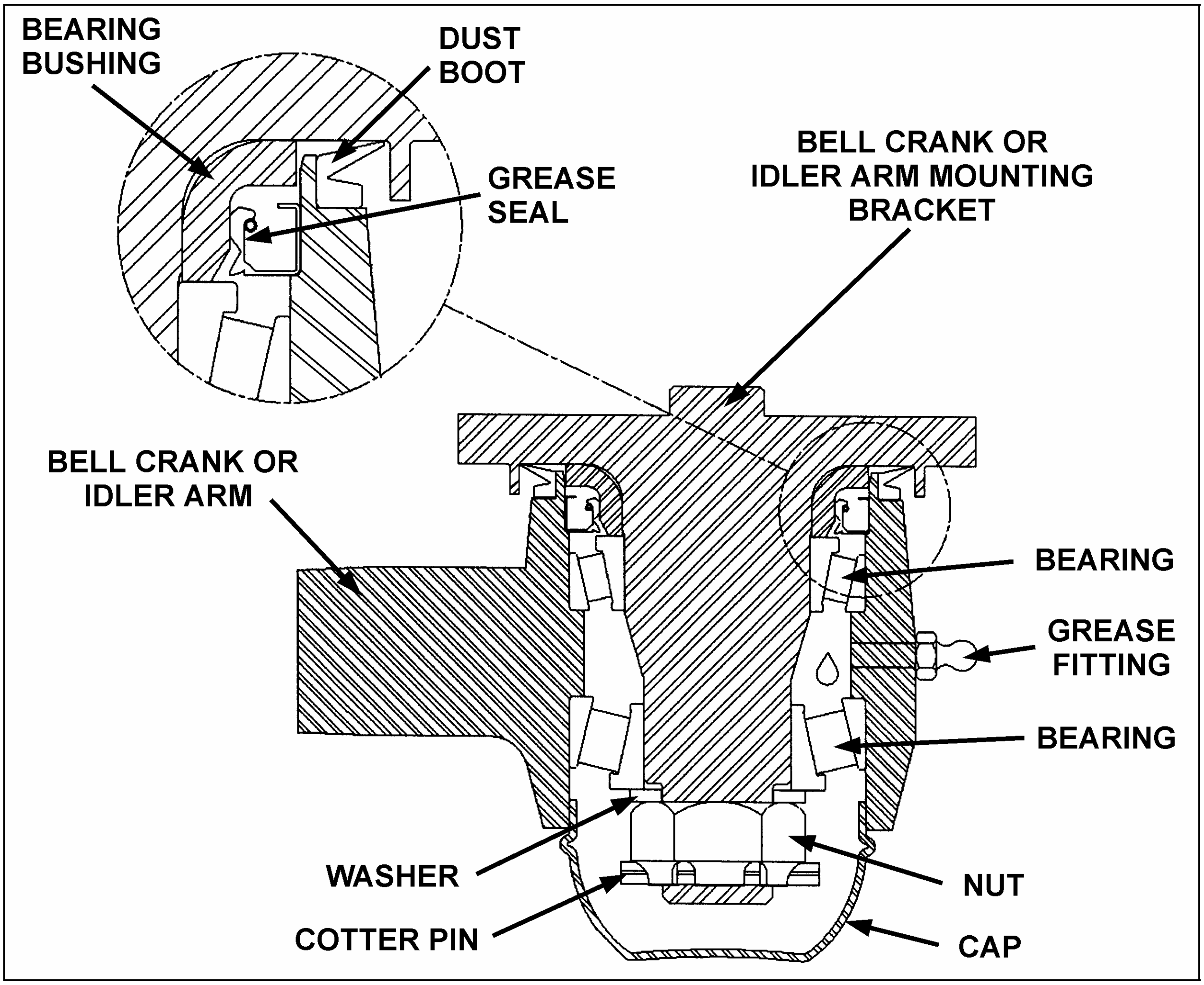


FIGURE 21: BELL CRANK AND IDLER ARM BALL JOINT 16109

3.8 RELAY ROD

Relay rod ends are equipped with lubrication fittings and should be lubricated as directed in paragraph "3.11 Lubrication Fittings" in this section.

NOTE
The relay rod is crimped in place and it is not possible to remove the ball joints.

3.8.1 Replacement

1. Remove cotter pins from bell crank and idler arm end of relay rod. Loosen nuts flush with end of studs.
2. Use a puller or place a sledge hammer behind the adjacent part to absorb shocks. Strike the studs with a brass hammer to loosen end assemblies.
3. Remove stud nuts and washers then remove studs.
4. Position relay rod studs into bell crank and idler arm then tap stud ends with a brass hammer to seat tapered surfaces.
5. Install washers and stud nuts. Tighten nuts to 160 lbf-ft (220 Nm) torque. Align cotter pin slot (tighten) and install a new cotter pin.

3.9 TIE RODS

Tie rod ends are connected to the bell crank and left steering arm, and to the idler arm and right steering arm. Each tie rod assembly consists of three parts; a tube and two socket end assemblies. The tie rod ends are threaded into the tube and secured with clamp bolts. Right and left hand threads are provided to ease toe-in adjustment. Tie rod assemblies are interchangeable from the right to the left side of the coach.

Tie rod end sockets require no maintenance other than periodic lubrication and inspection to see that ball studs are tight. Replace socket ends when there is excessive up and down motion, lost motion or end play at ball end of stud.

1. Periodically check bolt nut for tightness.
2. Inspect tie rod for bent condition and inspect tube for damaged threads. If tie rod is bent or threads are damaged, replace the assembly.
3. Lubricate tie rod end fittings as directed in paragraph "3.11 Lubrication Fittings" of this section.

3.9.1 Removal

1. Remove cotter pins and stud nuts which attach tie rod socket ends to bell crank and left steering arm (or idler arm) and right steering arm.
2. Remove tie rod ball stud by tapping on steering arm and bell crank or idler arm with hammer, while using a sledge hammer to absorb shocks.

NOTE
If tie rod end assemblies are damaged in any way, they must be replaced

3.9.2 Installation

1. Install socket end assemblies on tie rod. Be sure both ends are threaded an equal distance into the tube.
2. Make sure threads on stud and in stud nut are clean and not damaged.
3. Position ball studs (socket ends of tie rod) in holes in steering arm and bell crank or idler arm. Install a ball stud nut on each stud and tighten firmly.
4. Torque stud nuts to 160 lbf-ft (220 Nm). Align cotter pin slot (tighten) and install a new cotter pin.

NOTE
Adjust toe-in as directed in paragraph "3.16.4 Toe-In Adjustment" of this section.

5. Make sure tie rod ends are properly aligned with ball studs, then torque tie rod end clamp bolts to 40-60 lbf-ft (55-80 Nm).

NOTE
If tie rod is not properly aligned with stud, binding will result.

3.10 STEERING ARMS

The left and right wheel steering arms are secured to a swivel at one end and to a tie rod at the other end.

3.10.1 Removal

1. Remove wheel as directed in Section 13, "Wheel, Hubs and Tires" of the maintenance manual.
2. Remove cotter pin, washer and nut from stud securing tie rod to steering arm. Remove ball stud from steering arm by tapping on arm with a hammer, placing a sledge hammer underneath steering arm to absorb shocks.
3. Remove cotter pin and nut securing steering arm to swivel assembly. Remove steering arm from swivel.

3.10.2 Installation

1. Insert steering arm in swivel.
2. Torque steering arm to swivel nut to 190 lbf-ft (260 Nm). Align cotter pin slot (tighten) and install a new cotter pin.
3. Position tie rod ball stud in steering arm and tap with a brass hammer to seat ball stud in steering arm. Install washer and nut on stud. Torque nut to 160 lbf-ft (220 Nm). Tighten nut to nearest cotter pin slot and install a new cotter pin.
4. Install wheel as directed in Section 13, "Wheel, Hubs and Tires" under paragraph "2.3 Installation" of the maintenance manual.

3.11 LUBRICATION FITTINGS

All lubrication fittings must be clean before applying lubricant. Also, always be sure equipment used in applying lubricant is clean. Every precaution should be taken to prevent entry of dirt, grit, lint or other foreign matter into lubricant containers. Replace fitting when they become broken or damaged.

Intervals of application given in the following paragraphs are recommended for normal service. More frequent intervals may be applied under severe operating conditions. In selecting proper lubricants, supplier reputation must be considered. The supplier must be responsible for product quality. The diagram (Fig. 22) shows approximate location of steering lubrication fittings.

1. **Drag Link Ends:** Lubricate at two fittings, one at each end of link, every 6,250 miles (10 000 km) with good quality lithium-base grease NLGI No. 2 (Shell Retinax LX or equivalent).
2. **Relay Rod Ends:** Lubricate at two fittings, one at each end of rod, every 6,250 miles (10 000 km) with good quality lithium-base grease NLGI No. 2 (Shell Retinax LX or equivalent).
3. **Tie Rod Ends:** Lubricate at four fittings, one at each end of both tie rods, every 6,250 miles (10 000 km) with good quality lithium-base grease NLGI No. 2 (Shell Retinax LX or equivalent).
4. **Swivel Assembly:** Refer to DANA SPICER MAINTENANCE MANUAL NDS AXLES Lubrication and Maintenance" annexed at the end of Section 10.
5. **Idler Arm and Crank bell:** Lubricate at two fittings, one on the idler arm and the other on the crank bell, every 6,250 miles (10 000 km) with good quality lithium-base grease NLGI No. 2 (Shell Retinax LX or equivalent). Apply grease gun pressure to the fitting until lubricant appears at the top seal.
6. **Upper A-Arm Central Ball Joint:** Lubricate at fitting until you see some grease on the relief valve nearby, every 6,250 miles (10 000 km) with good quality lithium-base grease NLGI No. 2 (Shell Retinax LX or equivalent).

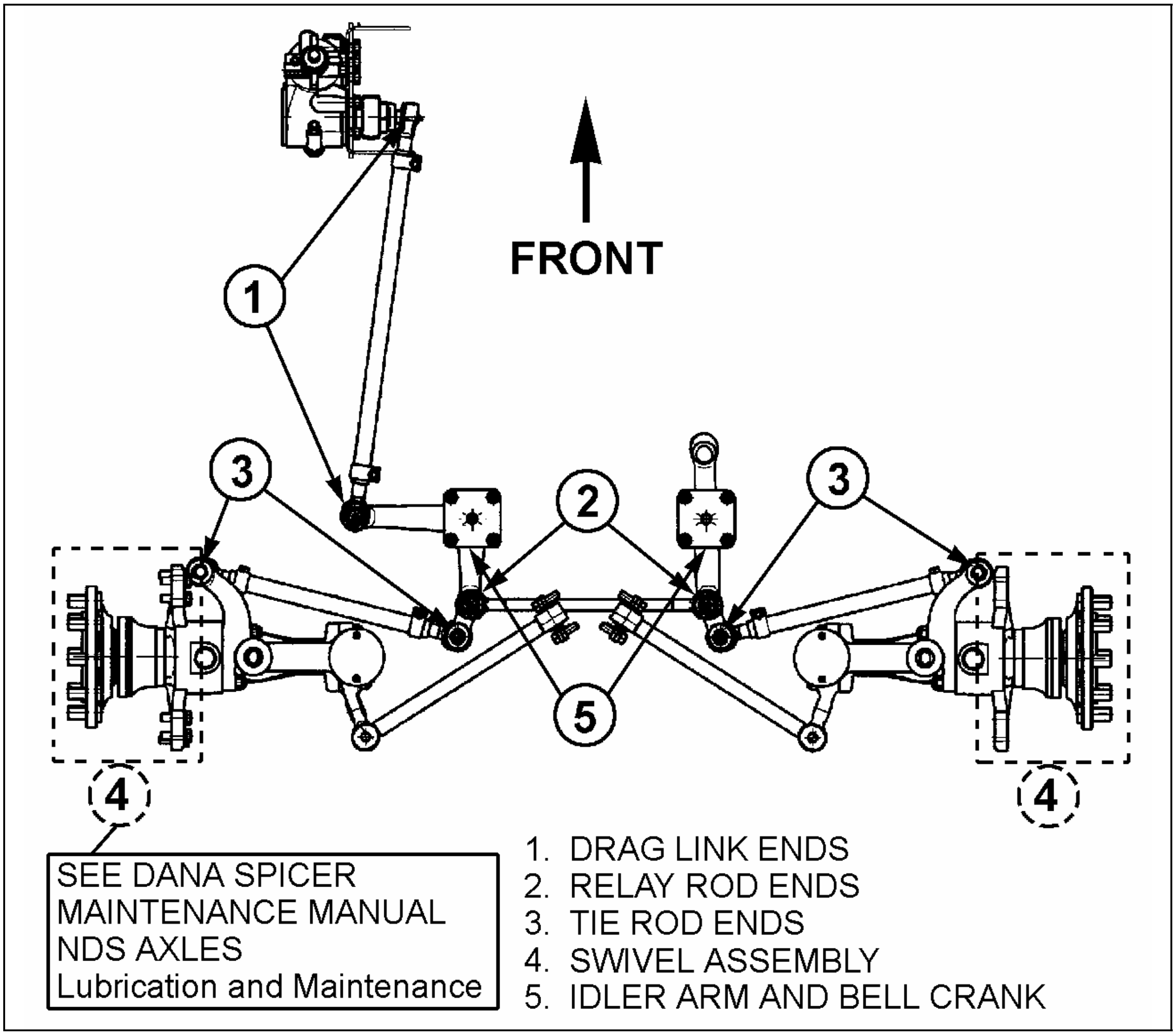


FIGURE 22: LUBRICATION FITTINGS' LOCATION DIAGRAM 16119

3.12 BALL JOINTS

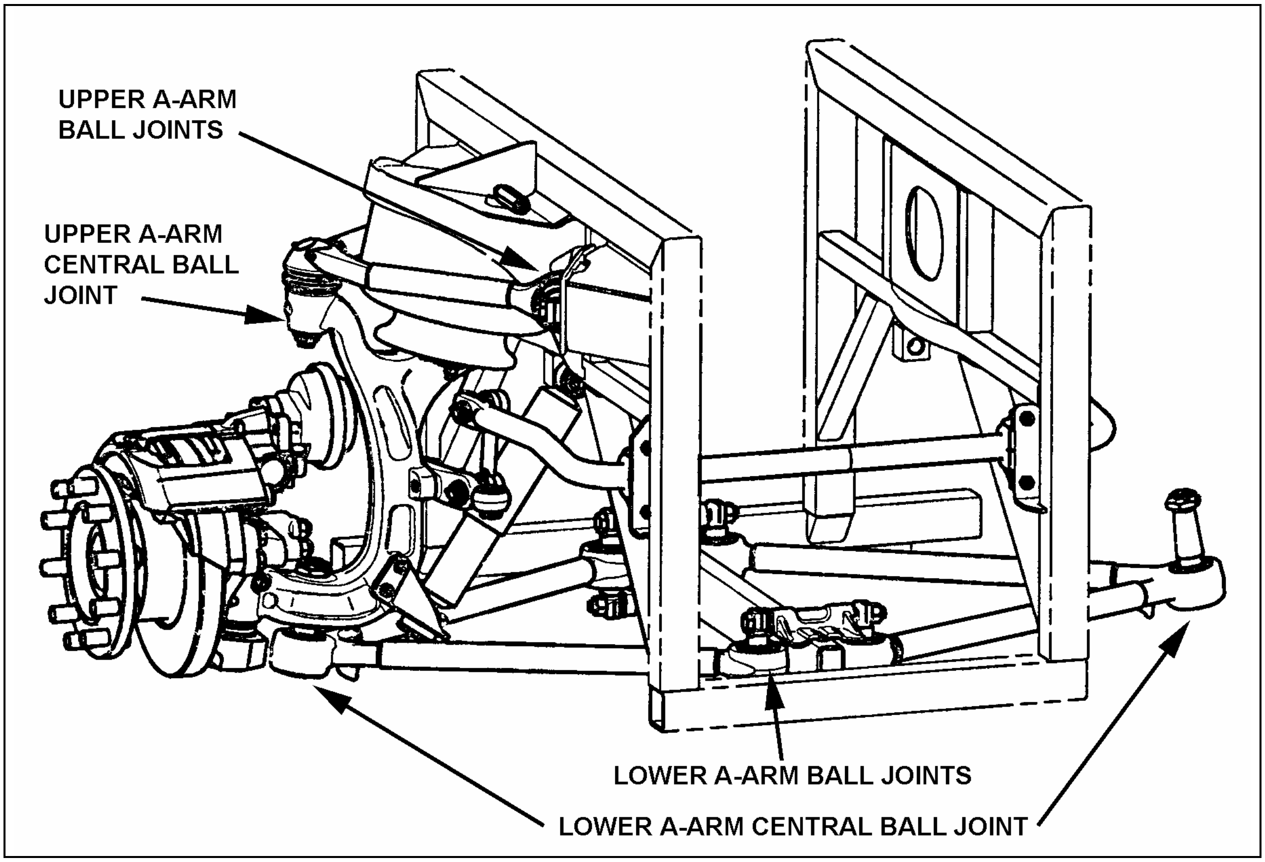


FIGURE 23: BALL JOINTS LOCATION 16137

3.13 LOWER AND UPPER A-ARM BALL JOINT

The assembly work may be done only by a recognized specialized workshop. Ensure that old and new parts do not get mixed up with each other. It is for this reason that all the old parts are to be scrapped immediately after a joint has been stripped down. A complete repair set must be used for each joint repaired, i.e. use of only part of a repair set is not permissible.

3.13.1 Inspection

Take off the load from the ball joint by lifting the front of the vehicle. Apply a load on the joint in all of the degrees of freedom in an axial, radial, etc. sense with a suitable lever tool. After the load is taken off, the joint has to spring back into its starting position. Free play is not acceptable.

Separation of rubber from ball pin or external joint shell is in accordance with "normal wear characteristics".

When the following characteristics are noted, the joint is to be changed:

- Free play;
- Radial cracking of the external sheet-metal race.

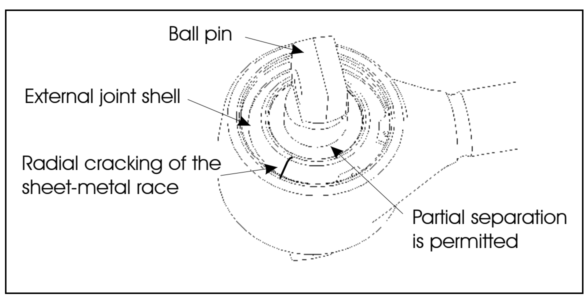


FIGURE 24: A-ARM BALL JOINTS 16173

3.13.2 Stripping Down

Strip down the defective joint through removal of retaining ring, annular spacer and ball pin/bushing, assembly and thereafter clean out housing bore and locking circlips groove.

3.13.3 Assembly

Execute assembly of the new joint parts in the following sequence:

1. Complete moistening of the contact surface between housing bore and ball pin through application of the grease.

NOTE
Apply grease, only in the case of repair kit (Prévost # 611114)).

2. Insert ball pin/bushing, assembly. In case of the two-bolt type, ensure that the bolt bores are in the correct position in relation to the axis of the tube.
3. Place joint in receiving fixture and mount annular assembly tool on the housing. Then locate annular spacer and retaining ring in the housing using axial load with the aid of assembly matrix. If the ends of the annular spacer are not in contact with each other, the thus formed opening must be located at 180° to the opening of the retaining ring. Pay attention during assembly to ensure that the retaining ring eyelets are located at each side of the housing shaft axis (retaining ring eyelet lug points to tube), and that retaining ring is properly engaged in the groove of the housing.
4. When repairing defective ball pin assemblies, the necked down-bolt must regularly be replaced with a new one.

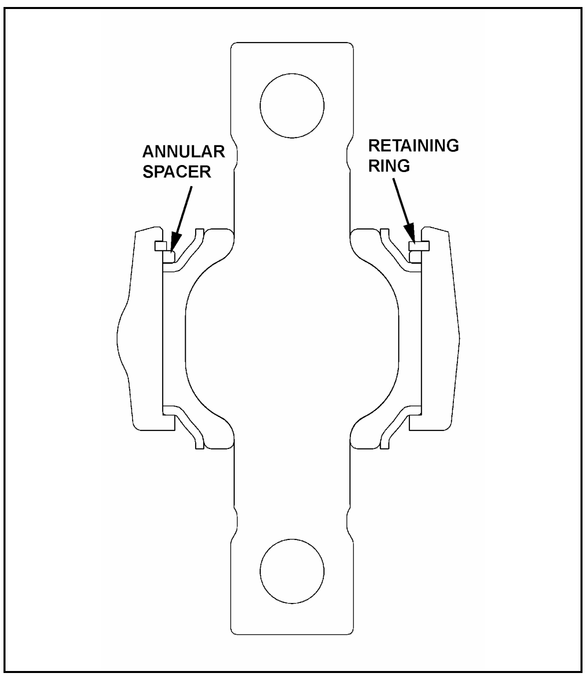


FIGURE 25: LOWER A-ARM BALL JOINTS 16114

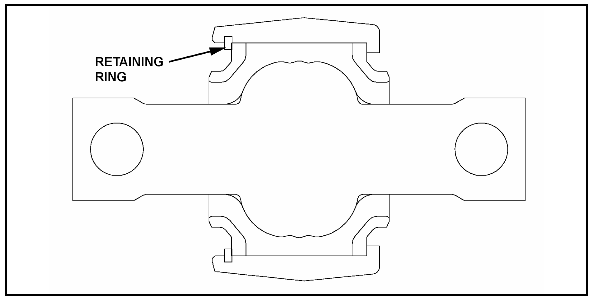


FIGURE 26: UPPER A-ARM BALL JOINTS 16115

3.14 LOWER A- ARM CENTRAL BALL JOINT

3.14.1 Inspection

Take off the load from the ball joint by lifting the front of the vehicle. Apply a load on the joint in all of the degrees of freedom in an axial, radial, etc. sense with a suitable lever tool. After the load is taken off, the joint has to spring back into its starting position. Free play is not acceptable.

Separation of rubber from ball pin or external joint bushing shell is in accordance with "normal wear characteristics".

When the following characteristics are noted, the joint is to be changed:

- Free play;
- Radial cracking of the external bushing shell.

3.14.2 Stripping Down

Strip down the defective joint through removal of retaining ring, annular spacer and ball pin/bushing, assembly and thereafter clean out housing bore and locking circlips groove.

3.14.3 Assembly

Assemble the new component parts of the joint in the following sequence:

1. Complete moistening of the contact surface between housing bore and ball pin through application of the grease.
2. Place joint in receiving fixture and mount annular assembly tool on the housing. Then locate annular spacer and retaining ring in the housing using axial load with the aid of assembly matrix. If the ends of the annular spacer are not in contact with each other, the thus formed opening must be located at 180° to the opening of the retaining ring. Pay attention during assembly to ensure that the retaining ring eyelets are located at each side of the housing shaft axis (retaining ring eyelet lug points to tube), and that retaining ring is properly engaged in the groove of the housing.

3. Faultlessly apply grease by mechanical means to bracket-outer core and ball-inner cone. Insert bracket outer cone in fixture with distance ring and then use press tool to apply pressure to press mount with ball-inner cone.

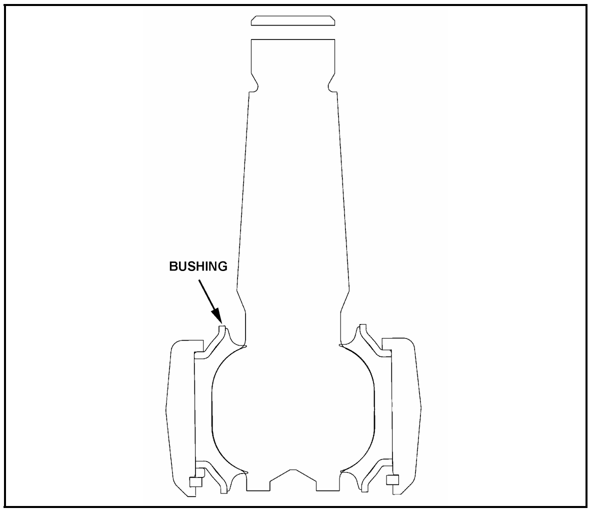


FIGURE 27: LOWER A-ARM CENTRAL BALL JOINT 16113

3.15 UPPER A-ARM CENTRAL BALL JOINT

3.15.1 Visual Inspection

Check the condition of the sealing boot, in particular:

Check if the retainer ring, which secures the sealing boot at the conical section of the ball stud, is still present.

Check if grease is present on the external surface of the sealing boots. Escaped fluid and accumulations of grease on the sealing boot may be the result of the sealing boot's rupturing. In this case, the ball joint must be systematically replaced.

3.15.2 Play Measurement

1. Raise the vehicle and support through axle jacking points.
2. Using a caliper, measure dimension A on figure 28.
3. With a lever tool, exert sufficient force under the upper A-arm as to separate the upper A-arm from the upright in order to have the ball joint to its maximum extent. Remeasure dimension A. If the difference between the two dimensions is greater than 0.060" (1.5 mm), then the ball joint should be replaced.

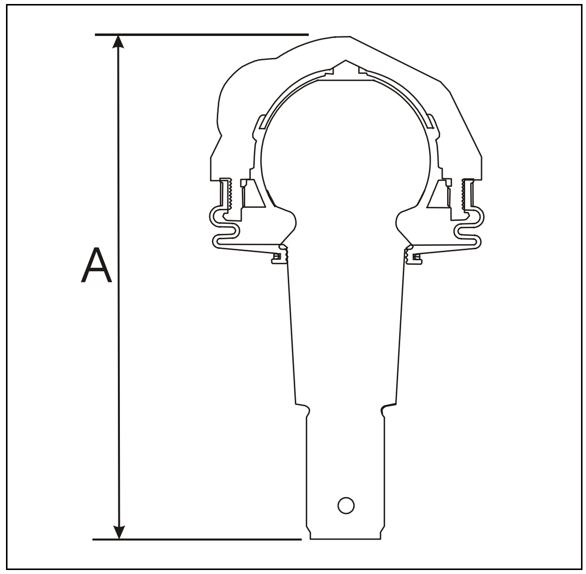


FIGURE 28: UPPER A-ARM CENTRAL BALL JOINT 16116

3.16 FRONT END ALIGNMENT

Proper front end alignment must be maintained to insure ease of steering and provide satisfactory tire life. When making front end alignment inspections, the vehicle must be level and empty with the full weight of the vehicle on the wheels.

Front end alignment inspections fall into two groups: regular service inspections performed at periodic intervals, and inspections to determine the extent of damage after a collision or severe service.

Regular service inspections concern toe-in, camber and caster.

Any variation from the specified alignment will indicate either a need for adjustment or a more thorough inspection to determine if parts replacement is required.

⚠ WARNING ⚠

During alignment, both camber and caster among other angles are adjusted. When adjusting these we install or remove shims from the lower "A" arms of the ISS suspension. After performing alignment, make sure that the following is done:

- **Installing a new lock nut after all shims are finalized.**
- **Torque replaced nuts as per figure 32.**
- **Installing a longer bolt if less the 2 threads are remaining after the nut.**
- **Using a Torque mark on the nut for future visual inspection.**

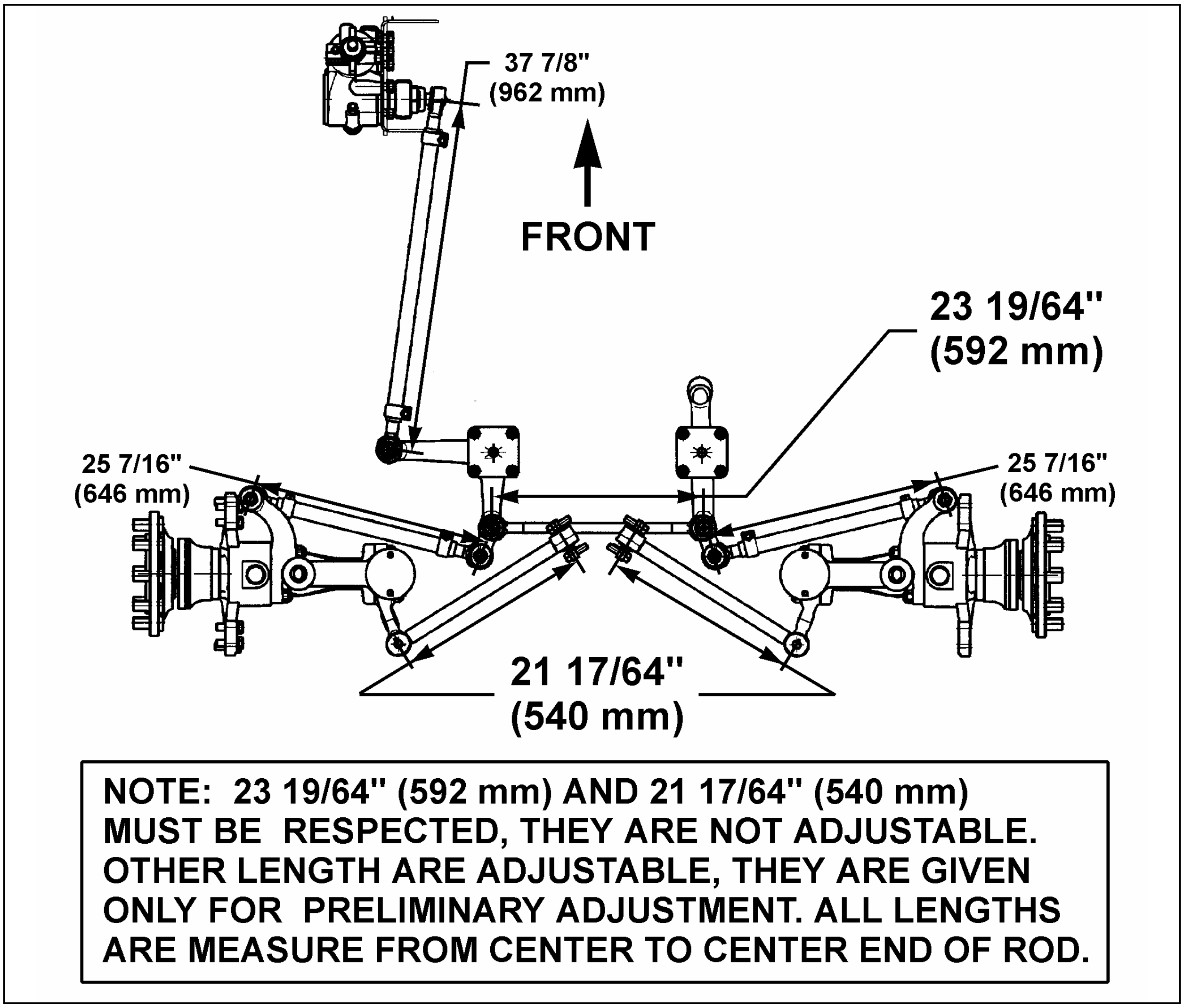


FIGURE 29: STEERING LINKAGE MEASURE 16130

3.16.1 Alignment Terminology

Wheel Camber

The amount the wheels are inclined from the vertical plane (A, Fig. 30).

Wheel Toe-In

The distance the front wheels are closer together at the front than at the rear of the tires (D minus E, Fig. 30).

King Pin Inclination

The inclination of the king pin from vertical toward the center of the vehicle at the top and outward at the bottom (B, Fig. 30).

Front Axle Caster

The inclination of the king pin from vertical in the fore and aft direction (C, Fig. 30).

3.16.2 Front End Inspection

Before checking front end alignment, make the following inspection:

1. Check that the vehicle is at normal ride height (see paragraph "5. Suspension Height Adjustment").
2. Check the tires for proper inflation.
3. Check wheel installation and run-out.
4. Check wheel bearing adjustment.
5. Check tie rods and drag link ends for looseness.
6. Check king pins for looseness.
7. Check if the length of the torque rod is 21 17/64" (540 mm) (Fig. 29). Check if the length of the relay rod is 23 19/64" (592 mm).

3.16.3 Front Wheel Camber

Positive camber is the outward inclination of the wheels at the top, negative or reverse camber is the inward inclination of the wheels at the top. Camber variations may be caused by wear at the wheel bearings, wheel spindle bushings, or bent suspension parts.

Check camber, with an accurate gauge. If camber is incorrect, check suspension parts for wear and replace worn parts. If wear is not perceptible, suspension parts may be bent or lower suspension arm may be improperly shimmed.

Check King pin inclination. If King pin inclination is incorrect, readjust the camber and check king pin inclination again.

NOTE
Camber is more important than king pin inclination, so adjust camber and verify king pin inclination.

Shim the lower suspension arm to adjust camber. If the king pin inclination is incorrect, the wheel king pin assembly may be bent and therefore should be replaced.

Excessive positive camber results in irregular wear of the tires at the outer shoulders. Negative or reverse camber causes wear at the inner shoulders.

NOTE
Shim only the lower suspension arm to adjust the front wheel camber.

⚠ CAUTION ⚠
Once the perfect shim combination is achieved, always install new stover nuts because the self looking effect is lost after tightening and loosening of the nut. It is recommended to punch marks to detect loosening of the nuts during future visual inspections.

3.16.4 Front Wheel Toe-In

Toe-in is measured from the center of the tire treads. Measurements at the front and rear of the tires must be made at the same height from the floor. Incorrect toe-in results in excessive tire wear and steering instability with a tendency to wander.

Toe-In Check

1. Check the camber adjustment and adjust if necessary.
2. Hoist the front of the vehicle and spin the wheels marking the centerline of the tire treads.
3. Place the wheels in the straight ahead position and lower the vehicle to rest on the floor.
4. Roll the vehicle ahead several feet. This removes any slack caused by looseness in the wheel bearings or steering connections.
5. Check the distance between the tire centerlines at the front and rear of the front tires. These two measurements must be made at the same height above the floor. The front measurement must be 3/32 ±1/32 of an inch less than the rear measurement.

Toe-In Adjustment

1. Loosen the tie rod clamp bolts.
2. Using a pipe wrench, turn the tie rod tubes to obtain the toe-in measurement specified in step 5 under paragraph "**Toe-in Check**" of this section.
3. Tighten the tie rod clamp bolts and recheck toe-in.
4. Check that the angular relationship of the pitman arm to the steering gear is as shown in figure 17.

NOTE
Use only tie rods to adjust toe-in.

3.16.5 Front Axle Caster

Positive caster is the inclination of the top of the king pins toward the rear of the vehicle. Negative or reverse caster is the inclination of the king pins toward the front of the vehicle. This vehicle is designed with positive caster. The purpose of caster is to provide steering stability by keeping the wheels in a straight ahead position.

Caster variations may be caused by bent upper suspension arm, lower suspension arm, or king pin housing. Caster should be adjusted with shims. Precision instruments should be used to measure caster. Shim bell crank and idler arm to adjust caster.

Variations from the specified caster will affect steering stability, cause wandering, wheel shimmy, and reduce returnability when pulling out of curves.

3.16.6 Major Damage

If the suspension has sustained major damage, it may be necessary to shim the bell crank and the idler arm to avoid the bump steer or roll steer. Moreover refer to paragraph "3.16: Front End Alignment".

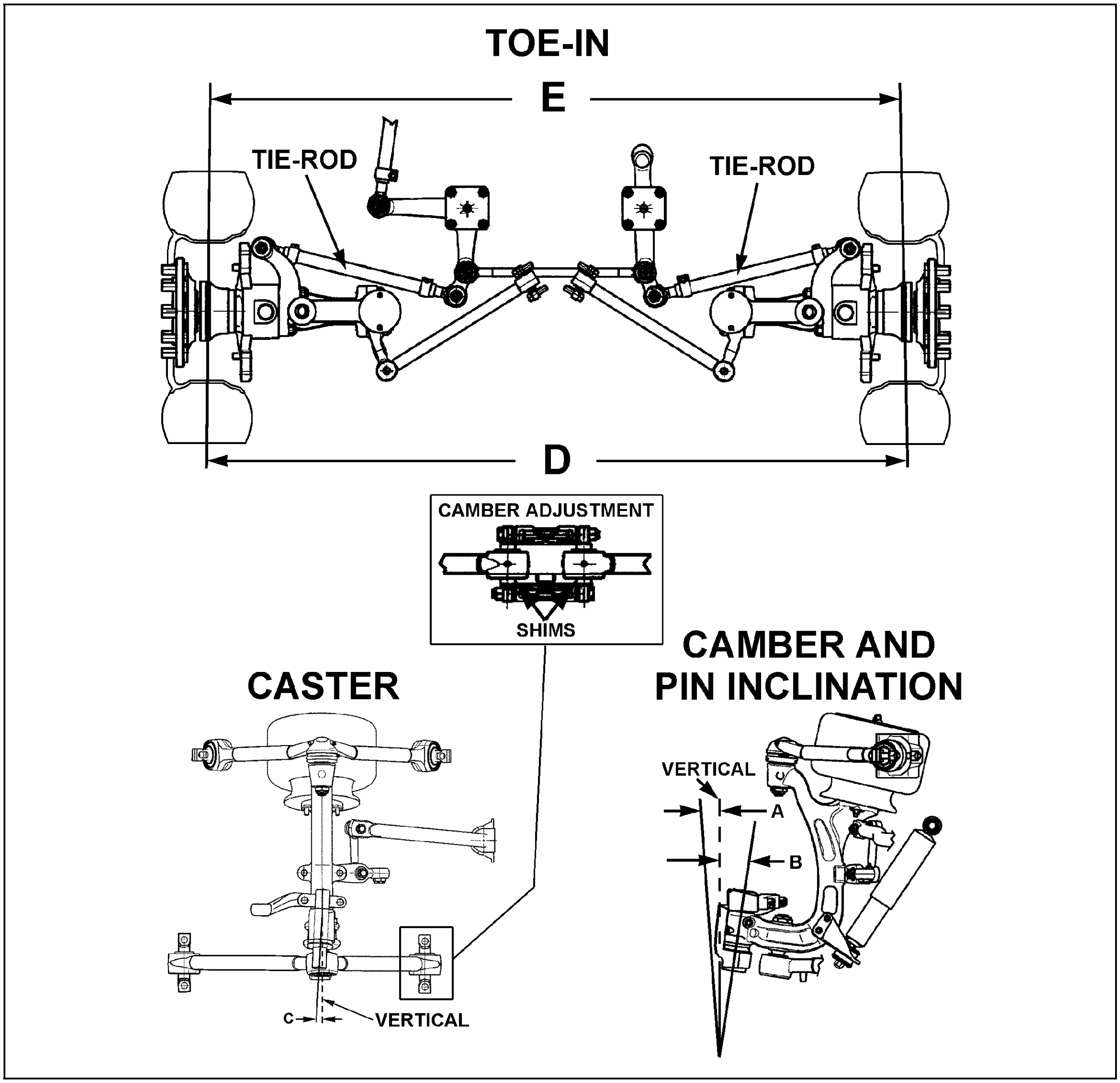


FIGURE 30: FRONT END ALIGNMENT DIAGRAM 16134

ALIGNMENT SPECS (See Figure 30)				
		Minimal	Nominal	Maximal
A	WHEEL CAMBER	0.0	0.150	0.35
B	KING PIN INCLINATION	8° (not adjustable)		
C	CASTER	2.35	2.6	2.85
D-E	TOE-IN	0.08	0.13	0.17

3.17 FRONT AIR SPRINGS

Two *"rolling lobe"* type air springs are used with the independent front suspension, one at each wheel. These air springs are special and use the complete piston as an extra reservoir to lower the spring stiffness. Front air springs are attached to the subframe and to uprights.

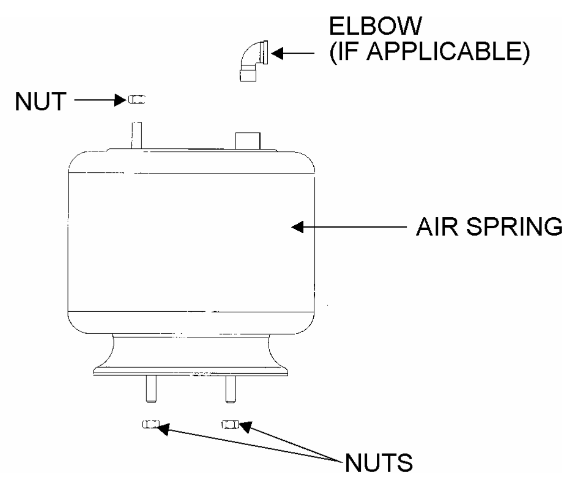


FIGURE 31: AIR SPRINGS 16052

3.17.1 Inspection

1. Check operation of bellows.
2. Visually inspect bellows for evidence of cracks, punctures, deterioration, or chafing. Replace the bellows if damage is evident.
3. With the primary air system at normal operating pressure (95 - 125 psi (655 - 860 kPa)), coat all suspension air line connections and bellow mounting areas with a water and soap solution. Bubbles will indicate an air leak, and none is permissible. Repair or replace defective parts.

NOTE

If air spring is removed from vehicle, bellows can be lightly inflated and submerged in water to detect any leakage. If leakage is detected, replace bellows.

⚠ WARNING ⚠

To prevent personal injury, do not apply more than 10 psi (69 kPa) air pressure to the unmounted air spring.

3.17.2 Removal

NOTE

Front air springs can be removed without removing the entire suspension assembly.

1. Safely support vehicle at the recommended body jacking points and jack up body understructure.
2. To gain access to a given air spring, the corresponding wheel can be removed.

⚠ CAUTION ⚠

Only the recommended jacking points must be used as outlined in Section 18, "Body" in the maintenance manual.

3. Support the assembly with a suitable jack.
4. Exhaust compressed air from accessory air tank by opening drain cock under reservoir.
5. Disconnect the height control valve link and pull down the overtravel lever to ensure all air is exhausted from air springs.

NOTE

While performing this step, do not change the height control valve overtravel lever adjustment.

6. Disconnect air line from air spring, remove elbow (if applicable), and cover both the line end and fitting to prevent the entry of foreign matter.
7. Remove the air spring upper nut, and then the two lower nuts. Remove air spring and remove the back up plate from the top of the air spring.

3.17.3 Installation

NOTE

To facilitate air spring installation, compress it manually then put a piece of tape over the air line threaded fitting. This prevents air from getting back into the bag and keeps it compressed, thus enabling to place the bag in between the mounting plates and greatly easing installation.

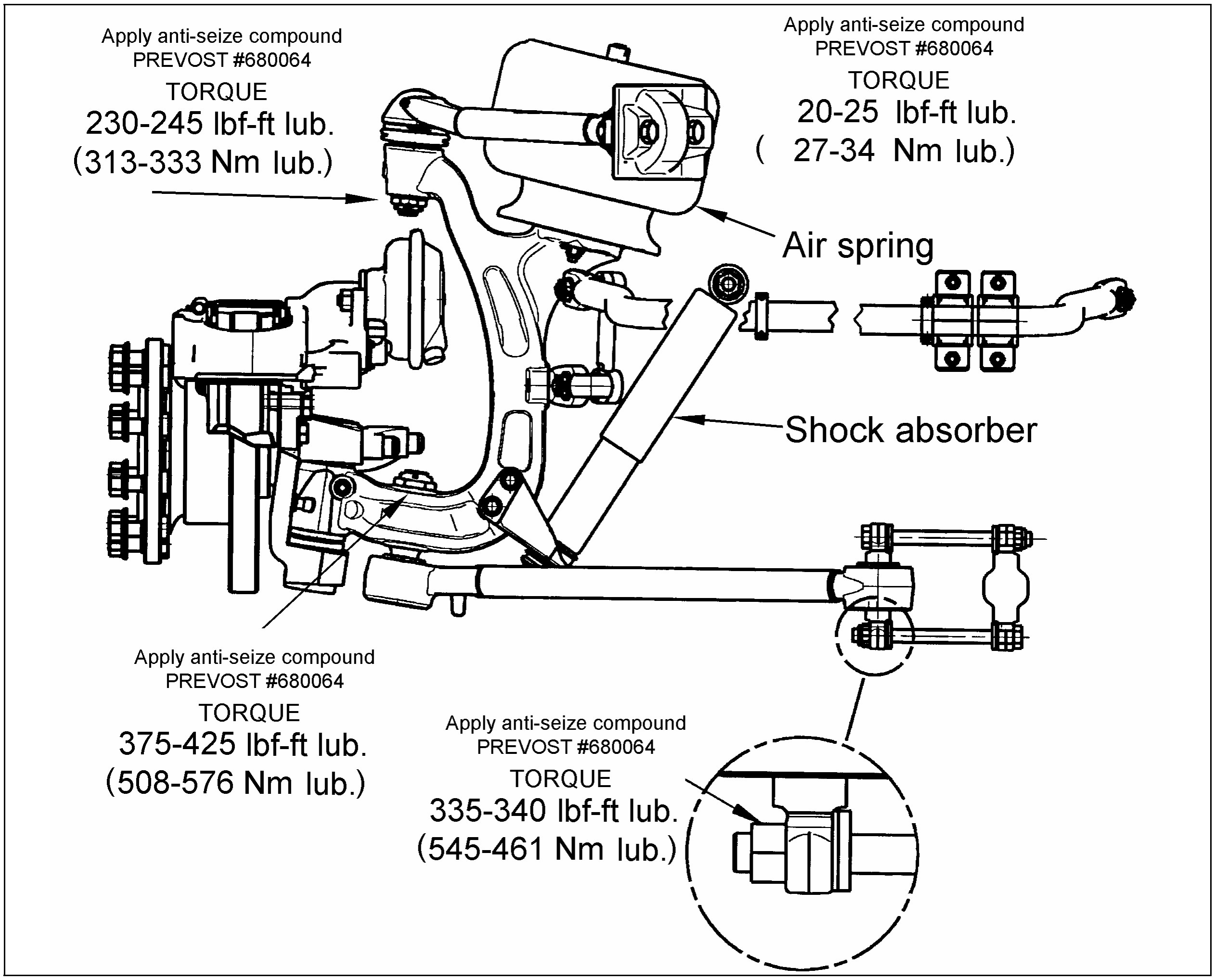


FIGURE 32: AIR SPRING AND SHOCK ABSORBER 16145

1. Compress air spring as necessary, then aligning studs with their holes, position air spring between both the lower and upper supports. Thread the lower nuts and the small upper nut a few turns.
2. Tighten and torque the lower stud nuts, and then the upper nut to 20-25 lbf-ft (27–34 Nm).
3. Install elbow (if applicable), then connect air line.
4. Connect the height control valve link.
5. Build up air pressure in system.

NOTE
To accelerate this operation, air reservoirs can be filled from an exterior air supply connected to the accessory tank fill valve or to the emergency fill valve.

6. Check operation of bellows and with the primary air system at normal operating pressure (95 - 125 psi (655 - 860 kPa), coat the air line connections and air spring mounting areas with a water and soap solution. Bubbles will indicate an air leak, and none is permissible. Repair or replace defective parts.
7. Remove the hydraulic floor jack from underneath shock absorber bracket.

3.18 SHOCK ABSORBERS

The two front shock absorbers are double-acting and telescopic type. Shock absorbers ensure a smooth ride and enhance vehicle stability on the road. Front shock absorbers have eye-type mountings on the upper side and bayonet type on lower side. Shock absorbers are non-adjustable and non-repairable.

⚠ CAUTION ⚠

When a shock absorber is found defective, always replace with a new set on affected axle, except if there has been a recent replacement of one unit. The following method will help in determining if both shock absorbers on the same axle have to be replaced.

3.18.1 Shock Absorber Removal

1. Remove the nut, washer and rubber joint from shock absorber mounting stud. Discard the rubber joints.
2. Remove the nut and washer from shock absorber mounting pin (upper side), taking care to identify the inner and outer washers to ease reinstallation. Refer to figure 33 for details.
3. Remove the shock absorber from the vehicle.
4. Remove inner: washers, rubber joint and bushings from the shock absorber. Discard bushings and rubber joint.

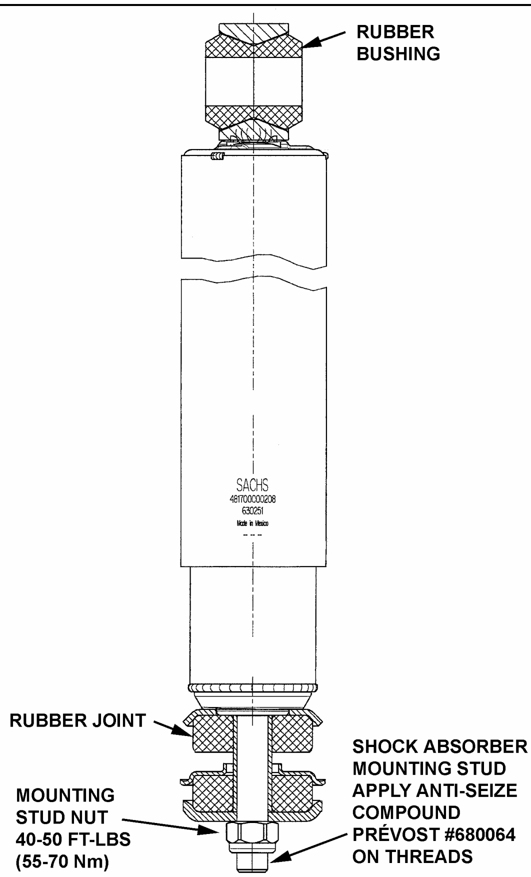


FIGURE 33: SHOCK ABSORBER 16112

3.18.2 Shock Absorber Installation

1. Check that the shock absorber mounting pin torque is proper (350-400 lbf-ft (475-545 Nm)). Ensure that the stud is clean and not stripped (upper side).
2. Install new rubber (mounting) bushing on shock absorber (upper side).
3. Place the inner washer on shock absorber pin (Fig. 33).
4. Install washer and rubber joint on shock absorber mounting stud (lower side).
5. Install the shock absorber as shown in figure 32 with the mounting stud protruding through the hole in the mounting bracket and the shock absorber eyes over the mounting pins. Install the outer washer.
6. Place a rubber joint and washer on the shock absorber mounting stud. Place the lower shock absorber mounting stud nut and torque to 40-50 lbf-ft (55–70 Nm).
7. Place the upper mounting pin stud nut and torque to 70-85 lbf-ft (95–115 Nm).

3.19 SWAY BAR

A sway bar is provided on the front and rear suspensions to increase vehicle stability. It controls lateral motion (swaying movement) of vehicle.

3.19.1 Removal

1. Disconnect the two links from sway bar.
2. Safely support the sway bar. Unbolt bushing collars from subframe.
3. Remove sway bar.

NOTE

Sway bar bushings are slit to ease their removal.

3.19.2 Installation

1. Loosely install the sway bar.
2. Torque bushing collar nuts to 60 lbf-ft (82 Nm).
3. Torque sway bar link upper nuts to 120-140 lbf-ft (163-190 Nm) on front suspension and to 100-120 lbf-ft (136-163 Nm) on rear suspension.
4. Torque sway bar link lower nuts to 120-140 lbf-ft (163-190 Nm) on front suspension and to 70-80 lbf-ft (95-110 Nm) on rear suspension.

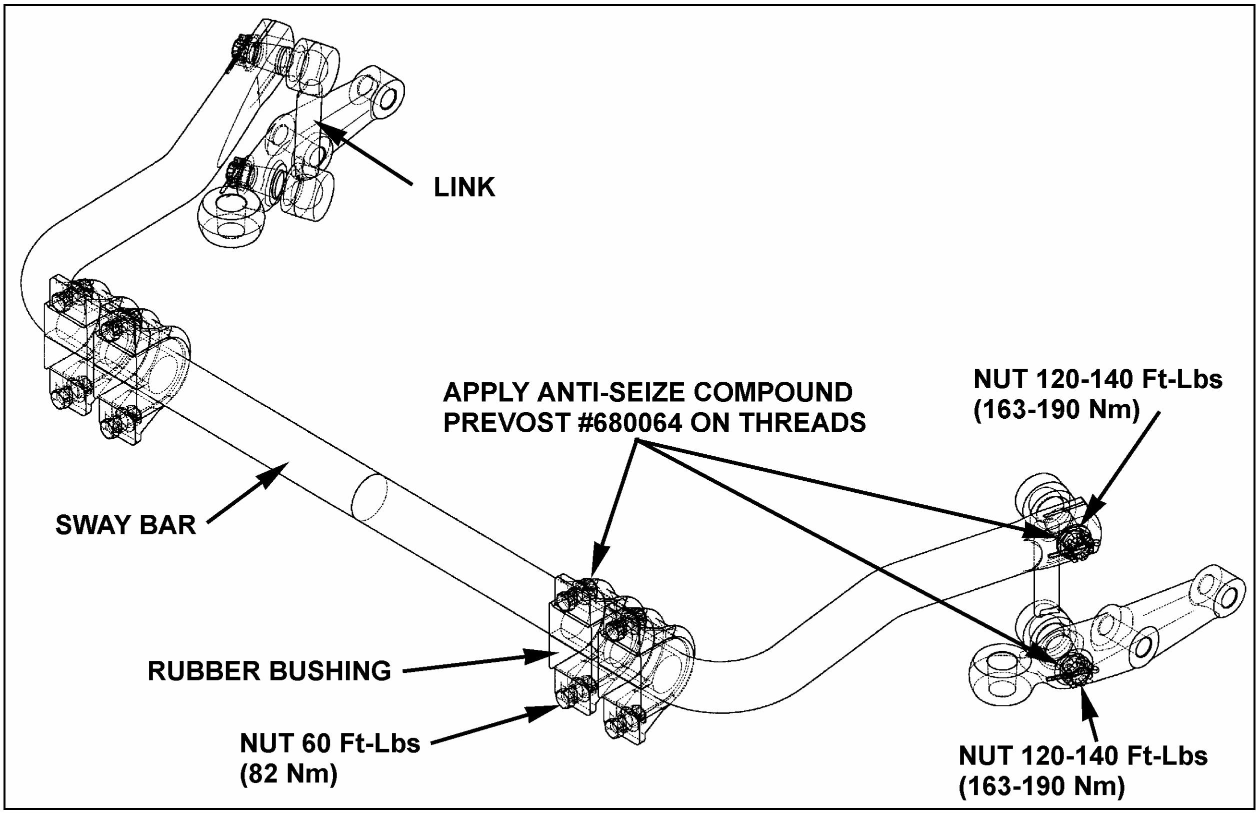


FIGURE 34: SWAY BAR (FRONT SUSPENSION) 16138B

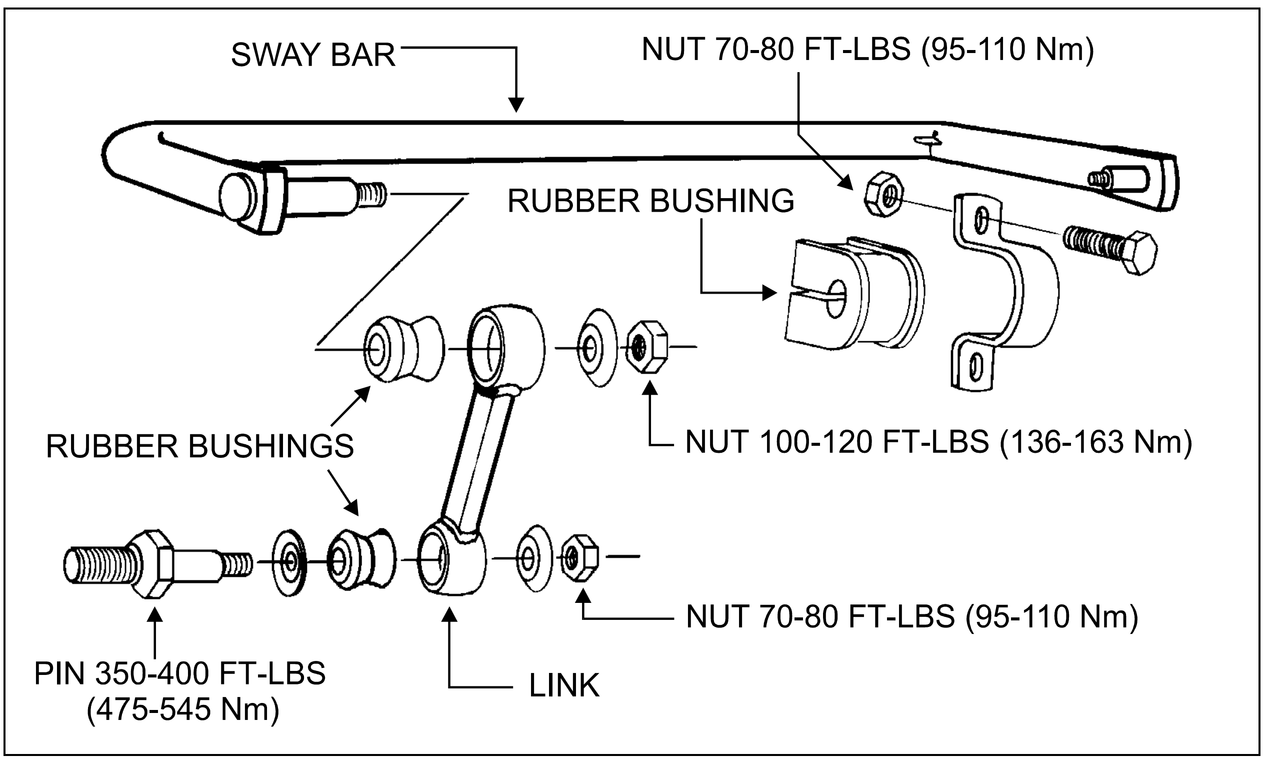


FIGURE 35: SWAY BAR (REAR SUSPENSION) 16144

4. REAR SUSPENSION

For a description of all these systems, refer to the appropriate heading in this section.

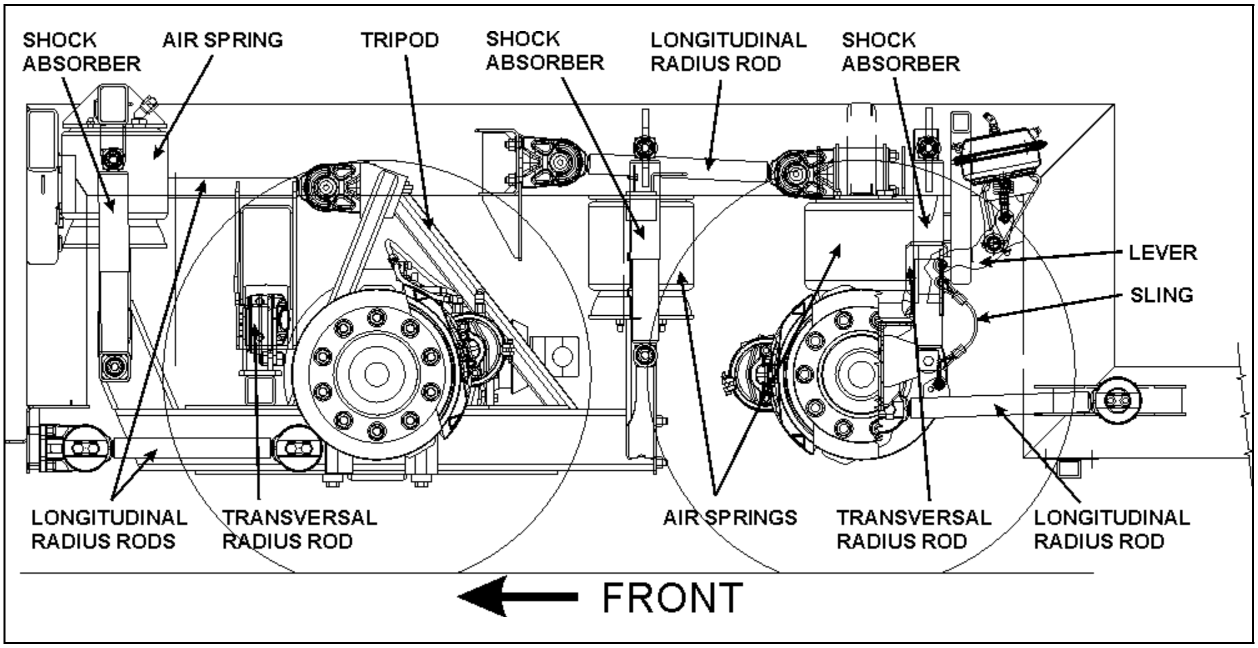


FIGURE 36: REAR SUSPENSION COMPONENTS 16167

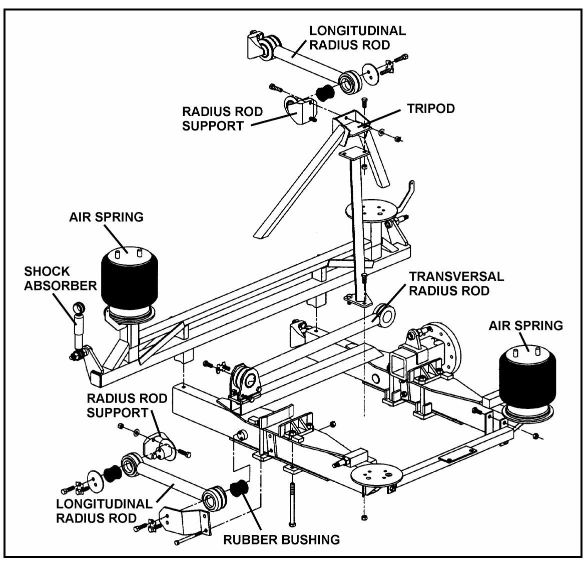


FIGURE 37: DETAILS OF REAR SUSPENSION 16106

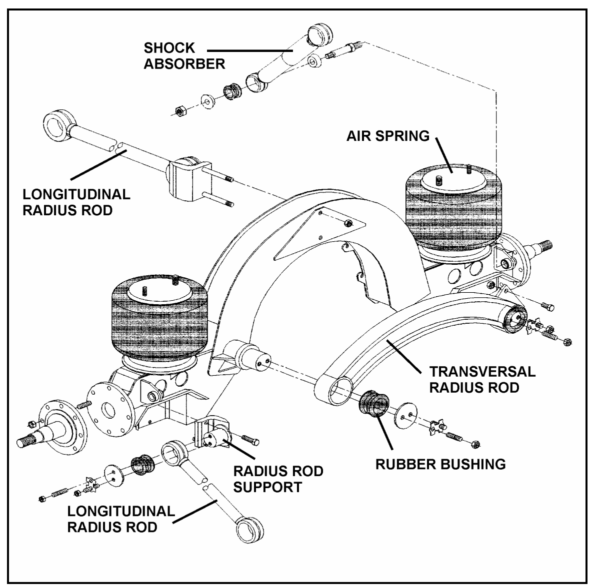


FIGURE 38: TAG AXLE SUSPENSION 16107

4.1 AIR SPRINGS

The air springs are made from a special compound rubber molded to the proper contour and dimensions. The entire vertical load of the vehicle is supported by these springs. Each of the two axles is provided with air springs that are attached to the subframe and to the axles (Fig. 39).

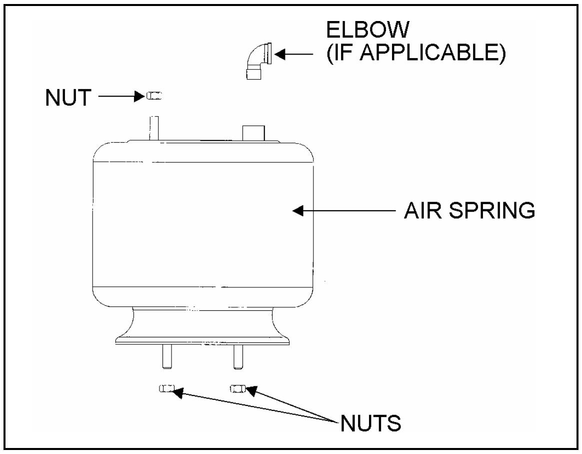


FIGURE 39: AIR SPRING 16052

4.1.1 Inspection

1. Check operation of bellows.
2. Visually inspect bellows for evidence of cracks, punctures, deterioration, or chafing. Replace the bellows if any damage is evident.
3. With the primary air system at normal operating pressure (95 - 125 psi (655 - 860 kPa)), coat all suspension air line connections and bellows mounting areas with a water and soap solution. Bubbles will indicate an air leak, and none is permissible. Repair or replace defective parts.

NOTE

If air spring is removed from vehicle, bellows can be lightly inflated and submerged in water to detect any leakage. If any leakage is detected, replace bellows.

WARNING

To prevent personal injury, do not apply more than 10 psi (69 kPa) of air pressure to the uninstalled air spring.

4.1.2 Removal

NOTE

Suspension air springs (drive and tag axles) can be removed without removing the entire axle assembly.

1. Safely support vehicle at the recommended body jacking points. To gain access to a given air spring, the corresponding wheel can be removed as follows.

   a) Jack vehicle until the tire clears the ground, and place safety supports underneath body.

CAUTION

Only the recommended jacking points must be used as outlined in Section 18, “Body”.

   b) Support the axle with a suitable hydraulic floor jack at the recommended jacking point.

   c) Remove wheel.

2. Exhaust compressed air from accessory air tank by opening drain cock under reservoir.
3. Disconnect the height control valve link and pull down the overtravel lever to ensure all air is exhausted from air springs.

NOTE

While performing this step, do not change the height control valve overtravel lever adjustment.

4. Disconnect air line from air spring, remove elbow (if applicable), and cover both the line end and fitting to prevent the entry of foreign matter.
5. Remove the air spring upper nut, and then the two lower nuts. Remove air spring.

4.1.3 Installation

1. Compress air spring as necessary, then aligning studs with their holes, position air spring between both the lower and upper supports. Thread the lower nuts and the small upper nut a few turns.

NOTE
To facilitate air spring installation, compress it manually then put a piece of tape over the air line threaded fitting. This prevents air from getting back into the bag and keeps it compressed, thus enabling to place the bag in between the mounting plates and greatly easing installation.

2. Tighten and torque the lower stud nuts, and then the upper one to 20 – 25 lbf-ft (27 – 34 Nm).
3. Thread the remaining upper nut (large nut) and tighten to 20 – 25 lbf-ft (27 – 34 Nm).
4. Install elbow (if applicable), then connect air line.
5. Connect the height control valve link.
6. Build up air pressure in system.

NOTE
To accelerate this operation, air reservoirs can be filled from an exterior air supply connected to the accessory tank fill valve or to the emergency fill valve.

7. Check operation of bellows, and with the primary air system at normal operating pressure (95 – 125 psi (655 – 860 kPa)), coat the air line connections and air spring mounting areas with a water and soap solution. Bubbles will indicate an air leak, and none is permissible. Repair or replace defective parts.
8. Reinstall wheel.
9. Remove the hydraulic floor jack from under the axle, then lower vehicle to ground.

4.2 SHOCK ABSORBERS

Double-action, telescoping-type shock absorbers ensure a smooth ride and enhance vehicle stability on the road. All shock absorbers are eye-type mountings. The tag axle is provided with two shock absorbers while the drive axle is provided with four of them (Fig. 36, 37 and 38).

Shock absorbers are non-adjustable and non-repairable. Maintenance requirements involve replacement of the rubber mounting bushings, and tightening of all shock absorber pins at the proper torque of 500 - 550 lbf-ft (680 - 750 Nm) when shock absorber replacement occurs. If a shock absorber becomes inoperative, complete unit must be replaced.

⚠ CAUTION ⚠
When a shock absorber is found defective, always replace with a new set on affected axle, except if there has been a recent replacement of one unit. The following method will help in determining if both shock absorbers on the same axle have to be replaced.

4.2.1 Inspection

Loosen lower mounting of both shocks, and then carefully attempt to raise and lower the bottom portion of each shock. Note the rate of effort for distance of travel. Replace both shocks if a definite differential rate is found.

The shock must be bench checked in an upright, vertical position. If checked in any other position, air will enter the cylinder tube and make the shock absorber appear defective.

Proceed as follows to check shock absorbers:

1. With the shock absorber in a vertical position (top end up), clamp the bottom mount in a vise.

⚠ CAUTION ⚠
Do not clamp the reservoir tube or the dust tube.

2. Rotate the dust tube. Notice any binding condition (may be compared with new unit). Binding condition indicates a scored rod. Units with scored rods should be replaced.
3. Fully extend shocks and check for leaks in the seal cover area. Shock fluid is a very thin hydraulic fluid that has a characteristic odor and dark brown tint. A slight trace of shock fluid around the seal cover area is not a cause for replacement. The shock seal is designed to permit a very slight seepage to lubricate the rod. Units that leak should be replaced.
4. Visually check shock for dents that could cause the shock to bind. Also, check for a bent rod.
5. Extend and collapse shock several times to determine that it has control (resistance) in both rebound and compression.
6. Visually inspect the shock mountings and vehicle mounting for:

a) Broken mounts;

b) Extreme bushing wear;

c) Shifted bushing or sleeve;

d) Deep cracks in bushing material (shallow surface cracks are normal);

e) Loose shock absorber pins;

f) Presence of convex washers, and their position relative to the rubber bushing.

4.2.2 Removal

1. Remove nuts and washers from shock absorbers on upper and lower mounting pins, taking care to identify the inner and outer washers to ease reinstallation. Refer to figure 40 for details.
2. Remove the shock absorber assembly from pins.
3. Remove the two inner bushings from the shock absorber and discard them.

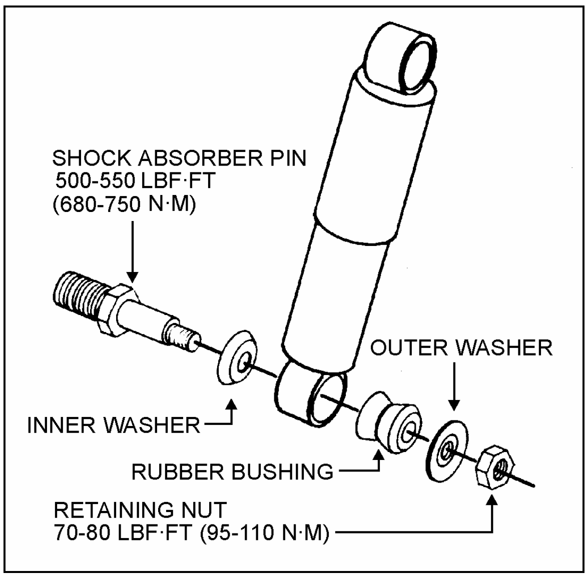


FIGURE 40: SHOCK ABSORBER 16008

4.2.3 Installation

1. Ensure that the shock absorber mounting pins are tight and that the threads are not stripped.
2. Install new rubber mounting bushings on shock absorbers (upper and lower).
3. Place the inner washers (with washer convex side facing the shock absorber rubber bushing) on each shock absorber pin (Fig. 41).
4. Install the shock absorber eyes over the mounting pins, then the outer washers (with washer convex side facing the shock absorber rubber bushing) on each shock extremity.

NOTE
If shock absorber pins are removed, they must be reinstalled using "loctite" (see "Parts Specifications" in this section).

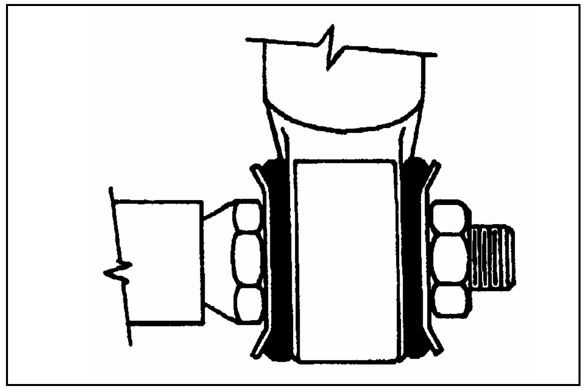


FIGURE 41: TYPICAL SHOCK ABSORBER SETUP 16009

5. Place the lower and upper mounting pin stud nuts and torque to 70 - 80 lbf-ft (95 – 110 Nm).

4.3 RADIUS RODS

Radius rods are used to secure the axles in the proper transversal and longitudinal positions. Four radius rods are provided on the drive axle suspension (three longitudinal and one transversal) and also four on the tag axle with a layout similar to the drive axle. Refer to figures 36, 37 and 38 for details. These rods transmit both braking and driving forces from the axles to the vehicle body.

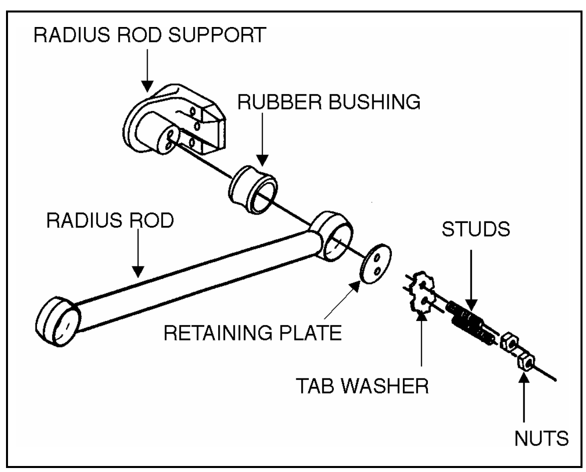


FIGURE 42: TYPICAL RADIUS ROD SETUP 16010

4.3.1 Inspection

The following instructions apply to all radius rods used on this vehicle:

1. Clean all parts thoroughly.
2. Inspect radius rods for distortion and cracks. We recommend the "Magnaflux" process to detect cracks in the radius rod. Any damaged part should be replaced with a new one.

NOTE
New bushings should be used when rods are replaced.

3. The radius rod bushings should be checked periodically for signs of shearing, deterioration, or damage. Any defective part should be replaced with a new one.

4.3.2 Removal

1. Flatten the tab washer which secures the two retaining nuts (or bolts), then unscrew the nuts (or bolts) at each extremity of the radius rod (Fig. 42).
2. Remove the tab washer and the retaining plates and radius rod ends from anchor pins, and then remove the radius rod.

4.3.3 Bushing removal

1. Safely support the radius rod as shown in figure 43.

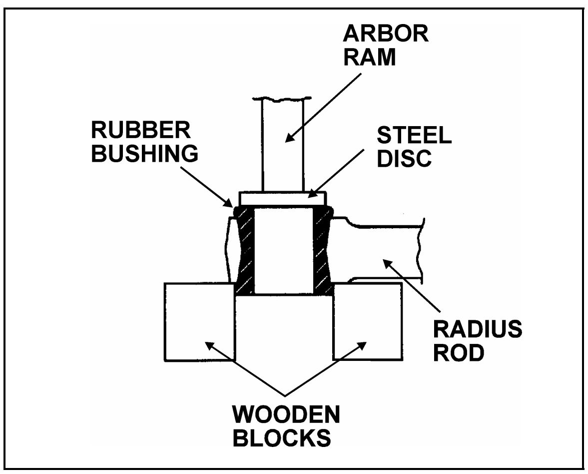


FIGURE 43: RADIUS ROD BUSHING REMOVAL 16011

2. Place a flat steel disc, slightly smaller than the outside diameter of the bushing (Fig. 43).
3. Using an arbor press or a suitable driving tool, press or drive the old bushing out of the rod and discard the bushing.

⚠ CAUTION ⚠
Make sure to prevent the steel disc from contacting the radius rod end.

4.3.4 Bushing installation

1. Lightly spray the inner and outer surfaces of radius rod bushing with water.

⚠ CAUTION ⚠
No lubricant whatsoever is to be used on the rubber bushing.

2. Safely support the radius rod, and place new bushing on top of the radius rod end (Fig. 44).
3. Place a block of wood on top of bushing and press on it manually.
4. If necessary, use an arbor press or a suitable driving tool. Press or drive the bushing into the radius rod end until it extends equally on both sides of the rod.
5. It is also possible to proceed differently. Place radius rod bushing on a plane surface. Spray a light coat of water on the inner and outer surfaces of radius rod bushing.
6. Take radius rod, align the bushing. Tap radius rod on bushing until latter is positioned correctly.

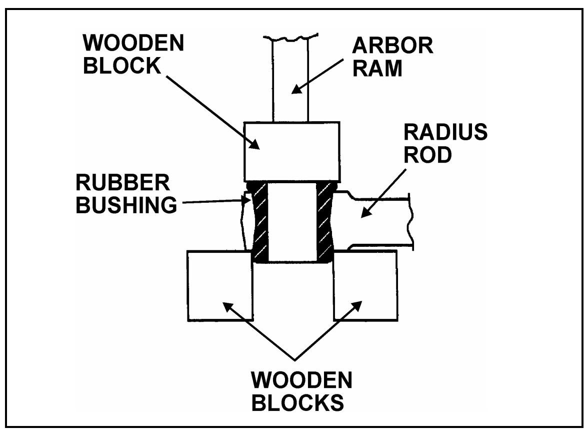


FIGURE 44: RADIUS ROD BUSHING INSTALLATION 16012

4.3.5 Installation

1. Lightly spray the radius rod support with water. Place the radius rod end over the radius rod support (Fig. 45).

2. Position the retaining plate. Install the tab washer and nuts (or bolts).

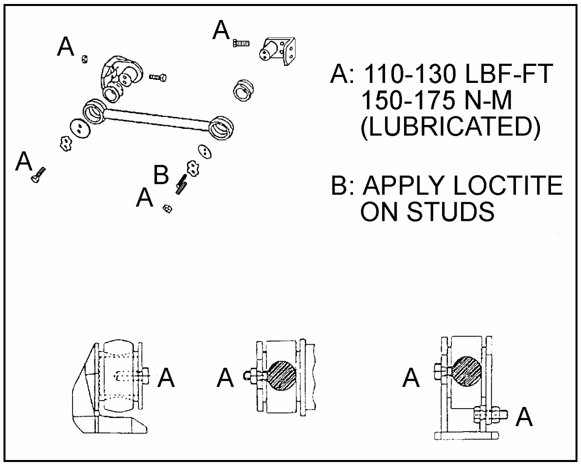


FIGURE 45: RADIUS ROD INSTALLATION 16028

> ⚠ **CAUTION** ⚠
>
> **Always use new tab washers at installation.**

3. Tighten the nuts (or bolts) lightly, and repeat at the other end.
4. Refer to heading *"Suspension Height Adjustment"* later in this section, and set the vehicle to normal ride height.
5. With the vehicle at normal ride height, apply oil on threads and tighten all radius rod anchor pin nuts or bolts to 110 – 130 lbf-ft (150 – 175 Nm).

> ⚠ **CAUTION** ⚠
>
> **It is extremely important upon reconnection of the rods that the proper clearance height between the axle and body be maintained. Otherwise, the rubber bushings in radius rod ends will become preloaded, thus reducing their life span.**

5. SUSPENSION HEIGHT ADJUSTMENT

The flow of pressurized air from the accessory air tank to the air springs is controlled by three height control valves. The two rear valves are mounted to the subframe and connected to the rear axles through an arm and link connection. The front valve is mounted to the subframe and connected to the front air tank support. These connections allow the valves to apportion air pressure in the springs to the vehicle load, maintaining normal ride height.

Immediate response height control valves increase or decrease the air pressure in the suspension system as required. One height control valve is located **at center of front sway bar**, and regulates air to front suspension air springs in order to maintain the vehicle at the required height. Two are located at the drive axle, one on each inner side of rear wheelhousing.

The appropriate vehicle body height is obtained by measuring the clearance of all the air springs installed on the vehicle. The two front air springs clearance should be 11 ± ¼" (279 ± 6 mm). Refer to figure 46 to identify the correct area to take measurement. The rear air springs clearance should be 11 ½ ± ¼" (292 ± 6 mm).

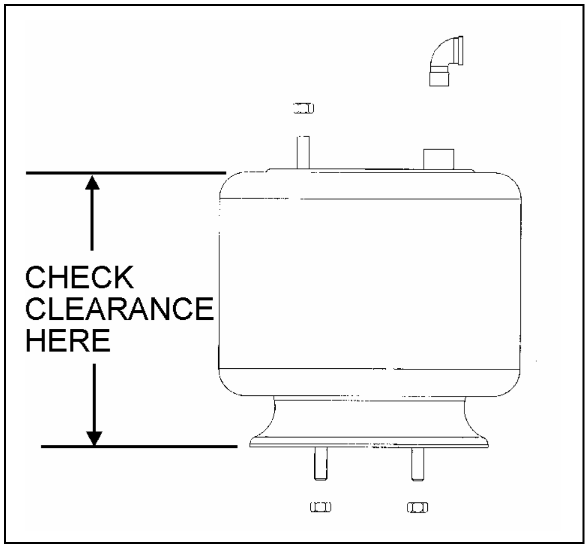


FIGURE 46: TYPICAL AIR SPRING CLEARANCE 16058

At this point, it should not be necessary to make an adjustment under normal service conditions. However, if an adjustment is required, change the position of the overtravel lever in relation to the overtravel control body. The lever should be moved up to raise vehicle height, and down to lower it. Check that main air pressure is at normal operating pressure and raise the vehicle to the specified height.

> ⚠ **CAUTION** ⚠
>
> **Always adjust on "fill cycle". If it is necessary to lower vehicle height, release sufficient air to be well below height, and adjust to height or fill cycle.**

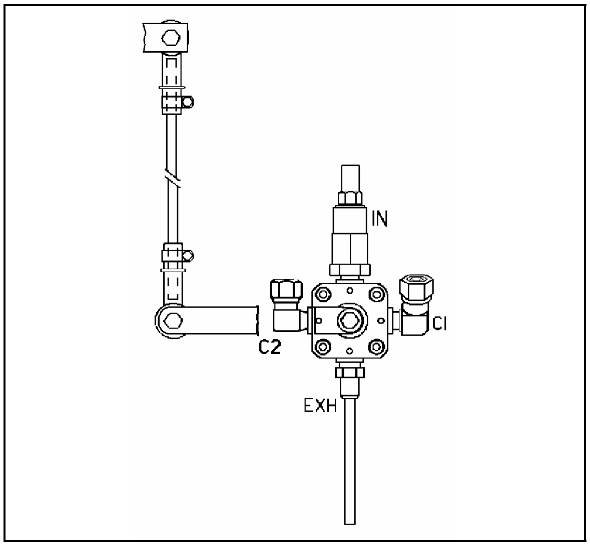


FIGURE 47: FRONT HEIGHT CONTROL VALVE 16100

The normal ride height is obtained by adjusting air spring clearance of both front and rear suspension as follows:

Front air spring clearance

1. With the vehicle at normal operating air pressure [100 - 125 psi (689 - 860 kPa)], measure air spring clearance. This clearance should be 11 ± ¼“ (279 ± 6 mm).

NOTE
The measurement should be taken from underneath the upper air spring support on subframe to top of the lower air spring support on axle (refer to figure 46 for more details). If adjustment is required, begin with the drive axle.

2. Loosen the clamp on the height control valve rubber coupling and bring it up or down (Fig. 47).

NOTE
Allow suspension to stabilize before taking reading.

When the desired height is obtained, tighten clamp.

Rear air spring clearance

1. With the vehicle at normal operating air pressure [100 - 125 psi (689 - 860 kPa)], measure air spring clearance. This clearance should be 11 ½ ± ¼" (292 ± 6 mm).

NOTE
The measurement should be taken from underneath the upper air spring support on subframe to top of the lower air spring support on axle (refer to figure 46 for more details).

2. Loosen the clamp on the height control valve rubber coupling and bring it up or down (Fig. 48).

NOTE
Allow suspension to stabilize before taking reading.

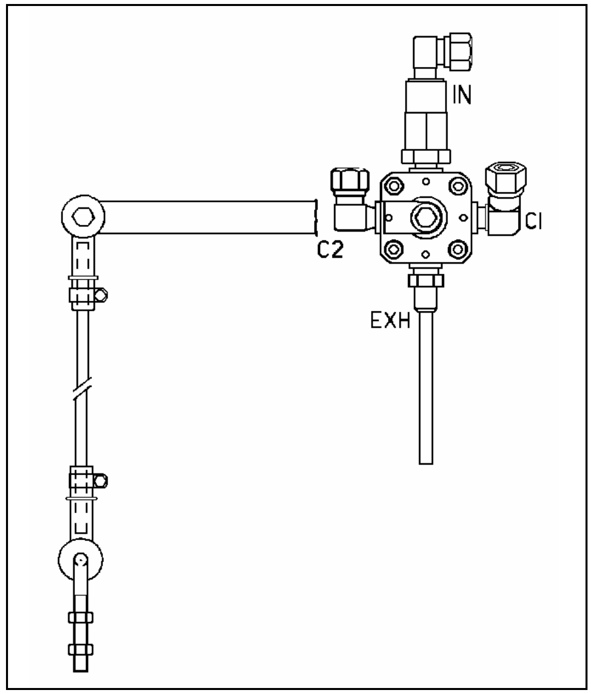


FIGURE 48: REAR HEIGHT CONTROL VALVE 16093

When the desired height is obtained, tighten clamp.

6. HEIGHT CONTROL VALVE

The height control valves automatically add air to, or release air from air springs to maintain constant suspension height regardless of load, or load distribution. Each valve adjusts independently according to the following conditions:

Loading Position

As the load increases and lowers the vehicle body, the overtravel lever commands the height control valve to add air to air springs.

Neutral Position

When vehicle body reaches the normal ride height, the height control valve overtravel lever reaches the "neutral" position and keeps both the supply and exhaust ports closed to ensure normal ride height is maintained. This condition remains static until the vehicle load is altered.

Unloading Position

As the load decreases and raises the vehicle body, the overtravel lever commands the height control valve to release air from air springs.

6.1 MAINTENANCE

The height control valve requires no periodic maintenance. Height control valve linkage operates on rubber bushings and no lubrication should be attempted at this location. Inspect the valve for loose joints, air leaks and worn bushings.

6.1.1 Removal and Installation

Before disconnecting a height control valve air line, securely support the vehicle by its jacking points on the body, and place safety supports underneath body. Refer to paragraph *"16. Vehicle Jacking Points"* in Section 18, *"Body"*.

1. Exhaust air from air system by opening all air tank drain cocks. Remove height control valves.
2. Disconnect overtravel lever from link and pull down lever to exhaust remaining air from air springs.
3. Disconnect air supply and delivery lines from the height control valve. Cover line ends with tape to prevent entry of foreign matter.
4. Remove the nuts retaining the height control valve to the mounting bracket, then remove valve assembly.

Reverse removal procedure to replace height control valve. After installation, check for leakage using a soap and water solution.

7. AIR SYSTEM

The basic air system consists of an air compressor, tanks, valves, filters and interconnecting lines and hoses (refer to Section 12, "Brake and Air System" for complete information). It provides a means for braking, operating controls and accessories, and suspension. An air system schematic diagram is annexed at the end of this section for better understanding of the system.

The air coming from the air dryer is first directed to the wet air tank, then to the primary (for the primary brake system), secondary (for the secondary brake system), and accessory (for the pneumatic accessories) air tanks (Fig. 49 and 50).

In addition, an expansion air tank may be installed in series with each air spring.

7.1 AIR TANK MAINTENANCE

Ensure that the accessories air tank is purged during pre-starting inspection. A good practice is to purge this tank at the end of every driving day by the remote air tank drain valve located in the steering compartment (Fig. 52).

Moreover, purge all tanks by their bottom drain valves at specified intervals.

7.1.1 Wet Air Tank

This tank is installed above the drive axle on the L.H. side, and is provided with a bottom drain valve. It is recommended to **purge** the wet air tank by its bottom drain valve every 12,500 miles (20 000 km), or once a year, whichever comes first.

A remote valve located in engine compartment and accessible through engine R.H. side door is used to **drain** the air dryer (Fig. 51).

7.1.2 Primary Air Tank

The primary air tank is located above the drive axle on the R.H. side.

This tank is provided with a bottom drain valve (Fig. 49 and 50). It is recommended to purge the primary air tank by its bottom drain valve every 12,500 miles (20 000 km) or once a year, whichever comes first.

7.1.3 Secondary Air Tank

This tank is located in front wheelhousing, between air springs. The tank may be installed vertically depending on type of front suspension and is provided with a bottom drain valve (Fig. 49 and 50).

It is recommended to purge the tank by its bottom drain valve, every 12,500 miles (20 000 km) or once a year, whichever comes first.

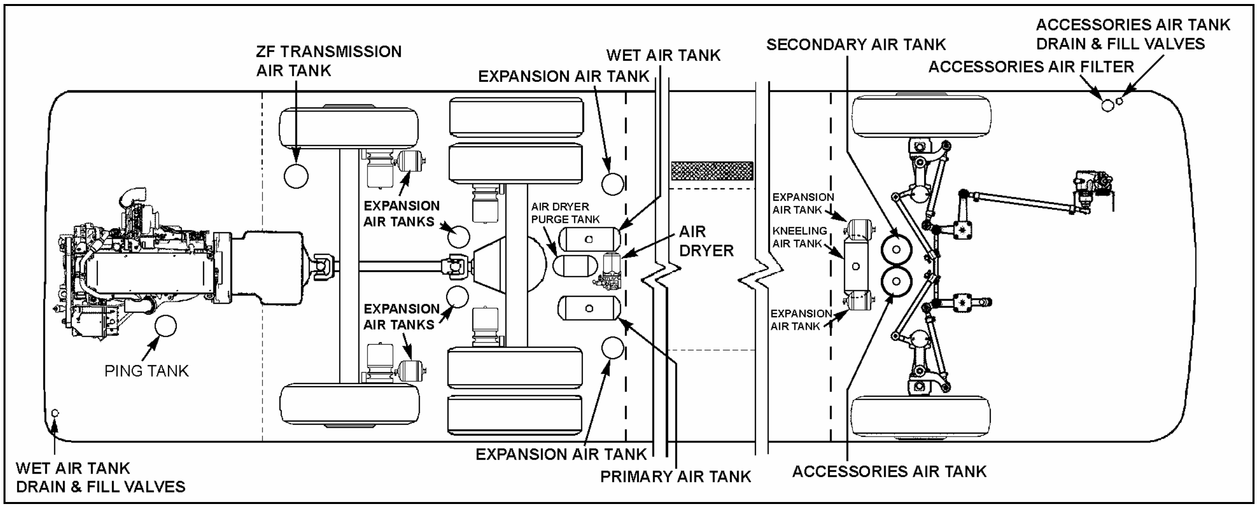


FIGURE 49: IFS AIR TANKS LOCATION 24034

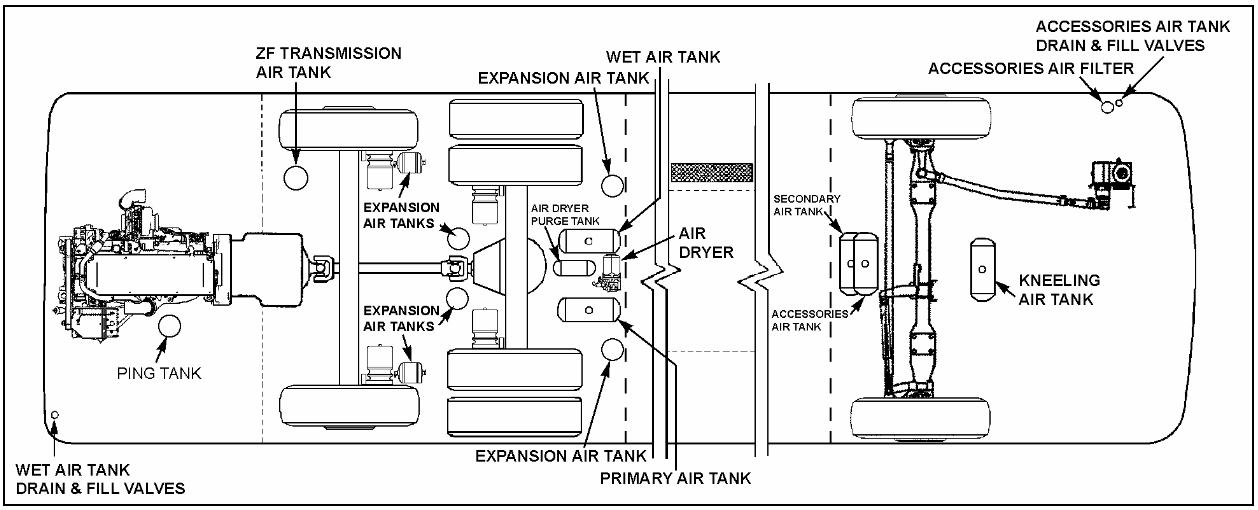


FIGURE 50: I-BEAM FRONT SUSPENSION AIR TANKS LOCATION 24035

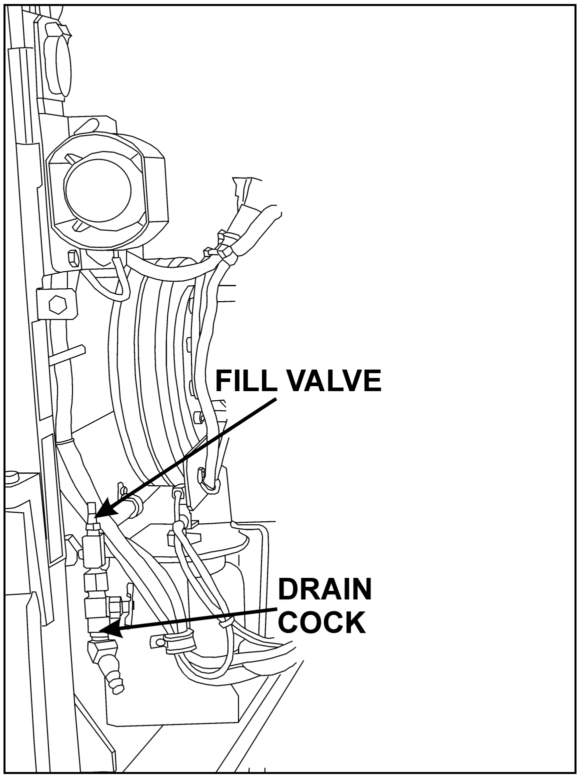


FIGURE 51: REAR VALVE LOCATION 12211

7.1.4 Accessory Air Tank

The accessory air tank is installed next to the secondary air tank. The tank may be installed vertically depending on type of front suspension and is provided with a bottom drain valve (Fig. 38).

It is recommended to purge the tank by its bottom drain valve, every 12,500 miles (20 000 km) or once a year, whichever comes first.

A remote drain valve is located in front service compartment (Fig. 52) underneath the accessory air filter. Refer to Section 12, paragraph "4. Accessory Air Filter" of the maintenance manual for daily purge procedure.

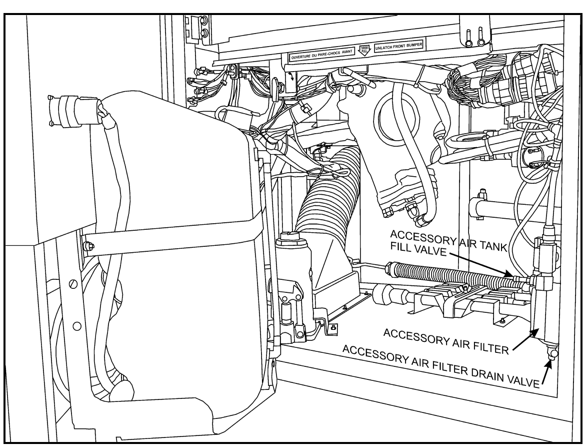


FIGURE 52: FRONT VALVE LOCATION 12210

7.1.5 Expansion Air Tank

Two expansion tanks will be installed in front wheelhousing if the IFS was chosen as an option. These air tanks are located behind secondary and accessory air tank. Also, six expansion tanks are located near rear air springs (Fig. 49 and 50). Expansion tanks are connected in series with air springs. Expansion tanks are used to lower the stiffness of the air spring. They are provided with a bottom drain valve.

It is recommended to purge them, with all other tanks, every 12,500 miles (20 000 km) or once a year, whichever comes first.

7.2 EMERGENCY FILL VALVES

The vehicle is equipped with two air system emergency fill valves to supplement the air system when air pressure is low and engine cannot be operated.

The rear valve is located in engine compartment and accessible from engine R.H. side door (Fig. 51).

⚠ **CAUTION** ⚠

No other point should be used to supply air system. The maximum allowable air pressure is 125 psi (860 kPa).

The front valve is located in the front service compartment close to accessory air filter (Fig. 52).

These two air valves are fitted with the same valve stems as standard tires, and can be filled by any standard external air supply line.

The rear valve will supply air for all systems (brakes, suspension and accessories) while the front valve will supply air for accessories only.

⚠ **CAUTION** ⚠

Air filled through these two points will pass through the standard air filtering system provided by Prévost. Do not fill air through any other points.

8. HUB UNIT AND SWIVEL ASSEMBLY

Refer to “DANA SPICER Service Manual General Information, Maintenance Manual Model NDS and Maintenance Manual NDS Axles” annexed to Section 10 of the maintenance manual.

9. FRONT KNEELING SYSTEM

The kneeling system is used to lower front of vehicle. This allows passengers to board the vehicle with greater ease. The kneeling action is achieved by exhausting air from the front air springs (bellows). This system bypasses the height control valve to provide a fast up and down movement of the front suspension. Only seven seconds are required to lower vehicle from normal level to the lowered position, and approximately the same time to raise the vehicle back to normal level. The quick response is achieved by an auxiliary air tank installed beside the secondary air reservoir (for exact position, refer to Section 12, *"Brake and Air System").* This tank provides sufficient air supply to the kneeling system for some successive operations.

The system is provided with two safety features; first, a speed switch will enable the kneeling system to work only at less than 5 mph (8 km/h). Secondly, the parking brake is automatically applied, and a limit switch will keep it applied as long as the vehicle has not returned to a certain height where the driver will be able to manually remove the parking brake.

The purpose of the hi-buoy function in this system is to raise the front end of the vehicle to allow an extra ground clearance for particular situations. In driving condition, the height control valve is in operation and only the hi-buoy can be operated.

9.1 PRINCIPLE OF OPERATION

Refer to the air system schematic diagram annexed at the end of Section 12, *"Brake and Air System".*

DOWN (FRONT KNEELING):

Both the bellows control and bellows exhaust solenoid valves are energized, so the air control valves release air from front air springs. The height control valve is bypassed to ensure no air is forwarded to air springs while lowering the front suspension.

UP (FRONT HIGH-BUOY):

Only the bellows control solenoid valve is energized, so the air coming from the kneeling air tank is routed through air control valves, and up to front air springs.

The height control valve is bypassed until the kneeling proximity switch signals the kneeling module to cut off the bellows control solenoid valve, about 1" (25 mm) below normal ride height. The final height adjustment is achieved by the height control valve.

9.2 MAINTENANCE

Since the kneeling action is issued from both the air system and electrical system, refer to Section: 12, *"Brake and Air System"* and Section 06, *"Electrical System".*

For diagnosis and understanding of the system, refer to wiring diagrams, and to the appropriate air system schematic diagram annexed to Section 12, *"Brake and Air System".*

9.3 BELLOWS CONTROL SOLENOID VALVES

9.3.1 Removal and installation

1. On the rear side of steering compartment, locate both the bellows control and bellows exhaust solenoid valves.
2. Identify hoses and wires to ease reinstallation. Disconnect solenoid wires and the three flexible black hoses from solenoid valves.
3. Unscrew and remove the control solenoid valve and exhaust solenoid valve assembly. Place on a clean working place.

Reverse removal procedure to reinstall.

⚠ CAUTION ⚠
Any cable tie that has been cut during removal procedure should be replaced with a new one.

10. HIGH-BUOY SYSTEM

The purpose of the rear high-buoy system is to raise the entire vehicle body about 4" (100 mm) in order to increase ground clearance to board a ferryboat, to jump a curb, etc. This system can be put into service during normal vehicle operation.

10.1 PRINCIPLES OF OPERATION

The rear high-buoy system is added over the front kneeling (with front high-buoy). The front end uses the same valves as the front kneeling (with front high-buoy). A solenoid valve is added to send air to the double shuttle valves for the rear end. It uses the same dash switch as the kneeling (with front high-buoy).

UP:

The air coming from the control valve flows through double shuttle valves, to supply air springs. The double shuttle valves prevent height control valves from releasing air from air springs.

DOWN:

The control valve, on the dashboard, cuts off air supply, so the double shuttle valves allow height control valves to accomplish their function. Height control valves release air from air springs until suspension returns to its normal position.

10.2 MAINTENANCE

Refer to the air system schematic diagram “Opt. Front Kneeling With Rear High-Buoy Combination” annexed at the end of this Section.

10.3 HIGH-BUOY – PRESSURE REGULATING VALVE

The regulating valve is located in the front service compartment. This valve should be adjusted to 90 psi (621 kPa).

10.3.1 Adjustment

1. Before turning on system air pressure, release jam nut (2, Fig. 53) then turn regulator adjustment counterclockwise until all load is removed from the regulating spring.
2. Turn on system pressure.
3. Turn regulator adjustment clockwise until the desired outlet pressure is reached.
4. To avoid minor readjustment after making a change in pressure setting, always approach the desired pressure from a lower pressure. When reducing from a higher to a lower setting, first reduce the pressure at a lower pressure, and then increase it to the desired level of pressure.
5. Tighten jam nut (2, Fig. 53) to lock pressure setting.

10.3.2 Disassembly

1. Shut off inlet pressure and reduce pressure in inlet and outlet lines to zero. Turn regulator adjustment (1, Fig. 53) counterclockwise until all load is removed from regulating spring. Regulator can be disassembled without removal from air line.
2. Disassemble regulator in accordance with the item numbers on the exploded view.

10.3.3 Cleaning

1. Clean parts with warm water and soap. Dry parts and blow out internal passages in body using clean, dry compressed air.
2. Inspect parts. Replace those found to be damaged.

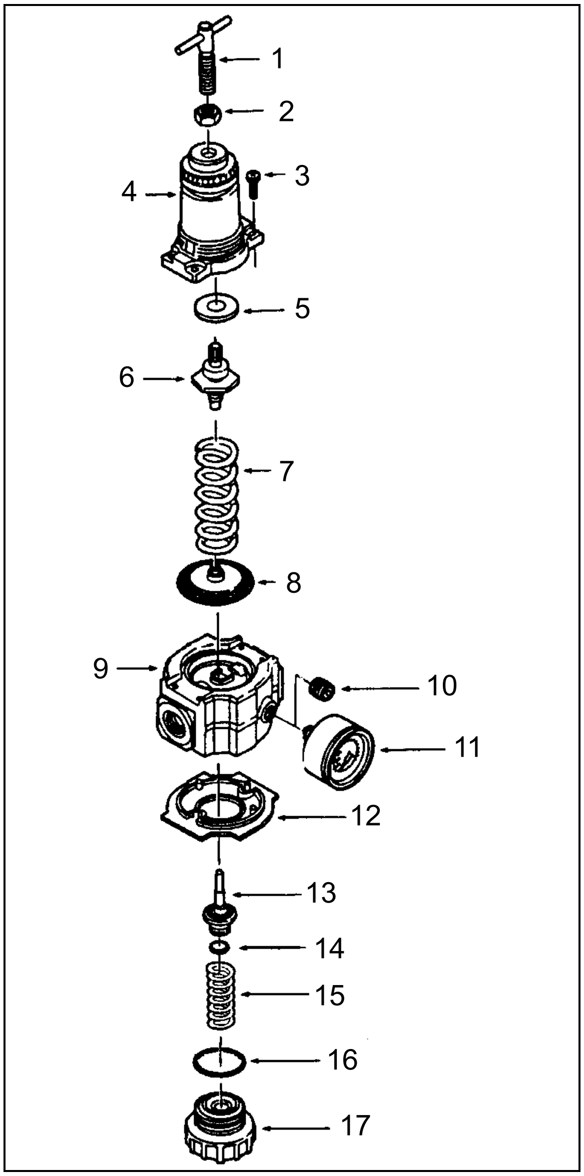


FIGURE 53: REGULATING VALVE 16035

10.3.4 Reassembly

1. Lubricate O-ring (14 and 16, Fig. 53), valve stem (13, Fig. 53), tip of adjusting screw (1, Fig. 53), and the outer circumference and both sides of the thrust washer (9, Fig. 53) with a light coat of good quality O-ring grease.

2. Assemble the regulator as shown on the exploded view.

Torque Table	
Item	Torque in lbf-inch (Nm)
3 (Screw)	25-35 (2.8-3.9)
17 (Bottom plug)	20-25 (2.3-2.8)

11. LOW-BUOY SYSTEM

The purpose of the low-buoy system is to lower the whole suspension by about 4" (100 mm) in order to reduce the overall height for low clearances. This system can be put into service during normal vehicle operation.

11.1 PRINCIPLES OF OPERATION

On X3 coaches, the rear low-buoy is added over the front kneeling system. The control valve on the left console panel sends an electric signal from its pressure switch to control the front suspension as if kneeling. It also removes air from a relay valve that exhausts air supply to all leveling valves and the quick release in the rear section. Air from the rear suspension can then be depleted through the check valve-quick release assembly.

Down:

The control valve, on the L.H. control panel, cuts off air supply, so air is released from air springs. A relay valve prevents height control valves from supplying air springs.

Up:

The control valve, on the L.H. control panel, supplies air to close the passage between both the delivery and supply ports. A relay valve opens and provides air springs until the suspension reaches the normal ride height.

11.2 MAINTENANCE

Refer to the air system schematic diagram "Opt. Front Kneeling With Rear Low-Buoy Combination" annexed at the end of this Section.

12. TROUBLESHOOTING

Condition	Cause	Correction
Bellows deflate over time	1. Defective check valve assembly. 2. Defective exhaust valve assembly. 3. Leak in air line and/or bellows. 4. Defective valve cover, rubber O-rings or gasket.	1. Replace check valve assembly. 2. Replace exhaust valve assembly. 3. Replace air line or bellows. 4. Replace valve cover, O-rings or gasket.
Bellows raise to full height and fail to exhaust air pressure	1. A clogged exhaust screen in height control valve assembly. 2. A combination clogged exhaust screen and defective air inlet valve assembly.	1. Remove and clean screen. 2. Clean exhaust screen and replace air inlet valve assembly.
Erratic valve action	1. Dirt or foreign matter in the air valve lever chamber. 2. Defectives valves.	1. Remove valve cover and blow out dirt. Install cover using new gasket. 2. Overhaul height control valve assembly
Vehicle body fails to level to satisfactory ride height	1. Improper height control valve overtravel lever adjustment	1. Adjust lever as directed.

13. PARTS SPECIFICATIONS

Front suspension and tag axle air springs

Make........................ Goodyear Tire and Rubber
Model..1200
Type .... Mae West
Nominal diameter ....12” (304 mm)
Supplier number..................................1R12-319
Prévost number......................................630125

Drive axle air springs

Make........................ Goodyear Tire and Rubber
Model..1100
Type ....Double Flare
Nominal diameter ....11.5” (292 mm)
Supplier number..................................1R11-088
Prévost number......................................630104

Independent Front suspension shock absorbers

Make.. Arvin
Color...Black
Piston Diam..1 5/8 inch
Collapsed length ....14.16 inches
Extended length ....22.44 inches
Supplier number............................. 680510-40J
Prévost number......................................630136

I-Beam Front suspension shock absorbers

Make...Sachs
Color...Black
Type NUV45X230HA
Ext. Diam...75 mm
Collapsed length ....14.88” (378 mm)
Extended length ....23.86” (606 mm)
Supplier number......................... 481700000206
Prévost number......................................630254

Drive and tag axle shock absorbers

Make ....Sachs
Color ....Black
Type N45X225HA
Ext. Diam. ....75 mm
Collapsed length .... 15.51” (394 mm)
Extended length .... 24.37” (619 mm)
Supplier number 481700000209
Prévost number 630253

Height control valve (Front only)

Make ....Barksdale
Quantity used...1
Supplier number 52321POAQ3-Q62
Prévost number 630157

Height control valve (Rear only)

Make ....Barksdale
Quantity...2
Supplier number 52321POAQ3-Q26
Prévost number 630156

Bellows control and exhaust solenoid valve assembly

Make ....Norgren

Solenoid valve manifold

Supplier number D0043B
Prévost number 641130

Coil

Voltage... 24 V DC
Current draw ....29 amperes
Supplier number 54932-27
Prévost number 641144

Valve (3 way, 2 positions)

Type .... N/C

Supplier number....................... 411-C-456235W

Prévost number...................................... 641357

Type .... N/O

Supplier number....................... 411-D-456236X

Prévost number...................................... 641356

Radius rod bushing

Make.. Prévost

Prévost number...................................... 630021

Loctite

Make.. Loctite

Prévost number...................................... 680039

Sway bar bushing (Front Suspension)

Make .... Prévost

Prévost number 630020

Sway bar link

Make .... Tennaco Automotive

Supplier number 934400

Prévost number 630230

Shock absorber bushings

Make .... Monroe

Supplier number 45380

Prévost number 630062

Air regulator

Make .... Norgren

Recommended pressure sett. . 90 psi (621 kPa)

Supplier number R74G-4AT-RMN

Prévost number 641352

14. TORQUE SPECIFICATIONS

1- Shock absorber pin .... 500-550 lbf-ft (680-750 Nm)

2- Shock absorber pin nut .... 70-80 lbf-ft (95-110 Nm)

3- Radius rod stud .... 20-40 lbf-ft (27-54 Nm)

4- Radius rod retaining nut or bolt .... 110-130 lbf-ft lubricated (150-175 Nm lubricated)

5- Radius rod support nut .... 110-130 lbf-ft lubricated (150-175 Nm lubricated)

6- Axle attachment nut .... 425-475 lbf-ft (580-645 Nm)

7- Air spring stud nut .... 20-25 lbf-ft (27-34 Nm)

8- Sway bar link nuts .... 110-130 lbf-ft lubricated (150-175 Nm lubricated)

9- Sway bar bushing collar bolts .... 70-80 lbf-ft (95-110 Nm)

NOTE
During assembly, use "Loctite 242" (Prévost No 680038) with item 1 and 3. After assembly, apply "anti-seize compound" (Prévost No 680064) on all threads nuts.

CONTENTS

ILLUSTRATIONS

1. DESCRIPTION

A radiator and thermo-modulated fan are used to effectively dissipate the heat generated by the engine. A centrifugal-type water pump is used to circulate the engine coolant (Fig. 1).

Two full blocking-type thermostats are used in the water outlet passage to control the flow of coolant, providing fast engine warm-up and regulating coolant temperature.

The engine coolant is drawn from the lower portion of the radiator by the water pump and is forced through the transmission cooler before going through the oil cooler and into the cylinder block.

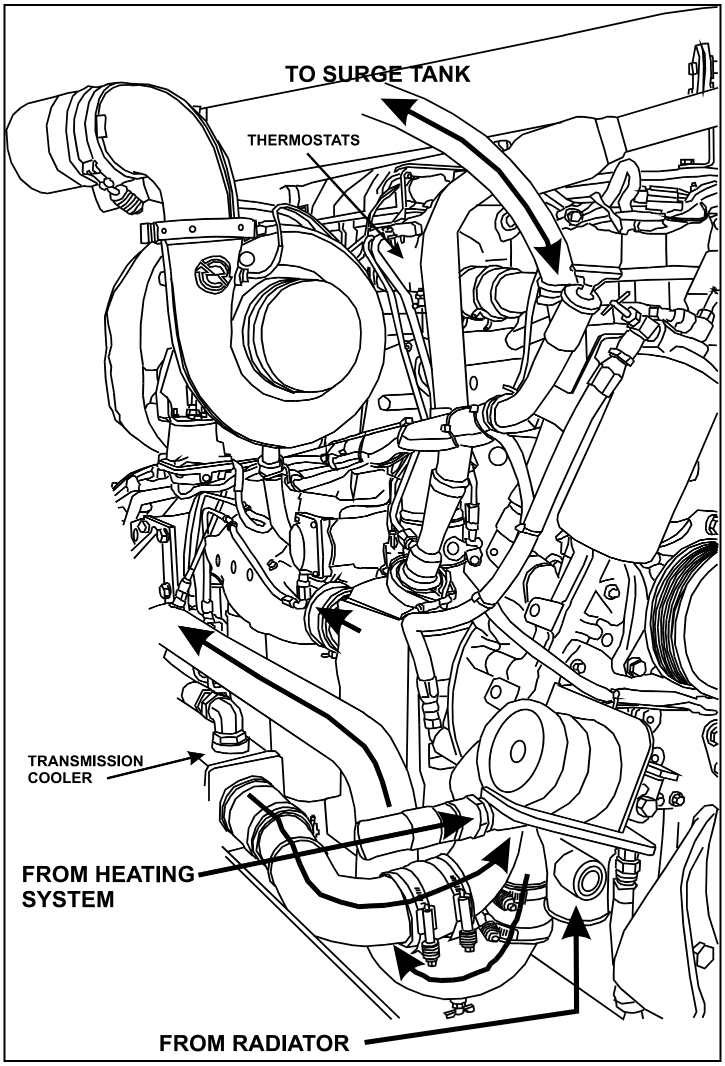


FIGURE 1: COOLING SYSTEM

From the cylinder block, the coolant passes up through the cylinder head and, when the engine is at normal operating temperature, it goes through the thermostat housing and into the upper portion of the radiator. The coolant then passes through a series of tubes where its heat is dissipated by air streams created by the revolving fan and the motion of the vehicle.

Upon starting a cold engine or when the coolant is below normal operating temperature, the closed thermostats direct coolant flow from the thermostat housing through the by-pass tube to the water pump. Coolant is recirculated through the engine to aid engine warm up. When the thermostat opening temperature is reached, coolant flow is divided between the radiator inlet and the by-pass tube. When the thermostats are completely open, all of the coolant flow is to the radiator inlet.

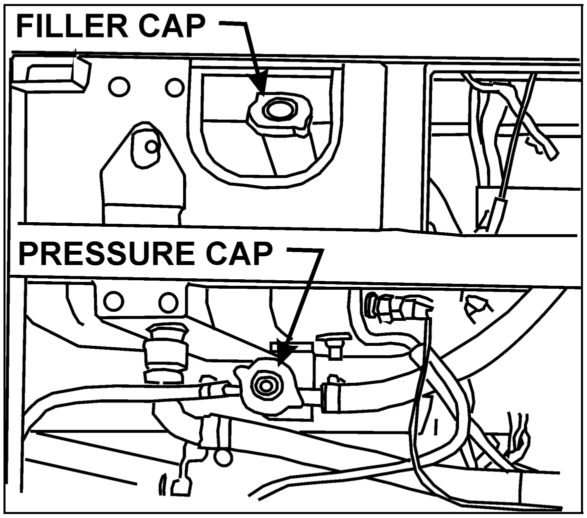


FIGURE 2: SURGE TANK - ENGINE COMP'T 05103

The cooling system is filled through a filler cap on the surge tank (Fig. 2). A pressure cap underneath the surge tank is used to maintain pressure within the system. When system exceeds normal pressure rating (14 psi - 96.53 kPa), the cap releases air and if necessary, coolant through the overflow tube (Fig. 2). Two thermostats are located in the housing attached to the right side of the cylinder head (Fig. 1). Furthermore, a water temperature sensor mounted on the cylinder head (radiator side) is also supplied for engine protection purposes.

The engine cooling system also provides hot coolant fluid for the vehicle heating system. Refer to section 22, *""HEATING AND AIR CONDITIONING"* in this manual for information relating to heating system water circulation.

2. MAINTENANCE

A systematic routine inspection of cooling system components is essential to ensure maximum engine and heating system efficiency.

- Check coolant level in the surge tank daily, and correct if required. Test antifreeze strength.
- Maintain the prescribed inhibitor strength levels as required. Coolant and inhibitor concentration must be checked at each oil change, every 12,500 miles (20 000 km) or once a year, whichever comes first to ensure inhibitor strength. For vehicles equipped with coolant filters replace precharge element filter with a maintenance element filter as per *"COOLANT FILTER"* in this section. If the vehicle is not equipped with a filter, add the recommended inhibitor concentration to the antifreeze/water solution.
- Drain, flush, thoroughly clean and refill the system every two years or every 200,000 miles (320 000 km), whichever comes first. For vehicle equipped with coolant filters, change the precharge element filter or the existing maintenance element filter for a new maintenance element filter. If the vehicle is not equipped with filters add the recommended inhibitor concentration to the antifreeze/water solution.

NOTE
Do not add inhibitors to the antifreeze / water solution if vehicle is equipped with a coolant filter.

Coolant must be discarded in an environmentally safe manner.

2.1 VEHICLES WITHOUT COOLANT FILTERS

Refer to Nalcool 3000 with Stabil-Aid bulletin annexed to the end of this section for preventive maintenance (at each oil change) and initial treatment instructions (each time the cooling system is drained and flushed).

2.2 VEHICLES WITH COOLANT FILTERS

Change the coolant precharge element filter for a maintenance element filter at initial oil change (see *"Specifications"* at the end of this section) and replace existing maintenance element filter with a new one as per *"COOLANT FILTER"* in this section. A precharge element filter must be installed each time the cooling system is drained and flushed prior to installing a maintenance element filter.

- Check belts for proper tension; adjust as necessary and replace any frayed or badly worn belts.
- Check radiator cores for leaks and make sure the cores are not clogged with dirt or insects. To avoid damaging the fins, clean cores with a low-pressure air hose. Steam clean if required.
- Inspect the water pump operation. A leaky pump sucks in air, increasing corrosion.
- Repair all leaks promptly. Unrepaired leaks can lead to trouble. Inspect and tighten

radiator mounts periodically. Test and replace thermostats regularly.

NOTE

In order to ensure the integrity of the system, it is recommended that a periodic cooling system pressure check be made. Pressurize the cooling system to 103-138 kPa (15-20 psi) using Radiator and Cooling System Tester, J24460-1. Do not exceed 138 kPa (20 psi).

Any measurable drop in pressure may indicate a leak. Whenever the oil pan is removed, the cooling system should be pressure checked as a means of identifying any incipient coolant leaks. Make sure the cause of the internal leak has been corrected before flushing the contaminated system.

Leaks at the thermostat housing hose connections may be caused by deformation of connections or by rough surfaces on the castings of the hose mounting surfaces. It is recommended that *"Dow Corning RTV-102 Compound"* or any equivalent product be applied on cast surfaces prior to hose installation.

⚠ CAUTION ⚠

Castings should be clean and free of oil and grease before applying compound. No other sealer should be used with RTV-102 compound.

3. HOSES

Rotten, swollen, and worn out hoses or loose connections are frequent causes of cooling system problems.

Serious overheating is often caused by an old hose collapsing or from rotten rubber shedding from hoses and clogging the coolant passages.

Connections should be inspected periodically and hose clamps tightened. Replace any hose found to be cracked or swollen.

When installing a new hose, clean pipe connections and apply a thin layer of a non-hardening sealing compound. Replace worn out clamps or clamps that pinch hoses.

3.1 CONSTANT-TORQUE HOSE CLAMPS

All hose clamps of 1 3/8" ID and over, used on the heating and cooling systems, are of the *"Constant-torque"* type. These clamps are worm-driven, made of stainless steel, and supplied with a series of Belleville spring washers. They also feature an extended integral liner that covers the band slots to protect soft/silicone hoses from damage, and help maintain consistent sealing pressure.

This type of clamp is designed to automatically adjust its diameter to compensate for the normal expansion/contraction of a hose and metal connection that occurs during vehicle operation and shutdown. The constant-torque clamp virtually eliminates coolant losses due to *"Cold flow"* leakage and greatly minimizes clamp maintenance.

3.1.1 Installation

A torque wrench should be used for proper installation. The recommended torque is 90 to 100 lbf-in. (10 to 11 Nm). The Belleville spring washer stacks should be nearly collapsed flat and the screw tip should extend ¼" (6 mm) beyond the housing (Fig. 3).

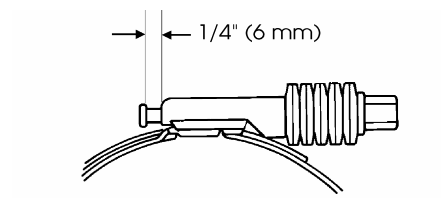


FIGURE 3: CONSTANT-TORQUE CLAMP 05037

⚠ CAUTION ⚠

The hose clamps will break if over-torqued. Do not over-tighten, especially during cold weather when hose has contracted.

3.1.2 Maintenance

The constant-torque clamps contain a *"Visual torque check" feature.* When the tip of the screw is extending ¼" (6 mm) out of the housing, the clamp is properly installed and maintains a leak-proof connection. Since the constant-torque clamp automatically adjusts to keep a consistent sealing pressure, there is no need to re-torque hose clamps on a regular basis. During vehicle operation and shutdown, the screw tip will adjust according to the temperature and pressure changes. **Checking for proper torque should be done at room temperature.**

4. COOLANT

4.1 COOLANT LEVEL VERIFICATION

Coolant level is correct when cold coolant is visible through the surge tank sight glass (Fig. 4). If coolant level is low, fill cooling system.

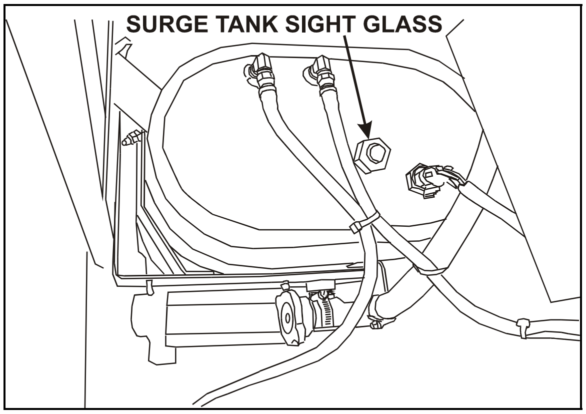


FIGURE 4: SURGE TANK SIGHT GLASS 05094

4.2 COOLANT LEVEL SENSOR

This warning device consists of a fluid level probe mounted on the surge tank. The probe sends a signal to the ECM to indicate coolant level. If the coolant level drops below the probe, the *"Check Engine"* light flashes and a diagnostic code is registered (see section 01″ *ENGINE"*).

⚠ CAUTION ⚠
Do not run engine with the "Check Engine" light flashing.

The level probe is mounted on the R.H. side of the surge tank while the electronic module is mounted inside the rear electric junction box.

4.3 THAWING COOLING SYSTEM

If the cooling system becomes frozen solid, place the coach in a warm area until the ice is completely thawed. Under no circumstances should the engine be operated when the cooling system is frozen, as it will result in engine overheating due to insufficient coolant.

Once thawed, check engine, radiator and related components for damage caused by expansion of frozen coolant fluid.

4.4 COOLANT REQUIREMENTS

The coolant provides a medium for heat transfer and controls the internal temperature of the engine during operation. In an engine having proper coolant flow, some of the combustion heat is conveyed through the cylinder walls and the cylinder head into the coolant. Without adequate coolant, normal heat transfer cannot take place within the engine, and engine temperature rapidly rises. Coolant must therefore be carefully selected and properly maintained.

Select and maintain coolant in order to meet the following basic requirements:

- Provide for adequate heat transfer.
- Provide protection from cavitation damage.
- Provide a corrosion and erosion resistant environment within the cooling system.
- Prevent formation of scale or sludge deposits in the cooling system.
- Be compatible with the cooling system hose and seal materials.
- Provide adequate freeze protection during cold weather operation.

Combining suitable water with reliable inhibitors satisfies the first five requirements. When freeze protection is required, a solution of suitable water and antifreeze containing adequate inhibitors will provide a satisfactory coolant fluid. Ethylene glycol-based antifreeze is recommended for use in Series 60 engines. The cooling system capacity is 24 US gal (91 liters).

NOTE
In general, antifreeze does not contain adequate inhibitors. For this reason, supplemental coolant additives are required.

For a complete overview of engine coolants used with Detroit Diesel Engines, refer to *"Coolant Selections"* For Engine Cooling Systems Guide at the end of this section (#7se298).

4.5 COOLING SYSTEM RECOMMENDATIONS

Always maintain cooling system at the proper coolant level. Check daily.

The cooling system must be pressurized to prevent localized boiling of coolant. The system must be kept clean and leak-free. The filler and pressure caps must be checked periodically for proper operation.

Recommended phosphate free coolants: Detroit Diesel “DDC Power Cool” (P/N 23512138) or Prestone AF977 (bulk) Prevost #685125, 72702 (3.78 L), 70119 (205L), 70102 (4L).

A decal (052635) located on the surge tank provides information on recommended coolants.

05104

4.6 INHIBITORS

A coolant solution, which has insufficient inhibitors or no inhibitors at all, invites the formation of rust, scale, sludge and mineral deposits within the cooling system. These deposits can cause water pump seal wear and coat the interior of coolant system passages. Heat transfer is reduced as deposits build up, leading to an overheating condition. Continued operation with this condition can lead to serious engine damage: liner scuffing, scoring, piston seizure and cylinder head cracking. These damages can occur quickly or over a longer period of time, depending of location and amount of deposits. Improperly inhibited coolants can become corrosive enough to "eat away" coolant passages and seal ring grooves and cause leaks to develop. Hydrostatic lock can occur if leak is internal and accumulates on top of a piston. The result may be a bent connecting rod. Cavitation erosion may occur in improperly inhibited coolants. Cavitation erosion is caused by the implosion of tiny bubbles against localized surfaces of the system. Such implosion causes pinpoint pressures high enough to erode pump impellers, cylinder liners and cylinder blocks. In extreme cases, their surfaces are so deeply pitted that they appear to be spongy, and holes can develop completely through them.

4.6.1 Inhibitor Test Procedures

Test Kits are commercially available to check engine coolant for nitrite concentration. Nitrite concentration is an indication of Supplemental Coolant Additive (SCA) level. Nitrite must be maintained within recommended levels. Coolant must be tested at each oil change to insure that inhibitor levels are maintained within the ranges shown hereafter:

NOTE

Above SCA values with Detroit Diesel #7se298 or TMC RP-329 “Type A”. Use Nalco Chemical Company nitrite test kits (CO-318). A factory coolant analysis program is available through Detroit Diesel distributors under part number 23508774.

DDC Fully Formulated Glycol Coolant Limits	
-30 — 50(°F)	Freeze Point (°F)
125 — 500 ppm	Boron (ppm)
800 — 3200 ppm	Nitrite (ppm)
200 — 750 ppm	Nitrate (ppm)
50 — 250 ppm	Silicon (ppm)
0 ppm MAX	Phosphorus (ppm)
8.0 — 11.0	pH
40 ppm MAX	Chlorides (ppm)
100 ppm MAX	Sulfates (ppm)

4.7 COOLANT RECOMMENDATIONS

1. Always use recommended antifreeze, inhibitor and water at proper concentration levels. A 50% coolant/water solution is normally used as factory fill. Antifreeze concentration over 70% is not recommended because of poor heat transfer capability, adverse freeze protection and silicate dropout. Antifreeze concentration below 30% offers little freeze, boilover or corrosion protection.
2. Use only ethylene glycol antifreeze meeting the Detroit Diesel #7se298 or TMC RP-329 “Type A” formulation.
3. Use an antifreeze solution year-round for freeze and boil-over protection. Seasonal changing of coolant from an antifreeze solution to an inhibitor/water solution is recommended.
4. Pre-mix coolant makeup solutions at proper concentrations before adding to the cooling system.
5. Maintain the prescribed inhibitor strength levels as required.
6. Do not mix different base inhibitor packages.

7. Always maintain proper coolant level.

⚠ CAUTION ⚠

Always test the solution before adding water or antifreeze.

8. If cooling system is not at the proper protection level. Mix coolant/water solution to the proper concentration before adding to the cooling system
9. Use only non-chromate inhibitors.
10. Distilled water is recommended.

4.7.1 Coolant Not Recommended

- All antifreeze and coolant containing phosphorous;
- Automotive type coolants;
- Methoxy propanol-base antifreeze;
- Methyl alcohol-base antifreeze;
- Sealer additives or antifreezes containing sealer additives.

4.7.2 Additives Not Recommended

- Soluble Oils;
- Chromates.

⚠ WARNING ⚠

Never remove filler cap while coolant is hot. When coolant is at ambient temperature, release pressure from system by turning the pressure cap counterclockwise 1/4 turn; then remove filler cap slowly. A sudden release of pressure from the heated cooling system can result in severe burns from the expulsion of hot coolant fluid.

4.7.3 Vehicles Without Coolant Filters

Refer to Nalcool 3000 with Stabil-Aid bulletin annexed to the end of this section for preventive maintenance (at each oil change) and initial treatment instructions (each time the cooling system is drained and flushed).

4.7.4 Vehicles With Coolant Filters

Change the coolant precharge element filter for a maintenance element filter at initial oil changes (see Specifications at the end of this section) and replace existing maintenance element filter with a new one as per *"COOLANT FILTER"* in this section. A precharge element filter must be installed each time the cooling system is drained and flushed before installing a maintenance element filter.

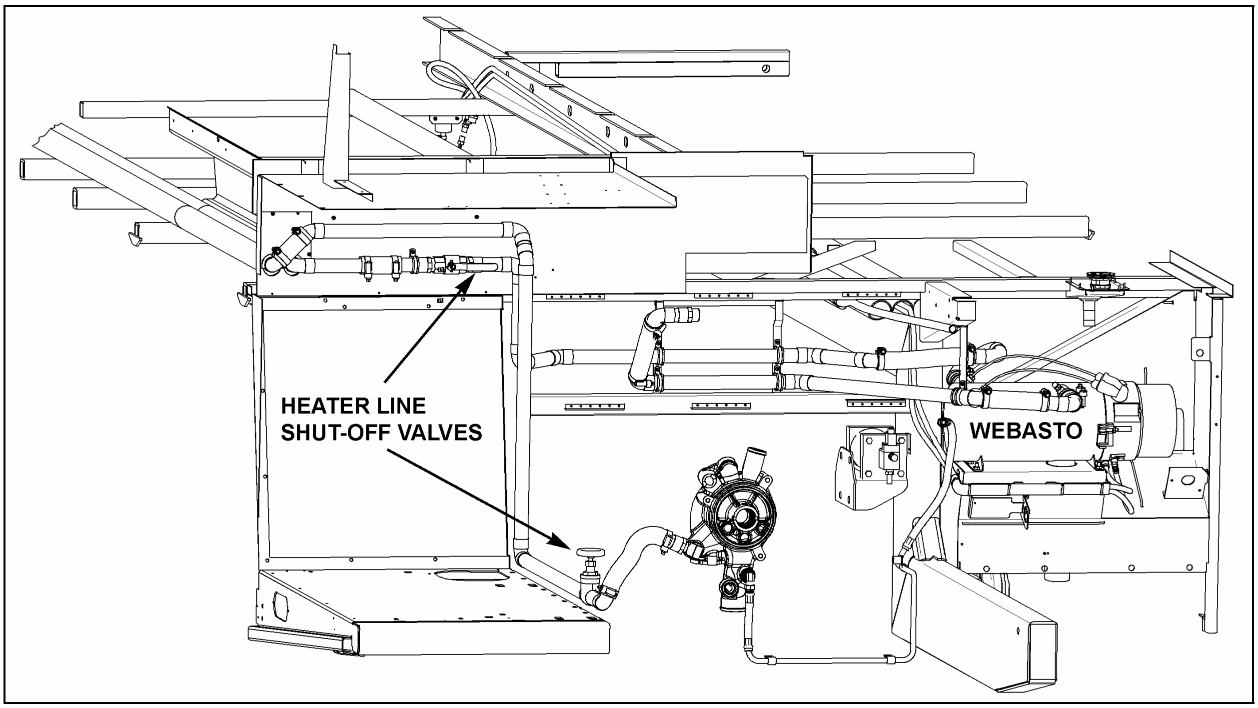


FIGURE 5: LOCATION OF HEATER LINE SHUT-OFF VALVES IN ENGINE COMPARTMENT 05105

NOTE
The coolant filter contains inhibitors.

5. DRAINING COOLING SYSTEM

Use the following procedures to drain the cooling system partially or completely.

To drain engine and related components:

1. Stop engine and allow engine to cool. Close both heater line shutoff valves.

On X3- 45 coaches, the valves are located in the engine compartment. One is located under the radiator fan gearbox; another valve is on the L.H. side of the engine compartment in front of the radiator (Fig. 5).

NOTE
Refer to section 22 under "Preheating System" for information about preheater access and heater line shutoff valve.

⚠ WARNING ⚠
Before proceeding with the following steps, make sure the coolant has cooled down. The sudden release of pressure from a heated cooling system can result in loss of coolant and possible personal injury (scalding) from the hot liquid.

2. Unscrew the surge tank pressure cap counterclockwise, ¼ turn to let air enter the system and permit the coolant to drain completely from system.

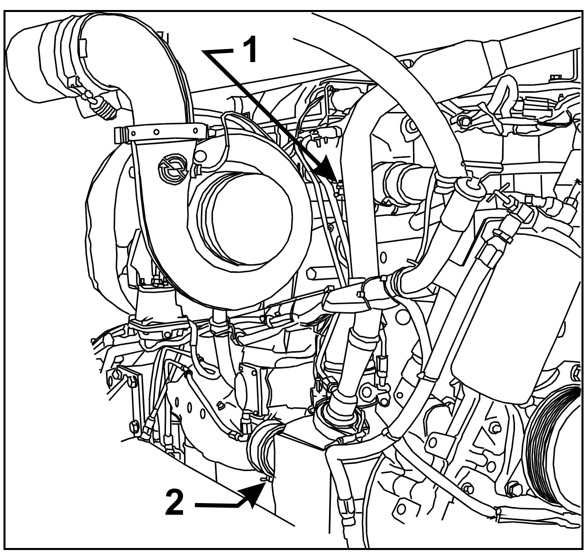


FIGURE 6: ENGINE COOLANT DRAIN COCKS 05088

3. Unscrew the water pump housing inlet line drain plug (Fig. 7).
4. Open drain cock at bottom of thermostat housing to drain the coolant trapped above the thermostats (1, Fig. 6).
5. Open the radiator drain cock.

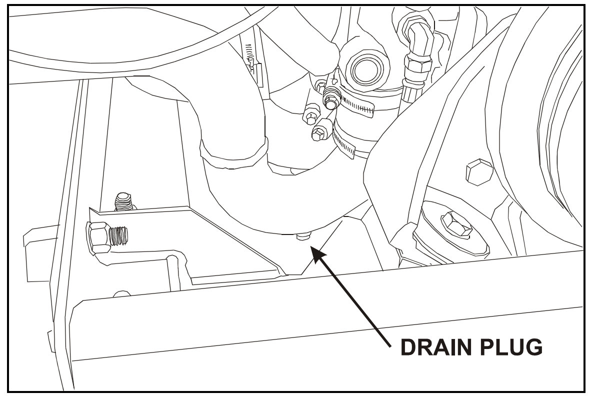


FIGURE 7: WATER PUMP DRAIN PLUG 05093

6. Open engine drain cock (2, Fig. 6).
7. Remove the transmission oil cooler. Drain, flush and inspect. Refer to Section 7, “TRANSMISSION” for oil cooler maintenance or preventive replacement.

⚠ CAUTION ⚠
Drain water pump completely before extended storage to avoid possible water pump damage.   **If freezing weather is anticipated and the engine is not protected with antifreeze, drain the cooling system completely when vehicle is not in use. Trapped water in the cylinder block, radiator or other components may freeze and expand resulting in damages. Leave the drain plugs open until the cooling system can be filled with coolant fluid. Do not run engine with cooling system empty.**

To drain the entire system, do the previous steps while maintaining the shutoff valves in the open position; then follow the procedure under *“9.2 Draining Heating System”* in Section 22.

6. FILLING COOLING SYSTEM

If only the engine and related components were drained, maintain the two heater line shutoff valves in their closed position, then proceed as follows.

1. Close all drain cocks. Refer to draining procedure for the location of draining points.
2. Refill cooling system from the surge tank filler cap inlet with a recommended ethylene glycol-based antifreeze and water solution of the required concentration. Add Detroit Diesel selected product cooling system inhibitors (if required).

NOTE
The coolant level should remain within two inches of the surge tank filler neck.

NOTE
Make sure the vent line at top of thermostat housing is properly connected and not obstructed. The vent line (thermostat housing dome to radiator top tank) is required to ensure complete engine fill and proper venting of air in the system.

3. Install the filler and pressure caps, then start the engine and run it at fast idle until reaching normal operating temperature. Check for leaks.

NOTE
If for any reason, the coolant level drops below the surge tank level probe, the Check Engine light will flash.

4. Stop engine and allow cooling.
5. Open the two heater line shutoff valves, check the coolant level in the surge tank, and then add as required.

⚠ CAUTION ⚠
Never pour cold coolant into a hot engine. The sudden change in temperature may crack the cylinder head or block.

If the entire system has been drained, redo the previous steps while maintaining the two heater line shutoff valves in the "Open" position. With engine running, activate the driver's and central heating systems to permit coolant circulation. Complete the procedure by bleeding the heater cores as explained in Section 22, under *“9.4 Bleeding Heating System”.*

7. FLUSHING

If the cooling system is contaminated, flush the cooling system as follows:

1. Drain the coolant from the engine.
2. Refill with clean water.

⚠ CAUTION ⚠
If the engine is hot, fill slowly to prevent rapid cooling and distortion of the engine castings.

3. To thoroughly circulate the water, start and run the engine for 15 minutes after the thermostats have opened.
4. Fully drain system.
5. Refill with clean water and operate for 15 minutes after the thermostats have opened.
6. Stop engine and allow cooling.
7. Fully drain system.

Vehicles without coolant filters:

Fill with a 50/50-antifreeze/water solution and add required inhibitors.

Vehicles with coolant filters:

Replace the coolant filter with a precharge element filter; in this case do not mix inhibitors with antifreeze/water solution.

Dispose of spent fluids in an environmentally responsible manner according to regulations in effect in your area.

7.1 COOLING SYSTEM DESCALERS

If the engine overheats and the fan belt tension, coolant level and thermostat operation have been found to be satisfactory, it may be necessary to de-scale and flush the entire cooling system.

Remove scale formation by using a reputable and safe de-scaling solvent. Immediately after using the de-scaling solvent, neutralize with a neutralizing agent. It is important that product directions be thoroughly read and followed.

After using the solvent and neutralizer, fully drain the system, and then reverse flush the engine and radiator (see *"Reverse Flushing" in this section)* before filling the system with coolant solution.

7.2 REVERSE FLUSHING

After the engine and radiator have been thoroughly de-scaled, they should be reverse-flushed. The water pump should be removed and the radiator and engine reverse-flushed separately to prevent dirt and scale deposits from clogging the radiator tubes or being forced through the pump. Reverse flushing is accomplished by hot water, under pressure, being forced through the cooling system in a direction opposite to the normal flow of coolant, loosening and forcing deposits out.

The radiator is reverse flushed as follows:

1. Remove the radiator inlet and outlet hoses and replace existing radiator cap with a new one.
2. Attach a hose to the top of the radiator to lead water away from the engine.
3. Attach a hose at the bottom of the radiator and insert a flushing gun in the hose.
4. Connect the water hose of the gun to the water outlet and the air hose to the compressed air outlet.
5. Turn on the water and when the radiator is full, turn on the air in short blasts, allowing the radiator to fill between blasts.

NOTE
Apply air gradually. Do not exert more than 138 kPa (20 psi) air pressure. Too great a pressure may rupture a radiator tube.

6. Continue flushing until only clean water is expelled from the radiator.

The cylinder block and cylinder head water passages are reverse flushed as follows:

1. Remove the thermostats and the water pump.
2. Attach a hose to the water inlet of oil cooler housing to drain water away from engine.
3. Attach a hose to the water outlet at the top of the cylinder head (thermostat housing) and insert the flushing gun in the hose.
4. Turn on the water until the jackets are filled, and then turn on the air in short blasts. Allow jackets to fill with water between air blasts.
5. Continue flushing until the water from the engine runs clean.

If scale deposits in the radiator cannot be removed by chemical cleaners or reverse flushing as outlined above, it may be necessary to remove the upper tank and rod out the individual radiator tubes with flat steel rods. Circulate the water through the radiator core from the bottom to the top during this operation.

8. SPIN-ON COOLANT FILTER

The optional engine cooling system filter is used to filter out impurities such as scale or sand from the coolant and it also eliminates the process of adding inhibitors to the antifreeze/water solution. The filter is located beside the belt tensioning arm (Fig. 8).

The precharge element filter lasts for 12,500 miles (20 000 km) or one year, whichever comes first. Replace the precharge element filter with a maintenance element filter, which lasts for 200,000 miles (320 000 km) or two years, whichever comes first. Each time the coolant is renewed, a precharge element filter must be installed before installing a maintenance element filter.

NOTE
If a coolant filter is to be installed on an engine already in service, drain and flush the cooling system before installing the filter.

To replace a filter:

1. Close the two filter shutoff cocks on the filter mounting head and unscrew the old filter from mounting.

⚠ WARNING ⚠
Failure to relieve cooling system pressure may result in personal injury.

2. Remove and discard the filter.
3. Clean the filter adapter with a clean, lint-free cloth.
4. Coat surface of gasket with oil, tighten 2/3 to 1 turn after gasket makes contact with head.
5. Open the two filter shutoff cocks.
6. Start engine and check for leaks.

⚠ CAUTION ⚠
Do not exceed recommended service intervals.

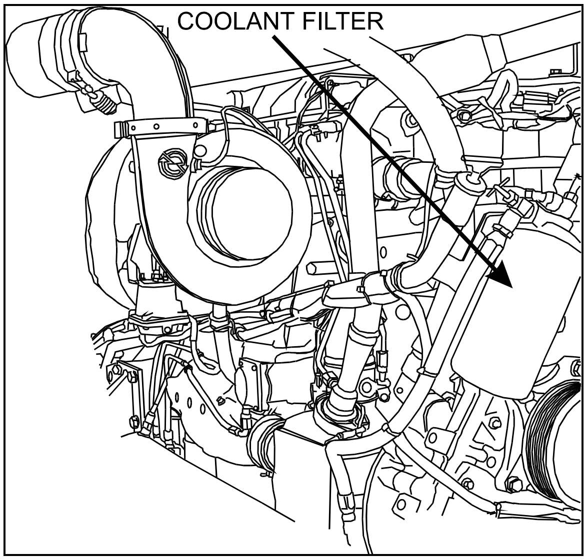


FIGURE 8: COOLANT FILTER 05089

9. RADIATOR

The radiator is mounted on the L.H. side of engine compartment. It is designed to reduce the temperature of the coolant under all operating conditions. It is essential that the radiator core be kept clean and free from corrosion and scale at all times.

9.1 MAINTENANCE

Inspect the exterior of the radiator core every 25,000 miles (40 000 km) or once a year, whichever comes first. Clean with a quality grease solvent, such as a mineral spirits and dry with compressed air. Do not use fuel oil, kerosene, gasoline, or any caustic material. It may be necessary to clean the radiator more frequently if the vehicle is operated in extremely dusty or dirty areas. Refer to coolant system flushing and reverse flushing in this section for maintenance of radiator interior.

9.2 CHARGE AIR COOLER LEAKAGE

Spec for CAC acceptable leakage:

“The CAC is considered acceptable if it can hold 30 psi (206 kpa) gauge pressure with less than 5 psi (34.5 kpa) loss in 15 seconds after turning off the hand valve.”

NOTE
This spec does not apply if there is any evidence that the leak was caused by a foreign object impact.

9.3 CHARGE AIR COOLER HOSE CLAMPS

If for any reason such as an accident hose clamps need to be changed; install and tighten hose clamps to 10 ± 1 lbf-ft (dry) as per the following specifications:

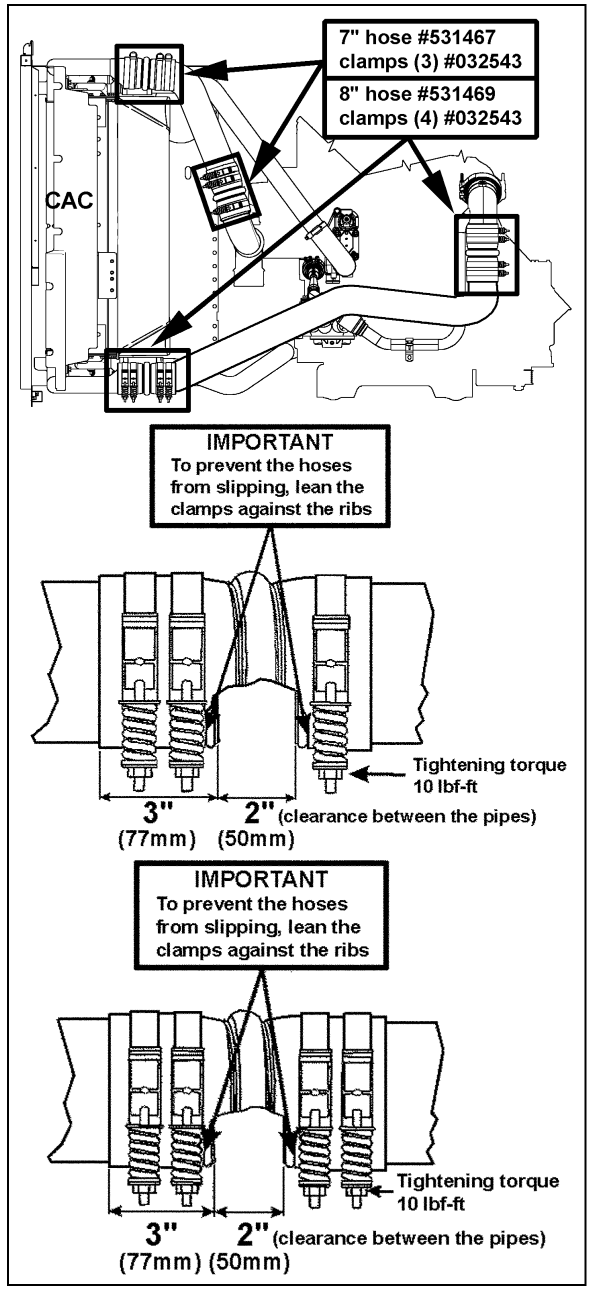


FIGURE 9: HOSE AND CLAMPS REPLACEMENT 05106

10. VARIABLE SPEED RADIATOR FAN

The radiator fan has two thermostatically controlled speeds. The ECM controls the speed by comparing data from engine coolant temperature, charge air cooling temperature, engine oil temperature, A/C condenser temperature, transmission retarder state, manual switch to a set of calibration data. Once fan switches to a state, it stays at that state for 30 seconds long before changing, to reduce clutch cycling. The fan drive clutch is electromagnetic; the ECM sends an electric current to regulate speed by activating one magnetic coil for the first speed and two magnetic coils for the second speed.

The settings are:

- 190°F (87.5°C) Thermostat starts to open
- 192°F (89°C) Fan medium speed, descending, off
- 196°F (91°C) Fan medium speed, rising, on
- 199.5°F (93°C) Fan high speed, descending, off
- 203°F (95°C) Fan high speed, rising, on
- 205°F (96°C) Thermostats fully open

NOTE
In case of an electrical power failure, a mechanical locking device consisting of two threaded bushings fixed on the pulley and two drilled metal plates fixed on the rotor will prevent engine from overheating by forcing fan rotation. Use the two screws located on the face of the clutch to fasten the metal plates and the bushings (Fig.10).

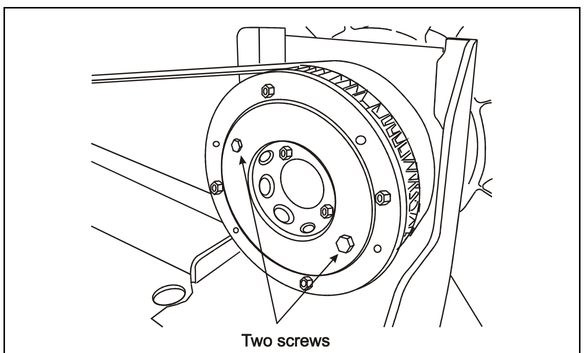


FIGURE 10: SCREWS LOCATION 05096

10.1 MAINTENANCE

1. Clean the fan and related parts with clean fuel oil and dry them with compressed air. Do not clean with steam or high-pressure jet.
2. Check the fan blades for cracks or other damage. Replace the fan if the blades are cracked or deformed.
3. Remove any rust or rough spots in the grooves of the fan pulley. If the grooves are damaged or severely worn, replace the pulley.
4. Do not add any fluids or lubricants to the fan driving mechanism.
5. Do not restrict fan rotation during engine operation for any reason.
6. Do not operate fan-driving mechanism with a damaged fan assembly. Replace a damaged fan as soon as the fault is noted.
7. Immediately investigate and correct any operator complaint involving driving mechanism or cooling system performance.
8. When questions arise, obtain answers before proceeding. Assistance is available through the authorized Field Sales distributor serving your area.

10.2 INSPECTION

WARNING
Set the starter selector switch in engine compartment to the "Off" position to prevent accidental starting of the engine.

- Check security of fasteners securing fan blade assembly to fan driving mechanism.
- Check coupling installation between fan blade assembly and gearbox.
- Visually inspect fan driving mechanism, fan blade assembly, shroud, radiator, and surrounding area for evidence of contact between rotating and non-rotating parts.
- Check fan transfer belt for fraying, cracking, and proper tension.
- Turn fan through at least 360° of rotation. It should turn smoothly with no resistance.

10.3 THERMOSTAT OPERATION

Coolant temperature is controlled by two blocking-type thermostats located in a housing attached to the cylinder head, on the turbo side of the engine (Fig. 11).

At coolant temperature below approximately 190°F (88°C), the thermostat valves remain closed and block the flow of coolant from the engine to the radiator. During this period, all of the coolant in the system is recirculated through the engine and directed back to the suction side of the water pump via a bypass tube. As the coolant temperature rises above 190°F (88°C) the thermostat valves start to open, restricting the bypass system, and allowing a portion of the coolant to recirculate through the radiator. When the coolant temperature reaches approximately 205-207°F (96-97°C) thermostat valves are fully open, the bypass system is blocked off and the coolant is directed through the radiator.

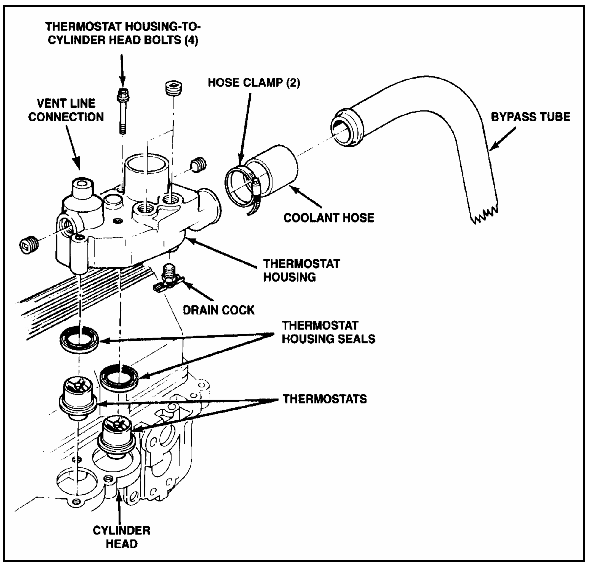


FIGURE 11: THERMOSTAT AND RELATED PARTS 05034

11. FAN GEARBOX

The radiator fan is belt driven from the engine crankshaft pulley through a standard gearbox, which is designed with two output shafts.

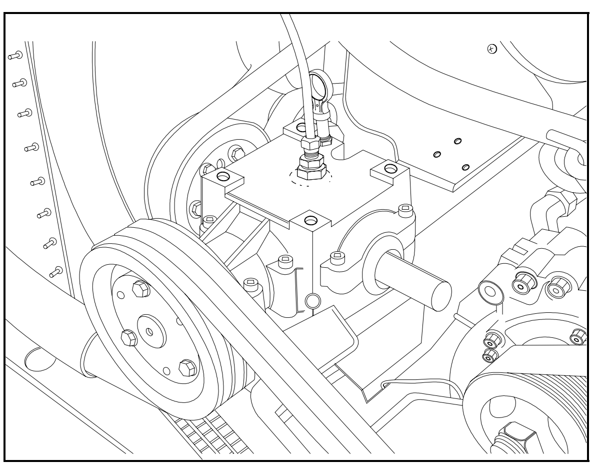


FIGURE 12: FAN GEARBOX 05062T

11.1 MAINTENANCE

Change the gearbox oil at 3,000 miles (4,800 km) and subsequently every 50,000 miles (80,000-km) or once a year, whichever comes first.

11.2 OIL CHANGE

1. Stop engine and make sure that all engine safety precautions have been observed.
2. Remove the drain plug located underneath the gearbox case.
3. Drain gearbox.
4. Replace drain plug.
5. Remove the dipstick located on top of gearbox and wipe with a clean rag (Fig. 12).
6. Adjust level to ″Full″ mark using Mobil SHC 630 (Prévost #180217) synthetic oil.
7. Insert dipstick in gearbox case, then remove again to check mark.
8. Reinsert the dipstick.

12. RADIATOR FAN BELT REPLACEMENT

Locate the belt tensioner pressure-releasing valve (Fig. 13), then turn handle counter-clockwise in order to release pressure in belt tensioner air bellows, thus releasing tension on belts.

Remove existing belts (3″V″belts & 1 Poly) from fan assembly and replace with new ones.

Turn the pressure-releasing valve clockwise to its initial position to apply tension on the new belts.

NOTE
For proper operation of the belts, adjust the air bellows tensioner pressure regulating valve (located next to control valve) to 50 psi (345 kPa).

12.1 BELT TENSION ADJUSTMENT

The regulator is located in the engine compartment behind the belt tension pressure releasing valve panel. Turn the screw located under the regulator assembly to change the tension pressure. Check proper pressure using the pressure check valve (Fig. 13).

Use Belt Tension Gauge #68-2404 to measure tension of engine belts. For proper operation of air tensioners, adjust upper tensioning bracket to provide a ¼" (7 mm) gap between stopper and bracket under normal pressure of 50 psi - 345 kPa. Refer to figure 14 for more information.

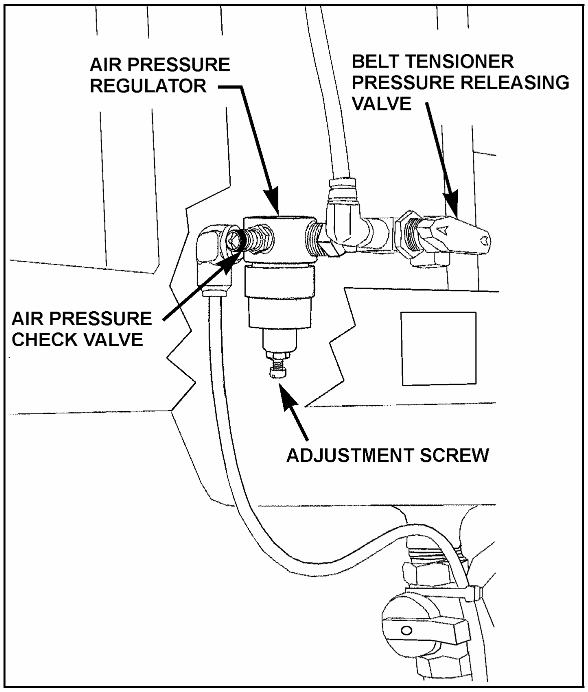


FIGURE 13: REGULATOR VALVE 12200

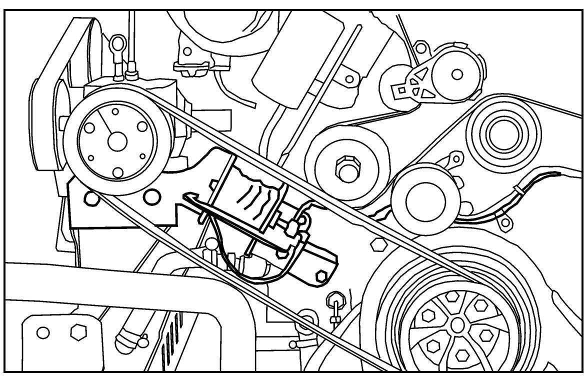


FIGURE 14: BELT TENSIONER 01169

13. FAN DRIVE ALIGNMENT

1. Install both attachment assembly plates (P/N 051779) (48, Fig. 15) through lower plating and secure with four spring nuts (P/N 500666), (70, Fig. 15). Then install one spacer (P/N 050705), (49, Fig. 15) on each spring nut at both anchoring locations (Fig. 15).

2. Center seat assembly in the fan shroud using the horizontal displacement of the fan driving mechanism support. Center with the slots in the floor at anchoring angle support (on some vehicles only). Vertical displacement of the fan clutch is made possible by slots at the base of the fan clutch (on some vehicles only) or by shimming with additional spacers at anchoring locations. Temporarily secure assembly with two nuts (P/N 500709), (74, Fig. 15) at both anchoring locations.

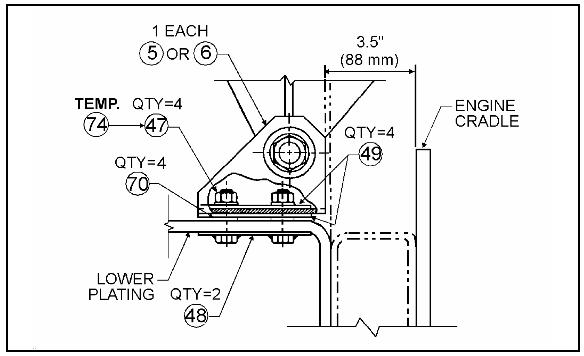


FIGURE 15: ANGLE SUPPORT 05014

⚠ CAUTION ⚠
Tilt fan and check for clearance.

3. Using a straight edge, align the 3"V"pulley on gearbox central shaft pulley with engine pulley, while taking pulleys outer edge thickness under consideration i.e. 3"V"pulley's outer edge is thicker than that of engine pulley's (Fig. 16).

4. Using a universal protractor, check 3"V" pulley's vertical angle with that of engine pulleys. If angles do not correspond, raise seat assembly by shimming with additional spacers (#49 - P/N 050705).

NOTE
Use a straight edge to measure engine pulley's vertical angle (Fig. 17).

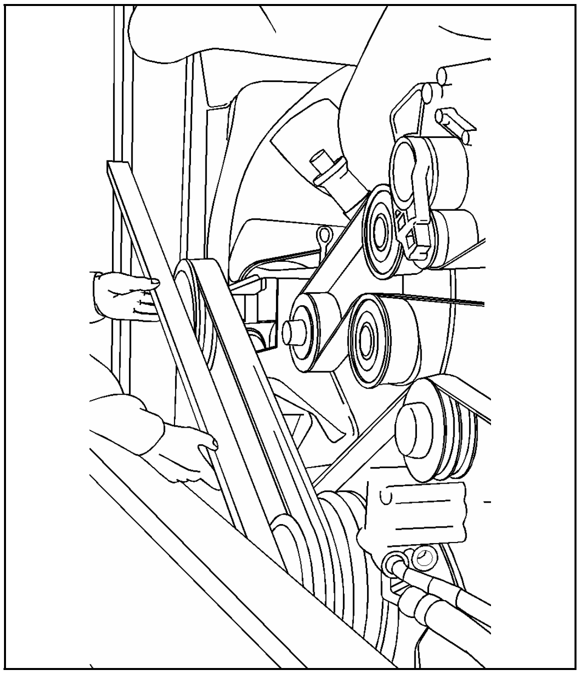


FIGURE 16: PULLEY ALIGNMENT 05064

5. Check alignments again (steps 2, 3 & 4) then replace temporary anchoring nuts (P/N 500709) (74, Fig. 15) with four nuts (P/N 500714) (47, Fig. 15) and tighten using a wrench.

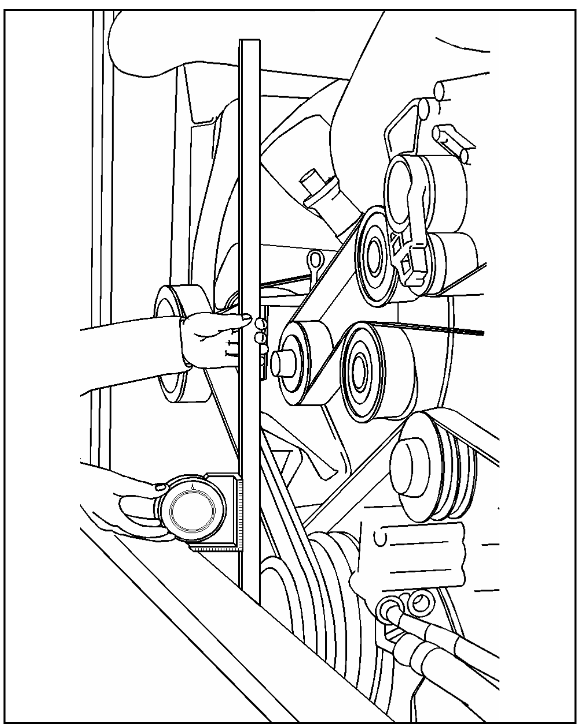


FIGURE 17: PULLEY VERTICAL ANGLE 05063

6. Align multi "V" pulley with fan pulley. Adjust the depth of the pulley on the gearbox shaft.
7. Set belt tensioner pressure regulating valve to 50 PSI - 345 kPa.

⚠ CAUTION ⚠

In order for tensioning system to work properly, adjust upper tensioning bracket to provide a ¼" (7 mm) gap between stopper and bracket. Otherwise, release tension on system and readjust distance using bolts securing upper tensioning bracket (Fig. 16).

.

14. SPECIFICATIONS

Cooling System Capacity (Approximation)

Includes heating system........................ 24 US gal (91 liters)

Thermostat

Number used........................2
Start to open........................186-193°F (86-89°C)
Fully open........................207°F (97°C)

Radiator

Make........................Valeo
Location........................Rear L.H. side
Supplier number........................1040153
Prevost number........................550820

Surge Tank Filler Cap

Make........................Stant
Model........................R3
Prevost number........................052355

Pressure Cap

Make........................Stant
Pressure setting........................14 psi (96.53 kPa)
Supplier number........................R12
Prevost number........................550606

Fan Clutch

Make........................Linnig
Type........................3 speed
<u>XL2 Buses</u>
Supplier number........................LA1.2.0118
Prevost number........................550837
<u>XL2 MTH</u>
Supplier number........................LA1.2.0131Y
Prevost number........................550839

Note: *The fan clutch is controlled by DDEC (not by thermoswitch).*

Fan Gearbox

Make........................Superior Gearbox
Ratio........................1:1
Supplier number........................411ACF-097-6
Prevost number........................550789
Lubricating Oil........................MOBIL SHC 630
Prevost number (Oil)........................683666

Fan Belt (gearbox-fan)

Make........................Dayco
Type........................Poly-V
Qty........................1
Supplier number........................10-55”
Prevost number........................506684

Fan Belt (gearbox-motor)

Make .... Dayco
Type .... V belt
Qty 3
Supplier number AX-73
Prevost number 506691

Coolant

Prevost Number 685125
DDC (Power Cool) 23512138
Prestone (Heavy Duty) .... AF977 (bulk), 72702 (3.78 L), 70119 (205L), 70102 (4L)

Corrosion Inhibitor and Coolant Stabilizer

Supplier number.......Detroit Diesel 23507857
Supplier number.......Nalco DD3000-15

Coolant Filter

Number used 1
Make .... Nalco
Type .... Spin-on

<u>MAINTENANCE ELEMENT FILTER</u>

Supplier number. ....Detroit Diesel 23507545
Supplier number......Nalco DDF3000
Prevost number 550630

<u>PRECHARGE ELEMENT FILTER</u>

Supplier number. ....Detroit Diesel 23507189
Supplier number......Nalco DDF60
Prevost number 550629

SECTION 13: WHEELS, HUBS & TIRES

CONTENTS

ILLUSTRATIONS

1. WHEELS

The vehicle is equipped with hub-mounted wheels as standard equipment, all studs and nuts have right-hand threads When the vehicle is provided with stud-mounted wheels, wheel studs and nuts on the left side of the vehicle have left-hand threads whereas those on the right side have right-hand threads.. Either steel wheels or optional aluminum-polished wheels may be installed on the vehicle. Both are mounted with radial tubeless tires.

All wheel dimensions are 22.50 X 9.0 inches (571.5 X 228.6 mm) for 315/80 R 22.5 tires except inner drive wheels ,which are always steel wheels and 22.50 X 8.25 inches (571.5 X 209.6 mm) for 315/80 R 22.5 tires. All other wheels can either be steel or aluminum wheels.

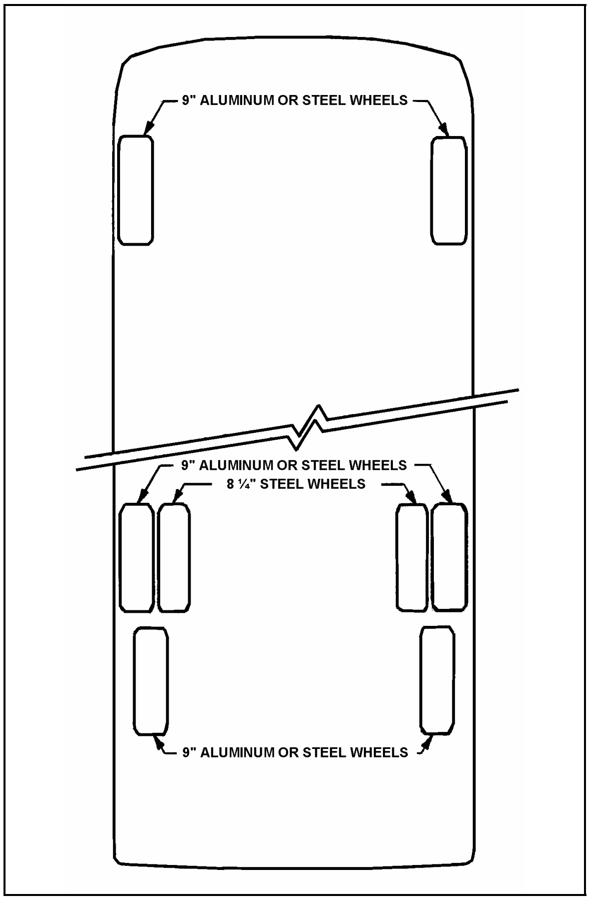


FIGURE 1: ALUM/STEEL WHEEL ARRANGEMENT 13001

2. WHEEL MAINTENANCE

Wheel maintenance consists of periodic inspections. Check all parts for damage and make sure that wheel nuts are tightened to the proper torque. In the case of a new vehicle, or after a wheel installation, stud nuts should be tightened every 100 miles (160-km) for the first 500 miles (800-km) to allow setting in of clamping surfaces.

Wheel studs and nuts must be kept free from grease and oil. No lubricant whatsoever should be used. Cleanliness of the wheel and its rotor mating surfaces is important for proper wheel mounting.

However, for hub mounted wheels, it is recommended to add some rust protection lubricant on the pilot diameter of the hub (to facilitate future removal).

It is also important that wheel stud nuts be tightened alternately on opposite sides of the wheel. Refer to Figure 2 for the suggested tightening sequence.

2.1 INSPECTION

Tighten stud nuts progressively as shown in Figure 2. The final tightening should be done with a torque wrench. Tighten stud nuts to 450 - 500 lbf-ft (610 - 680 Nm) for aluminum as well as steel wheels.

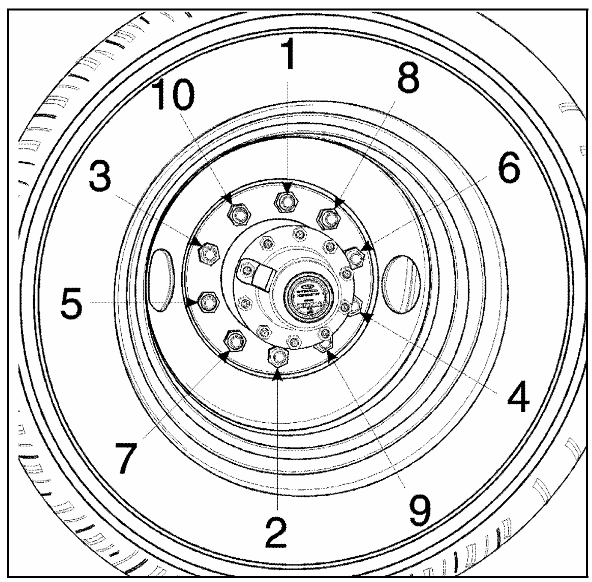


FIGURE 2: TIGHTENING SEQUENCE 13018

2.2 SINGLE WHEEL REMOVAL

1. Stop engine and apply parking brake.

2. Loosen wheel nuts about one turn (do not remove the nuts). This is not necessary if equipped with hydraulic powered gun.

NOTE
For stud-mounted wheels, turn nuts counterclockwise for R.H. side and clockwise for the L.H. side of vehicle. For hub-mounted wheels, turn nuts counterclockwise on both sides of the vehicle.

3. Raise the vehicle by its jacking points on the body. See Section 18, *"Body"*, under heading *"Vehicle Jacking Points";*
4. Unscrew wheel hex stud nuts and remove the wheel;

⚠ CAUTION ⚠
Always mark position of the wheel on the axle prior to removal in order to replace wheel at the same location, thus avoiding a new wheel balancing.

2.3 SINGLE WHEEL INSTALLATION

1. Mount the wheel over studs, being careful not to damage stud threads;
2. Screw in the hex stud nuts (refer to Figure 2 for sequence) so that wheel will position itself concentrically with hub. This is important, otherwise wheel may be eccentric with hub and will not run straight. In this initial step, slightly tighten the nuts to correctly position the wheel;
3. Tighten stud nuts progressively as shown in Figure 2. The final tightening should be done with a torque wrench. Tighten stud nuts to 450 - 500 lbf-ft (610 - 680 Nm) for aluminum as well as steel wheel.

⚠ CAUTION ⚠
Insufficient mounting-torque can result in damage to parts. Excessive mounting torque can cause studs to break and the wheel to crack in stud hole area.

3. DUAL WHEELS

3.1 OUTER WHEEL REMOVAL

Same as described in *"Single Wheel Removal"* procedure described previously.

3.2 INNER WHEEL

1. Remove outer wheel;
2. Unscrew inner cap nuts
3. Remove inner wheel.

3.3 INNER WHEEL INSTALLATION

1. Mount the wheel over studs, being careful not to damage stud threads;
2. Screw in the inner cap nuts (Fig. 4), so that wheel will position itself concentrically with hub. Refer to Figure 2 for sequence;
3. Tighten inner cap nuts progressively according to sequence shown in Figure 2. Final tightening should be done with a torque wrench. Tighten inner cap nuts to 450 - 500 lbf-ft (610 - 680 Nm) for aluminum as well as steel wheel.

⚠ CAUTION ⚠
Insufficient mounting-torque can result in damage to parts. Excessive mounting torque can cause studs to break and the wheel to crack in stud hole area.

3.4 OUTER WHEEL INSTALLATION

With inner wheel installed, tighten the hex stud nuts (Fig. 4) using the single wheel installation procedure described previously.

NOTE
On dual wheel assemblies, position the wheels with the tire valves 180º apart in order to have access to both the inner and outer valves.

3.5 INSPECTION

1. Loosen a hex stud nut three turns (Fig. 4);
2. Tighten the inner cap nut to 450 - 500 lbf-ft (610 - 680 Nm);
3. Tighten the hex stud nut to 450 - 500 lbf-ft (610 - 680 Nm).

Repeat for each of the 10 *"hex stud nut - inner cap nut assemblies"* according to the tightening sequence in figure 2.

⚠ CAUTION ⚠
Do not attempt to tighten an inner cap nut without having previously loosened the hex stud nut.

⚠ CAUTION ⚠
The actual length of thread engagement present in an assembled wheel can not always be determined by visual inspection of measurement of a tightened assembly. The relationship of the wheel cap nut seat to the end of the stud may vary. If there is any doubt that enough thread engagement is present, the number of engaged threads may be counted. Tighten all nuts in the regular manner, then loosen one to hand-tightness. The number of turns to disengage a 1-1/8-inch nut should be at least five full turns. At least seven full turns should be required to disengage a ¾-inch nut or a M22 nut. Ideally, when torqued to the proper load, the stud should be flush with the face of the nut. The face of the nut may be recessed in nuts that are taller for improved wrenching. With most of the nuts in present use, a few unengaged threads at the outer end will cause no problem provided at least 5-7 full turns are required to disengage the nut depending on thread size.

4. ALUMINUM WHEEL ANTI-CORROSION PROTECTION

Clean wheels often by means of a high pressure water jet. Cleaning may be accelerated with mild soap. Do not use concentrated alkaline cleaning products.

When tire is removed, clean and inspect wheel thoroughly. Remove dirt and corrosion on rim by means of a wire brush. Do not use a wire brush on the outer surface of the wheel.

The following measures should be taken to maintain original appearance of the aluminum wheels:

1. Remove any tar from wheel surface with a good quality tar remover.
2. Spray Alcoa Cleaner (Prévost #683529) evenly on cool outer surface of wheel. Let work 15-20 minutes (keep wet by spraying more Cleaner if necessary).
3. Rinse thoroughly with clean water and let air dry. Heavy oxidation may require a repeat application of cleaner.
4. Apply Alcoa Polish (Prévost #683528) sparingly to a small area using a clean, soft cloth. Work polish into surface as you would a rubbing compound.
5. Buff, turning cloth frequently, until surface is clean and shiny. Let air dry. Use power buffer to improve ease of use and gloss uniformity.
6. On completely dry, clean and polished surface, generously apply Alcoa sealant (Prévost #683527). Rinse thoroughly with water while surface is still wet in appearance (have water source ready as the dry time is very short, usually less than 2 minutes).
7. For best results, finish by wiping the surface with a clean rag to remove excess water, then allow surface to dry.

Clean aluminum wheels as required to maintain original look.

⚠ WARNING ⚠
Wheel surfaces may have sharp or cutting edges that may cause injury to the hands. To prevent contact with sharp edges, it is strongly recommended to wear rubber gloves when washing or polishing wheels.

5. WHEEL STRAIGHTNESS TEST

1. Slightly raise axle to be checked and place a safety support underneath;
2. Check wheel lateral run-out. Install a dial gauge as shown in figure 3, then rotate the wheel by hand one full turn. As the wheel turns, note any variation on the dial gauge;

⚠ CAUTION ⚠
Damage to the dial gauge could occur if it strikes a wheel balancing weight.

3. If the variation in lateral run-out exceeds 0.0625 inch (1,6 mm), the wheel must be replaced.

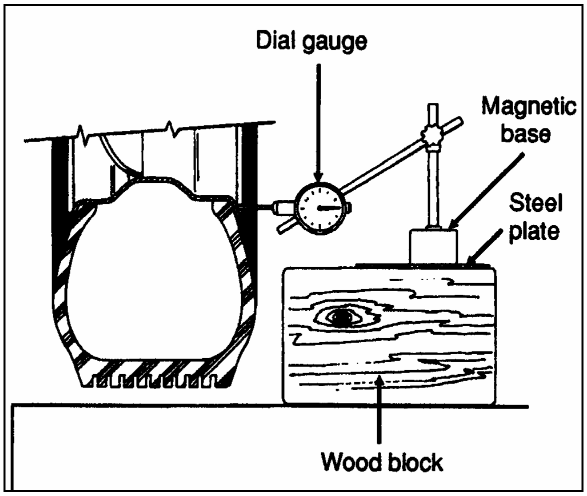


FIGURE 3: DIAL GAUGE INSTALLATION 13008

If doubt exists whether wheel or hub is distorted, hub may be checked as follows:

- Replace the existing wheel with a wheel known to be correct;
- Check wheel lateral run-out as outlined in step 2;
- If, within specifications, the hub is correct but the suspected wheel must be replaced.

⚠ WARNING ⚠
NEVER STRAIGHTEN ALUMINUM WHEELS. Never heat aluminum wheels to repair damages incurred after hitting a curb or resulting from other causes. The special alloy in wheels has been heat treated, and any uncontrolled heating could alter wheel structure. Furthermore, never weld aluminum-forged wheels for any reason whatsoever.

6. WHEEL STUDS

Stripped threads may be the result of excessive torquing or may have been damaged during wheel installation when placing the wheel over the studs. A stud having damaged threads must be replaced. Broken studs are a direct result of operating with loose stud nuts or improperly seated wheels. When a broken stud is replaced, the adjacent studs, on each side of the broken one must also be replaced since they could have been subjected to excessive strain and may be fatigued.

When installing wheel studs to hubs, check nuts retaining the wheel stud to wheel hub and replace if they are deformed, damaged or severely corroded. Install nut (and washer where applicable) to new stud. Torque to 450 - 500 Ft-lbs (610 - 680 Nm).

NOTE
For stud-mounted wheels, turn nuts counterclockwise for R.H. side and clockwise for the L.H. side of vehicle. For hub-mounted wheels, turn nuts counterclockwise on both sides of the vehicle.

6.1 DRIVE AXLE STUDS

Stud-mounted wheels are mounted on the drive axle with ¾"-16 studs with an inner cap nut, and a 1-1/8"-16 nut. Hub-mounted wheels are mounted with M22 x 1.5 studs and an M22 flange nut.

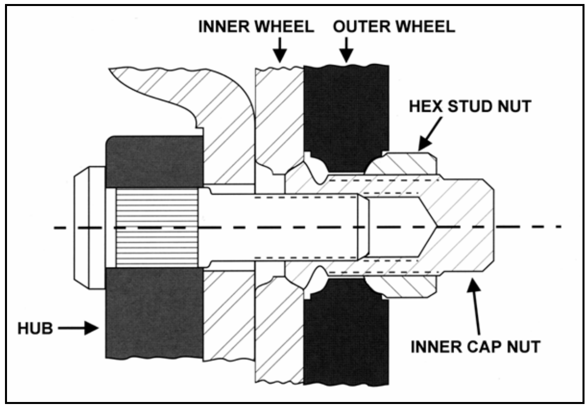


FIGURE 4: STUD-MOUNTED WHEELS 13007

6.2 FRONT AND TAG AXLE STUDS

Wheel can be mounted on tag axle with studs (1-1/8"-16 thread) or hub mounted (M22 x 1.5 thread).

NOTE
Wheel studs and nuts must be kept free from grease and oil. No lubricant whatsoever should be used.

7. HUB MOUNTED WHEELS

Wheel surfaces in contact with hubs, nuts or other wheels should be kept free of all rust, grease and paint (except for initial "E" coat protection, applied to stop rusting and to facilitate wheel removal). The reason for this is to assure that all faces are clamped together without buildup of any coating. The threads of the wheel studs and the wheel nuts should be clean and undamaged.

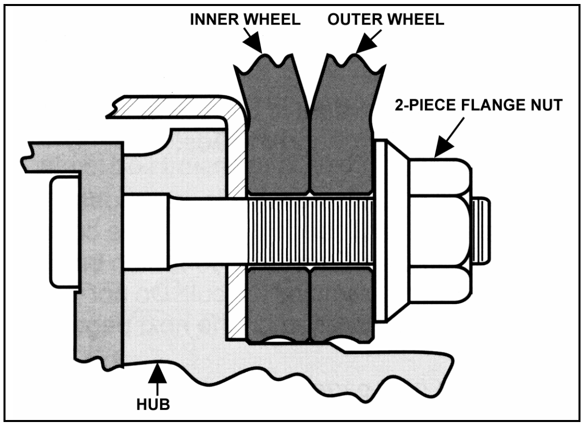


FIGURE 5: HUB-MOUNTED WHEELS 13025

NOTE
When painting wheels, make sure to mask all surfaces identified above.

Using a calibrated torque wrench, tighten wheel nuts to 450 - 500 lbf-ft (610 - 680 Nm) of torque. Do not use power tools or long bars for tightening. Tighten wheel nuts alternately as shown in figure 2.

NOTE
Tightening should not be done immediately after prolonged braking or when wheel ends are hot

Check wheel nut torque at every 100 miles (160 km) for 500 miles (800 km) after fitting wheels. Let cool before checking. If any relaxation of the initial 450 - 500 lbf-ft (610 - 680 Nm) of torque has occurred, retighten. Relaxation of initial torque may occur because of the “bedding down” of the hub and wheel surfaces.

NOTE
Torque relaxation occurs when wheel ends are hot but should revert to original setting when cool. Retightening when hot will produce a higher torque reading than recommended.

7.1 CARE OF WHEELS

Check for cracks in wheels, especially around the fixing holes, studs, nuts and washers. If in doubt, renew.

Do not simply retighten very loose wheel fixings or wheels that are continually becoming loose. Find out why they are loose and whether any damage has been caused.

Use trained personnel and keep records of all attention to wheels and fixings, including which parts were renewed and when.

8. FRONT AND TAG AXLE WHEEL HUBS

The unitized hub bearings used on the NDS range of axles, are non-serviceable items. Bearings are pre-adjusted, lubricated and have seals fitted as part of the manufacturing process. The bearings are greased for life and there is no need or facility for re-lubrication

8.1 HUB BEARING INSPECTION

An inspection should be made at intervals of 30,000 miles (48 000 km).

- Apply parking brake, raise wheels off the ground and support axle on stands. When the wheels are raised, they should revolve quite freely without roughness.
- Place magnetic base of a dial indicator on brake caliper and position dial indicator stem against a convenient marked spot on face of hub flange.
- With dial indicator in position pull hard but steadily on hub flange and oscillate at same time until a steady reading is achieved.
- Without releasing the pressure, turn bearing so that dial indicator stem contacts marked spot and note reading on indicator.
- Push bearing flange hard and oscillate as before until a steady reading is achieved.
- Without releasing the pressure, turn bearing so that indicator stem again contacts the marked spot and note new reading on indicator.
- The difference between readings is the amount of mounted end play in bearing unit.
- The mounted end play figure should not exceed 0.050 mm for a new bearing.

NOTE
If original bearing unit is re-fitted, and end-float is measured at 1 mm, with hub not fully tightened to correct torque, then the retaining clip within the unit is damaged and a new unit must be fitted.

NOTE
For more information on front and tag axle wheel hub, refer to "DANA SPICER Maintenance Manual Model NDS and Maintenance Manual NDS Axles" annexed at the end of Section 11.

9. DRIVE AXLE WHEEL HUBS

Drive wheels use a single oil-seal assembly. They are lubricated from the oil supply in the differential housing. Bearings are tapered rollers, adjustable to compensate wear. Maintain differential oil level with general-purpose gear lubricant (refer to Section 24 *"Lubrication"* for proper oil grade selection) to ensure adequate oil supply to wheel bearings at all times.

9.1 BEARING ADJUSTMENT

To adjust drive wheel bearings:

1. Raise vehicle until both dual wheels can be turned freely (approximately 6 inches from the ground). Position jack stands under drive axle, then lower vehicle approximately 2 inches in order to avoid entire weight of the axle being supported by the suspension air bellows and the shock absorber pins.
2. Remove axle shaft as indicated in *"Meritor - Maintenance Manual No. 5"* under heading *"Single Reduction Differential Carriers"* annexed to *"Section 11"* of this manual. Remove gaskets. Unscrew lock nut and remove adjusting nut lock ring.
3. To adjust, tighten adjusting nut until the wheel binds. Rotate the wheel while tightening so that all surfaces are in proper contact. Back off adjusting nut approximately, ¼ to 1/3 turn to assure 0.001/0.007" (0.0254/0.1778 mm) endplay and to ensure that wheel turns freely. Replace the lock ring, and adjust nut dowel pin in one of the holes. The ring may be turned over if necessary to allow more accurate bearing adjustment.
4. Tighten lock nut and check bearing adjustment. Replace the axle shaft using a new gasket.

9.2 DISASSEMBLY AND REPAIR

1. Jack vehicle as per "Bearing Adjustment" and remove axle shaft as indicated in *"Meritor - Maintenance Manual No. 5"* entitled *"Single Reduction Differential Carriers"* annexed to Section 11 of this manual.
2. Remove wheels and tires.

⚠ CAUTION ⚠
To replace wheel at the same location, always mark position of the wheel on the axle before removal, thus avoiding a new wheel balancing.

3. Remove lock nut, lock ring and adjusting nut from axle housing to prevent the outer bearing from falling out. Remove outer bearing cone and roller assembly.
4. Remove screws attaching inner oil seal retainer to hub, and remove inner oil seal assembly. Remove inner bearing cone and roller assembly. Bearing cups can be separated from the hub using a hammer and a long brass drift.
5. Thoroughly clean all parts. Bearing cone and roller assemblies can be cleaned in a suitable cleaning solvent using a stiff brush to remove old lubricant.
6. In case that excessive wear, deterioration, cracking or pitting is present on the bearing cups, rollers or cones, the bearings should be replaced. Seals should be replaced each time they are removed from the hub. To install new oil seal, use a suitable adapter and drive the seal into the retainer bore until it bottoms.
7. When installing wheel on spindle, center the wheel hub with spindle to avoid damaging the seal with the end of the spindle. Push wheel straight over the spindle until inside diameter of seal press fits on wiper ring. Fill hub cavity with general-purpose gear lubricant (refer to Section 24 *"Lubrication"* for proper oil grade selection). Lubricate, then install outer bearing cone. Adjust bearing and lock. Assemble axle flange to axle using a new gasket. Apply sealant in stud area. After both wheels have been assembled according to above procedure, fill the differential with the recommended lubricant to the proper factory recommended level.

NOTE
During regular inspection, do not forget to check lubricant level in differential. Clean thoroughly or replace vent as required.

10. SPARE WHEEL

Tire failure is a rare event if tires are properly cared for. In case of a flat tire, move vehicle a safe distance away from traffic and apply parking brake. Remember to use the hazard flashers and according to the Highway Code regulations, set up the triangular reflectors (see *"Emergency Warning Reflectors"* in the Operator's Manual) at an adequate distance, to warn incoming motorists. This kit is located at the ceiling of the first baggage compartment, on the R.H. side.

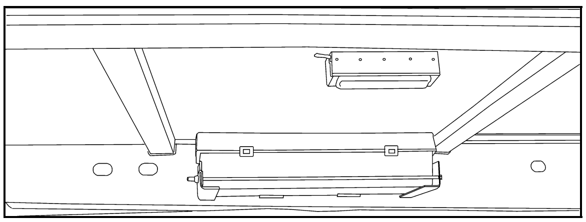


FIGURE 6: WARNING REFLECTORS LOCATION 23376

The spare wheel is stored in a dedicated compartment behind the front bumper. To access, pull the release handle located in the front service compartment. Although the bumper is heavy, sprung hinges permit one person operation.

When closing bumper compartment, make sure bumper is securely installed.

⚠ WARNING ⚠
This compartment has not been designed for storage. Never leave loose objects in this area since they may interfere with steering linkage mechanism. Make sure bumper is safely locked in place after closing the compartment.

10.1 PULLING OUT SPARE WHEEL

To remove the spare, untighten the pressure screw holding the tire in place, then press down on the spring loaded locking pin located at the top of the retaining bracket and remove the bracket. Using the strap, pull the spare out of the compartment (refer to the following illustrations). Rollers ease manipulation. Remove the protective cover. Install the flat in place of the spare by reversing the procedure. Do not forget to have the flat repaired as soon as possible.

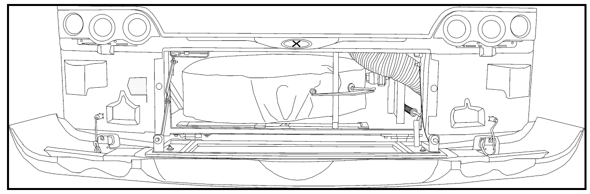


FIGURE 7: SPARE WHEEL COMPARTMENT 18614

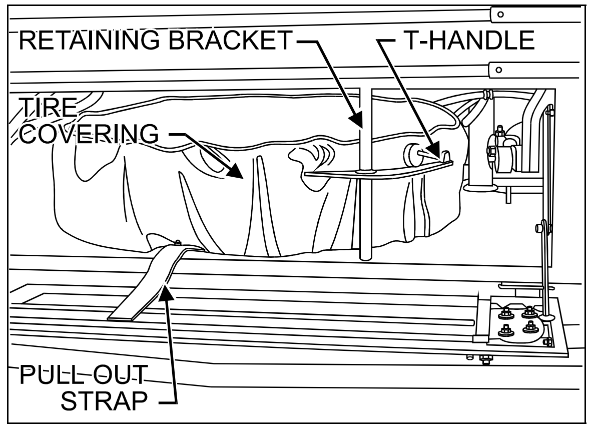


FIGURE 8: SPARE WHEEL AND TIRE 18415

NOTE
The jack and wheelnut wrench are stored in front service compartment.

The jack/tools kit stowed in the front service compartment contains a:

1. 30 ton hydraulic jack;
2. Wheel nut wrench and lever.

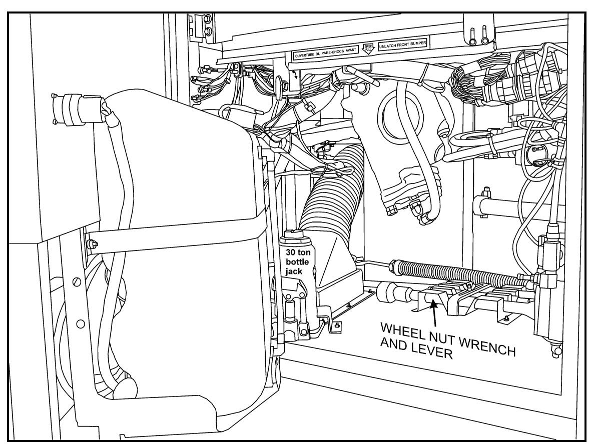


FIGURE 9: FRONT SERVICE COMPARTMENT 23377

NOTE
Check the inflation pressure of the spare tire periodically to keep it ready for use. Inflate spare tire to the pressure of the tire, which has the highest pressure on the vehicle. When installing, deflate to correct pressure if necessary.

10.2 CHANGING A FLAT

In case of flat tire, refer to appropriate procedure under “Wheel Maintenance" heading in this section.

NOTE
For hydraulic jack placement, refer to Section 18 "Body", under heading "Vehicle Jacking Points".

⚠ WARNING ⚠
Place jack on stable and level ground; if necessary, place a board under the jack. Do not raise the vehicle until you are sure the jack is securely engaged.

⚠ WARNING ⚠
To prevent personal injury and/or equipment damage, use only the recommended jacking points. Passengers must not remain inside vehicle while wheel is being replaced.

⚠ CAUTION ⚠
Adjust tire pressure according to the appropriate cold tire inflation-pressure.

NOTE
Store damaged wheel in spare tire compartment. Repair and balance the flat tire as soon as possible.

10.3 SPARE WHEEL MAINTENANCE

Maintenance of the spare wheel and tire consists in ensuring that tire inflation pressure is the same as the tire on the coach that has the highest inflation pressure (refer to “Specifications” in this section for the recommended tire inflation pressure). Inspect rim to ensure that there is no important corrosion. In addition, check if spare wheel covering is in good condition and check that spare tire is securely fastened in compartment.

11. TIRE MAINTENANCE

The most critical factor in tire maintenance is proper inflation (Fig. 9). No tire is impervious to loss of air pressure. To avoid the hazards of under inflation, always maintain tires at their recommended inflation pressure. Improper inflation decreases tire life.

An under inflated tire builds up heat that can cause sudden tire destruction, resulting in improper vehicle handling and possible loss of vehicle control. At least once a week, before driving (when tires are cold), check inflation pressure on all the tires, including the spare tire. This is especially important in cases when different drivers operate the vehicle.

⚠ WARNING ⚠
Failure to maintain correct tire inflation pressure may result in sudden tire destruction, improper vehicle handling, and will cause rapid and irregular tire wear. Inflation pressure should be checked weekly and always before long distance trips.

11.1 INFLATION PRESSURE

The condition and pressure of the tires can greatly affect both useful tire life and road safety.

At regular intervals, verify the tire pressures. Use an accurate tire pressure gauge when checking inflation pressures. Never exceed the maximum inflation pressure specified on each tire.

NOTE
Inflation pressure should be checked when tires are cold. Cold tire inflation pressure can be measured when a vehicle has not been driven for at least 3 hours or less than 1 mile (1.6 km). Driving, even for a short distance, causes tires to heat up and air pressure to increase. Check inflation pressure on all tires (including the spare tire) using an accurate tire gauge.

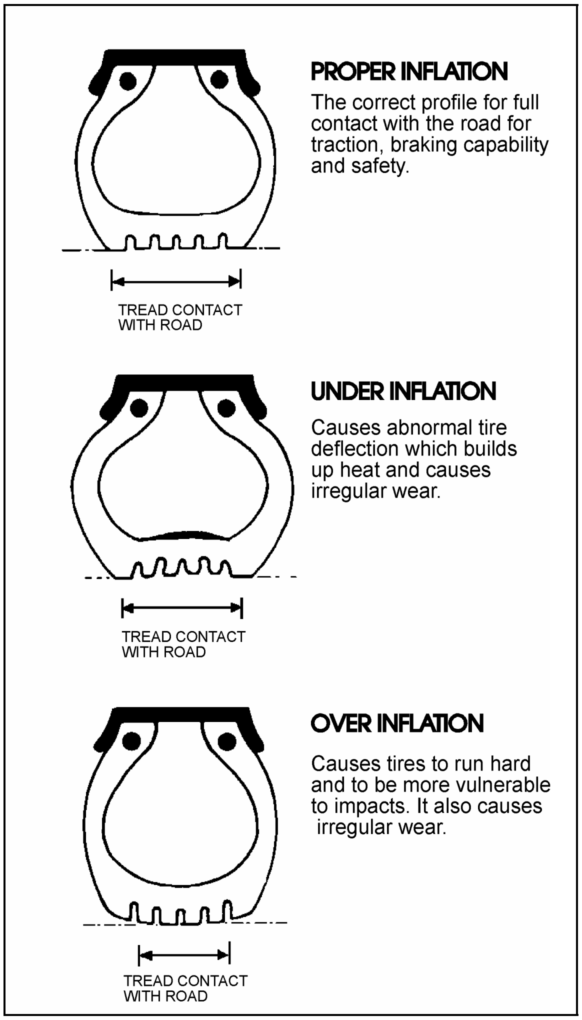


FIGURE 10: TIRE INFLATION 13009

NOTE
The recommended tire inflation pressures are given in the applicable documents supplied with the vehicle. In addition, cold tire inflation pressures are listed on the Department of Transport's certification plate, affixed on the panel behind the driver's seat. For special tire selection, a "PRÉVOST COACH SPECIAL SPECIFICATION" chart is supplied with the vehicle and is affixed on the left wall near the driver's seat. Remember, tire inflation pressure must be adjusted according to vehicle loading - see table in "Coach Final Record"

⚠ CAUTION ⚠
Never bleed air from hot tires as tires will then be under inflated. Use an accurate tire gauge to check pressures (Do not kick tires as an inflation check. This is an unreliable method).

⚠ CAUTION ⚠
These tire pressures are established in accordance with the maximum allowable load on each axle. A lower pressure is recommended if the axle load is less than the above specifications. Weigh vehicle fully loaded and pressurize according to tire manufacturer's recommendations. For other tire and wheel specifications, see Prévost tire pressure tabulation in "Coach Final Record".

⚠ WARNING ⚠
Incorrect tire pressures cause increased tire wear and adversely affect road holding of the vehicle, which may lead to loss of vehicle control.

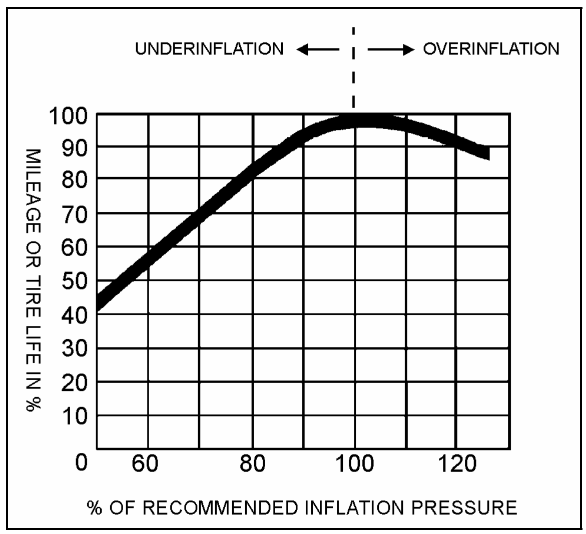


FIGURE 11: TIRE LIFE / INFLATION PRESSURE 13010

⚠ WARNING ⚠
Recommended tire inflation pressures and maximum allowable loads apply to speeds up to 65 mph (105 km/hr). Do not drive vehicle at a higher speed than 65 mph (105 km/h) or above the posted speed limit.

⚠ WARNING ⚠
All tires on the same axle should always be inflated to the same pressure. There should not be a difference in pressure between right and left tires on the same axle. A 5-psi (35-kPa) underinflation in one front tire can not only reduce vehicle maneuverability, but will create steering hazards which can lead to an accident.

11.2 TIRE MATCHING

Unmatched tires on drive axle will cause tire wear and scuffing, as well as possible damage to the drive unit. Consequently, we recommend that tires be matched within 1/8" (3 mm) of the same rolling radius.

NOTE
It is recommended that all tires on coach be of the same type.

11.3 WHEEL BALANCING

Before balancing, wheels must be clean and free from all foreign matter. The tires should be in good condition and properly mounted. An unbalanced wheel can be due to a bent wheel or improper mounting. Before removing the wheel from the vehicle, check for swaying movement and if necessary, check the wheel lateral runout as outlined under heading *"Wheel Straightness Check"*.

⚠ WARNING ⚠
When balancing wheel and tire assemblies, it is strongly recommended to closely follow instructions covering the operation of wheel balancer.

⚠ CAUTION ⚠
A maximum of 16-oz (450 g) of balancing weight is recommended. If more weight is necessary, check and correct the cause.

11.4 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 the wear rate on the tires is perceptively different (from axle to axle), then tires should be rotated in such a manner as to alleviate the condition.

NOTE
There is no restriction on criss-cross rotation.

12. SPECIFICATIONS

STEEL WHEELS (except inner drive axle)

Wheel size .... 9.0" X 22.5"

Wheel nut torque .... 450 - 500 lbf-ft (610 - 680 Nm)

Tire size .... 315/80 R 22.5

STEEL WHEELS (inner drive axle)

Wheel size .... 8.25" X 22.5"

Wheel nut torque .... 450 - 500 lbf-ft (610 - 680 Nm)

Tire size .... 315/80 R 22.5

ALUMINUM WHEELS (All wheels are 9" X 22.5" except inner drive axle)

Wheel size .... 9" X 22.5"

Wheel nut torque .... 450 - 500 lbf-ft (610 - 680 Nm)

Tire size .... 315/80 R 22.5

RECOMMENDED TIRE INFLATION PRESSURE AT MAXIMUM LOAD (cold)

NOTE
Vehicle is delivered with the specific inflation pressure certification plate according to the tire selection.

⚠ WARNING ⚠
Special tire selection may lower maximum allowable speed limit, even below posted speed limit. For maximum safety, check with tire manufacturer.

⚠ WARNING ⚠
Recommended tire inflation pressures and maximum allowable loads apply to speeds up to 65 mph (105 km/hr). Do not drive vehicle at a higher speed than 65 mph (105 km/h) or above the posted speed limit.

ALUMINUM WHEEL CLEANING AND MAINTENANCE PRODUCTS

Aluminum Wheel Cleaner (22 Oz bottle) .... Prévost #683529
Aluminum Wheel Polish (16 Oz bottle) .... Prévost #683528
Aluminum Wheel Sealer (13 Oz bottle) .... Prévost #683527

SECTION 14: STEERING

CONTENTS

ILLUSTRATIONS

1. STEERING SYSTEM

1.1 I-BEAM AXLE STEERING SYSTEM DESCRIPTION

The steering system consists of the steering wheel and column assembly, a vane-type hydraulic pump, reservoir, filter, interconnecting system lines and hoses, integral power steering gear, linkage and steering damper (Fig. 1). The steering linkage includes the pitman arm, drag link, steering arm, tie rod arms and tie rod.

Hydraulic components are added to transmit, increase and regulate steering control forces.

These elements are:

1. Steering stabilizer (damper);
2. A vane type hydraulic pump; and
3. Hydraulic reservoir and hoses.

The steering stabilizer reduces road shocks and vibrations in the system. The steering gearbox is self powered and provides movement with power assistance to the left wheel.

Steering stability and tire wear are influenced by wheels, hubs, tires, air suspension, brakes, front suspension and front end alignment which are all covered in their respective sections in this manual.

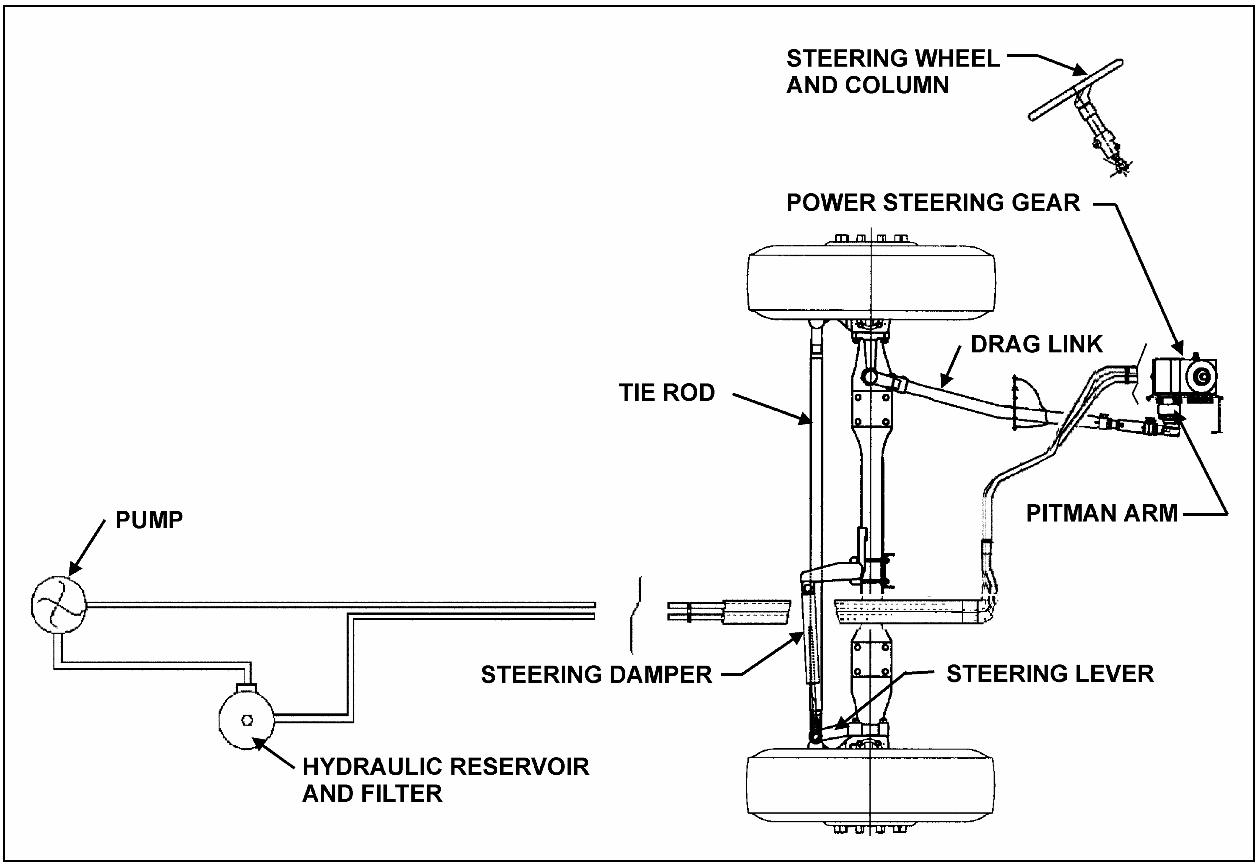


FIGURE 1: I-BEAM AXLE STEERING SYSTEM SETUP

1.2 INDEPENDENT FRONT SUSPENSION STEERING SYTEM DESCRIPTION

The steering system consists of the steering wheel and column assembly, a vane-type hydraulic pump, reservoir, filter, interconnecting system lines and hoses, integral power steering gear and linkage (Fig. 2). The steering linkage consists of tie rods connected to the bell crank and the steering arm at the left side of the coach, and to the idler arm and steering arm at the right side of the coach. The bell crank and idler arm are connected by a relay rod. A drag link connected to the bell crank and the pitman arm, which is mounted to the steering gear, transfers the turning motion of the steering wheel to the steering arms.

Hydraulic components are added to transmit, increase and regulate steering control forces.

These elements are:

1. A vane type hydraulic pump; and
2. Hydraulic reservoir and hoses.

The steering gearbox is self powered and provides movement with power assistance to the left wheel.

Steering stability and tire wear are influenced by wheels, hubs, tires, air suspension, brakes, front suspension and front end alignment which are all covered in their respective sections in this manual.

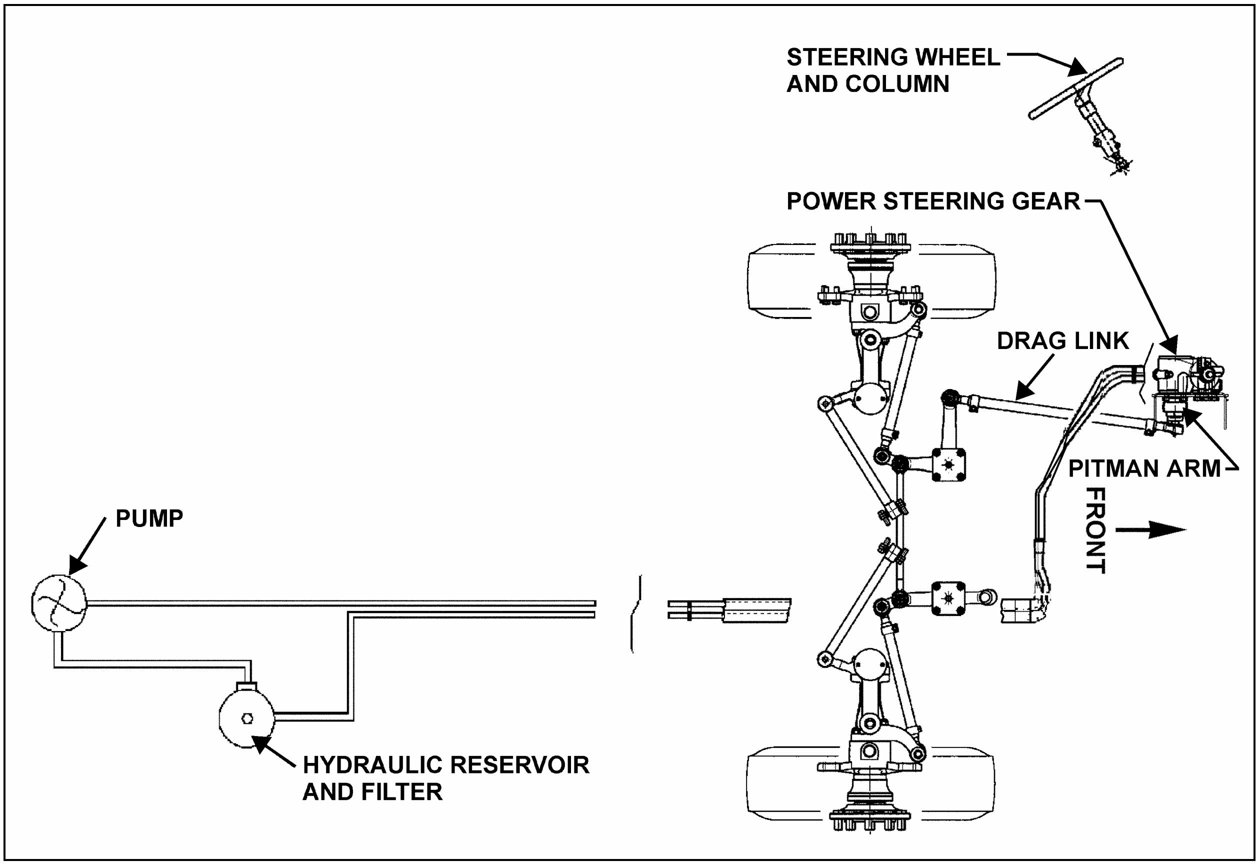


FIGURE 2: IFS STEERING SYSTEM SETUP 14060

2. POWER STEERING GEAR

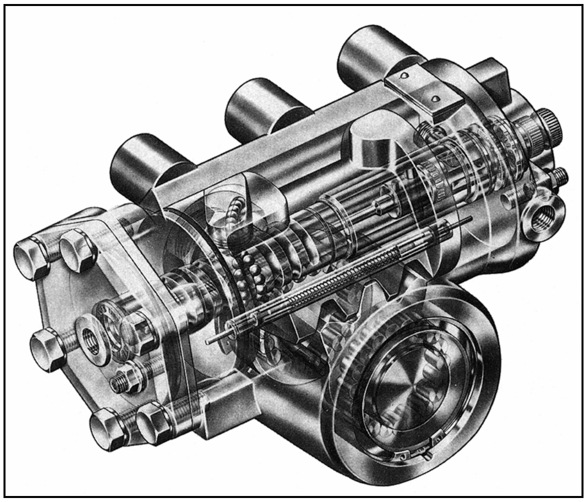


FIGURE 3: POWER STEERING GEAR 14035

2.1 DESCRIPTION

The power steering gear is located in the lower part of front service compartment (Figs. 3 & 4). The housing of the ZF-Servocom contains a control valve, working cylinder and a complete mechanical steering gear. The pressure oil for the steering is delivered by a motor-driven oil pump which is supplied with oil from an oil tank.

The housing is designed as a cylinder for the piston, which converts the rotation of the steering shaft and the worm into an axial movement and transfers this to the steering worm sector shaft. The serration of the sector shaft is straight-cut with a high surface quality in such a way that it is only possible to set a unique setting without play on installation in the straight-ahead driving area by means of the two eccentrically designed lateral housing covers.

The piston and worm are connected via a ball chain. When the worm is turned, the balls are collected by a circulating pipe at one end of the chain and fed in again at the other end, thus producing an endless ball chain.

The control valve consists of the valve slide in a needle bearing in the worm, with six control grooves on the circumference and the control sleeve on the worm, which also has six control grooves. The valve slide, designed with steering shaft connection, turns together with the worm as the steering wheel is turned.

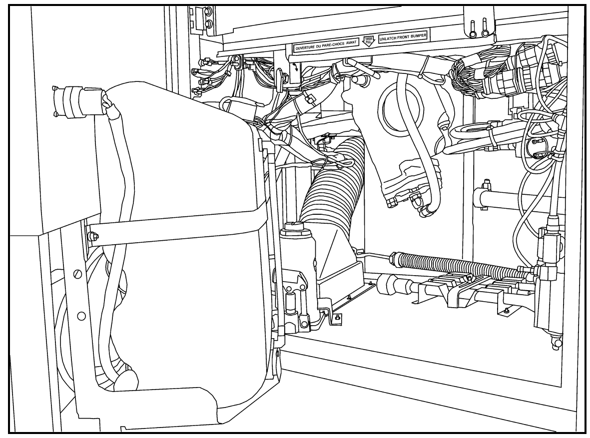


FIGURE 4: FRONT SERVICE COMPARTMENT 18611

A torsion bar, which is pinned with the valve slide and the worm, keeps the control valve in the neutral position as long as no opposing force is applied to the steering wheel. The steering housing contains a pressure relief valve, which limits the discharge pressure of the oil pump to the maximum value required. A replenishing valve can also be used, through which oil is sucked from the return if steering is not hydraulically boosted.

Compared with constant ratio, steering versions with variable ratio are more directly designed in the center area than outside the center area. The resulting smaller steering corrections benefit steering behavior in straight-ahead driving. At the same time, the indirect transmission means that there is a higher hydraulic torque available at the steering arm in parking movement. If the hydraulic assistance fails, the operating forces on the steering wheel are correspondingly lower in this area. This is achieved through a piston/steering worm sector shaft serration with differing modulus and angle of pressure.

Upon transfer of a torque from the steering shaft to the worm, or vice versa, the torsion bar is deformed in the elastic area so that there is torsion between the valve slide and the control sleeve. When the steering wheel is released, the torsion bar ensures that the valve is returned to the neutral position.

Refer to the *"ZF-SERVOCOM Repair Manual"* and "*ZF-SERVOCOM Operating, Servicing /Maintenance and Inspection Instructions"* annexed to this section for the functional aspects and maintenance procedure of the steering gear.

NOTE

Also available is the ZF-Servocomtronic, which provides variable assistance in function of speed.

2.2 POWER STEERING GEAR REMOVAL

WARNING

The steering gearbox weighs approximately 100 lbs (45 kg) dry. Exercise caution when handling.

1. Put a container into place, then disconnect both the inlet and outlet hoses from the power steering gear. Cover fittings to prevent fluid contamination.
2. Mark both the pitman arm and sector shaft with a line, then remove pitman arm. Refer to *"11.1 Pitman Arm Removal"* procedure.
3. Mark both the steering shaft universal joint yoke and steering gear input shaft with a line, then disconnect universal joint.
4. Unscrew and remove the power steering gear.

2.3 POWER STEERING GEAR INSTALLATION

Reverse *"Power Steering Gear Removal"* procedure paying particular attention to the following:

1. Tighten fasteners as recommended under paragraph 14: *"Torque Specifications"*.
2. Bleed air from the system as per step 3, next.

3. BLEEDING POWER STEERING HYDRAULIC SYSTEM

To bleed the power steering hydraulic system, refer to the *"ZF-SERVOCOM Repair Manual"* annexed to this section, under heading *"Setting And Functional Test"*.

4. HYDRAULIC PRESSURE TEST

Perform a pressure test as outlined in the *"ZF-SERVOCOM Repair Manual"* annexed to this section under heading *"Setting And Functional Test"*.

5. TROUBLESHOOTING

Perform troubleshooting of the steering gear as outlined in the *"ZF-SERVOCOM Repair Manual"*, the *"ZF-SERVOCOM Operating, Servicing /Maintenance and Inspection Instructions* and the *"TRW - Power Steering Pump Service Manual"* and the "TRW - Chart Your Way To Easy Steering" guide annexed to this section.

NOTE

For vehicles equipped with ZF-SERVOCOMTRONIC unit, refer to the supplement to the repair manual ZF-SERVOCOM.

6. POWER STEERING HYDRAULIC PUMP

6.1 DESCRIPTION

The power steering pump is a vane type, gear driven, hydraulic unit which supplies hydraulic pressure for the operation of the steering gear. The pump is mounted on the engine, on the crankshaft pulley's R.H. side.

6.2 REMOVAL AND INSTALLATION

The pump is accessible through the engine compartment rear door.

To remove the pump, proceed as follows:

1. Put an empty container directly below pump, then disconnect both the inlet and outlet hoses from the pump. Block fitting cavities to prevent fluid contamination.
2. Remove the two (2) mounting screws, then slowly pry out the pump.
3. Remove and discard gasket.

CAUTION

Inspect the drive coupling thoroughly, and replace if necessary (the drive coupling is a fiber component located between the engine and the pump).

For pump installation, reverse the removal procedure paying particular attention to the following:

> ⚠ **CAUTION** ⚠
>
> **Ensure that drive coupling is correctly positioned before reinstalling the pump.**

1. Install a new gasket (Prévost P/N 510488).
2. Bleed air from the system as per step 3, *"Bleeding Power Steering Hydraulic System"*.

6.3 MAINTENANCE

Refer to the *"ZF-SERVOCOM Repair Manual"* and the *"TRW - Power Steering Pump Service Manual"* annexed to this section.

7. STEERING WHEEL

7.1 REMOVAL

1. Set the battery master switch located in the R.H. side rear service compartment, or the engine compartment to the *"OFF"* position.
2. Using a tool, such as a small flat head screwdriver, pry off the air horn cap.
3. Loosen the small screw in center of cap and the other retaining the black wire, then disconnect the white terminal. Remove horn cap.
4. Loosen and remove the steering wheel nut.
5. Using a suitable puller, remove the steering wheel.

7.2 INSTALLATION

To install, reverse the removal procedure. Torque steering wheel nut to 35-45 lbf-ft (47-60 Nm).

8. STEERING COLUMN

8.1 REMOVAL

To disassemble the steering column from system, refer to Figure 5. The steering column has no lubrication points. The lower steering column U-joint is easily accessible through the front service compartment. The upper steering column U-joint and the steering slip joint are accessible from the front driver's area. To access these joints, proceed as follows:

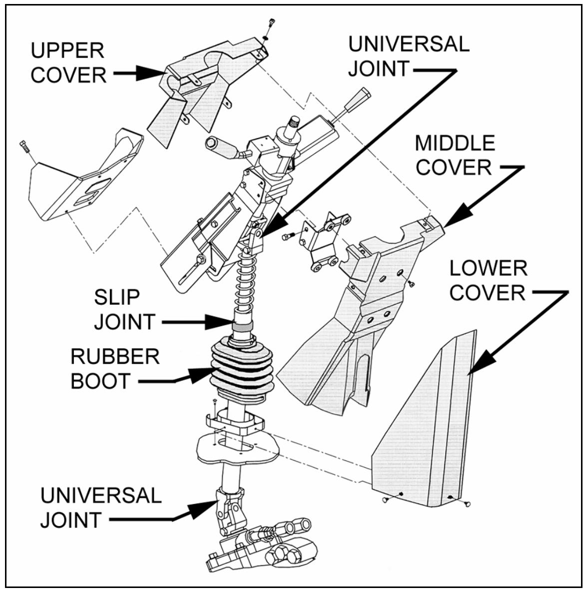


FIGURE 5: STEERING COLUMN 14040

1. From the front driver's compartment area, remove the three plastic fasteners on steering column lower cover. Remove the lower cover (Fig. 5).
2. Unscrew the four retaining screws on steering column middle cover.
3. Unscrew the four retaining screws fixing steering column upper cover to middle cover. Remove the steering column middle and upper covers.
4. Position the steering wheel in order to gain access to the joints.

9. TURNING ANGLE ADJUSTMENT

The maximum turning angle is set through two (2) steering stop screws installed on the axle center. Steering stop screws are factory adjusted to accommodate the chassis design, and therefore, do not require adjustment on new vehicles. However, these should be checked and adjusted if necessary, any time a steering system component is repaired, disassembled or adjusted. Refer to section 10 *"Front Axle"* under heading *‘’6.4 ‘’Turning Angle Adjusment".*

⚠ CAUTION ⚠

To prevent the steering damper from interfering with the adjustment of turning angles, make sure its fixing bracket is at correct location on the axle (refer to "12.2 Steering Stabilizer Cylinder (Damper)).

Hydraulic Stop

⚠ CAUTION ⚠

Reduce or shut off the power steering hydraulic pressure before the boss on the axle touches the stop screw. If not, the components of the front axle will be damaged (refer to* "ZF-SERVOCOM Repair Manual"** ***and "ZF-SERVOCOM Operating, Servicing/Maintenance and Inspection Instructions" annexed to this section, under heading **"Setting The Steering Limiter").**

⚠ CAUTION ⚠

Never maintain the relief pressure for more than 5 seconds, since damage to the power steering pump may occur.

10. STEERING LINKAGE ADJUSTMENT

The steering linkage includes the pitman arm, drag link, steering arm, tie rod arms and tie rod.

Perform lubrication according to *"DANA SPICER NDS Axles Lubrication and Maintenance"* annexed to section 10 *"Front Axle".*

Drag link ends are provided with grease fittings. Under normal conditions, these should be serviced every 6,250 miles (10 000 km). Refer to section 24 *"Lubrication".*

Steering linkage pivot points should be checked each time they are lubricated. Looseness can be visually detected while rotating the steering wheel in both directions. Replace defective parts.

⚠ CAUTION ⚠

Front wheel alignment should be checked and adjusted if necessary, any time a component of the steering system is repaired, disassembled or adjusted. Refer to section 10 **"Front Axle"** ***under heading*** **6. "Front Wheel Alignment".**

11. PITMAN ARM

11.1 REMOVAL

1. Remove cotter pin, nut and washers from drag link ball stud at pitman arm.
2. Disconnect drag link from pitman arm, using jaw style pullers (pressure screw type).

⚠ WARNING ⚠

Always wear approved eye protection when operating pullers.

⚠ CAUTION ⚠

Do not drive (hammer in) pitman arm on or off pitman shaft as this can damage the steering gear.

⚠ CAUTION ⚠

Heating of components to aid in disassembly is not allowed because it has a detrimental effect on axle components and steering linkages.

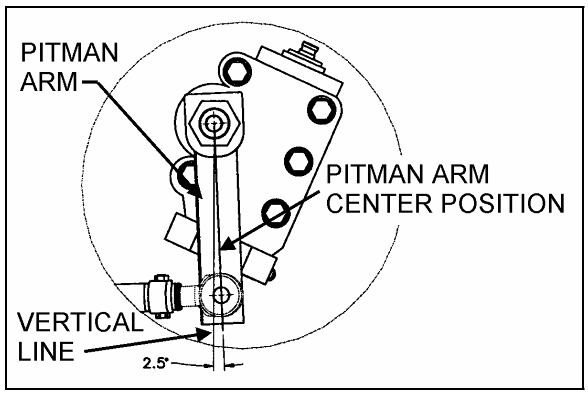


FIGURE 6: PITMAN ARM ADJUSTMENT 14037

3. Using a cold chisel, undo punch mark that locks fixing nut to the pitman arm.
4. Remove pitman arm fixing nut.
5. Check the radial position of the pitman arm in relation to the sector shaft prior to removal of pitman arm.
6. Add reference marks to the arm and shaft if necessary to ensure correct alignment at reassembly.
7. You must use a puller to remove pitman arm.

11.2 INSTALLATION

1. Position pitman arm on sector gear shaft with reference marks aligned.
2. Install fixing nut (Prévost #661050). Tighten nut to 470-570 lbf-ft (637-773 Nm).

NOTE
Use a new nut if the previously removed nut was punched.

3. Lock nut with sector shaft using a punch mark into the groove (Refer to figure 7).

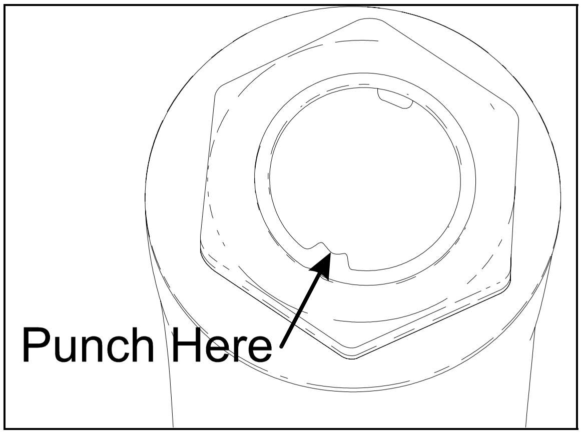


FIGURE 7: FIXING NUT PUNCH MARK 16098

4. Connect drag link to pitman arm while ensuring that rubber stabilizer is in place on the rod end. Install washers. Tighten nut to 160-215 lbf-ft (220-290 Nm). Afterwards, install a new cotter pin.

⚠ CAUTION ⚠
Input shaft marks must be aligned before adjusting pitman arm.

11.3 ADJUSTMENT

1. Disconnect the drag link from pitman arm. Center steering wheel by dividing the total number of steering wheel turns in two. Scribe a reference mark on steering gearbox at the center previously determined.
2. Using a protractor, check the angle of the pitman arm (refer to Fig. 6 for details).
3. The pitman arm should be adjusted to an angle of 2.5º in relation with the vertical axis (towards front of vehicle). If not, unscrew and remove fixing nut. Remove the pitman arm according to the procedure outlined under previous heading *"Pitman arm removal"*. Adjust to the proper angle.
4. When adjustment is achieved, replace fixing nut and torque to 400-450 lbf-ft (545-610 Nm).

11.4 TAG AXLE UNLOADING SWITCH ADJUSTMENT

1. Make sure vehicle wheels are straight and facing forward.
2. Line up switch lever with reference to the bracket center (Refer to figure 8).

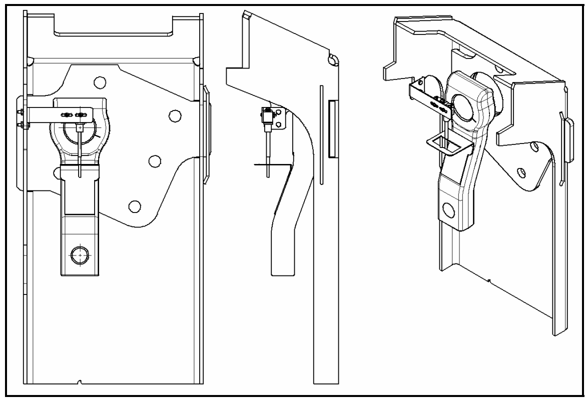


FIGURE 8: TAG AXLE UNLOADING SWITCH ADJUSTMENT 14061

12. MAINTENANCE

The power steering system requires little maintenance. However, the system should be kept clean to ensure maximum operating performance and troublefree service. Periodic inspections should also be made to check for leakage and all parts for damage or distortion. Insure all fasteners are tight (see *"14. Specifications"* for recommended tightening torques.

When the slightest evidence of dirt, sludge or water is discovered in the system, disconnect fluid lines at the power steering gear to drain the system. Drain and refill the system with *"Dexron-IIE or Dexron-III"* automatic transmission oil.

Air in the hydraulic system will cause spongy action and noisy operation. When a hose has been disconnected or when fluid has been lost for any reason, the system must be bled. Bleed system as outlined under heading 3*: "Bleeding Power Steering Hydraulic System".*

⚠ WARNING ⚠

Do not operate the pump without fluid in the power steering fluid reservoir.

If the steering linkage between the steering gear and the two front wheels is not properly adjusted, or if it is bent, twisted or worn, the steering of the vehicle will be seriously impaired. Whenever a steering linkage part is repaired, replaced or adjusted, steering geometry and front wheel alignment must be checked and necessary corrections made. Refer to section 10 *"Front Axle"* under heading 6: *"Front Wheel Alignment"*.

At regular lubrication intervals, the steering linkage should be thoroughly inspected for worn or loose components.

After the vehicle has been operated continually and high mileage figures have been reached, overhaul of the various steering units will be required. General overhaul procedure normally requires removal of the entire assembly, cleaning and inspection of all parts and final assembly. Careful inspection of all parts during overhaul is very important and must not be neglected.
Lubrication fittings must all be cleaned before applying lubricant. Moreover, always be sure the equipment used in applying lubricant is clean. Every precaution should be taken to prevent entry of dirt, grit, lint or other foreign matter into lubricant containers. Replace fittings that have become broken or damaged. Lubrication intervals, as well as the recommended lubricants for the steering components, are given in the *"Lubrication And Servicing Schedule"* in Section 24 of this manual. The intervals given in the schedule are recommended for normal service. More frequent intervals may be required under severe operating conditions.

12.1 POWER STEERING RESERVOIR AND FILTER

The power steering reservoir is located on R.H. side of engine compartment and accessible through the engine compartment doors. (Fig. 9).

12.1.1 Oil Level Check Procedure

1. Stop engine. Open engine compartment doors.
2. Unscrew and remove the dipstick located on top of reservoir and wipe with a clean rag.
3. Insert dipstick in reservoir. Remove it again to check fluid level (Fig. 10).
4. Adjust level to *"FULL"* mark using proper dipstick side depending on fluid temperature, use *"Dexron-IIE or Dexron-III"* automatic transmission oil.
5. Reinsert and tighten the dipstick.

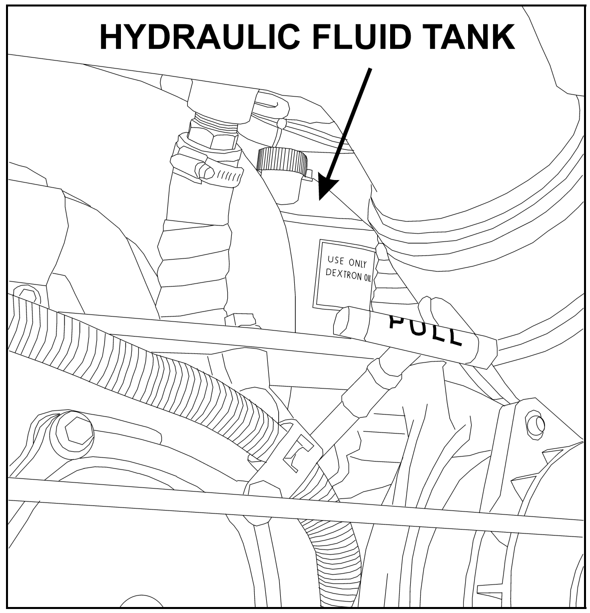


FIGURE 9: HYDRAULIC FLUID RESERVOIR LOCATION
14059

At regular intervals, fluid level should be checked in the reservoir and filter assembly. Furthermore, the oil filter cartridge element in the power steering reservoir should be replaced every 50,000 miles (80 000 km) or once a year, whichever comes first.

12.1.2 Filter Replacement

1. Unscrew and remove the cover nut located on top of the power steering reservoir.
2. Remove the reservoir cover and the gasket.
3. Remove the retaining spring and finally the filter cartridge element.

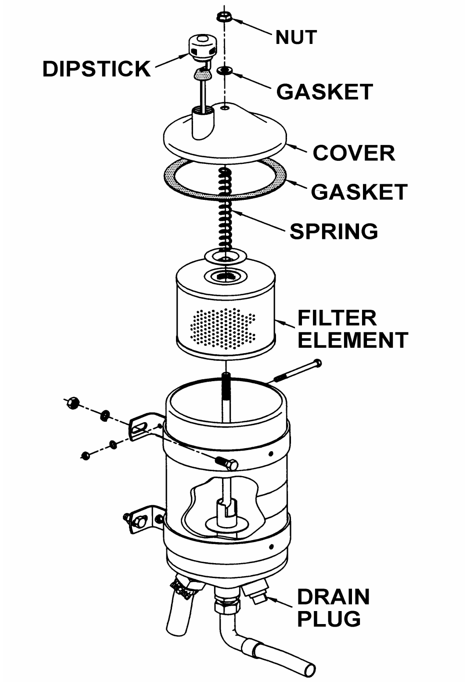


FIGURE 10: POWER STEERING FLUID RESERVOIR
14018A

12.2 STEERING STABILIZER CYLINDER (DAMPER)

The steering damper is located on R.H. side, at back of front axle (Fig. 11).

The cylinder is nonadjustable and non-repairable. Check for oil leaks or lack of resistance. Disconnect the cylinder from axle, then carefully attempt to extend and collapse it manually.

The rod end (ball joint) is provided with a grease fitting. Under normal conditions, it should be serviced every 6,250 miles (10 000 km) or twice a year, whichever comes first. Good quality lithium-base grease NLGI No. 1 and 2 are recommended (refer to section 24 *"Lubrication"*). Check the ball joint for wear, and replace if necessary.

12.3 DRAG LINK

Lubricate the fittings every 6,250 miles (10 000 km) or twice a year, whichever comes first. Good quality lithium-base grease NLGI No. 1 and 2 are recommended (refer to section 24 *"Lubrication"*).

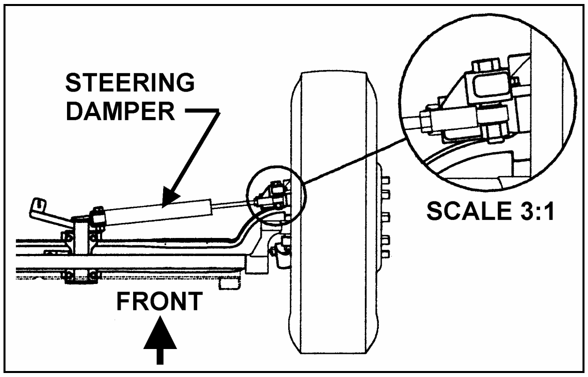


FIGURE 11: STEERING STABILIZER (DAMPER) 14042

12.4 POWER STEERING HYDRAULIC PUMP

For maintenance of the power steering hydraulic pump, refer to the *"TRW - Power Steering Pump Service Manual"* annexed to this section.

13. DRIVING TIPS

In order to maximize power steering pump service life, do not attempt to turn the steering wheel when the vehicle is stationary, and especially when service brakes are applied (wheel locking will oppose the effect of steering geometry which tends to make the front wheels rotate in opposite directions).

Persisting in turning, or maintaining the steering wheel with an extra effort, could make the hydraulic system work at the relief pressure, and consequently, cause the hydraulic fluid to become overheated.

⚠ CAUTION ⚠

Never maintain the hydraulic system at the relief pressure for longer than 5/10 seconds to avoid damaging the power steering pump.

NOTE

Unequal or low tire pressure, oversize tires, and vehicle overloading are some of the causes that may increase steering effort.

14. TORQUE SPECIFICATIONS

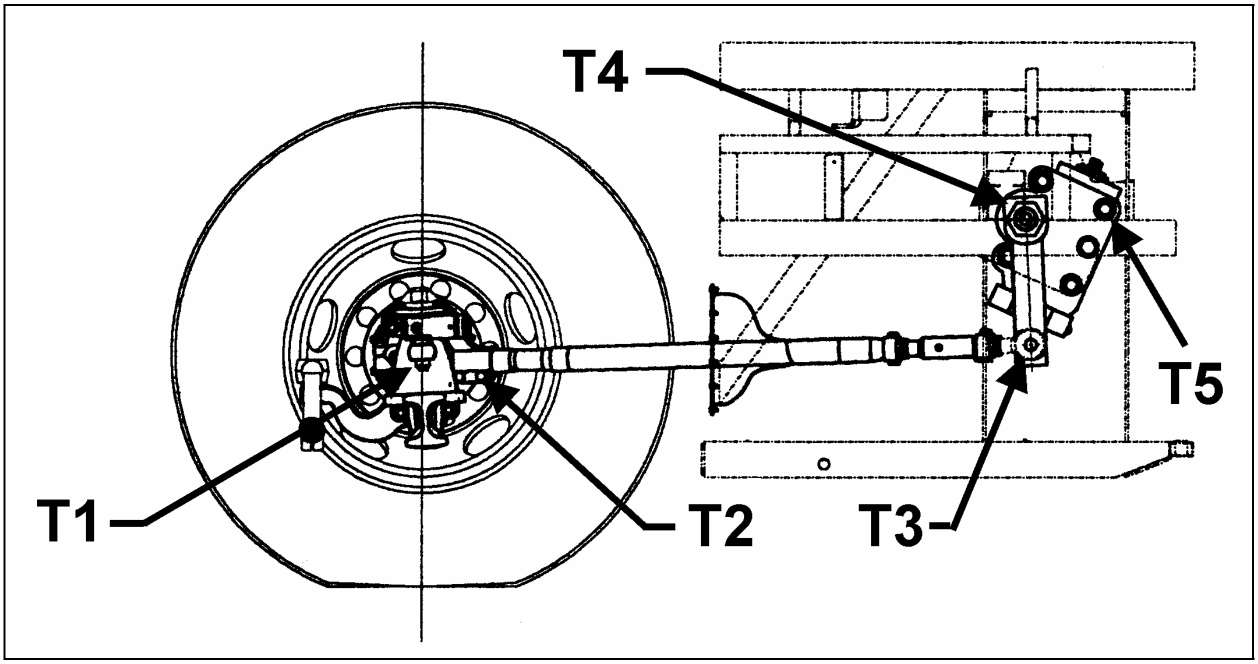


FIGURE 12: DRAG LINK COMPONENTS 14038

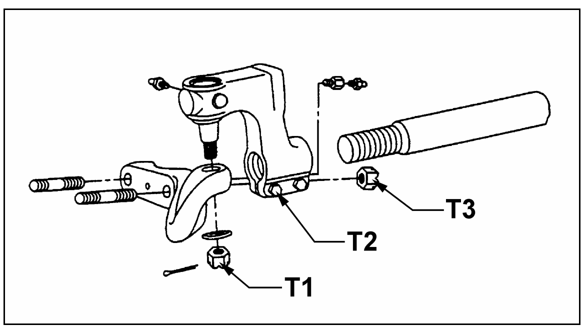


FIGURE 13: TIE ROD END 14036

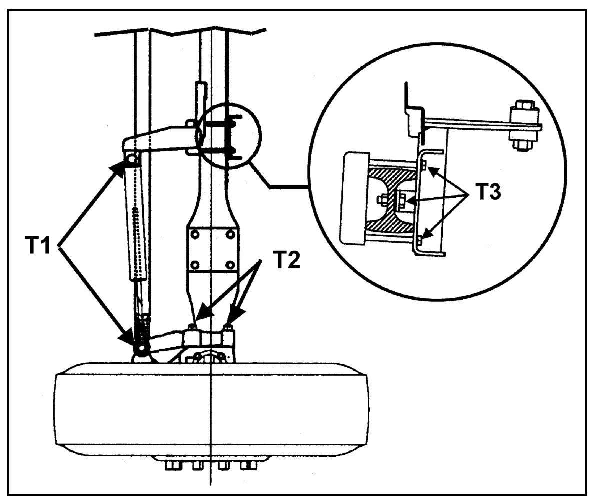


FIGURE 14: FRONT AXLE COMPONENTS 14045

DRY TORQUES			
Description	**Reference**	**Lbf-ft**	**Nm**
Drag Link End Stud Nut (on steering arm)	Fig. 12, T1	160-300	220-410
Drag Link End Pinch Bolt Nuts	Fig. 12, T2	50-65	70-90
Drag Link End Stud Nut (on pitman arm)	Fig. 12, T3	160-215	220-290
Pitman Arm Fixing Nut	Fig. 12, T4	470-570	637-773
Tie Rod End Screw Pin Nut	Fig. 13, T1	100-175	135-240
Tie Rod End Pinch bolt Nuts	Fig. 13, T2	65-75	90-100
Lower Lever Stud Nuts	Fig.13, T3	190-275	260-375
Steering Stabilizer (damper) Fixing Nuts	Fig. 14, T1	100-120	135-165
Steering Top Lever Nuts	Fig. 14, T2	150-200	205-275
Steering Damper Mounting Support Nuts	Fig. 14, T3	65-70	90-95

TORQUE (LUBRICATED WITH LOCTITE #242 BLUE)			
Description	**Reference**	**Lbf-ft**	**Nm**
Steering Gear Fixing Bolts (5)	Fig. 12, T5	265-310	360-420

15. SPECIFICATIONS

Power Steering Gear

Make .... ZF-SERVOCOMTRONIC
Model 8098
Supplier number 8098-988-571
Prevost number 661044
F.E.W. .... 16,600 lbs (7 545 kg)
Pressure rating .... 2,175 psi (150 Bar)
Gear ratio (center) .... 22.2 : 1
Gear ratio (extremities) .... 26.2 : 1
Minimum pump flow for 1.5 hwt/sec .... 4.22 gpm (16 lpm)

Power Steering Gear

Make	ZF-SERVOCOM
Model	8098
Supplier number	8098-988-570
Prevost number	661045
F.E.W.	16,600 lbs (7 545 kg)
Pressure rating	2,175 psi (150 Bar)
Gear ratio (center)	22.2 : 1
Gear ratio (extremities)	26.2 : 1
Minimum pump flow for 1.5 hwt/sec	4.22 gpm (16 lpm)

Power Steering Pump

Make	TRW
Type	PS Series
Relief valve setting	2,175 psi (14 990 kPa)
Controlled flow rate	4.23 gpm (16 lpm)
Inlet port	1 1/4 NPT
Outlet port	3/4-16 straight thread SAE O' ring boss conn.
Supplier number	PS251615L10200
Prevost number	661009
Gasket - Supplier number	23516100
Gasket - Prevost number	510488

Power Steering Reservoir

Make	Nelson Muffler
Oil capacity	4 US qts (3.7 liters)
Supplier number	91410A
Prevost number	660982
Make	Nelson Muffler
Element filter - Supplier number	83804 E
Element filter - Prevost number	660987

Steering Stabilizer Cylinder (Damper)

Make	Arvin
Extended length	32.73±0.12"
Collapsed length	20.26±0.12"
Stroke	12.47±0.12"
Supplier number	651535
Prevost number	660979
Dust cap - Prevost number	660980

CONTENTS

ILLUSTRATIONS

1 VEHICLE EXTERIOR VIEW

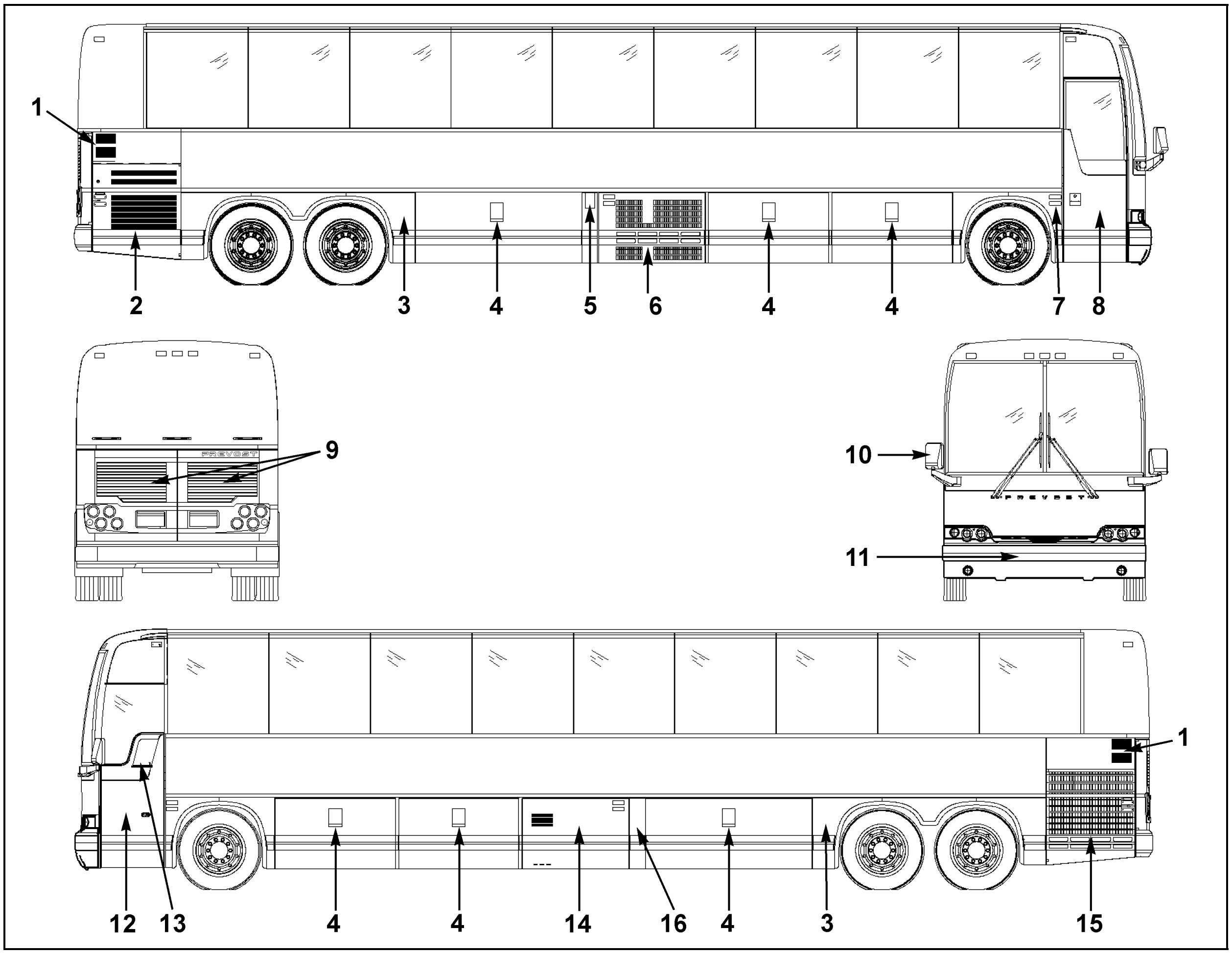


FIGURE 1: X3 COACHES EXTERIOR VIEW

1. Engine air intake
2. Engine compartment R.H. side door
3. Hinged rear fender
4. Baggage compartment
5. Fuel filler door
6. Condenser compartment
7. Entrance door control switch
8. Entrance door
9. Engine compartment rear doors
10. Rear-view mirror
11. Spare wheel compartment
12. Front electrical & service compartment
13. Driver's power window
14. Evaporator compartment
15. Radiator door
16. Rear electrical compartment

2 VEHICLE STRUCTURE

The body of the X3 vehicles is an integral structure made of 14, 16 and 18 gauge welded and braced high tensile steel and stainless steel members. All stainless exterior panels are glued to anti-corrosion coated members. The complete structure is protected against corrosion prior to assembly. The front and rear caps are made of molded fiberglass. The main roof is made of high tensile aluminum panels riveted to the roof structure. The floor is made of 2 layers of ½" (13 mm) thick plywood separated by a 1/8" (3 mm) insulation to reduce power train and road noises.

Welding

Since welding is a procedure that may be carried out either as specific instructions from Prévost or by an independent decision of the owner, the following information pertaining to welding should be read before beginning any welding procedure. The prohibitions and requirements outlined below must be followed during welding procedure:

1. Welding must be done only by a qualified and experienced person.
2. Adequate ground contacts and shields must be positioned as required to protect components from damage due to heat, contact by weld splatter, arcing, or other potentially damaging events associated with welding.
3. The following precautions are to be taken to protect the electronic control components. Refer to section 00, paragraph 3: “PRECAUTIONS TO BE OBSERVED BEFORE WELDING” in this manual.
4. Always wear the appropriate safety equipment.
5. Weld in clean and well ventilated area, and always have an appropriate fire extinguisher within your reach.

3 VEHICLE EXTERIOR MAINTENANCE

Regular washing to remove dust and dirt is recommended. See *"Operator's Manual"* for more details on washing and cleaning your vehicle.

3.1 CORROSION PREVENTION

Preventive maintenance is a key factor in avoiding corrosion and must be considered as part of the regular service intervals. The entire underside of the vehicle is sprayed with a heavy application of asphalt base undercoating.

The operating environment the vehicle is subjected to will largely influence the amount of dirt and corrosion that will accumulate over a given period. Corrosion is one of the most costly factors of part failure and shortened part life. It is, however, an item that can be controlled when it is conscientiously looked after and the proper steps are taken in a timely manner.

Certain areas of the coach are more vulnerable to corrosion than others, and it is these areas that should be addressed. For example, the rear baggage compartment bulkhead in the rear wheelhousing area contains many key components and should be examined regularly for corrosion. Other areas include the front wheelhousing area and the engine compartment.

Road splash will affect undercarriage, condenser coil and engine compartment. These areas must be thoroughly cleaned to remove dirt accumulations from flanges, channels and ledges. These places accumulate dirt and salt and hold it in direct contact with steel and aluminum surfaces. Use an understructure high pressure spray as part of a regular wash. Damaged undercoating or paint should be promptly repaired before corrosion can start.
Frequency of wash periods depends on operating conditions. During periods of exposure to salt, daily washing as described above is recommended. If underbody parts show evidence of rust or corrosion, treat as follows:

1. Remove dirt, grease and oil by solvent washing.
2. Remove corrosion as well as all loose coating by cleaning with a wire brush or sandblasting.

⚠ CAUTION ⚠
Sandblasting can be used for cleaning bulkheads, brackets and other structural members. It should not be used for exterior side paneling. Extreme care should be taken not to sandblast excessively.

3. Apply correct primer, paint and undercoating after removing all corrosion to prevent further damage.

3.2 PREVENTIVE MAINTENANCE SCHEDULE

NOTE
TECTYL 185 GW rust inhibitor may have been applied on your vehicle underbody as an option, if this is the case, follow this procedure thoroughly. For future application of product, refer to paragraph 3.3 in this section.

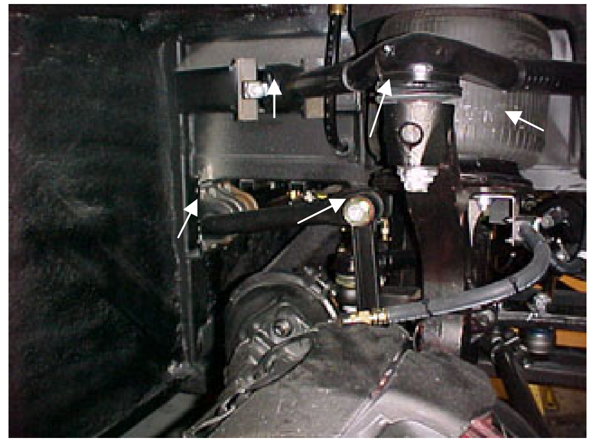
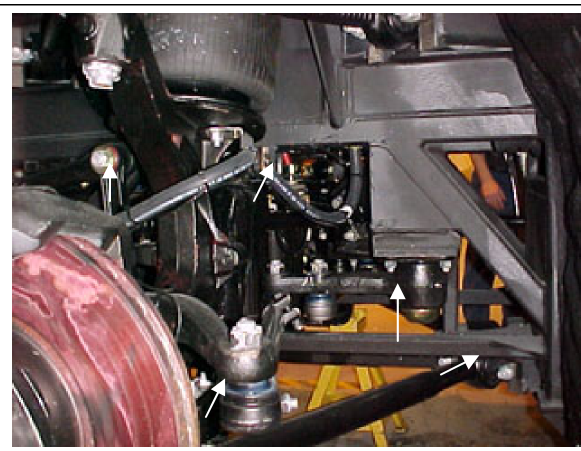
DESCRIPTION	INTERVALS		MAINTENANCE	CORRECTIVE ACTION	REFERENCE
	MONTHS	KM MILES			
BODY, EXTERNAL WINDOW FRAME	6	40 000 25 000	VISUALLY INSPECT SEALING BEADS CONDITION	REPAIR OR REPLACE SEALING BEADS IF NECESSARY	
VEHICLE UNDERBODY	12	100 000 60 000	USE A LOW PRESSURE SPRAY TO CLEAN UNDER-STRUCTURE AND VISUALLY INSPECT FOR CALCIUM DEPOSIT, CORROSION OR ANY DIRT ACCUMULATED ONTO EXPOSED SURFACES. VISUALLY INSPECT SEALING BEADS CONDITION.	APPLY UNDERCOATING LOCALLY AS NECESSARY.	
			VISUALLY INSPECT IF UNDERFLOOR IS PEALING. VISUALLY INSPECT WHEELHOUSING COATING.	APPLY UNDERCOATING LOCALLY AS NECESSARY	
			MAKE SURE DISCHARGE TUBES ARE FREE FROM OBSTRUCTIONS	REMOVE ANY OBSTRUCTION OR REPLACE DEFECTIVE TUBE	
SUSPENSION AND UNDERSTRUCTURE	12	100 000 60 000	VERIFY THE CONDITION OF ALL SUSPENSION AND UNDERSTRUCTURE FASTENERS AND CLAMPS	TIGHTEN OR REPLACE DEFECTIVE OR MISSING FASTENERS	
FLOOR COVERING	3	20 000 12 500	VISUALLY INSPECT IF FLOOR COVERING IS SHOWING SIGNS OF DETERIORATION SUCH AS CUTS, BURNS, ETC. ALSO, VISUALLY INSPECT SEALANT ALONGSIDE TRACKS. INSPECT WALL PANELS FROM BOTTOM TO WINDOWS	REPAIR OR REPLACE DEFECTIVE COVERING. MAKE SURE PROPER SEALANT IS USED.	
FLOOR CLEANING			CLEAN FLOOR COVERING AS NECESSARY		

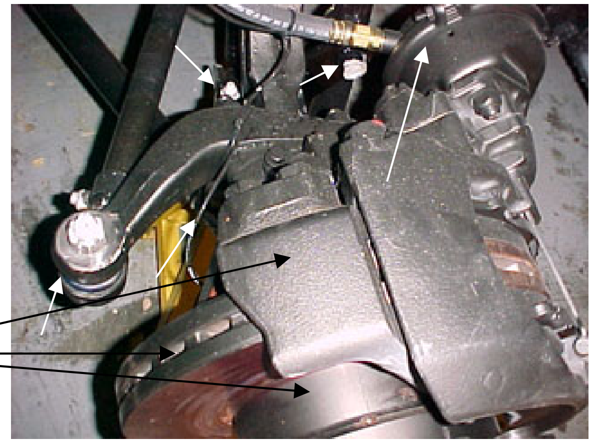
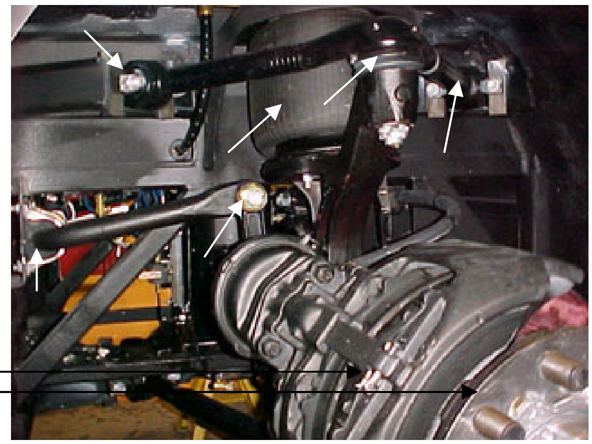
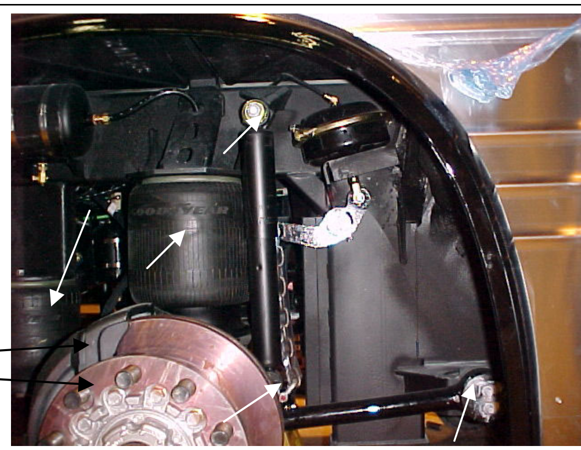
⚠ WARNING ⚠
Failure to follow this preventive maintenance schedule will result in warranty void.

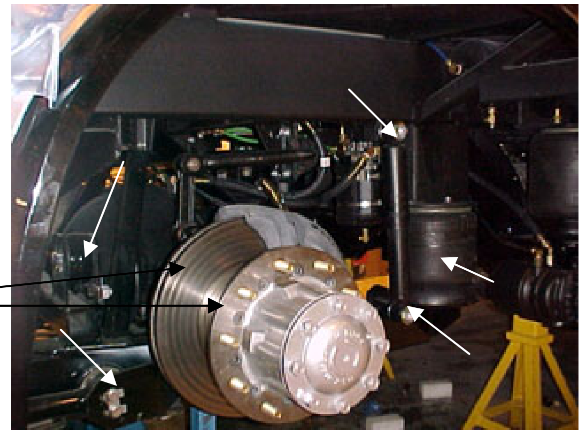
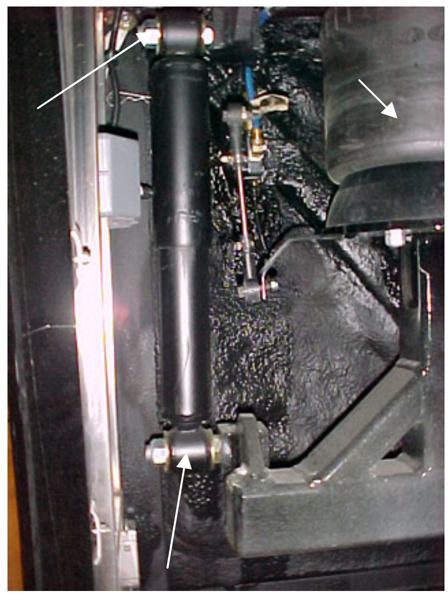
3.3 RUST INHIBITOR APPLICATION

Material: Tectyl 185 GW
R1KG21

Safety Rules: Use safety glasses
Supplied air hood
Solvent-resistant rubber gloves

1.0 Wash both wheelhousing mechanical parts before masking.	A water-hose nozzle is recommended. Water may be hot to reduce washing time especially during winter. If parts are soiled with oil, clean using R1KG21. Avoid rubber parts.
2.0 Dry all water sprayed parts. Surface temperature and dew point must be respected before applying rust inhibitor.	Air pressure system may be used, refer to annex 1 for surface temperature and dew point.
3.0 **Front wheelhousing** a) Mask all rubber joints. Braking system must also be protected (refer to arrows). Commercial aluminum foil may be used for masking.	
3.1 **Front wheelhousing** Front view	
3.2 **Front wheelhousing**	

3.3 **Front wheelhousing** (Entire braking system)	
4.0 **Rear wheelhousing** a) Mask all rubber joints. Braking system must also be protected (refer to arrows). Commercial aluminum foil may be used for masking (Entire braking system)	
4.1 **Rear wheelhousing** (Entire braking system)	

4.2 **Rear wheelhousing** (Entire braking system)	
4.3 **Rear wheelhousing**	
5.0 Close off wheelhousing using masking paper.	Prevent rust inhibitor from coming in contact with paint. To close off wheelhousing, a polythene sheet may be used.
6.0 Apply TECTYL 185 GW black rust inhibitor onto wheelhousing mechanical parts.	A spray gun and pumping system are required to apply the rust inhibitor. If the application is done inside a paint room, select high speed ventilation. **Minimum required thickness is 10 mils wet or 5 mils dry**.
7.0 Remove all masking material 30 minutes after application.	

ANNEX 1

1. Check and confirm that dew point and surface temperature are in accordance with to the following criteria:

   Surface temperature > 10°C

   Surface temperature > or = to dew point + 3°C

NOTE
Use the following table to determine dew point.

2. Check and confirm that TECTYL temperature is between 10°C and 35°C.

DEW POINT

	Relative Humidity (%)										
	10	20	30	40	50	60	70	80	90	100	
Temp (c)											
0	---	-16	-11	-8	-5	-3	-1	0	1	3	
1	---	-15	-10	-7	-5	-3	-1	1	2	4	
2	---	-14	-10	-6	-4	-1	0	2	3	5	
3	---	-13	-9	-5	-3	-1	1	2	4	6	
4	---	-13	-8	-5	-2	0	2	4	5	7	
5	---	-11	-7	-4	-1	1	3	5	6	8	
6	---	-11	-8	-3	0	2	4	6	7	9	
7	-18	-10	-6	-2	0	2	5	6	8	10	
8	-17	-9	-5	-1	1	4	6	7	9	11	
9	-16	-9	-4	-1	2	4	6	9	10	12	
10	-16	-8	-3	0	3	5	7	10	11	13	
11	-15	-7	-3	1	4	6	9	10	12	14	
12	-14	-6	-1	2	5	7	10	11	13	15	
13	-14	-6	-1	2	6	8	10	12	14	16	
14	-13	-5	0	4	6	9	11	14	15	17	
15	-12	-4	1	4	7	10	12	14	16	18	
16	-11	-4	1	5	9	11	13	15	17	19	
17	-10	-3	2	6	9	12	14	16	18	20	
18	-10	-2	3	7	10	13	15	17	19	21	
19	-9	-1	4	8	11	14	16	18	20	22	
20	-9	0		5	9	12	15	17	19	21	23
21	-8	0		5	10	13	16	18	20	22	24
22	-7	1		6	11	14	16	19	21	23	25
23	-6	2		7	11	15	17	20	22	24	26
24	-6	2		8	12	16	19	21	23	25	27
25	-5	3		9	13	16	20	22	24	26	28
26	-4	4		10	14	17	20	23	25	27	29
27	-4	5		11	15	19	21	24	26	28	30
28	-3	6		11	16	19	22	25	27	29	31
29	-2	6		12	17	20	23	26	28	30	32
30	-1	7		13	17	21	24	27	29	31	33
31	-1	8		14	19	22	25	27	30	32	34
32	0	9		15	20	23	26	29	31	33	35

4 COMMON FIBERGLASS REPAIR PROCEDURE

All repairs to fiberglass parts consist of filling the damaged area with fiberglass cloth and resin or strand fiberglass and resin. The repair is allowed to harden, and then finishing operations may be performed. Use of the various materials is determined by the type of repair to be made. Large holes, torn sections and separate joints require the adhesive qualities of the resin and the reinforcing qualities of the fiberglass. Small dents, scratches or pits can be repaired using resin and strand fiberglass and filler mixed into paste. Instructions for either mix are explained under their respective headings in this section. For best results when making repairs, temperature should be between 70 and 75°F (21-24°C). Some people experience a skin reaction to resins. In such cases, wipe resin off with denatured alcohol or a good thinner. Use of protective hand cream is recommended.

⚠ WARNING ⚠
Always wear a respirator and goggles when grinding or sanding.

Extreme care must be taken if the sander is electrically operated, as dust from some resins is combustible when subjected to sparks or open flames. The proper tool for sanding resin is a low speed, air driven disc sander with a water attachment or a dry sander having a vacuum bag. Either will eliminate flying glass and resin dust.

The following additional tools and materials will assist in making repairs: hacksaw blade, assorted files, emery paper or cloth (150 or finer), scissors or tin snips, wax paper or cellophane sheets, a 3" (75 mm) paint roller, paint brush, putty knife, acetone and one or more heat lamps.

4.1 REPAIR USING FIBERGLASS CLOTH

Where necessary, sand paint away around damaged area and scrape away undercoating, if any, and wipe clean with solvent. Grind or file the damaged area to form a "V" at the broken or cracked portion. Sides of "V" should have a shallow pitch for maximum bonding area.

NOTE
Roughening the surface improves adhesion of resin.

If part is warped from original shape, use clamping equipment to straighten the surface. Preheat area to be repaired with one or two heat lamps placed 18 to 24 inches (450-610 mm) from repair.

⚠ CAUTION ⚠
Temperature should not exceed 140 °F (60 °C) during 30 minutes in order to avoid distortion.

Cut fiberglass cloth with scissors or tin snips, 1 to 3 inches (25-75 mm) larger than area to be repaired. Build area to desired height.

Mix resin and hardener following instructions on their containers. Saturate layers of fiberglass with mixture and place laminates over damaged area. Smooth out wrinkles and make sure general contour of area is maintained. Bubbles and wrinkles can be eliminated with a roller.

⚠ CAUTION ⚠
The pot life of the mix is approximately 15 minutes. Any accidental contamination to the skin, clothing, tools, etc. must be removed within this period. Use acetone to remove uncured resin.

Heat resin material again by placing heat lamps 18 to 24 inches (450-610 mm) from repaired area. Allow 12 to 15 minutes for repair to cure. After repair is cured, grind, file or sand to contour. Files other than body files may be more suitable. Featheredge and finish sanding.

If small pits or irregularities appear after making repair, correct by using a liberal amount of chopped strand or filler mixed with resin to form a paste. Refer to heading *"Repair using Fiberglass Paste"* in this section.

4.2 REPAIR USING FIBERGLASS PASTE

Fiberglass paste is used for repairing small dents, scratches, and pits. Paste is made by mixing resin, hardener and fiberglass strand or filler to the consistency of putty. Where it may be necessary, sand paint away around damaged area. On underside of coach, scrape away undercoating from damaged area, and wipe clean with solvent.

Preheat the area to be repaired using heat lamps. Mix desired quantities of resin and hardener according to manufacturer's instructions. Add powdered fiberglass strand into mixture to thicken it into a putty state.

NOTE
If repair is made on a vertical surface, adding powdered filler material to mixture will reduce tendency of hot resin to flow or run.

Apply the material with a putty knife or similar object, building material up to the desired contour. For deep filling and on vertical surfaces, several layers of material may be used.

A hacksaw blade, held flat to adjacent contour and then moved in a sawing action across the repair when the resin is in a gel state, will remove excess resin from repair. Finish repair with the same procedure as when using fiberglass cloth.

4.3 TYPICAL FIBERGLASS REPAIR PROCEDURE

Remove all loose particles or damaged material using a power sander or rasp. Clean area, overlapping hole approximately 1" to 1-½" (25-40 mm) all around. Remove all dirt, grease and paint from area to ensure good bonding surface. Feather the cleaned area all around (Fig. 2).

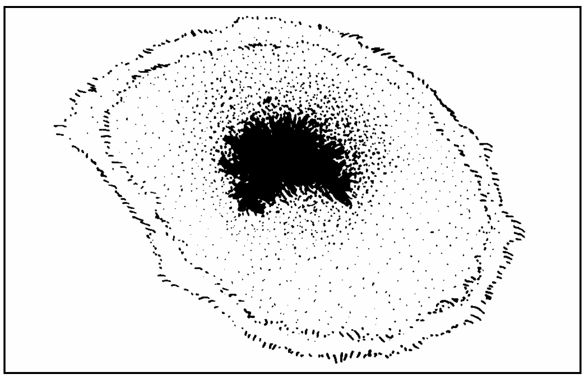


FIGURE 2: FIBERGLASS REPAIR 18089

Cut a piece of fiberglass mat slightly larger than area being repaired. Impregnate mat with general purpose polyester resin catalyzed normally. Use a clean paint brush to apply the polyester resin. Apply impregnated mat over hole and press onto surface with brush to obtain good adherence. Another coat of general purpose polyester resin can be applied at this time (Fig. 3).

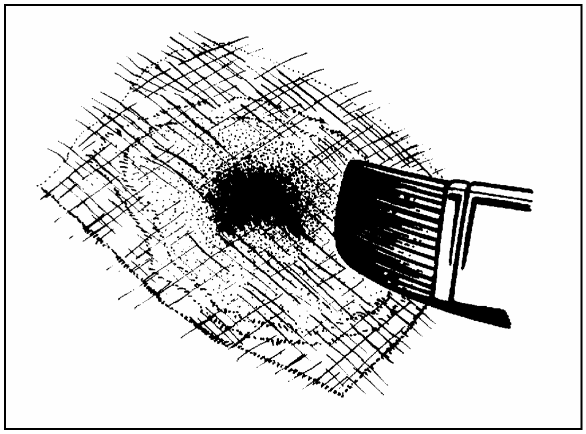


FIGURE 3: FIBERGLASS REPAIR 18090

NOTE
Remove all air between surfaces being joined. Allow area to harden and sand surface to remove any wax.

Apply another mat, followed by a cloth patch, and another mat. All layers must be thoroughly impregnated with polyester resin, brushed well and free of air. Apply more layers of mat and cloth as required until the desired strength and thickness is obtained, minimum two 1-½ oz (43 g) mats and one 9 oz (255 g) cloth (Fig. 4).

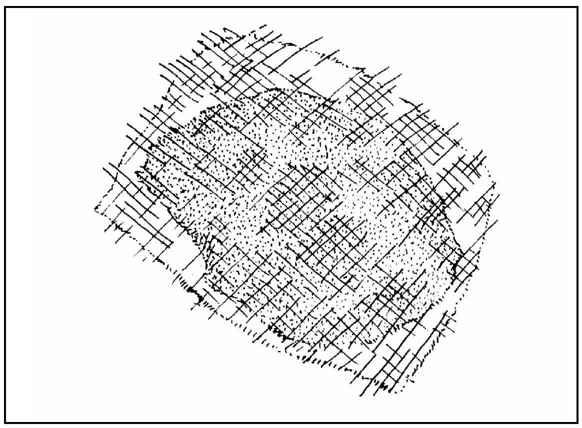


FIGURE 4: FIBERGLASS REPAIR 18091

Allow area to harden and contour the area with coarse sandpaper #100 (Fig. 5).

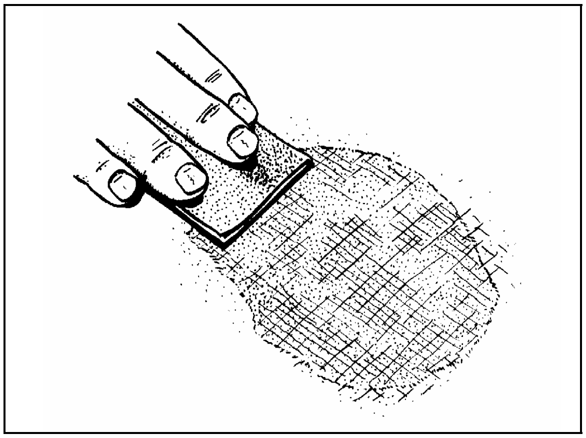


FIGURE 5: FIBERGLASS REPAIR 18092

Cover the area with a layer of resin putty and allow drying for approximately 15 to 20 minutes (Fig. 6).

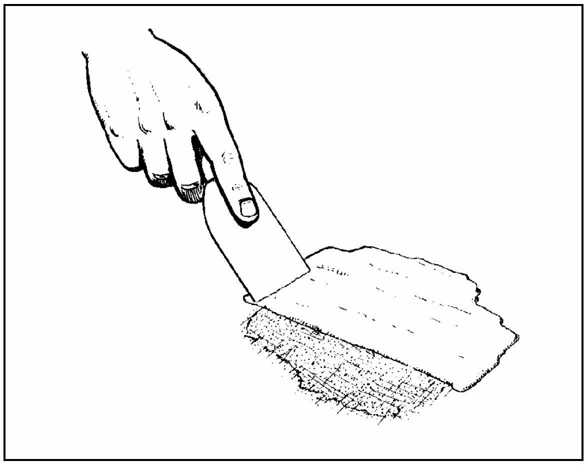


FIGURE 6: FIBERGLASS REPAIR 18093

Smooth off surface with coarse sandpaper #100 to desired shape. Further smooth surface with fine sandpaper #120 until repaired surface matches surrounding area paneling. Prime and paint the area to match surrounding paintwork.

5 COMMON PAINTING PROCEDURE

5.1 NEW PAINT CARE

Our paint supplier recommends that you follow these simple precautions the first months of your new vehicle's life.

⚠ CAUTION ⚠
Apply these recommendations after repainting vehicle.

During the first 30 days:

- Do not use a commercial bus wash. Stiff brushes or sponges could mar the finish and damage the surface. Wash the vehicle by hand only and with cool water and a very mild bus wash solution. Be careful to use only a soft cloth or sponge;
- Wash vehicle in the shade, never in direct sunlight;
- Do not "dry wipe" vehicle –always use clean water. Dry wiping could scratch the finish;
- Avoid extreme heat and cold. Park vehicle in the shade whenever possible;
- Do not park under trees which drop sap or near factories with heavy smoke fallout. Tree sap and industrial fallout may mar or spot a freshly painted surface;
- Trees are also likely to attract birds. Bird droppings are highly acidic and will damage a freshly painted surface. Bird droppings, tree sap and industrial fallout should be washed off as soon as possible;
- Do not spill oil, gasoline, antifreeze, transmission fluid or windshield solvent on new finish. IMMEDIATELY rinse off any such spill with clean water, DO NOT WIPE;
- Do not drive on gravel roads. Paint finish easily chips during the first 30 days;
- Do not scrape ice or snow from the surface. A snow scraper can act like a paint scraper if the finish is new. Brush off loose material with a soft snow brush.

During the first 90 days:

- Do not wax or polish the vehicle. This will allow the finish to dry and harden completely.

5.2 PAINT TOUCHUP

When paint touchup or partial repainting is necessary, refer to the vehicle's paint scheme for color codes and paint brand.

Prévost recommends using the original paint brand to ease color matching.

In the event you sand through to the gelcoat surface you should prime the area with Standox "Non Stop Fill Primer (ST-11000)".

If you sand through to metal surface, first prime with Standox “Etch Primer (ST-11858)” then with Standox “Non Stop Fill Primer (ST-11000)”.

⚠ CAUTION ⚠
Be sure to heed all paint manufacturer’s recommendations, especially concerning paint dilution and application.

5.3 PAINTING

The standard paint used on the exterior of the vehicle is Standox Basislack. It is a high gloss polyurethane enamel finish designed for exposure to extreme conditions. Other types of paint may be called for as options by owner but are not dealt with in this section.

5.3.1 Safety

Care should be exercised in storing, handling, mixing, and applying paint and chemicals listed in this manual. The topcoat, primer, solvent, catalysts, accelerators, and cleaners are highly volatile and/or toxic if not properly used. Observe all safety instructions marked on the different packaging, as well as the following:

1. Do not smoke in the paint room or in adjacent area exposed to residue fumes.
2. Wear respirators approved by the governing safety and health regulations.
3. Maintain adequate ventilation at all times.
4. Dispose of any leftover paint mix properly.
5. Wear rubber gloves, rubber apron, and face shield during all phases of paint and chemical handling.

5.3.2 Surface Preparation And Paint Application

	Aluminum and / or Stainless Steel	Fiberglass	Comments
Surface Preparation	Sand using P-150 grit sandpaper. It is recommended to sandblast rivets and panel edges with OLIMAG 35-70 blast media.	Sand using P-180 or P-240 sandpaper.	Do not use paint remover over aluminum or fiberglass.
Cleaning	STANDOX silicone remover ST-11654 (68-2989)		
Priming	STANDOX Reactive Etch Primer ST-13908 * Wait 30 minutes then apply STANDOX Non-Stop Füllprimer ST-11000 (68-2973)	STANDOX Non-Stop Füllprimer ST-11000 (68-2973)	Refer to product Technical Data sheet for proper mixing
Basecoat	Refer to paint scheme or coach record for proper color code and paint brand. We recommend using the same paint brand to ease color matching.		Refer to product Technical Data sheet for proper mixing
Clearcoat	STANDOX 2K MS Rapid Clear ST-11760 (68-2979) Allow 16 hours for drying		Refer to product Technical Data sheet for proper mixing

If assistance or technical information on STANDOX products is needed, please dial: 1 (800) 551-9296

6 GENERAL DESCRIPTION

The following procedures explain the steps to be followed for proper repair, installation and replacement for various doors, panels and windows. The paragraph divides the vehicle into zones to facilitate the search; each zone is then sub-divided into components.

Refer to the appropriate zone then component for complete procedure.

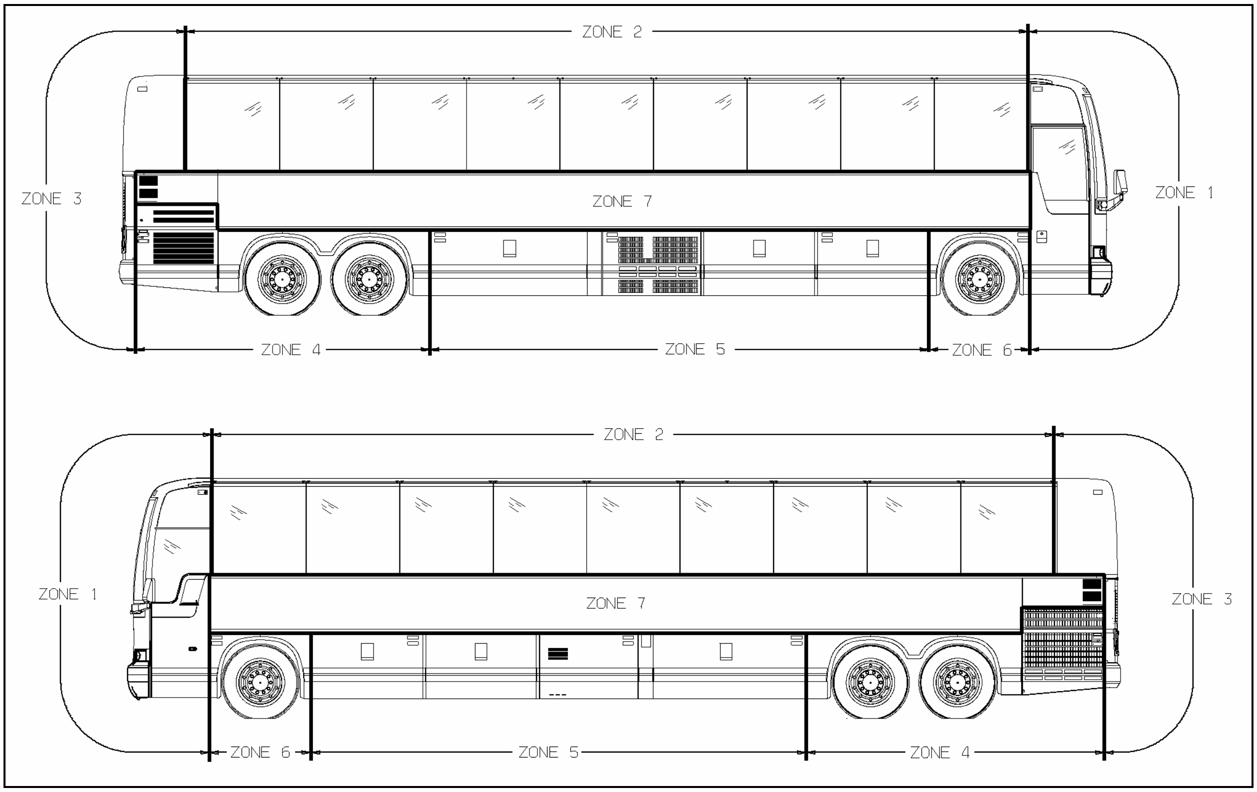


FIGURE 7: X3 COACHES ZONING 18623

7 ZONE 1

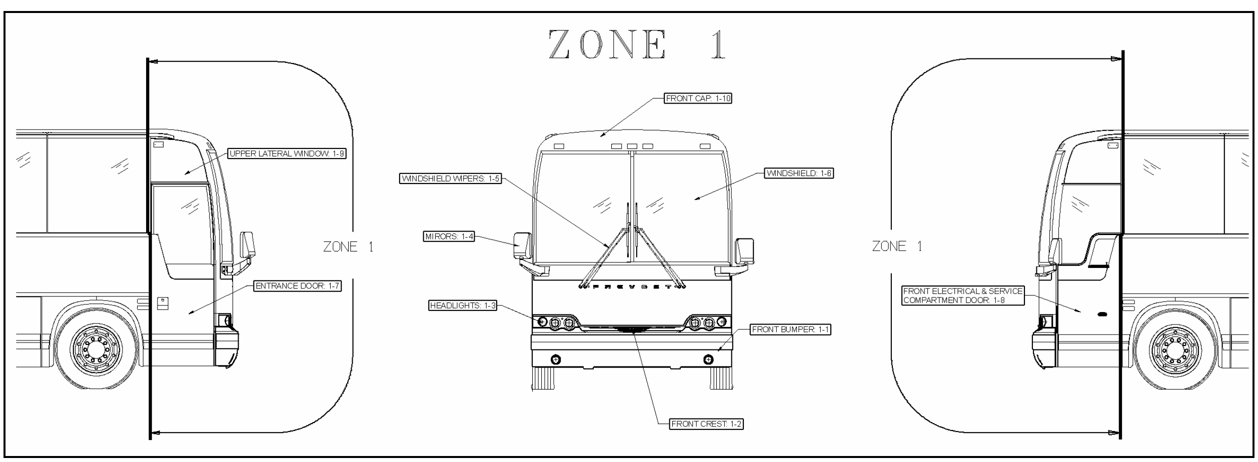


FIGURE 8: ZONE 1 18624

7.1 FRONT BUMPER

The front bumper is hinged to give access to the spare wheel and tire compartment. Pull the handle located in the front service compartment to open the spare wheel and tire compartment. Bumper must first be tilted down before its removal. Two people are required to remove and install the front bumper. Safely support the bumper and remove the two bolts on each bumper side to separate the bumper from the spare wheel compartment door. To install bumper, reverse the removal procedure.

WARNING
Front bumper is heavy. Use proper lifting equipment to support the bumper during the removal and installation operations to avoid personal injury.

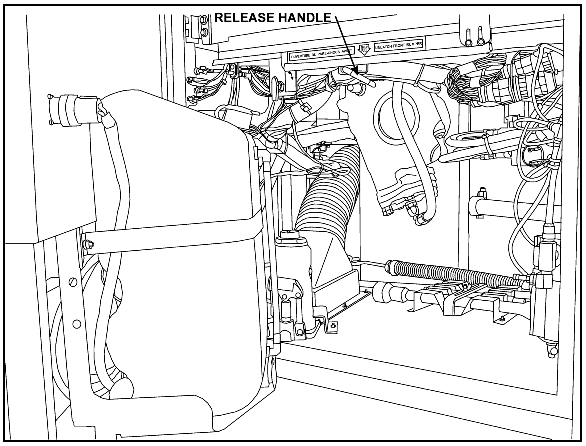


FIGURE 9: FRONT BUMPER RELEASE HANDLE 18613

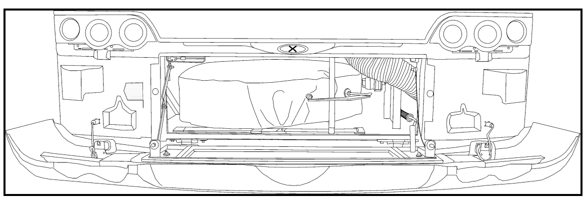


FIGURE 10: FRONT BUMPER 18614

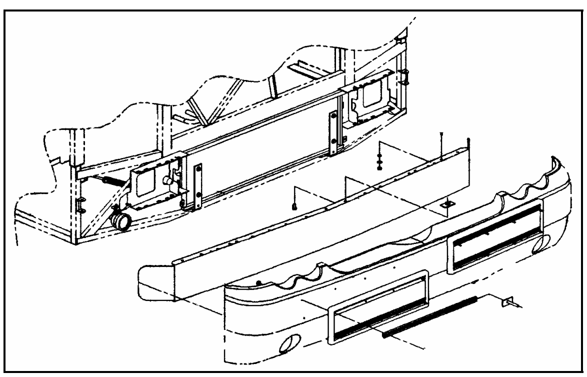
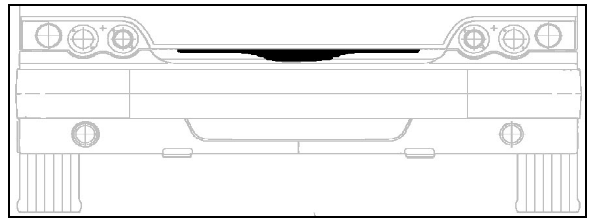


FIGURE 11: FRONT BUMPER REMOVAL 18565

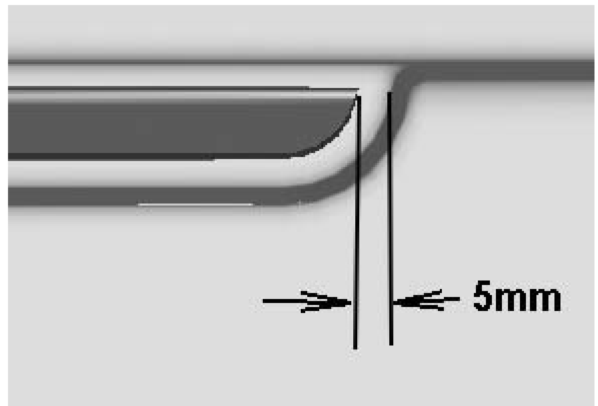
7.2 FRONT CREST

- Use a Chix cloth and anti-silicone to clean the surface where the crest will be applied.

CAUTION
Do not exceed the crest dedicated surface.



- Peel the back from the self adhesive crest side pieces.



- Peel the back from the self adhesive crest center piece. Center crest and apply.
- Compress the crest three pieces using your hands.

7.3 HEADLIGHTS

Refer to Paragraph 9.1 Headlights, included in Section 06: Electrical of the Maintenance Manual for complete information on headlights.

7.4 REAR VIEW MIRRORS (RAMCO)

Your vehicle is equipped with two exterior mirrors.

The mirrors may be equipped with an optional electric heating system which serves to minimize ice and condensation on the mirror glass in extreme weather conditions. Integral thermostats are installed in both mirrors to avoid continuous heating. Use the appropriate switch on the dashboard to activate the defroster system on both mirrors simultaneously. The mirrors can easily be adjusted by using the remote controls located on the L.H. side control panel. The mirrors have easy to replace glass in case of breakage. Remote control motors can also be replaced.

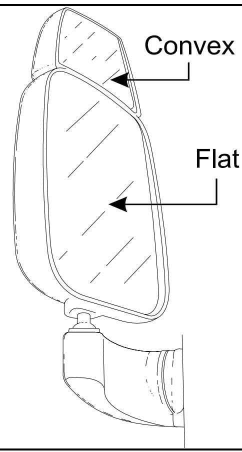


FIGURE 12: REAR VIEW MIRROR (RAMCO) 18398A

7.4.1 Adjustment

At the base of the mirror arm, loosen the mounting bolt to swing arm in or out.
To pivot the mirror head, loosen the setscrews on each side of the ball stub at the base of the mirror head to facilitate the adjustment.

7.4.2 Disassembly

At end of mirror arm, loosen the setscrews to relieve tension on the ball stem. Remove the ball stem from the arm.
Remove the four screws fastening the mirror arm base to the coach.

7.4.3 Assembly

Mount the mirror arm base to the coach. Insert the ball stem into the mirror arm and tighten the socket setscrews.

NOTE
Position the ball cup halves so the joint between them lies on the centerline of the arm. Ensure that the setscrews are not on the joint between the cup halves.

7.4.4 Replacement of Mirror Glass

Remove the broken glass.

Position new glass in mirror head and press to lock the Velcro in place.

7.4.5 Heated / Remote Controlled Rear View Mirrors

Heated/remote controlled external rear view mirrors may be provided to prevent the mirrors from frosting up in cold weather.

The remote controlled external rear view mirrors attach to support arms using a pivot collar secured by setscrews. Loosening the setscrews allows the whole head assembly to turn on the support arm for initial adjustment. A mounting bolt and washer hold the arm support to the mounting bracket. The arm support can be moved to position the mirror head into or away from the coach body.

The mirror heat switch is located to the left of the driver on the dashboard. This switch must be activated before the mirror heating element will energize. Once energized, the mirror heating element is kept at a sustained temperature (between 60-80°F) by a thermostat. Refer to wiring diagram annexed in the technical publication box.

⚠ CAUTION ⚠
Do not attach stick-on type convex mirror accessories to the heated mirror glass. This could impede uniform heat distribution on the mirror surface which could break the mirror.

Mirror Control

The remote control pointer knob(s) for the mirrors is (are) mounted on the L.H. side control panel. The harness to the mirror head runs through the arm support. The remote motor is mounted to the mirror head behind the mirror glass.

Turn pointer knob to the left for mirror head adjustments and to the right for convex mirror adjustment, then push down on either of the button's (4) sides to adjust the selected mirror viewing angle.

Disassembly

At end of mirror arm, loosen the setscrews to relieve tension on the ball stud. Remove the ball stud. Remove the ball stud from the arm and gently pull the harness out until the connector is exposed.

Remove the four screws fastening the mirror arm base to the coach. Slide the harness free of the mirror arm base.

Assembly

Attach a stiff wire (snake) to the end of the harness and insert the wire through the mirror arm base and arm, gently pull the harness through the arm and disconnect the "snake".
Connect the mirror head harness. Insert the harness connector back into the mirror arm.
Insert the ball stud into the mirror arm and tighten the socket setscrews.

NOTE
Position the ball cup halves so the joint between them lies on the centerline of the arm. Ensure that the setscrews are not on the joint between the cup halves.

Convex & Flat Mirror Removal

The mirror glass assembly is mounted to the control mechanism or to mirror base with Velcro strips. Remove the mirror glass by gently pulling the lens to release the Velcro. Disconnect the heater grid at the two connectors.
Connect the connectors of the new mirror's grid to the harness. Install the lens by positioning the lens in the mirror frame and pressing to lock the Velcro in place.

7.5 WINDSHIELD WIPERS

Refer to Paragraph 23.8 Windshield Wipers and Washers, included in Section 23: Accessories of the Maintenance Manual for complete information on windshield wipers.

7.6 WINDSHIELD

For the removal or installation of windshield, you will need:

A rope,

A plastic spatula to lift the rubber seal lip,

A metal rod or screwdriver to clean the seal groove,

A filler insertion tool,

Goggles and protective gloves.

- From inside of vehicle, remove center post and interior finishing panels surrounding the windshield. In this case, we are replacing the R.H. side windshield.
- From outside of vehicle, remove filler located inside rubber seal to ease damaged windshield removal.
- From inside of vehicle, push against the top L.H. side corner of windshield for the removal of a R.H. side windshield. If the L.H. side windshield had to be removed, you would have to push against the top R. H. side corner.

NOTE
We are referring to the L.H and R.H. side as viewed from the inside of the vehicle.

- At the same time, another person gradually lifts the rubber lip from the vehicle exterior using a plastic spatula from top to bottom.
- Remove the entire damaged windshield and broken glass if applicable.
- If applicable, using a screwdriver or metal rod, remove black butyl sealant residue from rubber seal then clean with Sika 205.

7.6.1 Windshield Installation

NOTE
Rubber seal may have to be replaced if it was used on several windshield replacements.

- Spray rubber seal with soapy water to ease windshield insertion.
- Insert rope into rubber extrusion leaving enough length at each corner to make a loop. Spray soapy water onto rope and rubber extrusion (Fig. 7).
- Slide windshield into rubber seal groove starting with the bottom curved side edge. Using a plastic spatula, move the rubber seal lip aside to gradually insert the windshield into the groove.
- Spray soapy water on a regular basis to ease this operation.
- Using the same type of plastic spatula, repeat the same operation from inside of vehicle, gradually inserting the windshield into the groove.

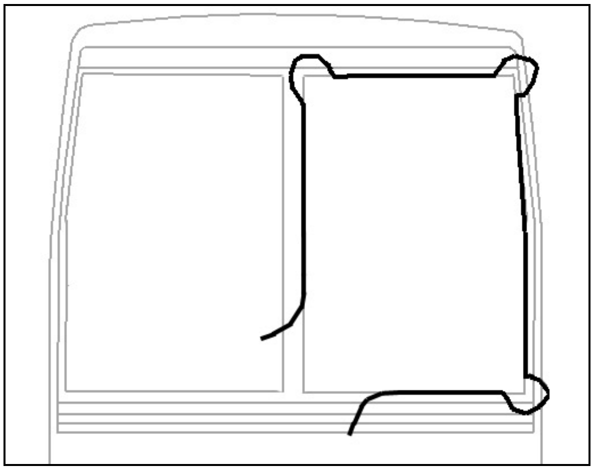


FIGURE 13: WINDSHIELD INSTALLATION USING ROPE

NOTE
Make sure windshield bottom edge is well inserted into the rubber seal groove before proceeding with the sides.

- Then, working from both sides of windshield bottom to top, gradually move the rubber seal lip aside to insert the windshield into the groove. Use also soapy water on the inside of vehicle to insert the windshield into the rubber seal groove.
- Insert the top curved corner then finish with the top of windshield.
- At the top of windshield, clean surface between fiberglass and rubber extrusion using Sika 205 (Fig. 9).
- Apply Sika 221 black between fiberglass and rubber extrusion
- Spray filler and rubber seal groove generously with soapy water.
- Using the special filler insertion tool, insert the filler into the rubber seal groove.
- Gradually insert filler into the rubber seal groove ensuring to leave a 2 inch excess length at the filler extremity.
- Every 6 inches or so, it is important to compress the filler due to its tendency to contract during drying process.
- When filler insertion is almost complete, cut filler leaving ¼” of excess length to thwart filler contraction over time then insert filler into groove.

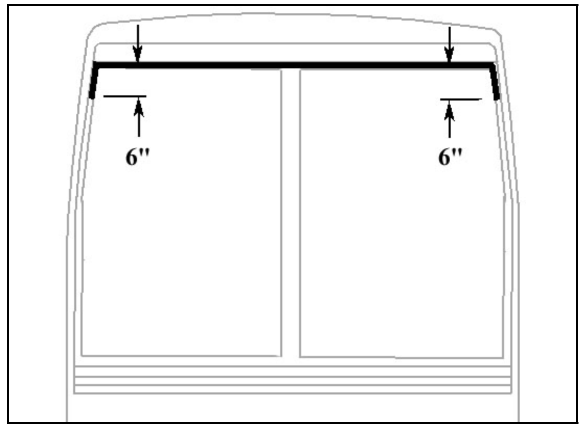


FIGURE 14: APPLICATION 0F SIKA 221 BLACK

- Reinstall center post and interior finishing panels.
- Clean windshield surface of butyl residue.

7.7 ENTRANCE DOOR

An air operated “sedan type” entrance door, with an air door cylinder and damper assembly are installed under the right hand dash. The opening and closing door speed cycle is adjustable by a damper mounted in parallel with the door cylinder on the door hinge. Door activation is controlled by a panel (Fig. 15), located near the defroster and wiper motors. The accessory air reservoir supplies air to this system.

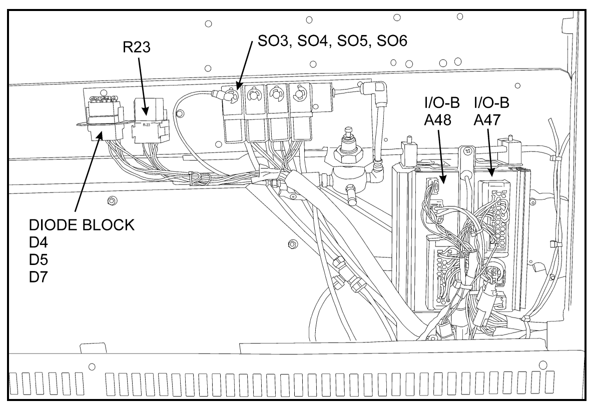


FIGURE 15: ENTRANCE DOOR & WIPER CONTROL PANEL 06619

The door is held in the closed position during coach operation by a two air cylinder locking mechanisms (Fig. 17). Air cylinders with return spring in the cylinder body are used. Air cylinders are controlled by an electrically operated solenoid valve energized by a rocker switch located under the right hand dashboard.

To open the door, initial movement of the rocker switch de-energizes the air lock solenoid valve, venting the door locking cylinders. The return locking spring pulls the door lock away from the latch, unlocking the door. Door movement starts only when pressure in the central air door lock is below 10 psi. The “air cylinder open solenoid valve” opens and allows air to flow to the door cylinder, “the air cylinder close solenoid valve” exhausts air from the rod side of the cylinder.

To close the door, initial movement of the switch energizes the “air cylinder close solenoid valve” and air flows to the cylinder by its rod side port. The “air cylinder open solenoid valve” exhausts air from cylinder. When entrance door latch is grounded with the door frame, the air lock solenoid valve is de-energized and loads the door lock cylinders. The cylinder moves the door lock in a position which engages a latch on the entrance door, holding the door positively closed.
Emergency exit valve, which opens the air valve circuit should be used only in emergencies, or when the door control system does not function properly.

Refer to the air system schematic diagram annexed at the end of section 12, “Brakes” and to page 22 of the wiring diagram.

7.7.1 Operation

The air-operated door is controlled from inside the coach by two push-button switches located on the R.H. dashboard.

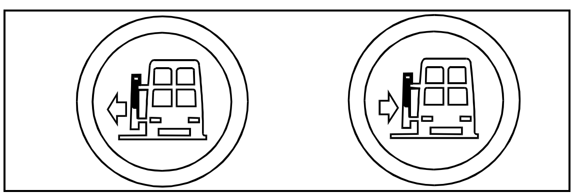


FIGURE 16: ENTRANCE DOOR OPERATING BUTTONS 06464

Opening and closing of the door from outside the coach is accomplished by a momentary toggle switch located under the front R.H. side marker light (Fig. 18).

To close the door, the switch must be pushed towards the rear of the coach and held in position until the door has completed its movement.

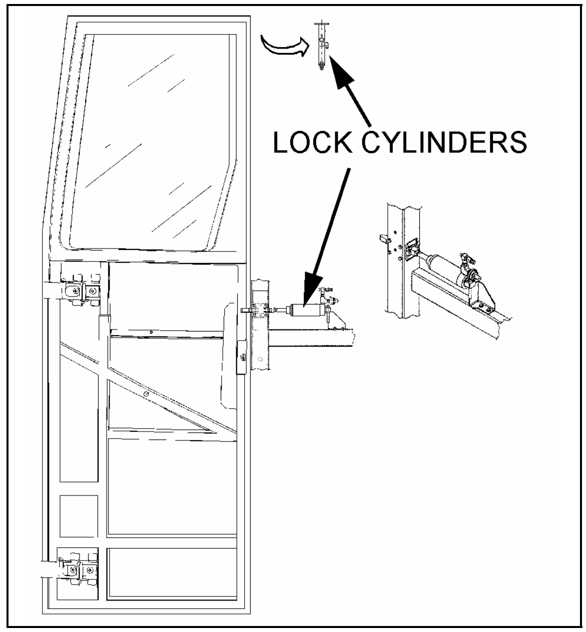


FIGURE 17: COACH ENTRANCE DOOR 18642

To open the door, the switch must be pushed towards the front of the coach and held in position. When the door reaches the fully opened position, the system will keep pressure in the cylinder locking the door in that position. The door can be stopped in any position by releasing the switch. The door is not locked in position when not fully opened or closed.

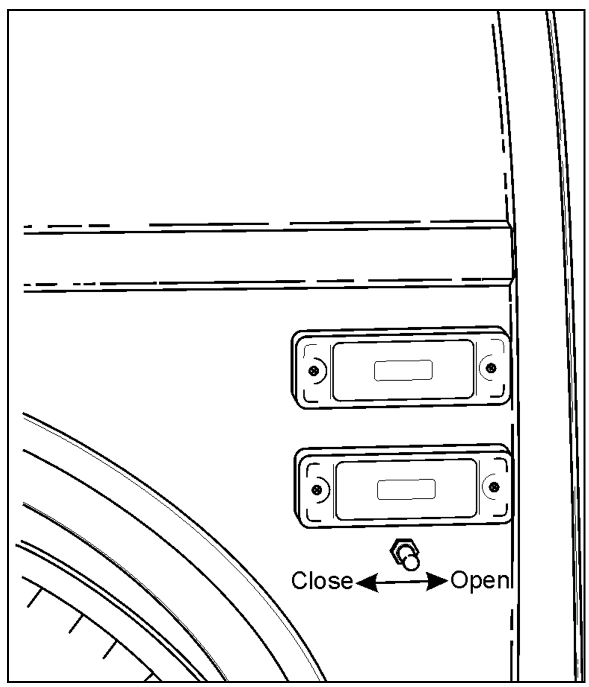


FIGURE 18: ENTRANCE DOOR CONTROL SWITCH 18599

If the door has been locked with the key, a lever on the door can be moved to unlock.

7.7.2 Emergency Exit Valves

From inside the vehicle, an emergency exit valve located near the door on the dash panel, releases the pressure from the lock cylinder. From the exterior, an emergency exit valve located in the front service compartment, also releases the air from the lock cylinder.

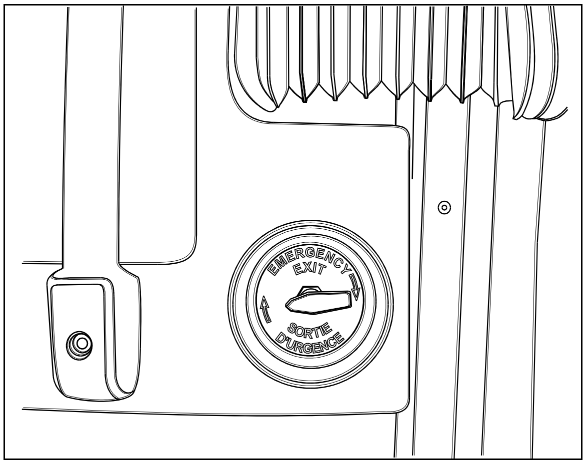


FIGURE 19: INTERIOR UNLATCH AIR VALVE 18330

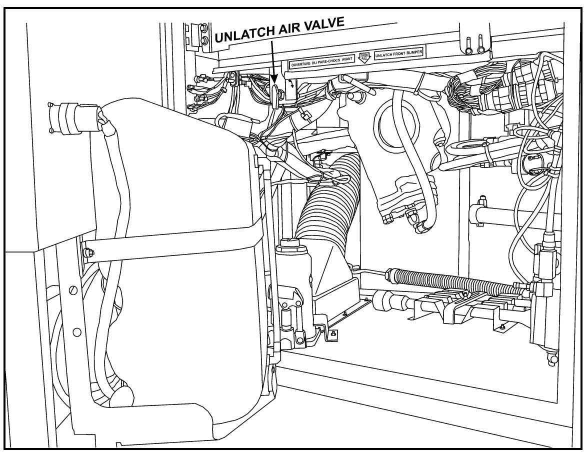


FIGURE 20: EXTERIOR UNLATCH AIR VALVE 12209

Without Air and/or Without Electricity

If the air pressure drops while the coach has or hasn't any electricity, the spring loaded cylinders will unlatch the door. In such a case, unlock the door by moving the lever on the door or by using the key, then open the door manually.

With Air but Without Electricity

From inside the vehicle, turn the emergency exit valve to the "UNLOCK" position. Move the lever. From the exterior, turn the emergency exit valve to the "UNLOCK" position. Open the door. Close it, lock with the key and reset the outside emergency exit valve to the "NORMAL" position.

7.7.3 Door Cycle Speed Adjustment

To do any adjustment, remove the two panels located next to the door hinge, as well as the door's upper hinge control.

⚠ CAUTION ⚠
It is important to make sure that damper does not reach end of stroke when door is completely closed or opened. The door cylinder must stop the door on opening. Screw or unscrew rod end to adjust if necessary.

To adjust opening and closing cycle speed on damper (Fig. 21):

1. Remove the damper from the vehicle and hold it vertically with the lower eye or pin attachment in a vice. Use clamp plates to prevent damage.
2. Fully close the damper while turning the dust cap or piston rod slowly CCW until it is felt that the cams of the adjusting nut engage in the recesses of the foot valve assembly (Fig. 21).

NOTE
In figure 21, if there is an indentation (B) in the dust cap (C) and the cover shows two holes (A), the damper is fitted with a bump rubber (D). If so, fully extend the damper and insert a round bar or screwdriver through the holes. Push the bump rubber down and remove. Remove the split plastic collar (E) (if fitted) from the piston rod.

3. The damper may have already been adjusted. Therefore check whether the damper is adjusted or not by keeping it closed and gently turning further CCW, counting at the same time the half-turns until a stop is felt. Stop turning and do not force.

4. While keeping the damper closed, make two CW half-turns. In case of prior adjustment, add the number of half-turns previously counted. The total range is about five half-turns. Pull the damper out vertically without turning for at least 3/8" (1cm) to disengage the adjusting mechanism. The dust cap or piston rod may now be turned freely.

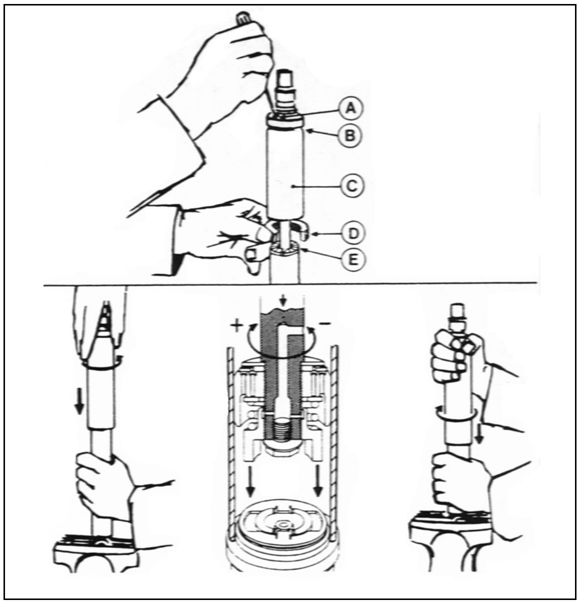


FIGURE 21: DAMPER 18643

NOTE
Where a bump rubber was installed, refit same inside the dust cap and by fully closing the damper, the rubber will seat again at top of the dust cap. Refit the split plastic collar E (Fig. 21).

5. The damper can now be refitted in the vehicle.
6. Reinstall panels and entrance door hinge cover.

7.7.4 Horizontal And Vertical Adjustment

Before attempting to correct any door operating problem by adjusting any part of the air cylinder assembly, first perform the following mechanical checks and procedure.

Check around the perimeter of the door for binding. If any binding is found, adjust as follows:

1. Remove the screws and the plastic molding covering each of the hinges.

NOTE
Ask an assistant to help you to perform the following adjustments.

2. Remove the Allen button head screw and the washer retaining the rod end with bearing to the upper hinge. See figure 22.
3. Support the door with a wooden block and a hydraulic jack.
4. Loosen the horizontal bolts retaining the door to the hinges. Adjust the door horizontally and vertically with the jack. Tighten the bolts to 30-36 Lbf-ft (40-50 Nm). Remove the jack and the wooden block.

⚠ CAUTION ⚠
Make sure the front side door does not interfere with the exterior panel.

5. Pull and fasten the rod end to the hinge with the washer and the button screw.
6. Screw the plastic moldings covering the hinges.

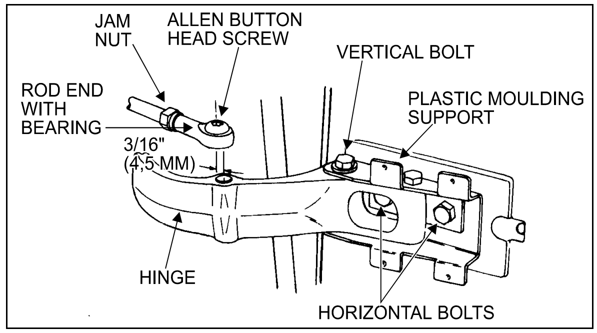


FIGURE 22: UPPER DOOR HINGE 18058

Seal Compression Adjustment

1. Turn the emergency exit valve to the “UNLOCK” position and close the door.
2. From the outside of vehicle, insert a straight edge in the gap along the door outside perimeter. Measure the distance between the door frame and the door outside surface at the door four corners (refer to figure 23).

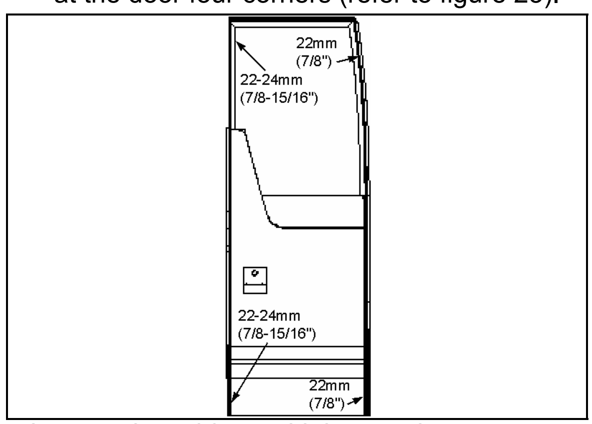


FIGURE 23: SEAL COMPRESSION ADJUSTMENT 18632

NOTE
The front measurements are the most important. If required, ask an assistant to help you to perform the following adjustments.

3. If required loosen the bolts retaining the door to the hinges. Adjust the bolts to obtain the proper seal compression.

Door Seal Replacement

1. Inspect the seal; if cracked or torn, it must be replaced:
2. Remove the old seal and with a sharp edge knife, scrape tape left on the fiberglass door surface.
3. Sand the surface of the door where a new seal will be applied with 240 grit sandpaper.
4. Clean the surface with alcohol.

⚠ CAUTION ⚠
Wear rubber gloves and do not smoke when cleaning.

5. Peel of protective paper from the seal. Position the seal flush with the top, sides and lower edges of the door.
6. Progress slowly all around the door.
7. Cut the seal and glue both ends with LOCTITE 414 glue.
8. To assure bonding, press a small roller on top of the new seal.

7.7.5 Troubleshooting

SYMPTOM	PROBABLE CAUSE	REMEDY
DOOR WILL NOT OPEN FROM EXTERIOR SWITCH.	Manual door locks engaged.	Release manual door locks.
	Upper and lower solenoid locks do not disengage.	Check voltage at solenoid locks when door is open. If the voltage is 24 volts then replace solenoid #641217. Else, check circuit power.
	Relay module do not receive current.	Reset breaker "ON" or check batteries power supply.
	Opening solenoid door does not receive current.	Check voltage at opening solenoid door. If the voltage is 24 volts then replace it. Else replace control relay.
	Switch malfunction.	Replace switch.
DOOR WILL NOT CLOSE FROM EXTERIOR SWITCH.	Switch malfunction.	Replace switch.
	Solenoid failure.	Check voltage at solenoid. If the voltage is 24 volts then replace solenoid. Else replace control relay.
DOOR WILL NOT OPEN FROM INTERIOR SWITCH.	Manual door locks engaged.	Release manual door locks (open position) from vehicle exterior.
	Upper and lower solenoid locks do not disengage.	Check voltage at solenoid locks when door is open. If the voltage is 24 volts then replace solenoid #641217. Else, check circuit power and replace control relay.
	Module relay does not receive electric current.	Reset breaker "ON" or check batteries power supply.
	Door opening solenoid does not receive current.	Check voltage at door opening solenoid. If the voltage is 24 volts then replace it. Else replace control relay.
	Switch malfunction.	Replace switch.
	Upper lock stays engaged	Lubricate upper lock assembly. Check wear and replace parts if necessary.
DOOR WILL NOT CLOSE FROM INTERIOR SWITCH.	Switch malfunction.	Replace switch.
	Door closing solenoid does not receive electric current.	Check voltage at door closing solenoid. If the voltage is 24 volts then replace it. Else replace control relay.
DOOR WILL NOT OPEN AFTER DRAINING AIR FROM SYSTEM BY EMERGENCY VALVE(S).	Manual door locks engaged.	Release manual door locks (open position) from vehicle exterior.
	Damper cylinder blocks the door.	Adjust or replace damper cylinder.

SYMPTOM	PROBABLE CAUSE	REMEDY
	The upper lock blocks the door.	Adjust upper lock. Lubricate upper latch bolt. Adjust upper latch height.
DOOR LOCKS STAY ENGAGED WHEN DOOR IS OPEN.	Power supply is cut at solenoid.	Place switch in open position.
	Lock solenoid does not disengage.	Check voltage at solenoid lock when door is OPEN. If the voltage is 24 volts then replace solenoid #641217. Else, check circuit power and replace control relay.
DOOR LOCKS DO NOT LOCK WHEN DOOR IS CLOSED.	Emergency valve is open.	Close emergency valve.
	Lock solenoid stays electrified.	Check latch bolt ground on door frame. If needed clean locks for better contact. Check ground circuit.
	Lock solenoid works in reverse.	Reverse air hoses at solenoid locks.
	Relay does not function.	Replace relay.

7.7.6 Lubrication

Part	Lubricant	Frequency
Latches Upper door catch Door cylinder rod end with bearing grease fitting	Low temperature grease	Every six months
Door locking mechanism	White grease	Every six months
Key hole Damper pins Hinges	Low viscosity oil	Every six months

7.7.7 Entrance Door Body Panel and Window

Window

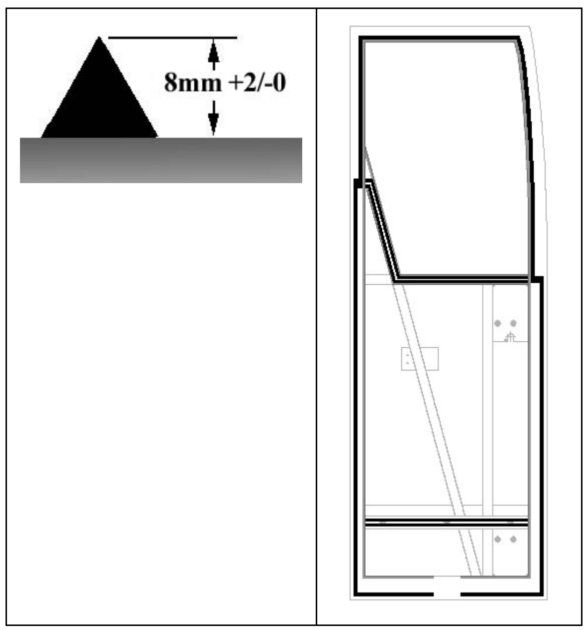
For the removal of entrance door window, you will need:

Pneumatic “Zip gun” type tool;
Razor sharp window scraper;
“Olfa” knife;
Face shield.

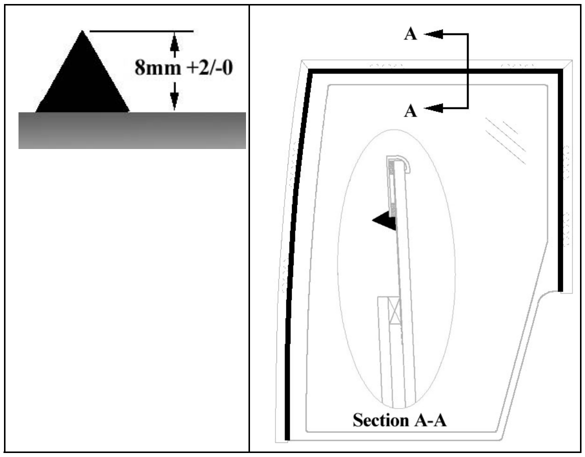
- Open entrance door.
- Mark the position of the entrance door window for future reference.
- Remove interior finishing panel.
- From inside of vehicle, cut Sika bead around window perimeter using a “Zip gun” while another person hold the window from the outside.

NOTE
Wear ear plugs during this operation.

- Then, move outside of vehicle and cut Sika bead to free window while somebody else hold the window from the inside.
- Carefully remove window from frame, ask for help if needed.
- Using a razor sharp window scraper, remove from window frame Sika bead and double-face self adhesive tape residue.
- Clean window using window cleaner.
- Apply Sika Aktivator around window perimeter.
- Clean door frame using anti-silicone.
- Using a scratch pad “Scotch Brite”, scratch the perimeter of the window frame where the adhesive will be applied.
- Clean door frame again using anti-silicone.
- Apply some Sika 206 G+P onto door frame.
- Apply Sika 255 onto door frame structure.



- Apply Sika 255 at junction of frame and window.



- Install and center window onto door frame. Using your hands, compress window.
- Discard waste according to applicable environmental regulations, use dangerous waste containers.
- Apply masking tape before applying Sika glue to protect paint and adjacent surfaces during surface treatment

Body Panel

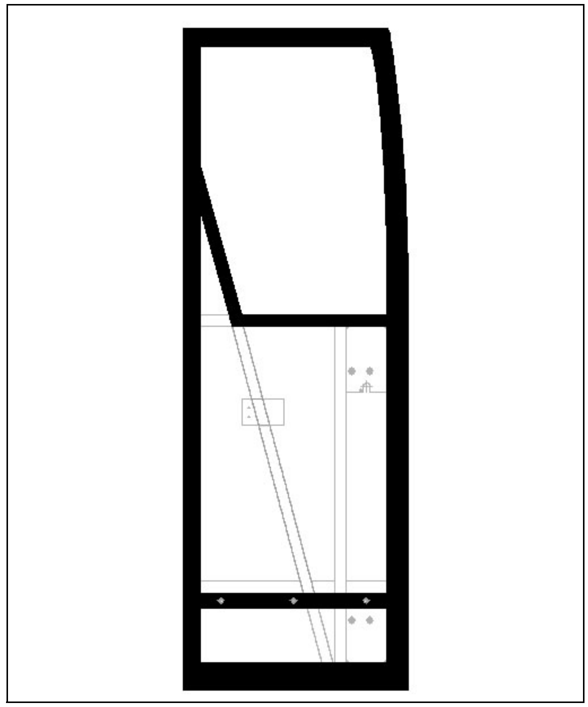
For the removal of entrance door body panel, you will need:

Pneumatic “Zip gun” type tool;
Razor sharp window scraper;

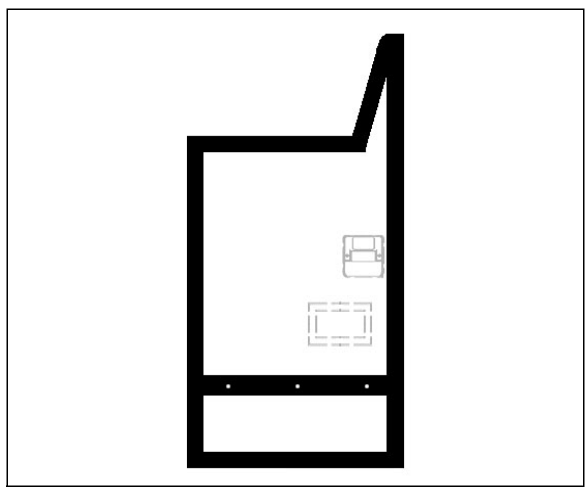
- Open entrance door.
- Remove interior finishing panels to access rub rail fixing bolts, then remove rub rail.
- Remove door lock and interior lighting.
- Using the “**Zip Gun**”, cut Sika bead located ¼ inch (7-8 mm) from each body panel edge.

NOTE
Wear ear plugs during this operation.

- Separate body panel from door.
- Using a razor sharp window scraper, remove from door frame Sika bead and double-face self adhesive tape residue.
- Using a scratch pad “Scotch Brite”, scratch the perimeter of the door frame where the adhesive will be applied.
- Clean door frame again using anti-silicone.
- Apply some Sika 206 G+P onto door frame.

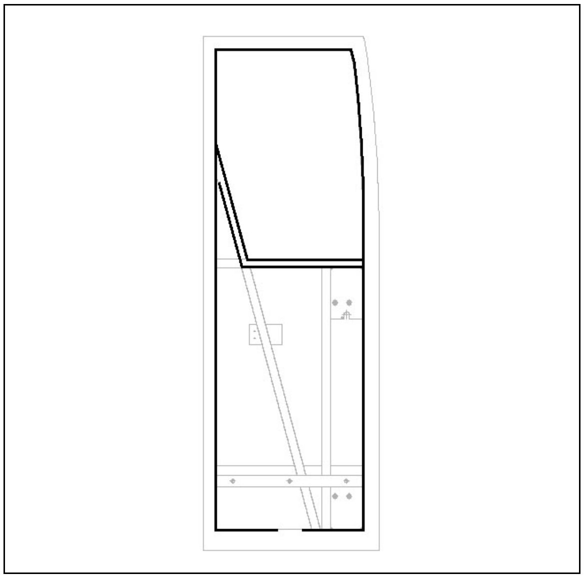


- Using a scratch pad “Scotch Brite”, scratch the perimeter of the body panel where the adhesive will be applied.
- Clean body panel using anti-silicone.
- Apply some Sika 206 G+P onto body panel.

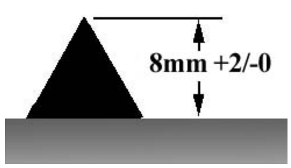


- Apply 1/8 x1/4 double face self-adhesive tape onto door frame.

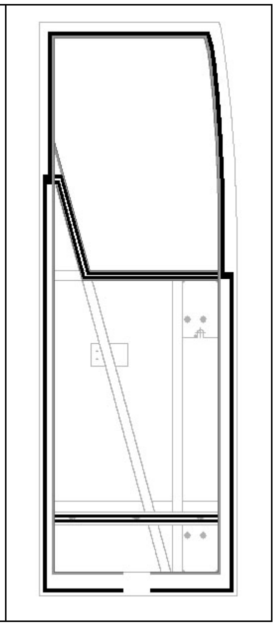
NOTE
Leave some space at the bottom (50mm) for water dripping.



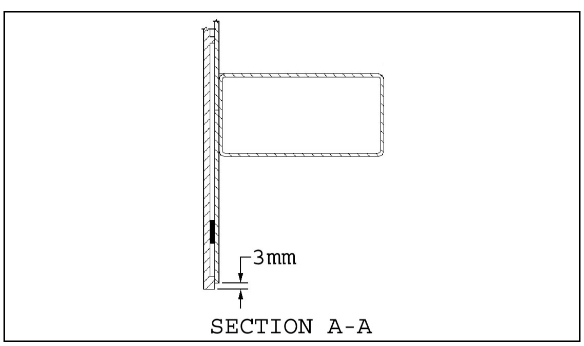
- Apply Sika 255 onto door frame structure.



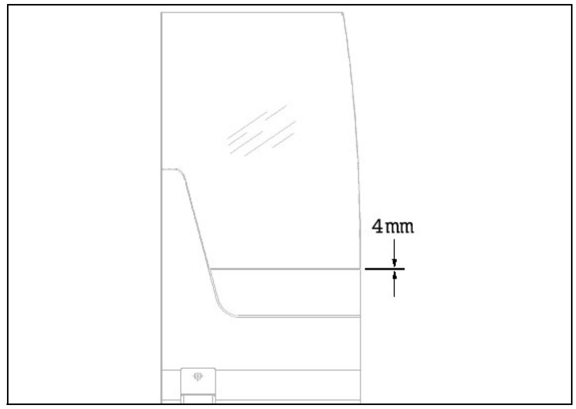
Note: Leave some space at the bottom (50mm) for water dripping.



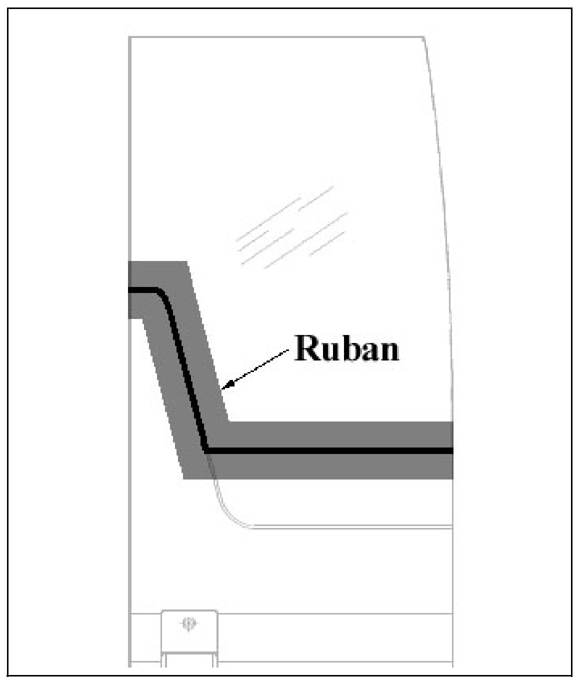
- Install and center fiber glass body panel onto door frame leaving an excess of 3mm all around the frame.



- Line-up body panel with window. There must be a gap of 4±2mm between window and body panel.



- Apply some masking tape **1mm** from window edge and body panel.
- Fill the gap between window and body panel with Sika 255.
- Smooth down the joint with a plastic scraper then remove masking tape.
- Wet Sika joint using water to accelerate the curing process and put the finishing touch with your finger.



- Discard waste according to applicable environmental regulations, use dangerous waste containers.

7.7.8 Front Electrical & Service Compartment Door Body Panel and Window

Door Body Panel

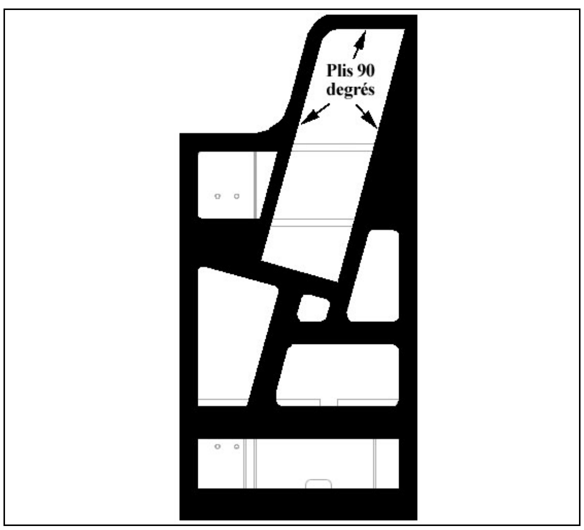
For the removal of front electrical & service compartment door body panel, you will need:

Pneumatic "Zip gun" type tool;
Razor sharp window scraper;

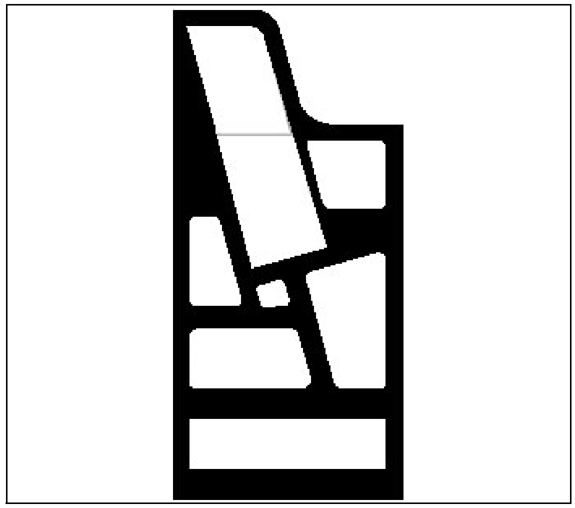
- Open service door.
- Remove interior finishing panels to access rub rail fixing bolts, then remove rub rail.
- Remove windshield washer reservoir, door lock and power window connector.
- Using the "**Zip Gun**", cut Sika bead located ¼ inch (7-8 mm) from each body panel edge.

NOTE
Wear ear plugs during this operation.

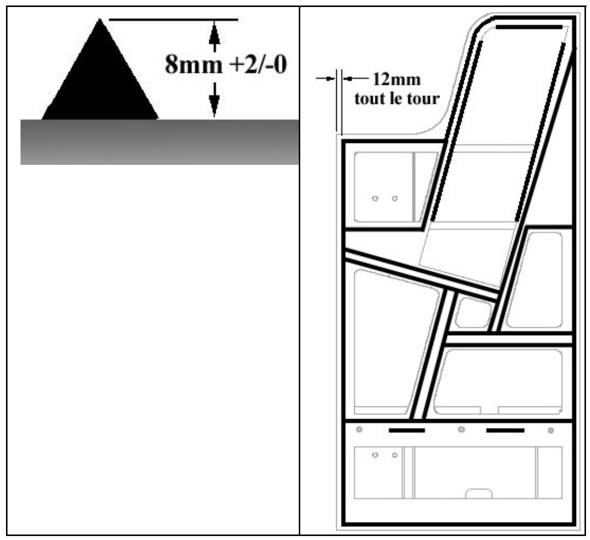
- Separate body panel from door.
- Using a razor sharp window scraper, remove from door frame Sika bead and double-face self adhesive tape residue.
- Clean door frame using anti-silicone.
- Using a scratch pad "Scotch Brite", scratch the perimeter of the door frame where the adhesive will be applied.
- Clean door frame again using anti-silicone.
- Apply some Sika 206 G+P onto door frame.



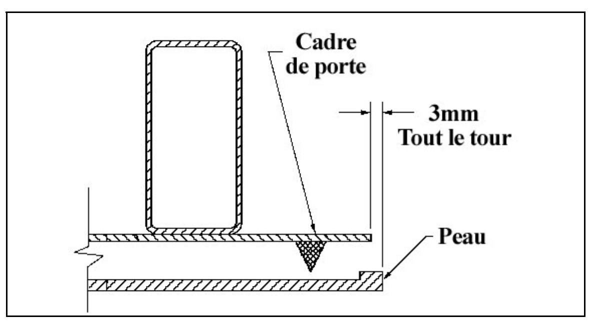
- Prepare new body panel using a scratch pad "Scotch Brite".
- Use a tack cloth to remove any dust or residue from the body panel surface.
- Clean body panel using anti-silicone.
- Apply some Sika 206 G+P onto body panel.



- Apply an even coat of Sika 255 onto the door frame.

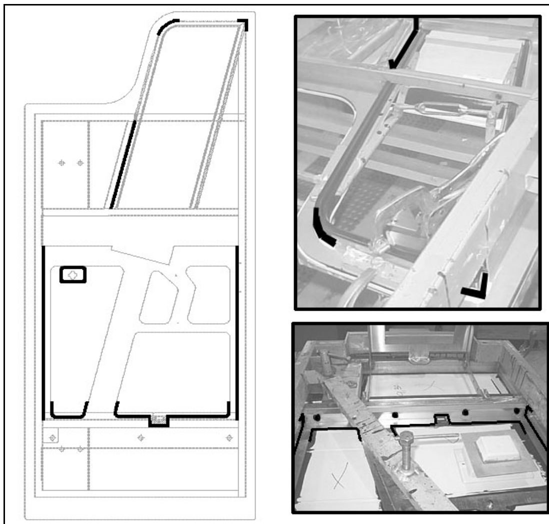


- Position body panel onto door frame and compress with your hands. Use a ruler.



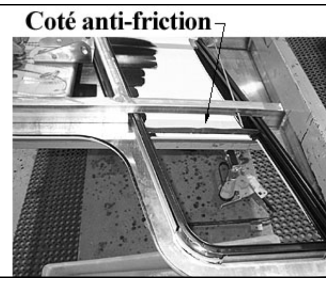
- Check body panel flatness using a 2-foot ruler (must be within 2mm).

- Check proper power window sliding inside window frame.
- If applicable, remove excess of Sika adhesive all around door frame using Sika 208.
- From the inside of the door, apply some Sika 221 between door body panel and frame and on welding spots as per figure.

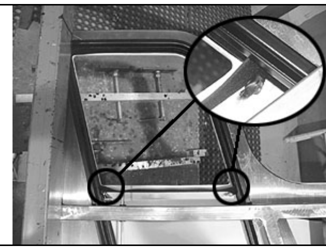


- Apply some #680066 glue inside fiber glass groove and fix power window wiper.

NOTE
Anti-friction side must be on glass side.

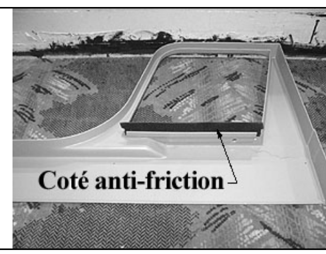


- From inside the door, apply some Sika 252 at the corners of window wiper.



- Apply some #680066 glue inside finishing panel groove and fix power window wiper.

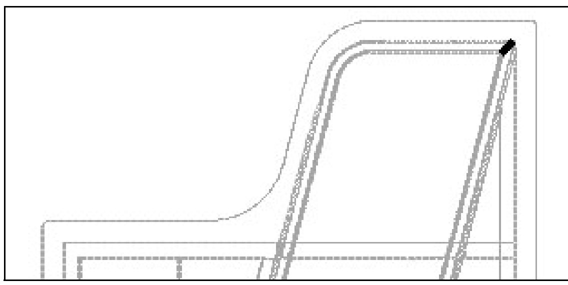
NOTE
Anti-friction side must be on glass side.



- Discard waste according to applicable environmental regulations, use dangerous waste containers.

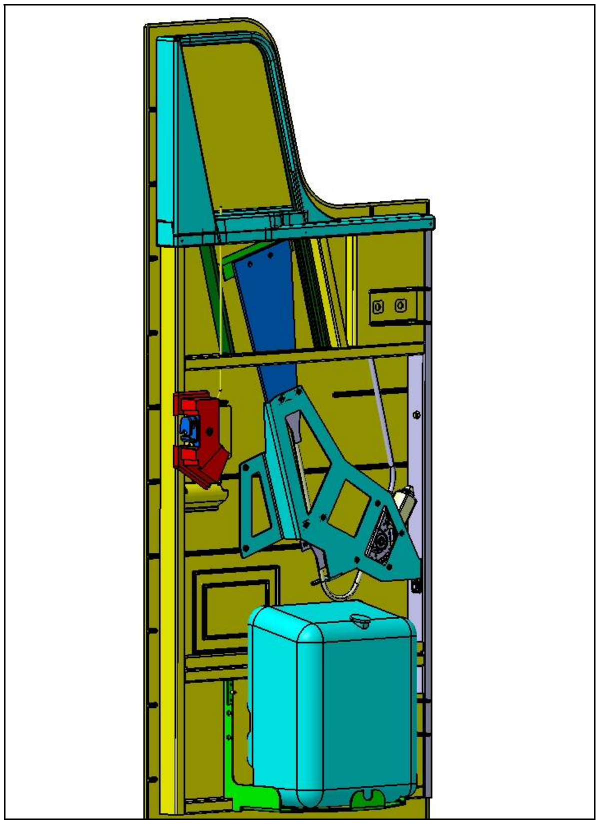
Electrical Power Window

- Insert 2 seals in the window frame.
- Apply some #680066 glue at the intersection of the 2 seals and also sparingly in order to fix the seal to the window frame.

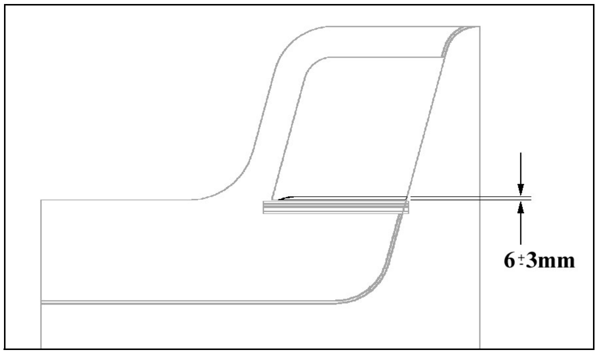


- Clean window using window cleaner.

- Insert window into frame.
- Secure window pane to raising mechanism.

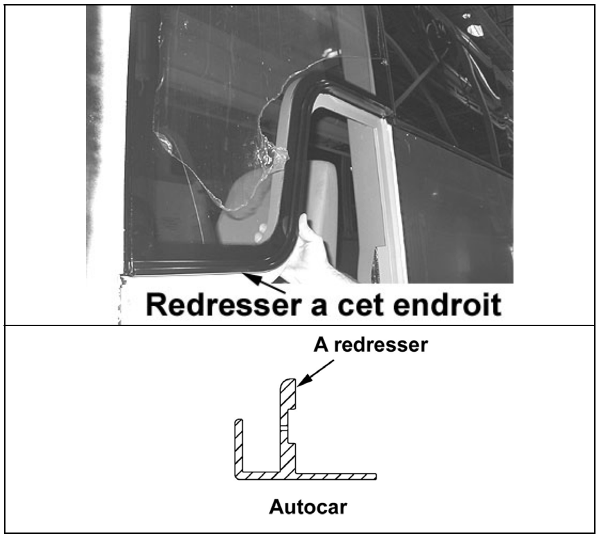


- Adjust window travel (6±3mm above window wiper).

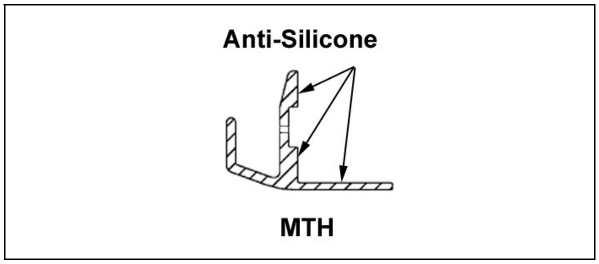


Driver's Window Gutter

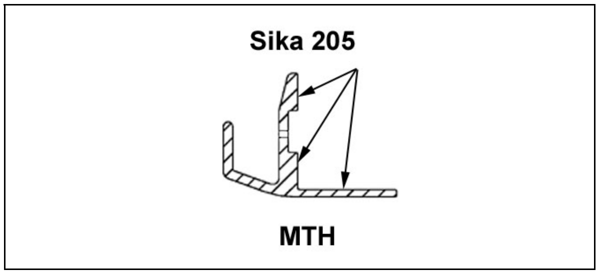
- Dry fit the gutter on the vehicle. If required, straighten up gutter using a hammer and a wooden block.



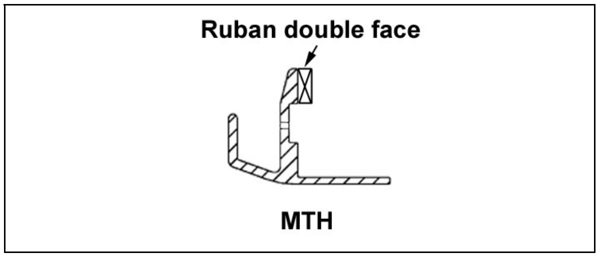
- Apply anti-silicone inside right angle.



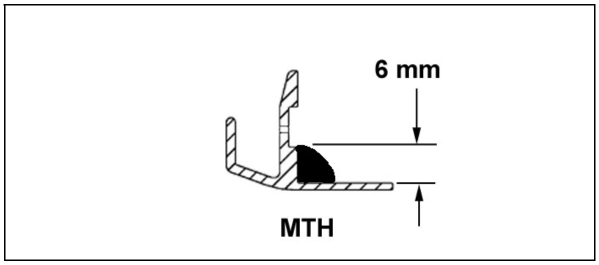
- Apply Sika 205 inside right angle.



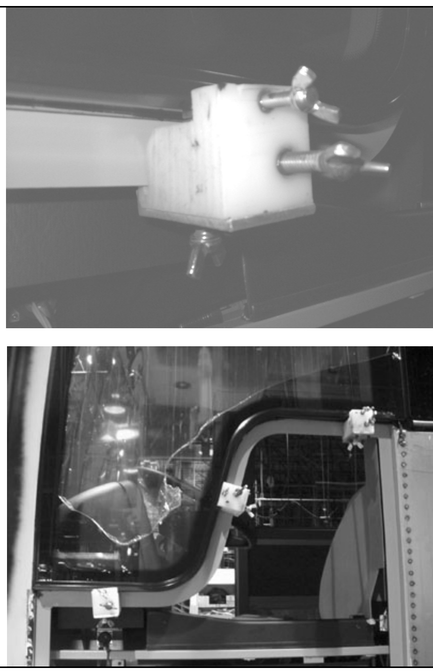
- Apply 1/16 x1/4 double face self-adhesive tape onto gutter.



- Peel the back from double face self-adhesive tape.
- Apply Sika 252 inside right angle.



- If applicable, remove plastic film at the bottom of driver's window.
- Remove excess of Sika underneath driver's window.
- Clean bottom of driver's window using window cleaner.
- Apply Sika Aktivator at the bottom of driver's window.
- Install gutter under driver's window then compress in order to fix double face self-adhesive tape.
- Install 3 clamps and allow curing for 4 hours.



7.7.9 Upper Lateral Window

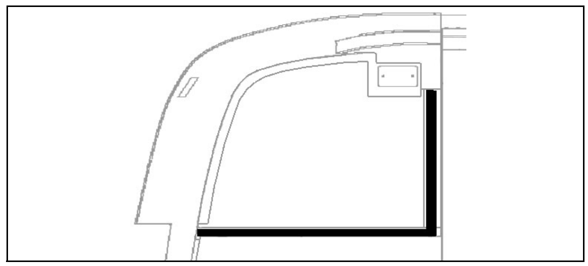
For the removal of upper lateral window, you will need:

Pneumatic «Zip gun» type tool;
Razor sharp window scraper;
"Olfa" knife;
Face shield.

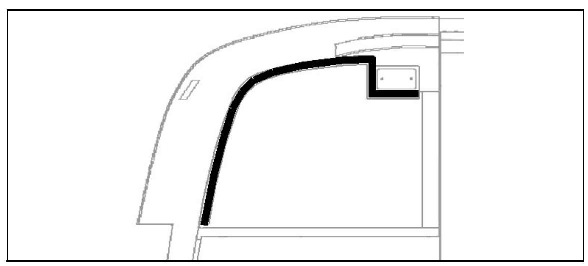
- From inside of vehicle, cut Sika bead around window perimeter using a "Zip gun" while another person hold the window from the outside.

NOTE
Wear ear plugs during this operation.

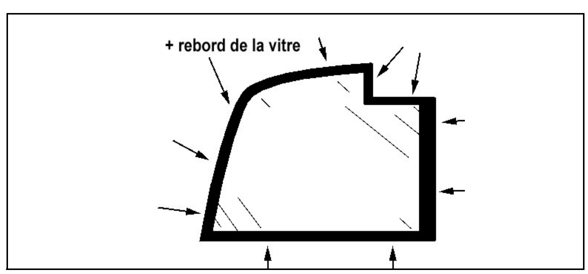
- Then, move outside of vehicle and cut Sika bead to free window while somebody else hold the window from the inside.
- Carefully remove window from frame, ask for help if needed.
- Using a razor sharp window scraper, remove from window frame Sika bead and double-face self adhesive tape residue.
- Remove clearance light
- Apply some water to vehicle structure to clean surface.



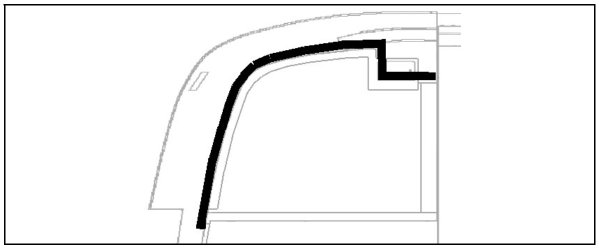
- Clean inside and outside of fiberglass using anti-silicone.
- Apply some Sika 206 G+P.



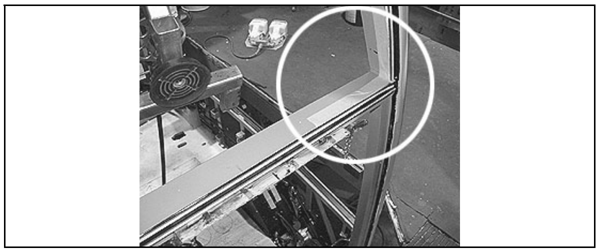
- Clean window perimeter and edges using window cleaner.
- Apply Sika Aktivator.



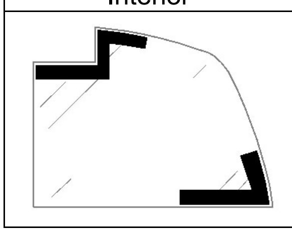
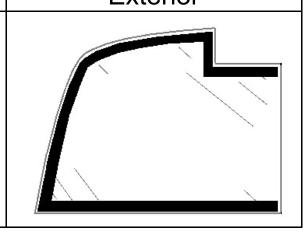
- Apply masking tape onto front face before applying Sika glue to protect paint and adjacent surfaces.



- Apply masking tape onto structure.

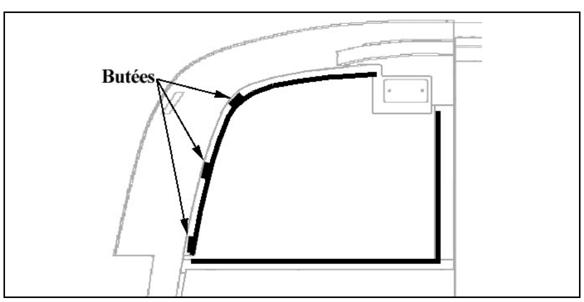


- Apply masking tape onto window.

Interior	Exterior
	

- Affix 3 spacers #790392 onto fiberglass.
- Apply a double-face self adhesive tape 1/8 by ¼ inch onto fiberglass perimeter (front face exterior).

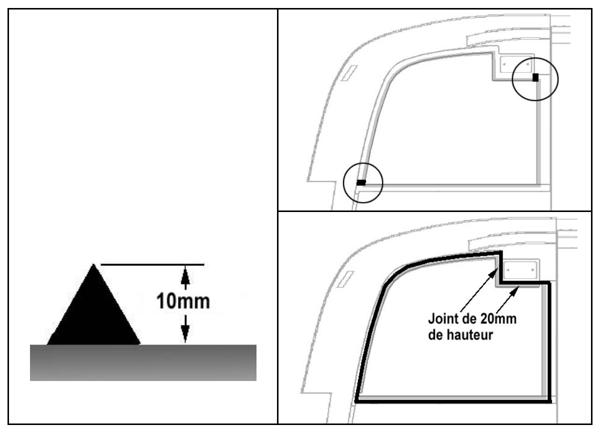
NOTE
Do not peel the back from double face self-adhesive tape at this moment.



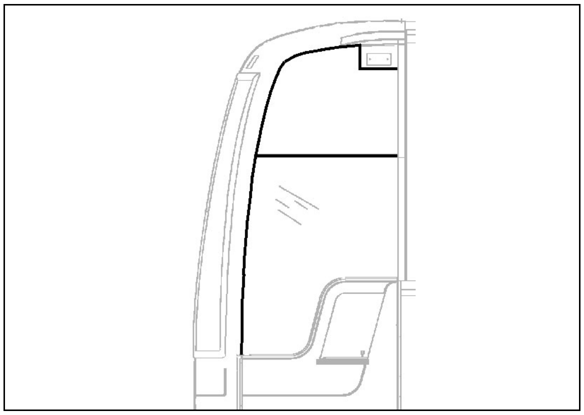
- Install window inside the opening to check if window curve and front face are the same.
  - o L.H. side: Front of window must line up with front of driver's window. Use shims to adjust window height if necessary.
  - o R.H. side: Once the window is centered, apply some masking tape on bottom of window to mark off the position.

- Peel the back from double face self-adhesive tape.
- Apply some Sika 255 onto fiberglass perimeter (front face exterior).

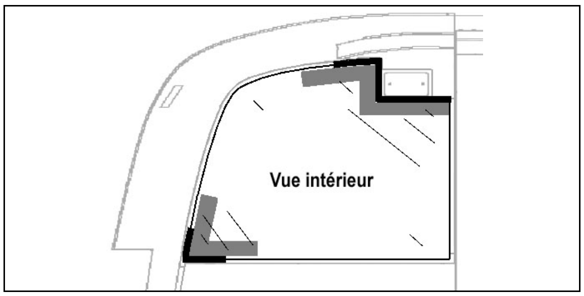
NOTE
Make sure the 2 small cavities between fiberglass and structure are filled with Sika.



- Install and compress all around window perimeter to fix window to self adhesive tape.
- To support the window, position two "Quick Grip" type pliers at the base of the frame.
- Center and align the window base using the two pliers while pressing firmly the window perimeter against the frame.
- Complete a finishing joint and scrape the excess with a plastic scraper.
- Carefully remove masking tape then smooth down finishing joint with your finger. Use soapy water or Sika 208.



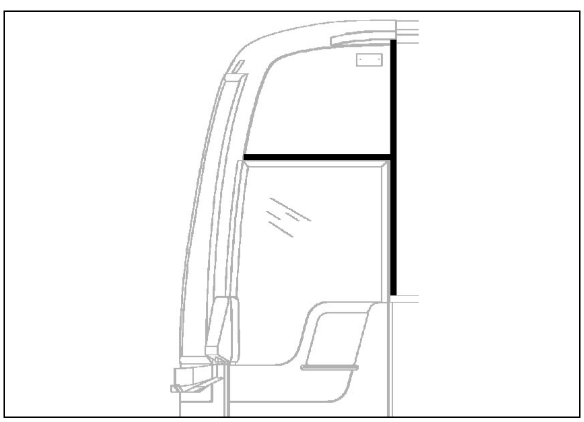
- From vehicle's interior, apply some Sika 255 and make 2 finishing joints. Smooth down the joints and remove masking tape.



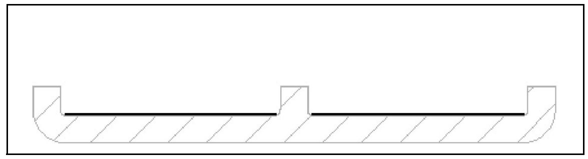
- Reinstall clearance lights.
- Discard waste according to applicable environmental regulations, use dangerous waste containers.

Glued Molding Installation

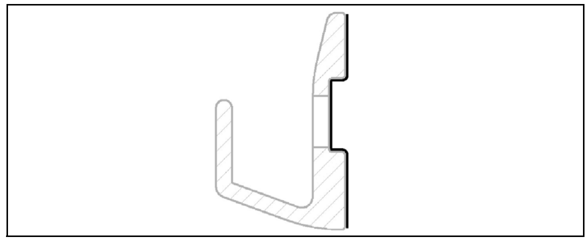
- Clean window gluing area using window cleaner.
- Apply Sika Aktivator onto gluing area making sure to avoid Sika adhesive if it is not cured yet.



- Apply anti-silicone onto molding.
- Apply Sika 205.

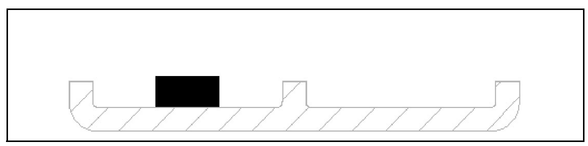


- Clean gutter using anti-silicone.

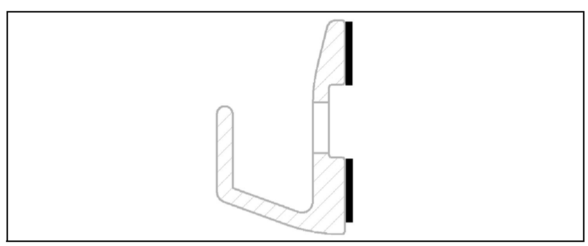


- To seal screw holes, remove screw, apply Sika 205 inside the hole then apply Sika 252.

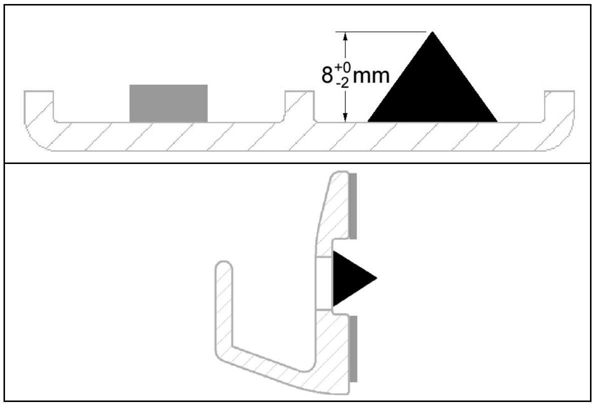
- Apply a double-face self adhesive tape 1/8 by ¼ inch inside the molding onto the whole length.



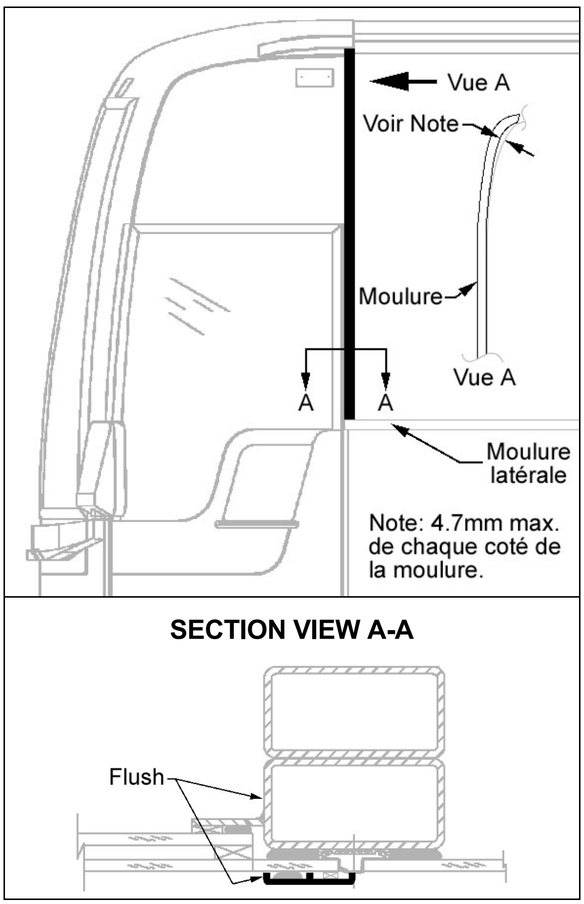
- Apply a double-face self adhesive tape 1/32 by ¼ inch onto the whole length of the gutter.



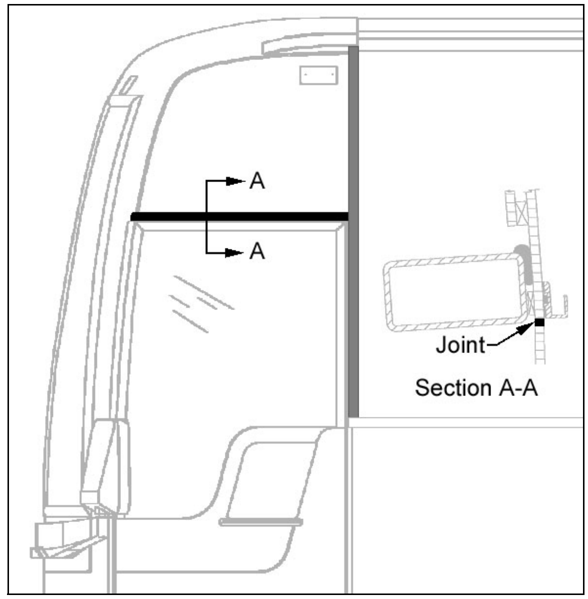
- Apply Sika 252 inside the moldings onto the whole length.



- Position and fix vertical molding. Lean vertical molding against lateral molding. Make sure vertical molding lines up with structural tubing.



- Position and fix horizontal molding (gutter). Lean gutter against vertical molding. Position gutter just above Sika finishing joint.



- Apply masking tape on each side of vertical molding. Apply Sika 252 to fill the gap between molding and windows.
- Smooth down the joint with finger.
- If required, clean surfaces using Sika 208.

7.7.10 Front Cap

The fiberglass front cap does not need any maintenance except painting as needed. It is held in place with adhesive. If ever it has to be replaced, make an appointment at a Prévost service center near you. For minor damages, refer to section 4 "Fiberglass Repair" and section 5 "Painting".

8 ZONE 2

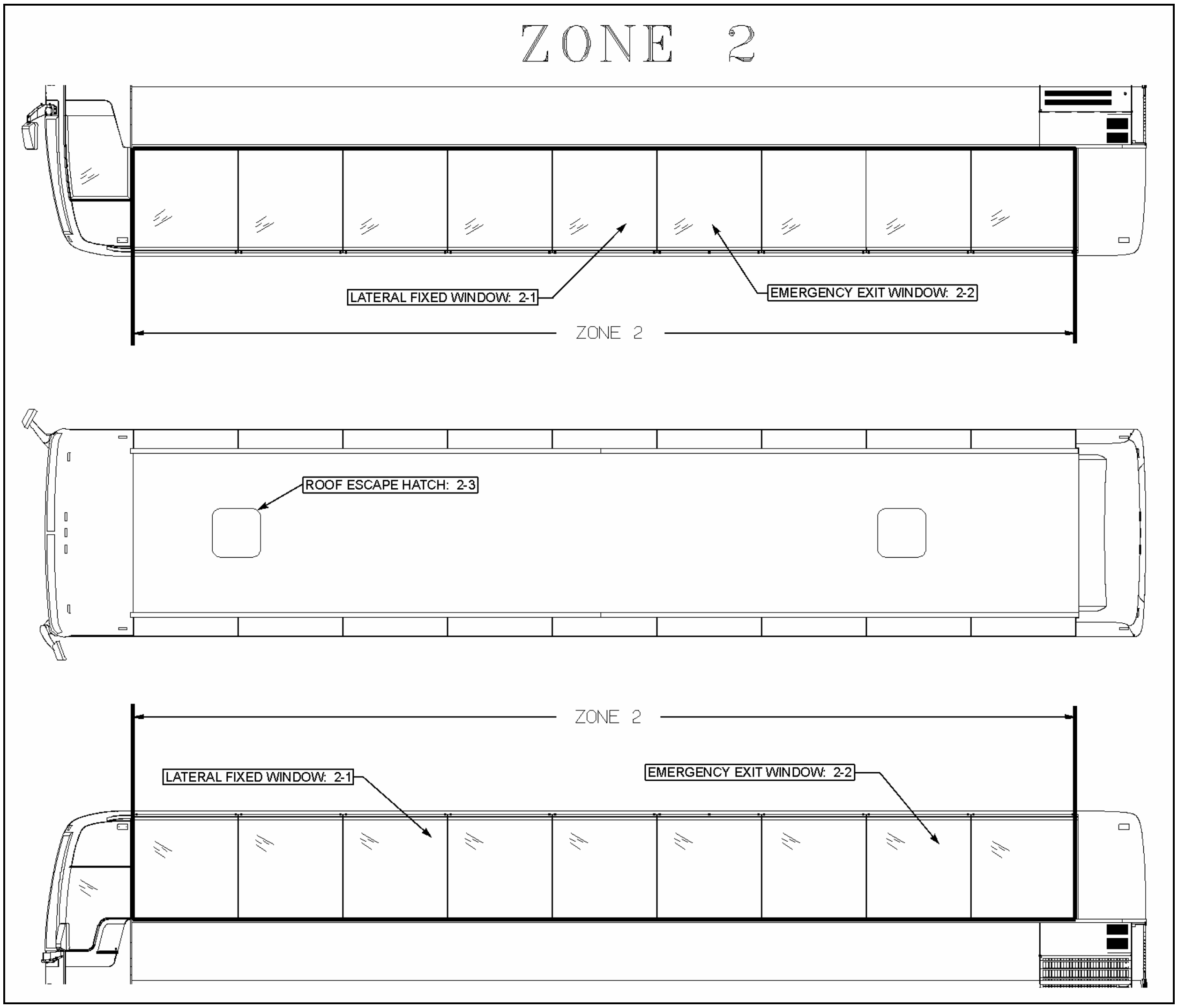


FIGURE 24: ZONE 2 18625

8.1 LATERAL FIXED WINDOW

Nine passenger side windows are provided on each side on X3-45. They are made of fixed, single or double-glazed, heat absorbing AS-3 glass. Windows are mounted in painted aluminum extrusions, which hold the glass in place from the top rail of the coach. The extrusion also serves as a hinge to allow the window to swing open when needed. The single-glazed windows are made of tinted tempered safety glass, while the double-glazed windows are made of tinted tempered safety glass outside and clear tempered glass inside.

For fixed side window removal or installation, you will need:

- Hammer or;
- Drill equipped with a sharp pointed rod into which a small hole was drilled;
- Braided windshield wire and a pair of handles;
- Gloves, goggles or face shield.

8.1.1 Fixed Window Removal

Method A

- Apply a sticky plastic film onto window outside surface (thermos) and break window. For single pane, apply a sticky plastic film on both sides of window.

Method B

- Using a drill equipped with the special sharp pointed rod, drill through the window seal into one of the bottom corners, from a 30º angle with reference to the vehicle.
- This procedure requires accuracy and it is possible not to succeed on the first attempt. From the inside of vehicle, a second person ensures the rod passes through.
- Remove the rod, thread the wire into the small hole. Reinsert the rod and the wire into the hole far enough so that the person inside the vehicle can pull the rod using a pair of pliers.
- Attach the wire ends to the specially designed handles.
- Pull in turn from the inside and the outside of vehicle to gradually cut the Sika bead on the window perimeter.
- When you reach top corner, detach wire from the outside handle, secure it to a fish wire or rod and thread it underneath the aluminum molding behind the rivets.
- Detach wire from fish wire and continue cutting using the handle.
- Cut Sika bead until you come back to starting point, then you can remove the window by carefully pushing it out from the inside of vehicle.

8.1.2 Preparation of Structure and Installation of Window

Preparation of Structure

- Remove old Sika adhesive.
- If primer was removed at the same time than Sika, perform the following steps:
  - Clean using anti-silicone.
  - Remove from structure old primer using a sander (120-150 grit).
  - Clean again using anti-silicone.
  - Apply 206 G+P primer.
- Reactivate 206 G+P primer.

Installation of Window

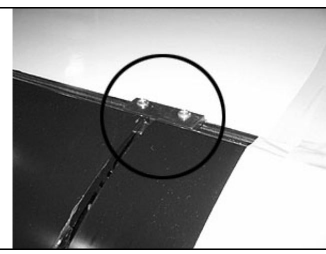
- Use window cleaner around window interior perimeter and edges to remove any oily film while inspecting for damages.
- Apply Sika Aktivator.
- Using a triangular nozzle (20mm X 10mm), apply Sika Ultrafast II onto structure.

NOTE
You only have 8 minutes to install window once the SIKA ULTRAFAST II product is applied.

- Install window.

⚠ CAUTION ⚠
To prevent damaging the Sika joint, do not raise the window once it as touched the bead.

- Before compressing window against Sika joint, install two stops into the aluminum extrusion one inch from each window edge.



- Verify window alignment with reference to adjacent surfaces.
- Vehicle must remain stationary for 30 minutes at more than 23°C.

8.2 EMERGENCY EXIT WINDOWS

Three of the windows on curb side of the X3-45 serve as emergency exits, while there are four on driver’s side. See figure 33. Except for the top window side, the three other glass sides are unprotected, which causes the workers to be exceptionally careful when manipulating or installing such windows.

In addition, when it becomes necessary to lay down the unprotected edges of the glass window, never use a steel or concrete floor support. It is recommended to use a wooden support, even better, a padded surface.

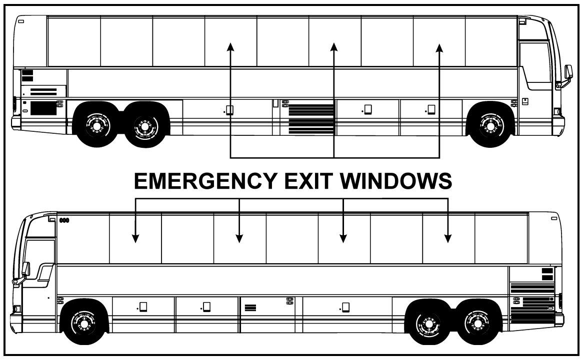


FIGURE 25: X3-45 COACH 18617

An emergency exit window can be opened by pulling the lower part of the release bar to disengage the safety latches, and then by pushing out the window frame (Fig. 32).

Emergency operating instruction decals are affixed under each emergency exit window. To close the window, pull back the window and push down the release bar.

8.2.1 Emergency Exit Release Bar

The emergency exit release bar system is generally maintenance free. It has been designed to answer the twenty pound resistance criteria for opening the emergency window. If this handle should be replaced:

1. Remove the screws and bolts securing it to the emergency exit window;
2. Install a new release bar, reverse the procedure.

NOTE
Check the legal twenty pound maximum resistance to be sure to comply with regulations.

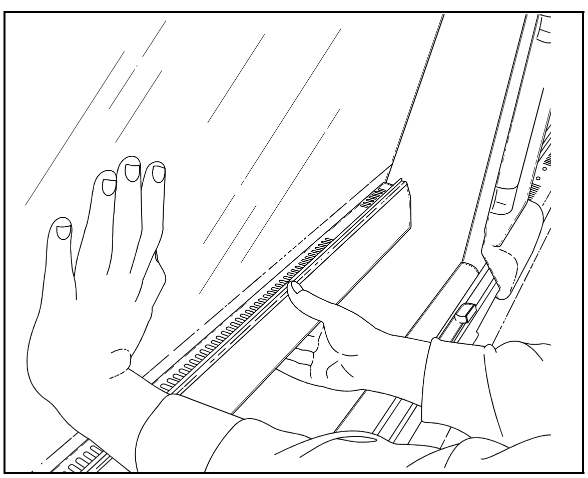


FIGURE 26: EMERGENCY EXIT WINDOW 18008

8.2.2 Emergency Exit Window Adjustment

Emergency exit windows should be checked periodically for easy opening and closing. Pulling the lower part of the release bar with both hands placed near the safety latches should disengage both locks on the window simultaneously. The tension required to release the window should not exceed twenty pounds (9 kg) of force.

The release bar mechanism itself has been designed such as no adjustments are necessary.

If too much effort is required to disengage the locks when pulling the release bar or if the window doesn't close tightly or rattles, check for interference by foreign objects or nearby parts into mechanism, such as the microswitch, rubber seal, wires, etc. Correct situation immediately.

NOTE
Tangs on the lock must be in a horizontal position.

8.2.3 Emergency Exit Window Replacement

1. Lift the bar release system;
2. Remove the stop blocks from the top exterior of the window.
3. Push the glass window out ninety degrees (90°).

⚠ WARNING ⚠
The window may fall out.

4. The window is free and can be unhooked.

Reverse the procedure to install a new emergency exit window.

8.3 ROOF ESCAPE HATCH

The vehicle can be equipped with one or two escape hatches. The escape hatch is designed to provide years of reliable service with a minimum of maintenance. All components are rust proof, and moving parts are Teflon coated to eliminate need for lubrication. Should water infiltrate the vehicle from the escape hatch, refer to the heading "Sealing" in this paragraph for procedures on how to seal this area.

⚠ CAUTION ⚠

Use of lubricants, paints, or other coatings such as graffiti deterring sprays is not recommended.

Suggested maintenance includes periodic inspection of fasteners for evidence of loosening due to tampering, and regular cleaning with mild soap and water.

Although there are other cleaning solutions available, some contain solvents and other chemicals that can attack the high strength materials used in the production of the escape hatch.

⚠ CAUTION ⚠

Ensure that cleaning solutions are compatible with the materials used on the escape hatch.

Graffiti removing cleaners often contain acetone, ether, lacquer thinner or other solvents known to destroy the high strength properties of many plastics. Use of these cleaners must be avoided. Graffiti-resisting coatings often leave a sticky residue that interferes with smooth up/down movement of the hatch mechanism. Some of these coatings also contain solvents that will reduce the strength of certain components.

⚠ CAUTION ⚠

Use of these coatings is at considerable risk and should be avoided.

8.3.1 Repair

All components used in the production of the escape hatch are available as service parts, except for one hinge that represents a possible hazard when improperly reattached to a hidden tapping plate, itself often damaged whenever the hinge is damaged. The tapping plate is permanently laminated between the inner and outer cover assemblies, and it cannot be inspected or replaced. It is therefore necessary to replace the entire assembly following damage to the hinge. See figure 25.

⚠ CAUTION ⚠

Hinge assembly is critical and hinge should never be removed from cover assembly. Fasteners used in this assembly are special and have critical torque requirements and tamper-resistant heads to discourage tampering.

8.3.2 Sealing

1. Open and tilt up the escape hatch cover.
2. Join the 2 ends of the rubber seal.

⚠ CAUTION ⚠

Seal joint should be toward rear of vehicle.

3. Apply rubber adhesive CA-40 (Prévost # 681285) in the gap between the seal ends.
4. Apply Sikaflex 221 sealant (Prévost # 680532) along the outline of the escape hatch on the roof of vehicle.

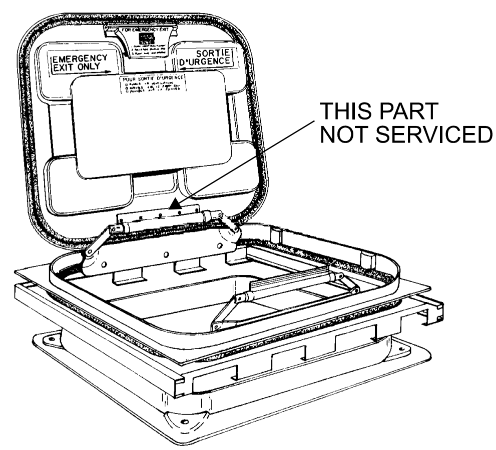


FIGURE 27: ESCAPE HATCH 18104

8.3.3 Escape Hatch Panel Assembly

The frame of the escape hatch is riveted to the roof of the vehicle. The escape hatch panel assembly can be replaced as a unit and a new panel assembly installed in the existing frame. To remove the panel assembly, remove the 4 bolts fastening the 2 hinges to the escape hatch frame and retain the 4 flat washers. Reinstall the panel assembly by fastening the 2 hinges with the 4 bolts and flat washers removed earlier.

⚠ CAUTION ⚠

When installing, roof escape hatch's hinge must be toward the front of vehicle, to prevent the hatch from being ripped out if accidentally opened while vehicle is running.

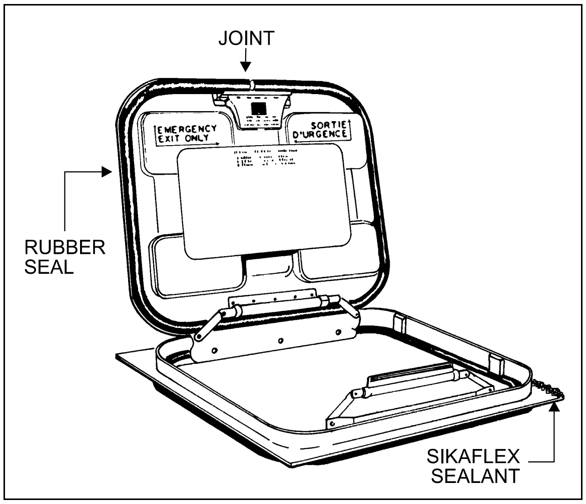


FIGURE 28: ESCAPE HATCH 18105

8.3.4 Escape Hatch Frame

When necessary, the escape hatch frame can be removed and replaced in the following way:

1. Support the frame from inside the vehicle.
2. Remove rivets.
3. Cut the rubber seal with a sharp edge knife and remove the hatch frame.
4. On vehicle top, using the knife, remove as much as possible the remaining rubber seal.
5. Drill holes (if needed) in the new metal frame.
6. Clean both vehicle top and new hatch frame with SIKA 205.
7. Apply rubber adhesive SIKA 221 under the hatch frame surface.
8. Install the frame in place and fix it with rivets.
9. Remove excess adhesive and clean all around.

9 ZONE 3

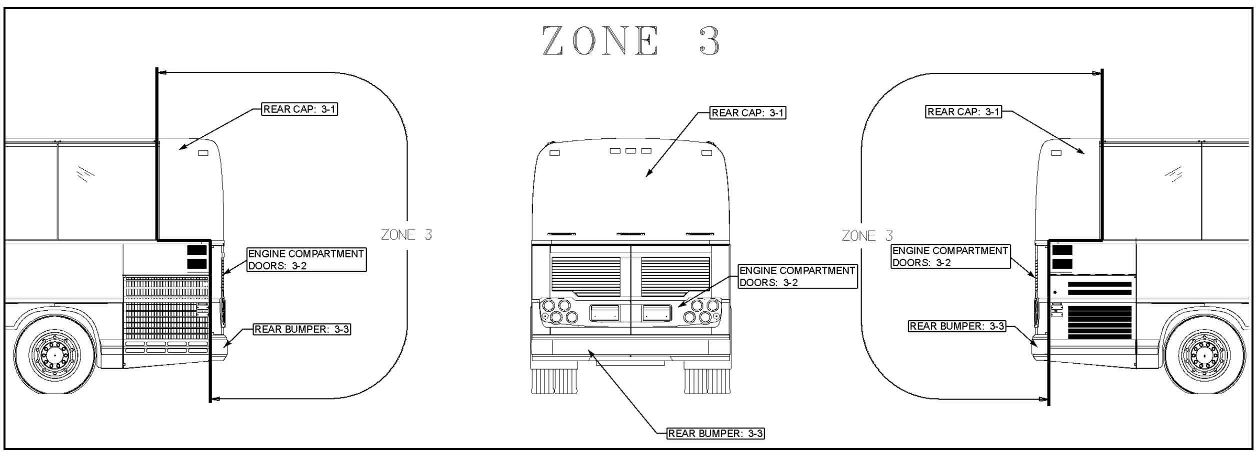


FIGURE 29: ZONE 3 18626

9.1 REAR CAP

The fiberglass rear cap does not need any maintenance except painting as needed. It is held in place with adhesive. If ever it has to be replaced, make an appointment at a Prévost service center near you. For minor damages, refer to Paragraph 4 "Common Fiberglass Repair Procedure" and Paragraph 5 "Common Painting Procedure".

9.2 ENGINE COMPARTMENT DOORS

Engine compartment doors may be adjusted for proper fit by untightening hinge bolts:

1. Loosen the bolts, (1, 2 Fig. 30) holding the hinge to the vehicle structure to shift the door "UP or DOWN".
2. Loosening the bolts (3, Fig. 30) allows the door to be shifted "LEFT or RIGHT" and "IN or OUT".
3. Adjust the doors position depending on the gap needed between exterior finishing panels.
4. Tighten the bolts.
5. Check that the doors swing freely and close properly. It may be necessary to adjust the door latch to get proper fit and operation.

To adjust the latch mechanism (4, Fig. 30) and the striker pin:

1. Open the doors to access the striker pin.
2. Slightly loosen the striker pin.
3. Using a hammer, adjust the striker pin to center it in the door latch mechanism.
4. Tighten the striker pin.
5. Check doors fit and operation.

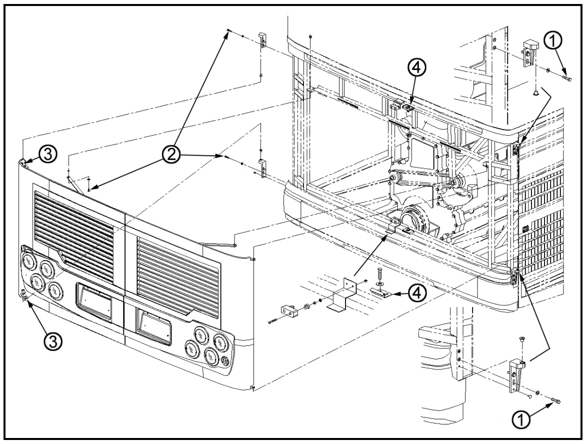


FIGURE 30: ENGINE COMPARTMENT DOORS 18633

9.3 REAR BUMPER

Remove three bolts on each side holding bumper to vehicle and remove bumper.

To install bumper, reverse the procedure.

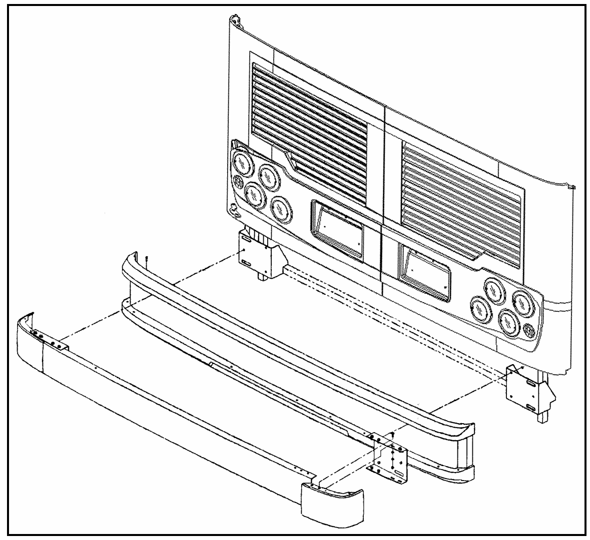


FIGURE 31: REAR BUMPER 18634

10 ZONE 4

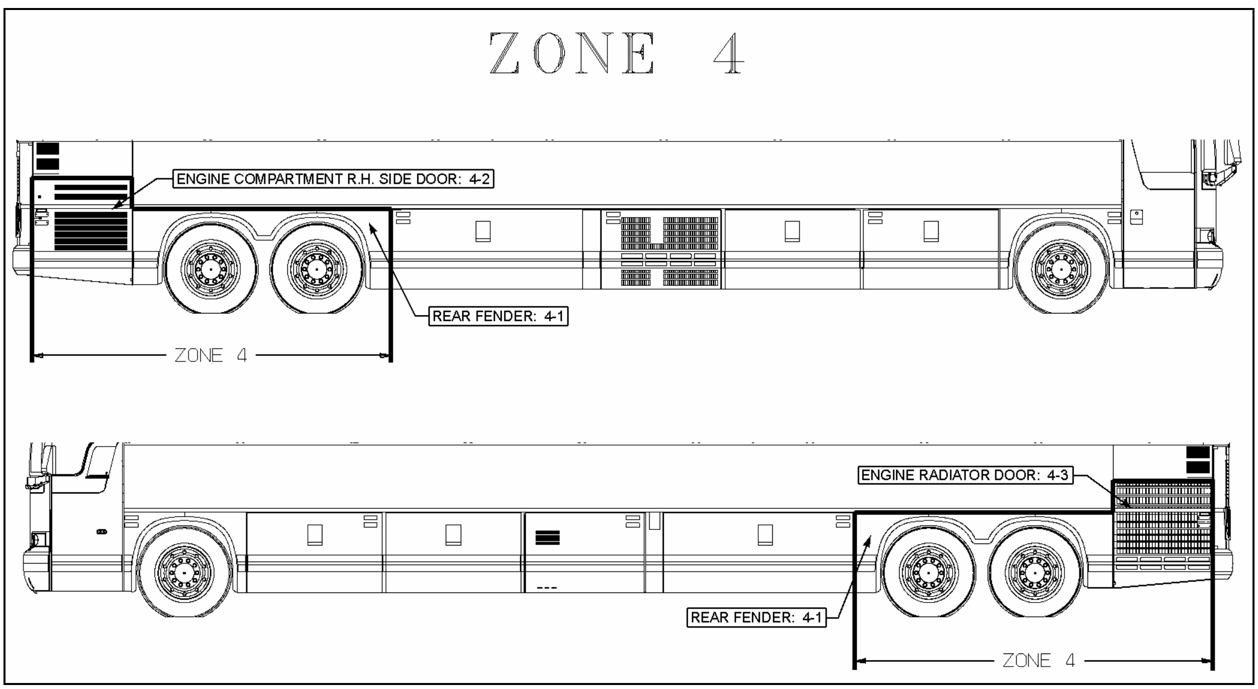


FIGURE 32: ZONE 4 18627

10.1 REAR FENDER

On the "X3" series vehicle, rear fenders are hinged for maintenance on brakes and suspension. Each rear fender panel has two mechanical spring loaded holding devices fixing it to the vehicle's structure. Push the spring type rod sideways to disengage the lock.

10.2 ENGINE COMPARTMENT R. H. SIDE DOOR

Engine compartment R. H. side door may be adjusted for proper fit by untightening hinge bolts:

1. Loosen the bolts, (1, Fig. 33) holding the hinge to the vehicle structure to shift the door "IN or OUT" and "UP or DOWN".
2. Loosening the bolts (2, Fig. 33) allows the door to be shifted "LEFT or RIGHT" and "UP or DOWN".

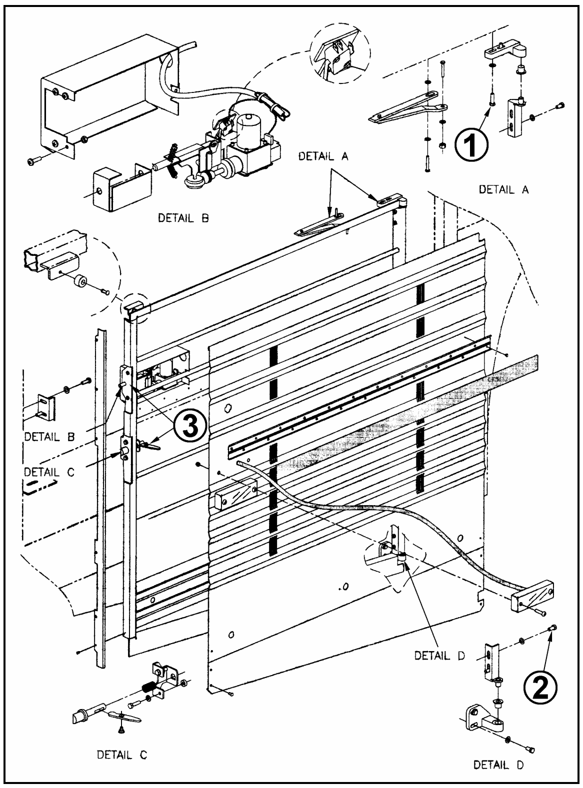


FIGURE 33: ENGINE COMPARTMENT R.H. SIDE DOOR 18635

3. Adjust the door position depending on the gap needed between exterior finishing panels.
4. Tighten the bolts.
5. Check that the door swings freely and closes properly. It may be necessary to adjust the door latch to get proper fit and operation.

To adjust the latch mechanism (3, Fig. 33) and the striker pin:

1. Open the door to access the striker pin.
2. Slightly loosen the striker pin.
3. Using a hammer, adjust the striker pin to center it in the door latch mechanism.
4. Tighten the striker pin.
5. Check door fit and operation.

10.3 ENGINE RADIATOR DOOR

Radiator door may be adjusted for proper fit by untightening hinge bolts:

1. Loosen the bolts, (1, Fig. 34) holding the hinge to the vehicle structure to shift the door "IN or OUT" and "UP or DOWN".
2. Loosening the bolts (2, Fig. 34) allows the door to be shifted "LEFT or RIGHT" and "UP or DOWN".

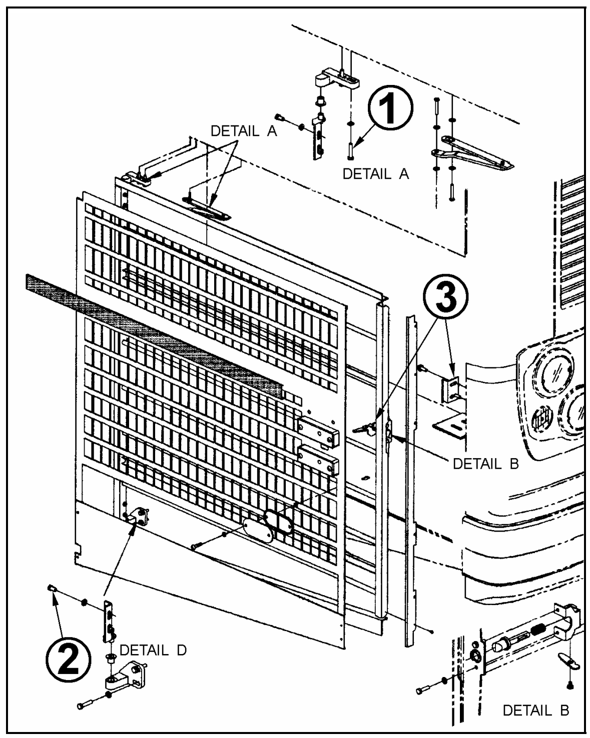


FIGURE 34: RADIATOR DOOR 18636

3. Adjust the door position depending on the gap needed between exterior finishing panels.

4. Tighten the bolts.
5. Check that the door swings freely and closes properly. It may be necessary to adjust the door latch to get proper fit and operation.

To adjust the latch mechanism (3, Fig. 34) and the striker pin:

1. Open the door to access the striker pin.
2. Slightly loosen the striker pin.
3. Using a hammer, adjust the striker pin to center it in the door latch mechanism.
4. Tighten the striker pin.
5. Check door fit and operation.

11 ZONE 5

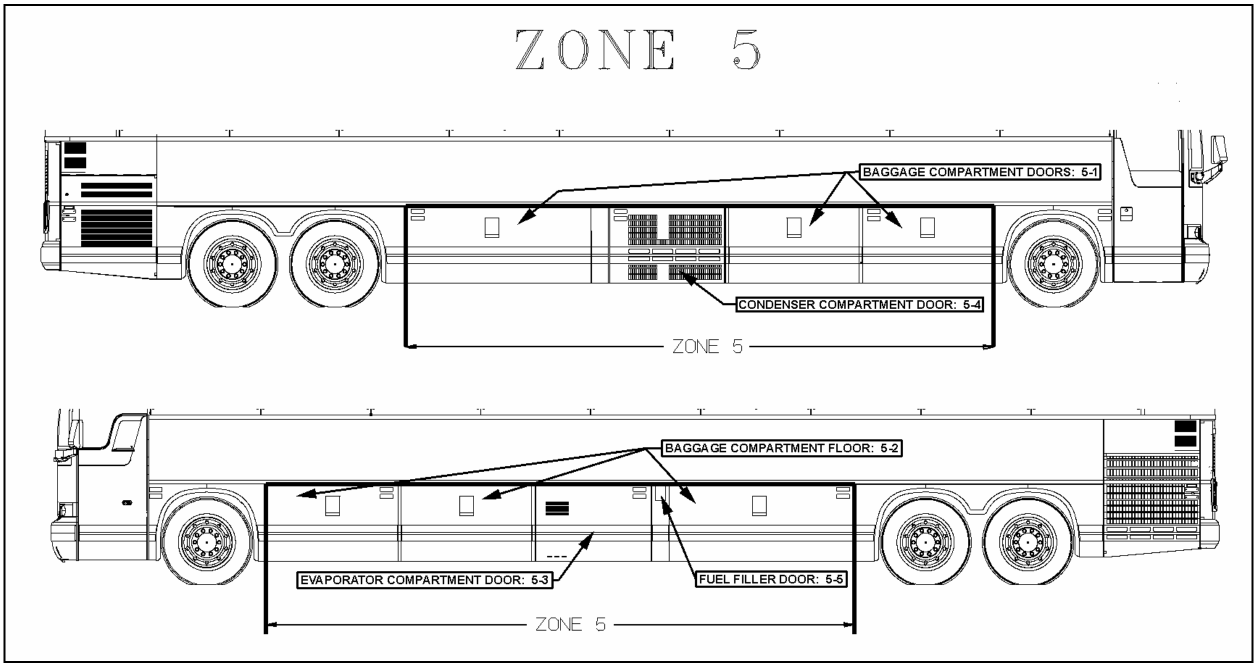


FIGURE 35: ZONE 5 18628

11.1 BAGGAGE COMPARTMENT DOORS

For the removal and installation of baggage compartment door stainless steel body panel, you will need:

A drill with drill bits;

Pneumatic “Zip gun” type tool;

Razor sharp window scraper or putty knife;

- Open damaged compartment door and unfasten rub rail fixing bolts. Remove rub rail.
- Unfasten bolts and disconnect cable if necessary in order to remove door from vehicle.
- Preferably install the door onto a work surface where it can be solidly fixed.

11.1.1 Door Lower Panel

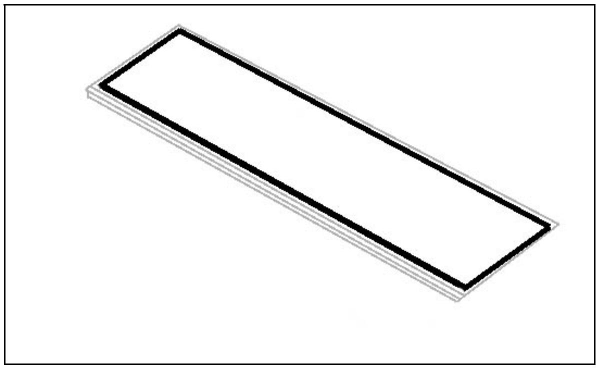
Panel Removal

- Using the “Zip Gun”, cut Sika bead located ½ inch from the door panel perimeter edge.
- Wearing gloves, goggles and ear plugs, pry loose body panel using a “Zip gun” or lever starting from the door lower part.
- Using the window scraper, remove any Sika bead or self adhesive tape residue left on the door frame.

Lower Panel Preparation and Installation

- Use a Chix cloth and anti-silicone to remove any dust or residue from door frame.
- Prepare door frame using a scratch pad “Scotch Brite”.
- Clean door frame again using anti-silicone.

- Apply some Sika 206 G+P onto door frame.
- Clean door lower panel using anti-silicone.
- Prepare door lower panel using a scratch pad “Scotch Brite”.
- Clean door lower panel again using anti-silicone.
- Apply some Sika 206 G+P onto door lower panel.
- Using a triangular nozzle (8mm X 9mm), apply some Sika 255 onto door lower panel.



- Position and install door lower panel onto frame.
- Compress and hold for 8 hours.

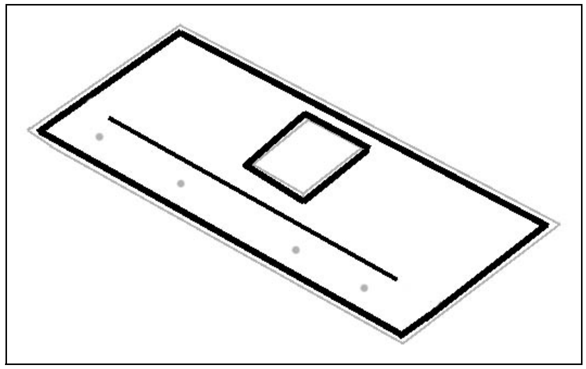
11.1.2 Door Upper Panel

Upper Panel Removal

- From the back of the baggage compartment door, remove handle housing fixing screws (6).
- Remove lock access panel
- Wearing gloves, goggles and ear plugs, pry loose body panel using a “Zip gun” or lever starting from the door lower part.
- Cut Sika bead around handle housing.
- Using the window scraper, remove any Sika bead or self adhesive tape residue left on the door frame.

Upper Panel Preparation and Installation

- Use a Chix cloth and anti-silicone to remove any dust or residue from door frame.
- Prepare door frame using a scratch pad “Scotch Brite”.
- Clean door frame again using anti-silicone.
- Apply some Sika 206 G+P onto door frame.
- Clean door upper panel using anti-silicone.
- Prepare door upper panel using a scratch pad “Scotch Brite”.
- Clean door upper panel again using anti-silicone.
- Apply some Sika 206 G+P onto door upper panel.
- Using a triangular nozzle (8mm X 9mm), apply some Sika 255 onto door lower panel.



- Position and install door upper panel onto frame.

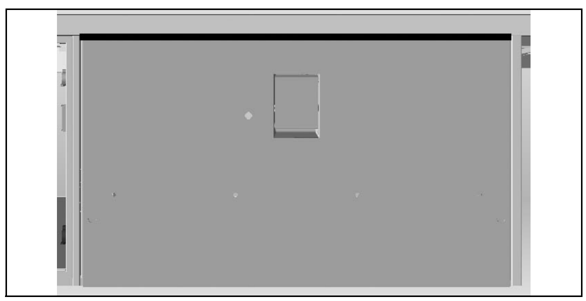
NOTE
Use rub rail fixing holes for upper panel proper positioning.

- Compress and hold for 8 hours.

Baggage Compartment Door Adjustment

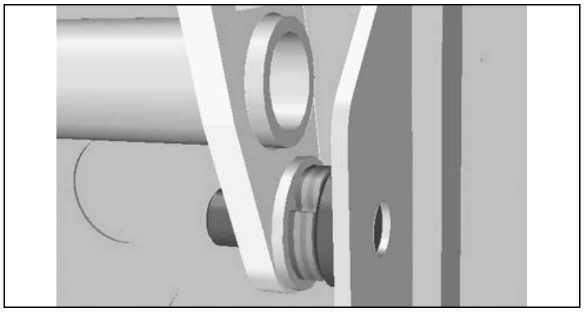
- Adjust door to get a 7mm gap at the top.

NOTE
Adjustment is made using the side plates.



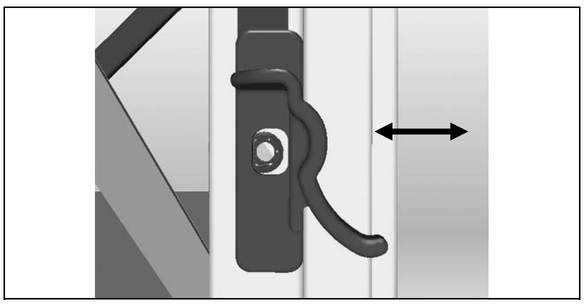
- Center door in the opening using the side plate shims.

> *NOTE*
>
> *Adjustment is made using shims on the side plates. A total of 8 shims per door must be used e.g. 4 on L.H. side and 4 on R.H. side or 2 on L.H. side and 6 on R.H. side, etc.*



- Adjust door position and evenness with reference to adjacent panels and doors.

> *NOTE*
>
> *Adjustment is made by moving IN or OUT the lock plates. Adjust one corner at a time.*



- Check handle adjustment. Handle must remain tight against its plastic housing.

> *NOTE*
>
> *Adjustment is made by moving UP or DOWN the lock plates.*

- Open baggage compartment door and adjust height using the catch plates.
- Tighten cylinder blocks fixing screws.

11.2 BAGGAGE COMPARTMENT FLOOR

11.2.1 Repair of Mantex Urethane Covering

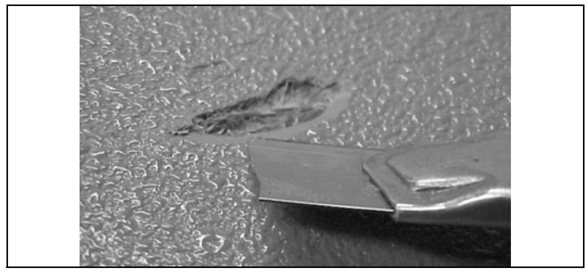
Minor Repair

Use “Dupont IMRON” paint. Apply using a paint brush or roller depending on gravity.

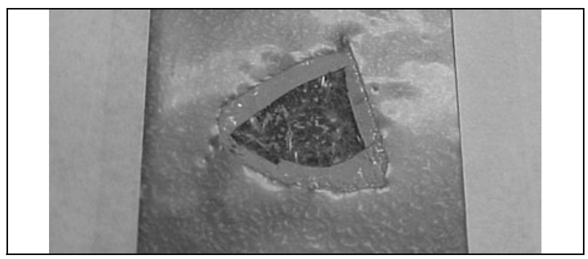
Paint Code: #J4099U

Major Repair (Hole)

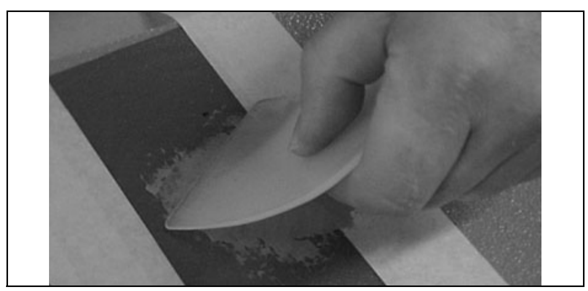
Chamfer the whole perimeter of the damaged area. If applicable, remove loose covering. Remove dust and particles.



Cover and protect damaged area surroundings.



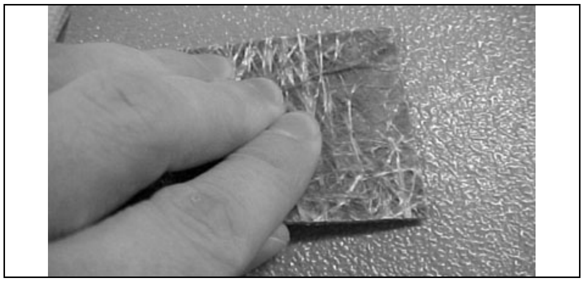
Using a plastic spatula, apply some Sika 221 grey onto the damaged area.



Remove masking tape and protection around damaged area.

Spray pure water onto Sika. Use a floor sample to create some texture onto the adhesive.

If possible spray some more water onto the adhesive to accelerate curing.

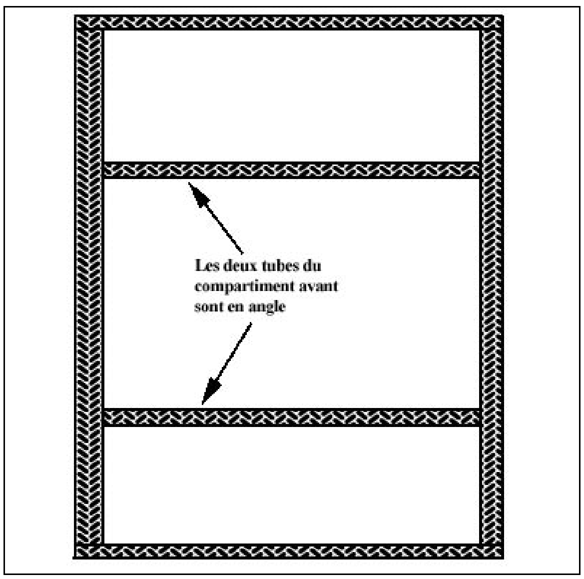


Allow drying for at least **2 hours** then repaint as per paragraph: Minor Repair.

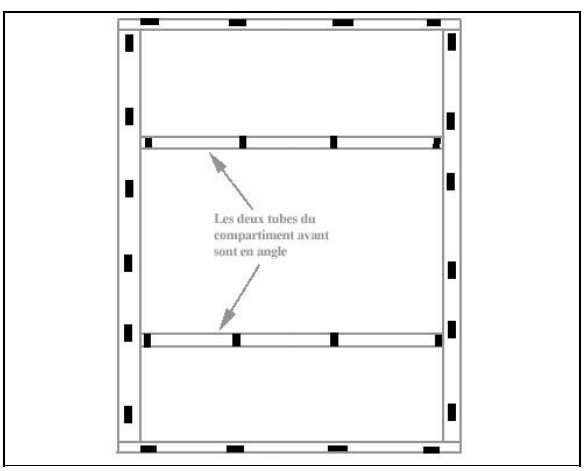
11.2.2 Baggage Compartment Floor Installation

Preparation and Installation

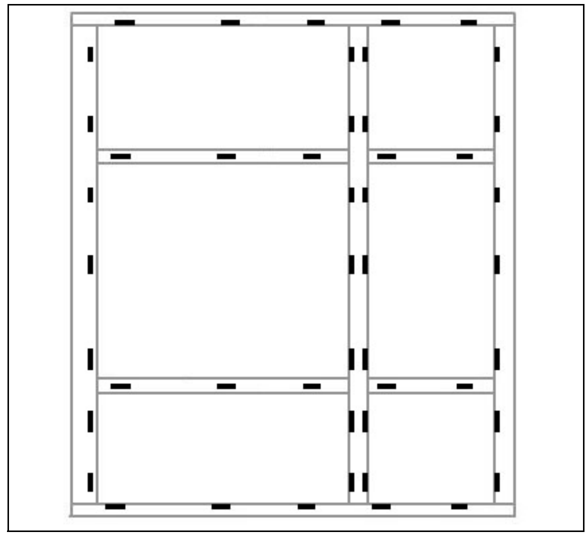
Clean baggage compartment support structure using anti-silicone.



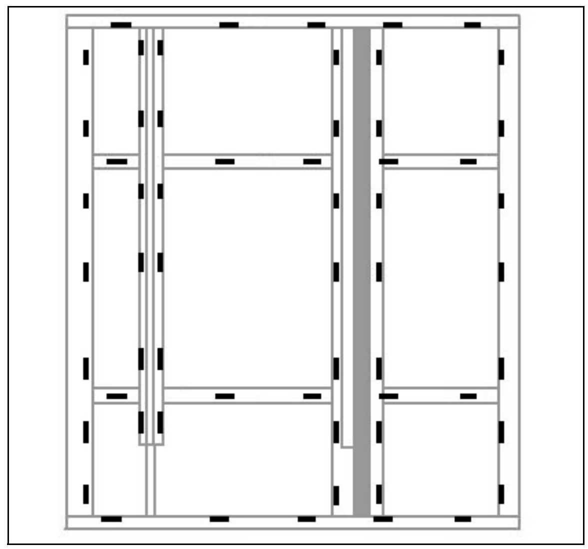
Glue spacers (790392) about 16-inch apart.



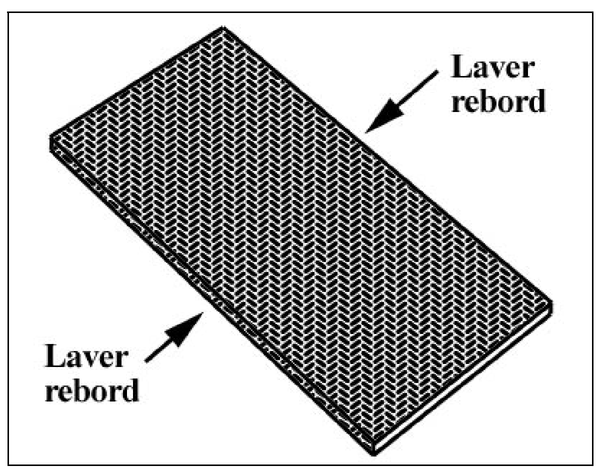
Rear baggage compartment without WCL.



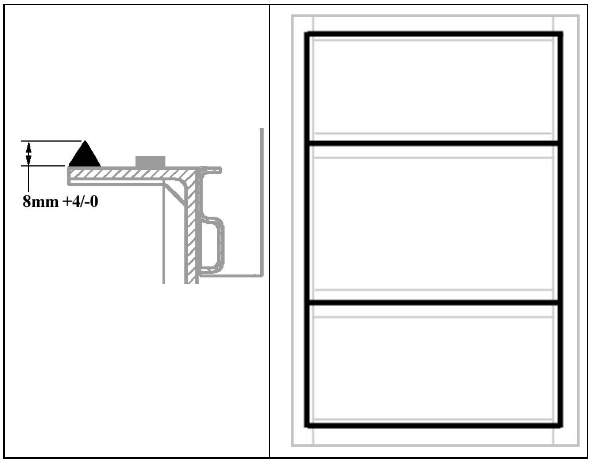
Rear baggage compartment equipped with WCL



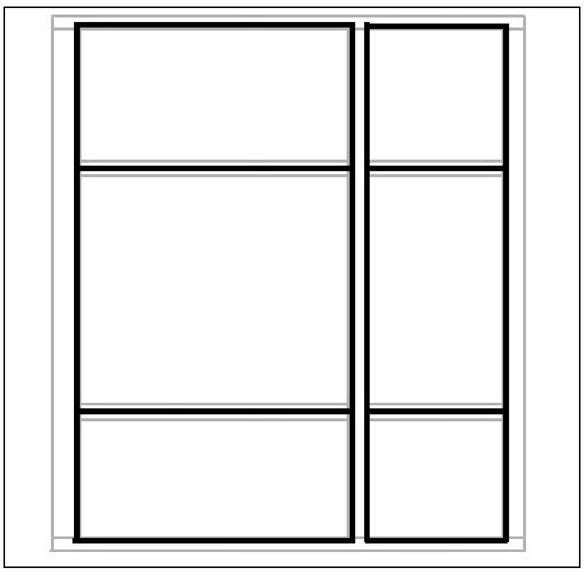
Prepare baggage compartment Mantex floor. Clean panel underside and edges.



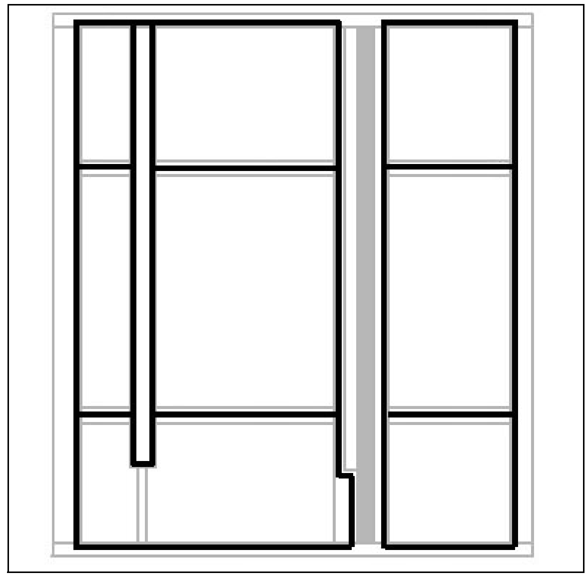
Using a triangular nozzle, apply "Simson" glue (685126) onto support structure.



Rear baggage compartment without WCL.



Rear baggage compartment equipped with WCL

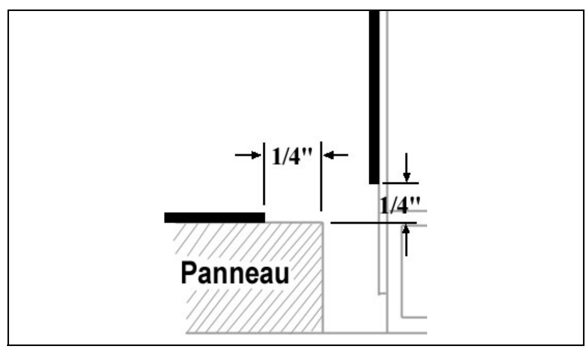


Carefully install panel onto support structure.

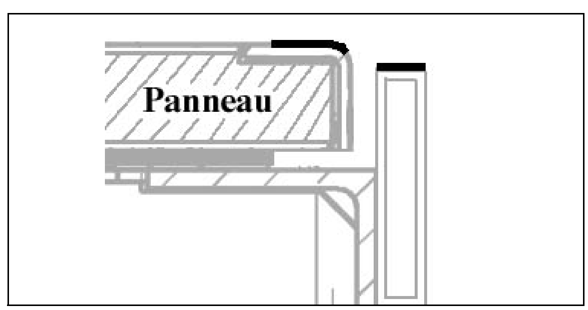
Evenly distribute and install conforming weights (6 to 8) (80 to 100 lbs **total**) onto panel for at least **4 hours**. Make sure panel does not move.

Finishing Joints

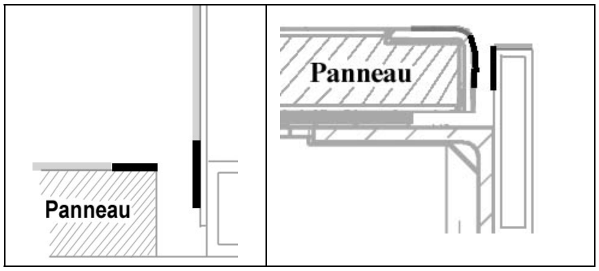
In the case of lateral finishing joint, apply some masking tape ¼" from panel edge and ¼" above panel.



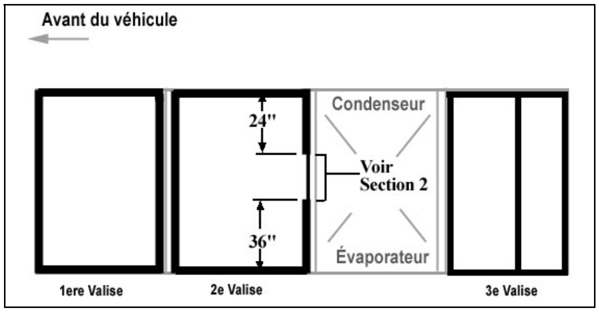
In the case of front finishing joint, apply some masking tape on each side of joint.



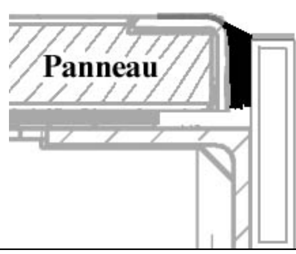
Clean with anti-silicone the area where the Simson glue will be applied.



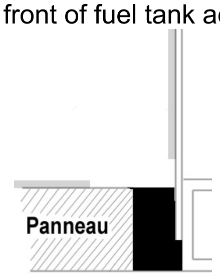
Apply some Simson glue to fill the gap.



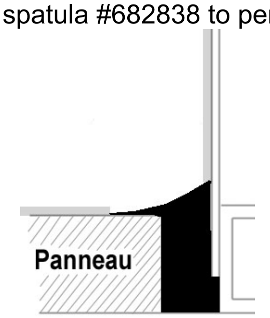
Front finishing joint



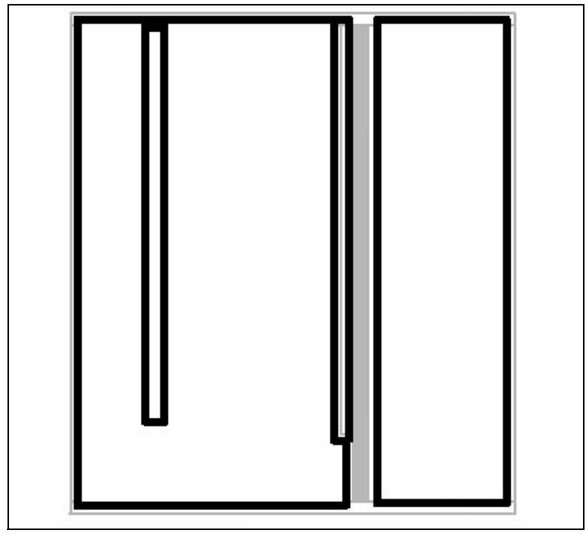
Section 2
Flat joint in front of fuel tank access panel



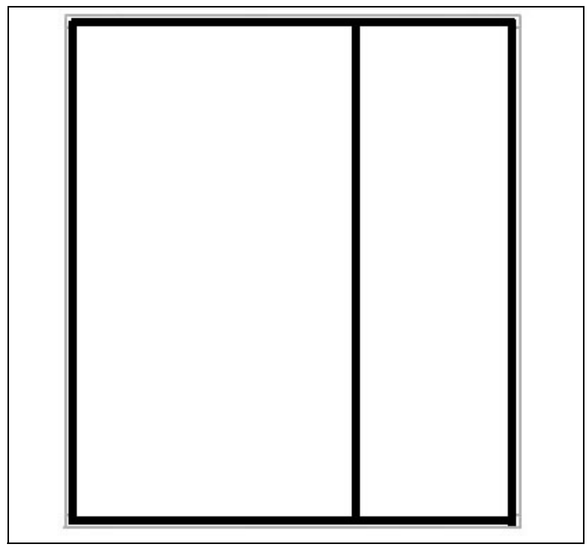
Use plastic spatula #682838 to perform radius



Rear baggage compartment equipped with WCL



Rear baggage compartment without WCL.



Remove masking tape.

Smooth down joints using soapy water.

11.3 EVAPORATOR COMPARTMENT DOOR

1. Open the evaporator door.
2. Loosen the screws fixing the hinge to hinge attachment or hinge to door assembly. Loosening the screws allows the evaporator door assembly to be shifted "LEFT or RIGHT" and "UP or DOWN" or “IN and OUT”.
3. Adjust evaporator door assembly position at the hinge.
4. Tighten the screws.

5. Respect the required gap between exterior finishing panels.
6. Check that the door swings freely and closes properly. It may be necessary to adjust the door latch to get proper fit and operation.

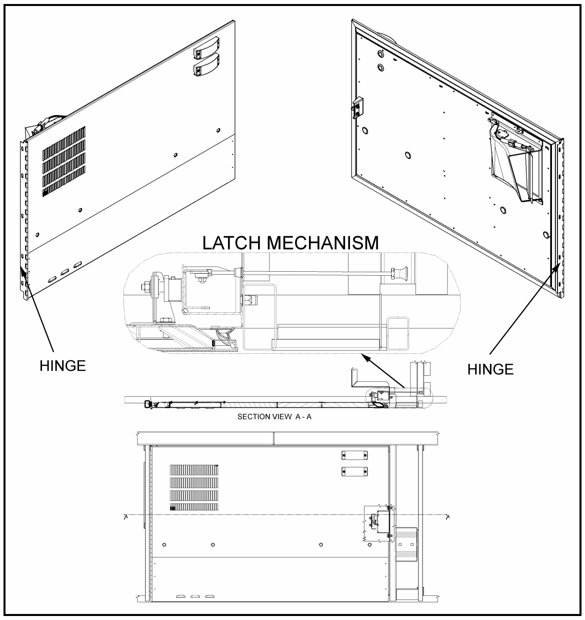


FIGURE 36: EVAPORATOR DOOR 18637

11.4 CONDENSER COMPARTMENT DOOR

1. Open the condenser door.
2. Loosen the screws fixing the hinge to hinge attachment or hinge to door assembly. Loosening the screws allows the condenser door assembly to be shifted "LEFT or RIGHT" and "UP or DOWN" or “IN and OUT”.
3. Adjust condenser door assembly position at the hinge.
4. Tighten the screws.
5. Respect the required gap between exterior finishing panels.
6. Check that the door swings freely and closes properly. It may be necessary to adjust the door latch to get proper fit and operation.

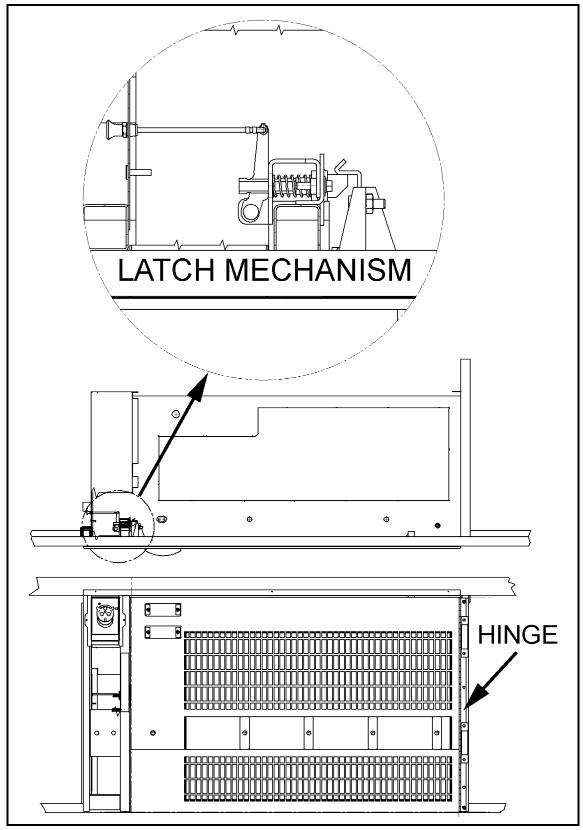


FIGURE 37: CONDENSER DOOR 18638

11.5 FUEL FILLER DOOR

1. Open the fuel filler door.
2. Loosen the screws holding the panel to hinge assembly.
3. Adjust the fuel filler door position according to distance required between exterior finishing panels.
4. Tighten the nuts.
5. Check that the door swings freely and closes properly.

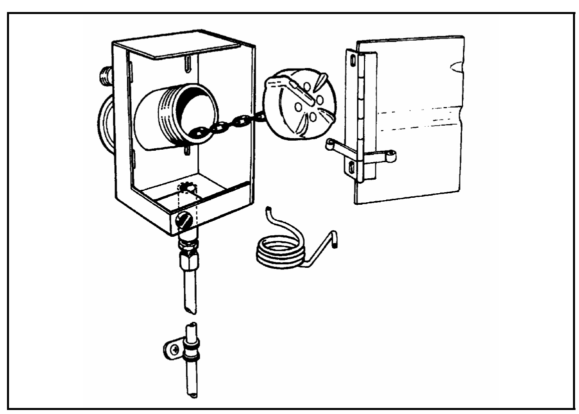


FIGURE 38: FUEL FILLER DOOR 03046

12 ZONE 6

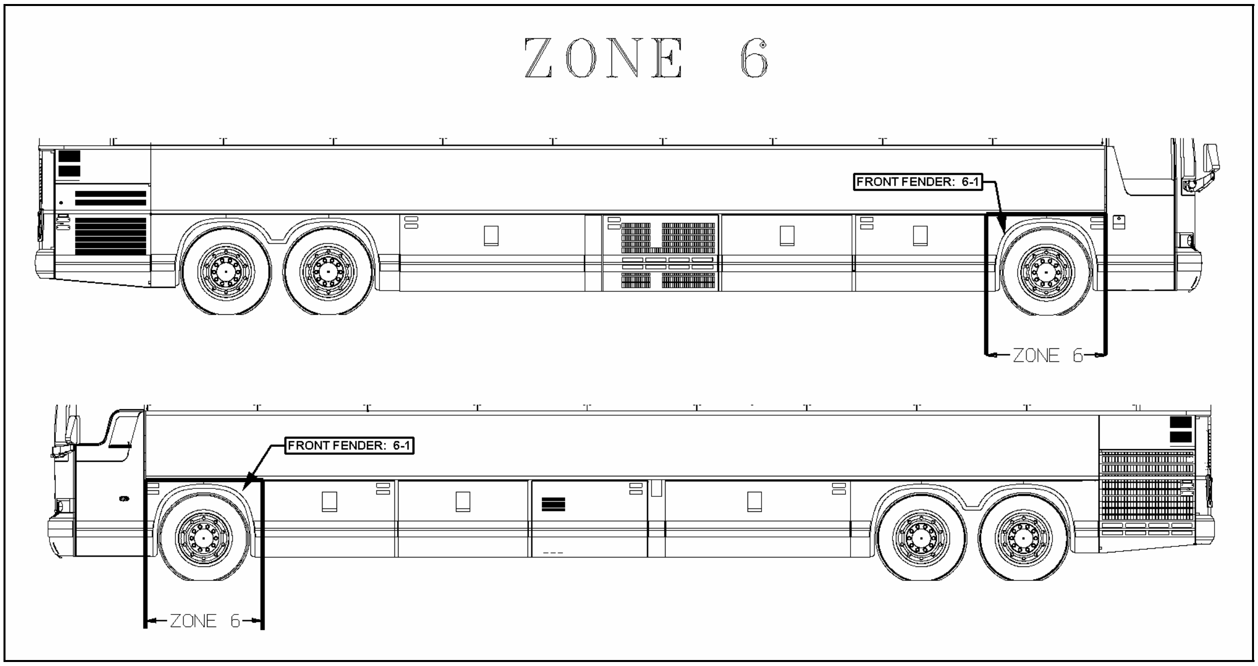


FIGURE 39: ZONE 6 18629

12.1 FRONT FENDER

Front fender may be removed using the following procedure:

Remove the nuts on the inside of the fender. Remove the fender from the vehicle. To reinstall, reverse the procedure.

13 ZONE 7

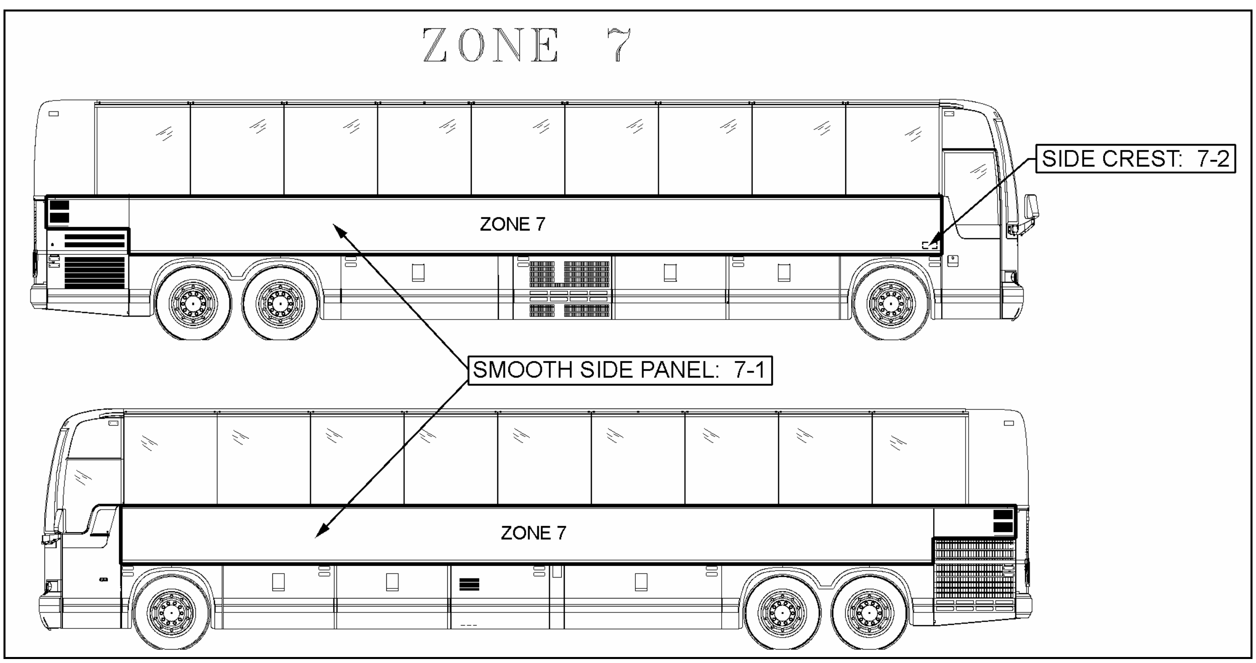


FIGURE 40: ZONE 7 18630

13.1 X3 SMOOTH SIDE PANEL REPLACEMENT PROCEDURE

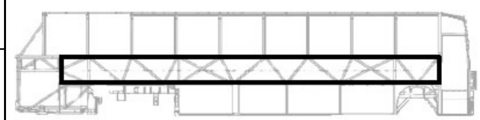
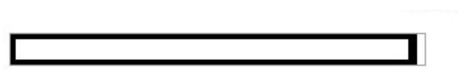
Material:

Anti-silicone (682989)	√	Scotchbrite gray (680226)	√	Sika 221 gray	√
CHIX cloth (682384)	√	Sika 205 1liter (683097)	√	Sika 252 black	√
Blue cloth (682383)	√				

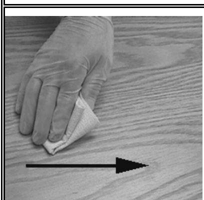
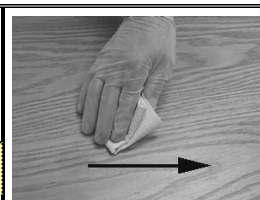
Equipment:

Glue gun	√	
Pencil	√	

SECTION 1 SMOOTH SIDE PANEL REMOVAL			
1.00		**REMOVAL**	
	A)	Remove finishing molding. Insert a screwdriver into snap-on finishing molding joint. Bend finishing molding enough to be able to fix a pair of locking pliers. Using the pair of locking pliers, pull the stainless steel molding and at the same time gradually cut Sika bead with a sharp knife.	Be careful not to damage the adjacent surfaces.
	B)	Using a hammer and punch, drive out rivet shanks from top and bottom and from front and rear finishing molding supports. Use a #11 titanium drill bit to remove rivet heads.	
	C)	Grind tig weld spots at each end of side panel.	
	D)	Safely support or temporary fix side panel.	**Warning: Panel weights over 200 pounds**
	E)	Insert a flat screwdriver between the side panel and the vehicle chassis, in the top left and right corners. Make sure to separate side panel from structure.	Be careful not to damage the adjacent surfaces.
	F)	Use the c-clamp to separate the side panel from the back structural panel and at the same time gradually cut Sika bead with a sharp knife.	Ideally, the hoist or chain block must be fastened to the floor while pulling from a 45° angle so as not to damage the vehicle structure
	G)	Remove as much glue as possible from the structure using a putty knife or pneumatic knife without damaging 206 G+P primer.	Never heat SikaFlex adhesive to remove.
	H)	Check panel horizontal supports for straightness using a straight edge. Take measurements with a ruler.	Tolerance : 1mm towards the outside and 1.5mm towards the inside.

SECTION 2 PREPARATION OF SURFACES			
2.00	**VEHICLE SURFACE PREPARATION**		
	A)	Clean using "anti-silicone" until all clothes come clean. See PR000001 section A.	
	B)	Use the belt sander (grit coarse) Use a new paper on each vehicle side.	
	C)	Clean using "anti-silicone" until all clothes come clean. See PR000001 section A.	
	D)	Apply – Sika 205 See PR000001 section B.	
2.05	**SIDE PANEL PREPARATION**		
	A)	Clean using “anti-silicone” until all clothes come clean. See PR000001 section A.	
	B)	Use the belt sander (grit coarse) Use a new paper on each vehicle side panel.	
	C)	Clean using “anti-silicone” until all clothes come clean. See PR000001 section A.	
	D)	Apply – Sika 205 See PR000001 section B.	

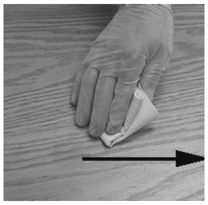
PR000001 Section A Alcohol or Anti-silicone

	**1. Apply** **CHIX cloth**		**2. Dry immediately** **Blue cloth**

3. Allow to dry

Mandatory	**Minimum time : Wait for product to evaporate**
	After 2 hours: Start cleaning operation again
Before applying any other product	If surface seems dusty, greasy or with finger marks, start cleaning operation again.

Section B Sika 205

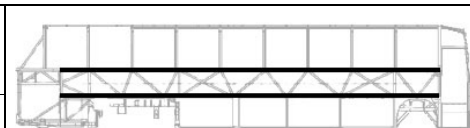
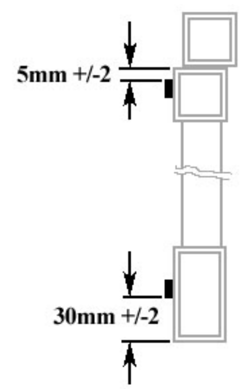
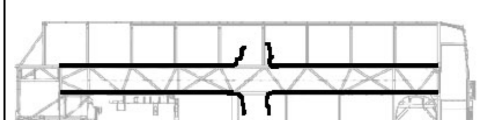


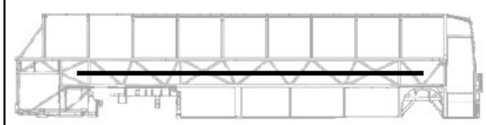
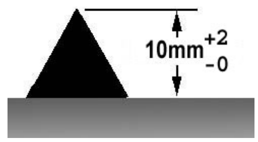
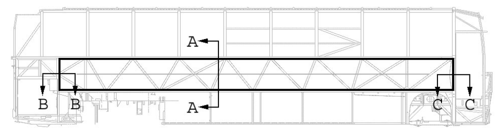
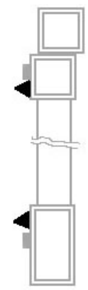
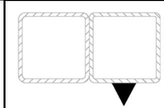
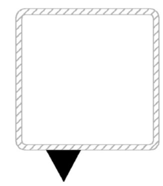
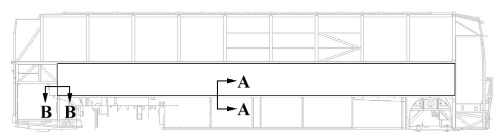
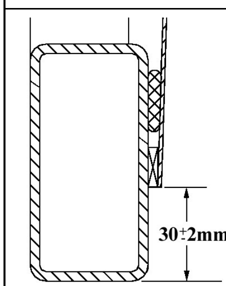
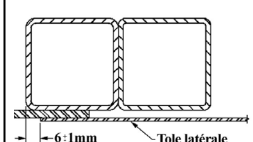
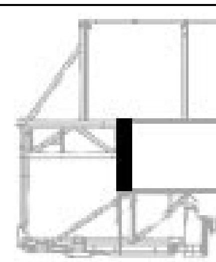
1. Apply

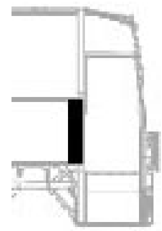
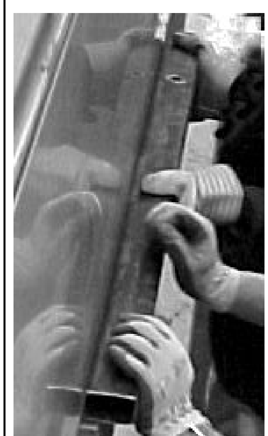
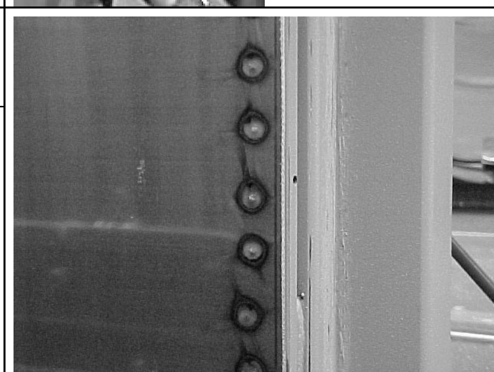
CHIX cloth

2. Allow drying

Mandatory	**Minimum time**	**- For a smooth surface (aluminum, stainless, steel, fiber glass (gelcoat side), etc.):**	**2 minutes**
		- Pour a porous surface (fiber glass (non gelcoat side), etc.)	**10 minutes**
	After 2 hours : Reactivate surface with Sika 205		
Before applying any other product	If surface seems dusty, greasy or with finger marks, start operation again.		

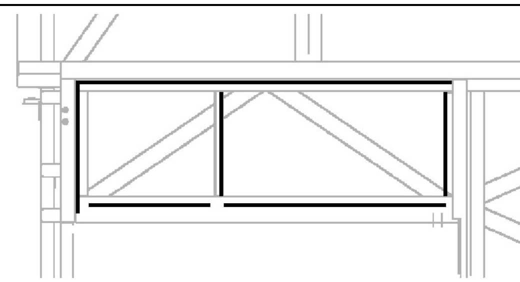
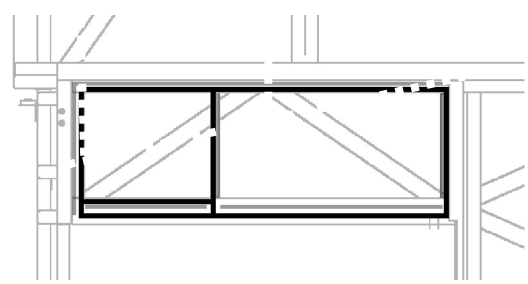
SECTION 3 SIDE PANEL INSTALLATION			
3.00	A)	Using a pencil, mark the double-face self adhesive tape position onto vehicle side.	
	B)	Apply 1/8 X ½”double-face tape as per marking.	
	C)	Compress tape	
	D)	Remove protective film from double-face self adhesive tape center section.	

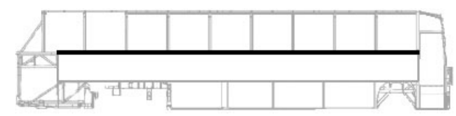
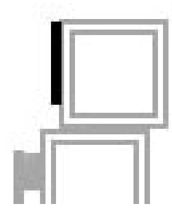
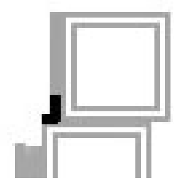
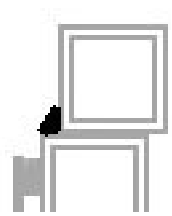
<table>
<tr><td>3.05</td><td colspan="2">Install 1/8 X ½” foam tape onto middle reinforcement then compress.</td><td colspan="3"></td></tr>
<tr><td rowspan="3">3.10</td><td colspan="2" rowspan="3">Apply Sika 252

– Onto vehicle surface
– Cut nozzle as per template
– Use the guide for the application
Bead must be continuous for the whole perimeter.</td><td colspan="3"></td></tr>
<tr><td>Section A-A</td><td>Section B-B</td><td>Section C-C</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td rowspan="6">3.15</td><td>A)</td><td>Install side panel onto support jig.</td><td colspan="3"></td></tr>
<tr><td rowspan="2">B)</td><td rowspan="2">Position side panel in front of vehicle structure</td><td>Section A-A</td><td colspan="2">Section B-B</td></tr>
<tr><td></td><td colspan="2"></td></tr>
<tr><td>C)</td><td>Perform final adjustment to make sure that side panel is true and square</td><td colspan="3">– 30 mm. ± 2 with reference to bottom tubing
– 6 mm ± 1 with reference to vertical tubing</td></tr>
<tr><td>D)</td><td>Sand rear of side panel 2" wide</td><td colspan="3"></td></tr>
<tr><td>E)</td><td>Perform tig spot welding (1” apart)</td><td colspan="3">Quantity of "tig spot": 30 minimum.</td></tr>
</table>

3.20	A)	Install pulling equipment at the other end of side panel	
	B)	Make a final adjustment in height	
	C)	Sand front of side panel 2" wide	
	D)	Pull side panel so that panel moves 1/8”	Make sure the equipment pulls along the whole width of side panel
	E)	Perform tig spot welding	Quantity of "tig spot": 30 minimum.
3.30	Remove pulling equipment		
3.40	A)	Remove protective film from double-face self adhesive tape.	
	B)	Compress top and bottom section of side panel	
3.50	A)	Cut excess of side panel. Make sure that cut is parallel with tubing.	
	B)	Grind side panel end to line up with door tubing.	
3.60	To seal each panel end, apply masking tape on each side of side panel joint. Use a caulking nozzle and grey Sikaflex 221 adhesive to fill the cavity between the panel and vehicle structure. Clean using Sika 205. Allow 5 minutes minimum for drying.		

	Wear surgical gloves and smooth down the joint with your finger.	

SECTION 4 ENGINE AIR INTAKE PANEL INSTALLATION		
4.00	Make sure that sealing of structure has been performed properly	
4.05	Prepare vehicle surface as for side panel.	Refer to step # 2.00
4.10	Prepare air intake panel as for side panel	Refer to step # 2.05

4.15	Install foam tape 1/8" X ¼" onto structure, as shown in picture	
4.20	Install foam tape 1/16" X ¼ onto air intake panel pleat	
4.25	Apply a bead of 252 onto structure as per picture Important: Make sure bead is continuous Triangular bead: 10mm x 8mm	
4.30	Install panel onto structure	Use a jig to make sure that panel is lined up with engine door tubing.
4.40	Use a brush to compress Sika bead	

5.00 *	**Finition Joint**		
	A)	Install a protective tape onto the tubing above welding	
	B)	Apply Sika 205 Use a plastic spatula inside a Chix cloth to ensure that Sika 205 reaches as far as the corner. See PR000001 section B.	
	C)	Apply Sika 252 black at the junction of both tubing. Smooth down the joint	
	D)	Remove protective tape	

13.2 SIDE CREST

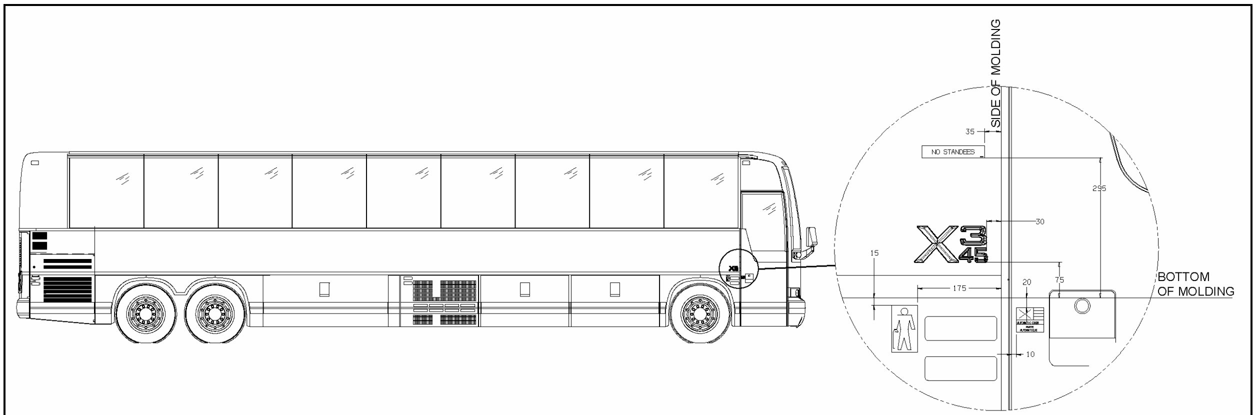


FIGURE 41: SIDE CREST POSITIONING 18639

- Clean vehicle surface using anti-silicone where the side crest and stickers will be applied.
- Using hands apply and compress side crest.
- Apply required stickers.

14 BODY PANEL AND WINDOW SPACING

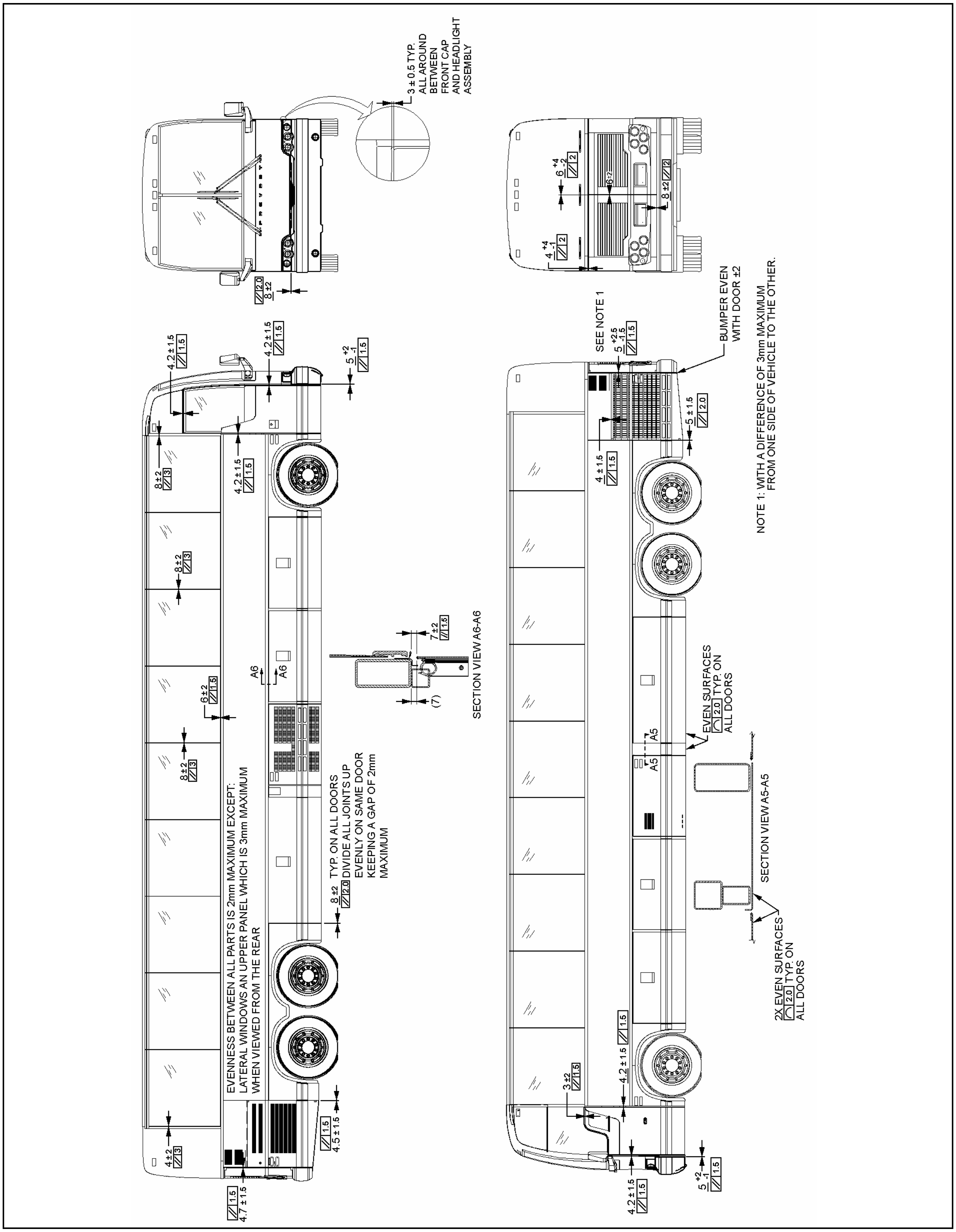


FIGURE 42: BODY PANEL AND WINDOW SPACING 18631

15 PASSENGER SEATS

X3 coaches can be equipped with any of 3 basic seat models and installed in a variety of seating arrangements:

1. The *"Tourismo 2"* seat is the base model and is available in heights of 40" (102 cm) and 42" (107 cm). Seating arrangement includes 2 card tables which can be folded and removed, and pivoting seats ahead of each card table. Each pair of seats is built on a welded steel frame fastened to the side wall and on a track-mounted pedestal.
2. The *"Silhouette"* seat is an optional model with each pair also built on a welded steel frame and mounted the same way as the *"Tourismo 2"* seat. Standard seating arrangement with "Silhouette" seat includes 2 card tables and 2 pivoting seats. Seating capacity is the same as with the *"Tourismo 2"* seat.
3. The *"V.I.P."* seat model is an optional seat. *"V.I.P."* seats are mounted on one row of paired seats built on a common frame on one side of the vehicle, and a row of single seats on the other side of the vehicle with an off-center aisle. Each *"V.I.P."* seat has its own set of armrests.

Each seat has a easily removable bottom cushion. Upholstery is clipped on the cusion frame for cleaning or replacement. To remove the fabric, simply unclip from the frame. The *"Tourismo 2"* and *"Silhouette"* seats have 3 armrests. The aisle and center armrests can be folded up and down manually, while the window armrest is fixed.

15.1 ROTATING SEATS

1. Remove 1 wing nut holding each seat bottom cushion from under the seat frame.
2. Lift front part of cushions and remove cushions.
3. Remove 4 wing screws fastening seat assembly to seat frame.
4. Pull seat toward aisle and rotate.
5. Align mounting holes and reinstall 4 wing screws.
6. Reinstall seat bottom cushions with wing nuts.

15.2 REMOVING FIXED SEATS

NOTE
Seats on one row are not interchangeable with seats of the other row.

To remove fixed seats, proceed as follows:

1. Remove 1 nut holding each seat bottom cushion from under the front part of the seat frame.
2. Lift front part of cushions and remove cushions.
3. Remove 4 finishing screws holding plastic cover between side wall and seat frame.
4. Remove 2 cap screws, nuts, and washers holding seat frame to side wall and retain the 2 holding brackets. See figure 43.
5. Remove 2 nuts and washers holding seat frame to pedestal rods. See figure 44.

NOTE
Bottom end of rod is coated with Locktite and threaded in a steel block which slides in the floor track. Removal of rod is possible if loosened from block. Otherwise, slide rod and block assembly to the front end of track after removing all seats located in front.

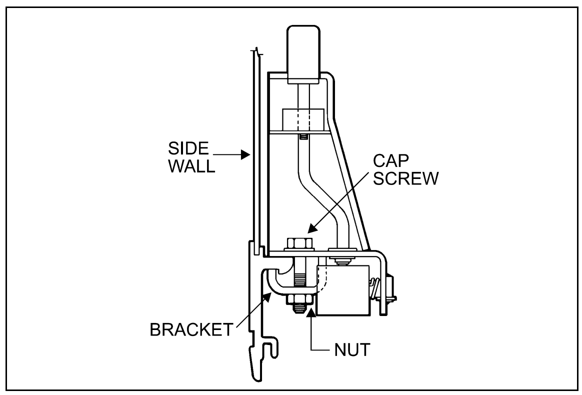


FIGURE 43: ARMREST 18106

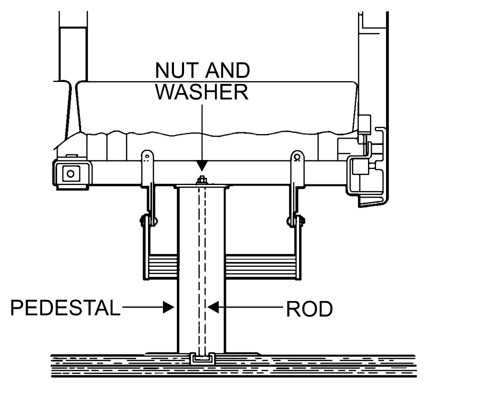


FIGURE 44: SEAT PEDESTAL ASSEMBLY 18107

6. Remove seat assembly.
7. Reverse the above procedure to install seat assembly.

NOTE
On newer vehicles, the rod consists of a carriage bolt inserted in a square plate sliding in the floor track. Removal is possible only by the front or rear end of track.

15.3 UPHOLSTERY MAINTENANCE

Coach seats are lightweight, with foam-padded backs and cushions. For both appearance and wearability, best results are obtained if upholstery is cleaned at regular intervals before dirt, dust and grit have been ground into the fabric. Seat fabric is made of 50% wool, 33% cotton, 9% nylon, and 8% acrylic.

15.3.1 Routine Cleaning

All that is required to remove the dirt is a gentle beating with the hand or the back of a brush. This will bring the dirt to the surface where it is easily removed with a vacuum or brush in the direction of the pile which can easily be recognized by running a hand lightly over the pile. If the fabric becomes excessively dirty, particles of grit will cause gradual wear, reducing the life span of the fabric.

15.3.2 Dry Cleaning

If covers are to be removed for cleaning, dry cleaning is recommended since washing might cause some shrinkage, preventing the covers from being reapplied to the seats without damage. Other than spot cleaning the covers while they are in place, dry cleaning is not recommended, since the resulting fumes could be hazardous in the confines of the coach and the solvent could be detrimental to the foam padding of the seats.

15.3.3 Cleaning With Covers in Place

The most effective and economical method to clean the fabric seat covers is by washing with either an approved foam upholstery cleaner or with a mild household detergent.

Thoroughly vacuum the upholstery. Remove any spots or stains before the seats are washed to avoid a cleaning ring.

Dilute household detergent or liquid foam cleaner according to directions on the container. Pour a small quantity into a flat pan and work into a thick foam with a sponge or brush.

Apply only the foam to the fabric with a sponge or brush. Clean a small area of the fabric at a time with the foam. DO NOT SOAK. Rub vigorously. Sponge the suds from the fabric with a clean sponge or cloth moistened with water. Rinse the sponge or cloth often and change the water when it becomes dirty.

Allow the upholstery to dry completely before the coach goes back into service. To speed up drying, excess moisture can be blown off the fabric with compressed air.

⚠ CAUTION ⚠
Oil in the air line will soil the fabric. Blow the line clear and test air discharge against a plain white piece of paper. It is also effective to press the edge of a flat hardwood stick down on the cushion and slowly draw it across the fabric.

Even very soiled areas can be returned to their original appearance by a thorough cleaning, but a regular schedule of cleaning that keeps the upholstery reasonably clean at all times will greatly enhance the life span of upholstery.

16 TARABUS FLOOR COVERING REPAIR OR REPLACEMENT

On X3 vehicles equipped with "Tarabus" covering, it is possible to replace or repair this covering. The purpose of this paragraph is to explain the steps to be followed to ensure the best results and adherence.

MATERIAL

Part No	Description	Qty
680028	Adhesive, Tarabus Floor Covering (White)	A/R
684655	Adhesive, Contact (3M)	3.8L
684654	Adhesive, Contact (3M)	18.9L
680532	Sikaflex 221 Gray	A/R

NOTE
Material can be obtained through regular channels.

1. Remove number of passenger seats required to perform repair.
2. Cut and remove damaged section of floor covering.

NOTE
It would be preferable to cut under two rows of seats so that repair is not as noticeable.

3. Clean plywood using a scraper.

NOTE
Make sure that no staples are sticking out beyond surface. Adjacent plywood sheets must be leveled.

4. Fill up holes and imperfections using MAPI PRP 110 then sand.
5. Remove dirt and adhesive residue.

⚠ CAUTION ⚠
Do not leave floor covering folded down except temporarily during installation.

6. Apply floor covering adhesive (680028) onto plywood using a serrated spreader with 1/8-inch serration. If required, apply contact adhesive (3M) (684655 or 684654) onto aluminum molding and also onto section of floor covering, which will be in contact with molding (refer to figure 45).

NOTE
Allow adhesive to dry (3 to 5 minutes).

7. Compress floor covering using a roller so as to remove any trapped air bubble.
8. Apply Sikaflex 221 gray sealant (680532) alongside passenger seat fixing tracks (refer to figure 46).

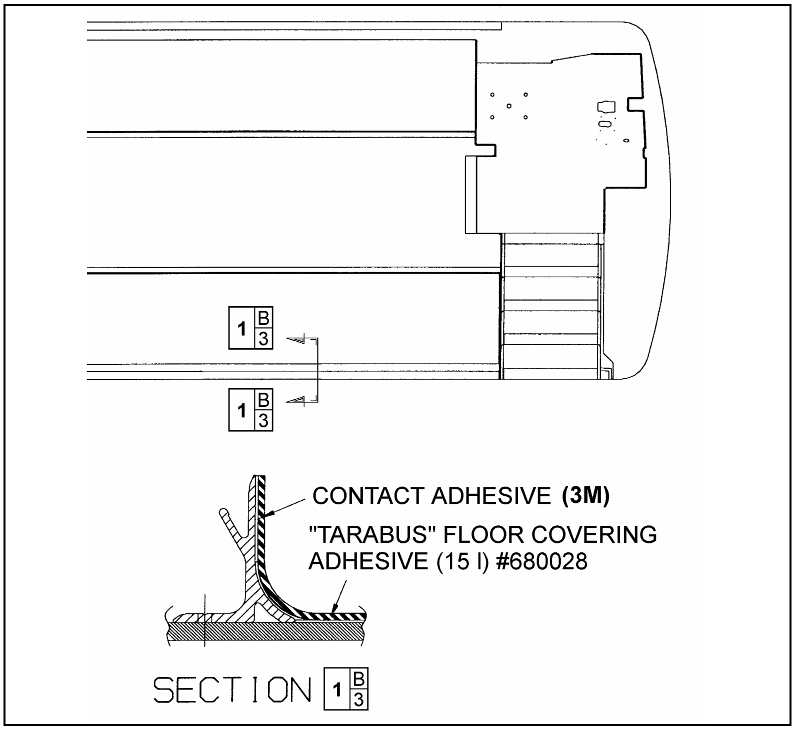


FIGURE 45: TARABUS FLOOR COVERING ADHESIVE APPLICATION 18640

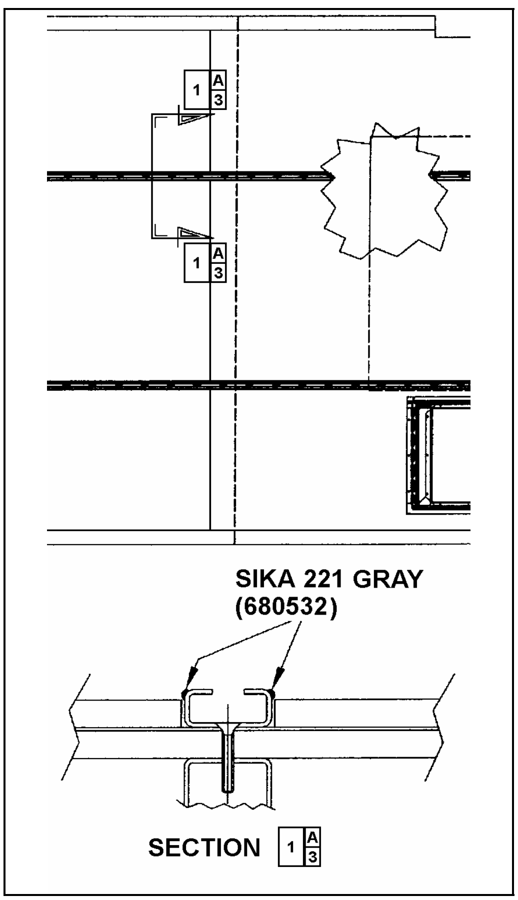


FIGURE 46: APPLICATION OF SIKA 221 GRAY 18641

16.1 FRONT STEPS REPLACEMENT PROCEDURE

MATERIAL

Part No	Description	Qty
682989	Anti-silicone	A/R
683097	Sika 205 (1 liter)	A/R
685101	Sika Remover 208	A/R
683916	Sika 215 (1 liter)	A/R

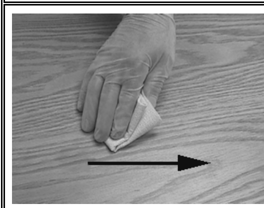
1. Cut and remove damaged step(s).
2. Remove dirt and adhesive residue.

NOTE
In wintertime, condensation and cold temperature may greatly influence bonding parameters. Working area must be at a temperature sufficient to prevent reaching condensation point. Mechanically preheat working area (heat lamp or heat gun) or wait until vehicle reaches room temperature.

PREPARATION OF “TARABUS” FLOOR COVERING

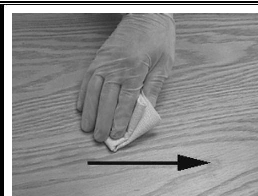
1. Sand under step using “Scotchbrite”.
2. Clean using anti-silicone (refer to Section A).

Section A Alcohol or Anti-silicone



1. Apply

CHIX cloth



2. Dry immediately

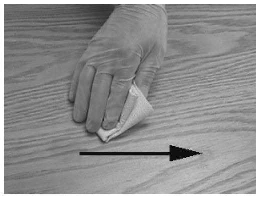
Blue cloth

3. Allow drying

Mandatory	**Minimum time : Wait for product to evaporate**
	After 2 hours: Start cleaning operation again
Before applying any other product	If surface seems dusty, greasy or with finger marks, start cleaning operation again.

3. Apply Sika Primer 215 (refer to Section D).

Section D Sika Primer 215



1. Shake bottle to mix product
2. Apply a thin layer

CHIX cloth

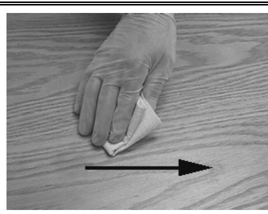
3. Allow drying

Mandatory	215	Minimum time : 20 minutes
		After 2 hours : Remove dust using damp cloth (pure water)
Before applying any other product		If surface seems dusty, dust using damp cloth.
		If surface seems greasy or with finger marks, reactivate with Aktivator.

PREPARATION OF FIBERGLASS

1. Clean using anti-silicone (refer to Section A).
2. Apply Sika 205 (refer to Section B).

Section D Sika Primer 215



1. Apply

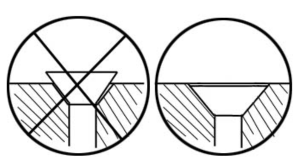
CHIX cloth

2. Allow drying

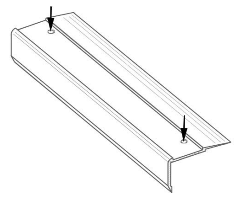
Mandatory	Minimum time	- For a smooth surface (aluminum, stainless, steel, fiberglass (gelcoat side), etc.):	2 minutes
		- For a porous surface (fiberglass (non gelcoat side), etc.)	10 minutes
	After 2 hours : Reactivate surface with Sika 205		
Before applying any other product	If surface seems dusty, greasy or with finger marks, start operation again.		

X3 VEHICLES FRONT STEPS GLUING

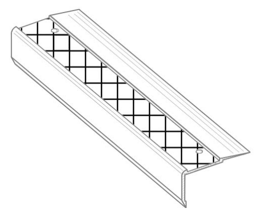
1. Use step nosing to measure and cut necessary length of white safety strip.
2. Use a screw to check depth of countersinking in step nosing. Screw top must not stick out beyond the aluminum surface. Countersink if needed.



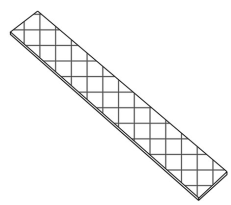
3. Apply some Sika 252 onto the step; make sure to cover the whole surface of the step. Use a serrated spreader with 1/8-inch serration to spread Sika.
4. Apply a bead of Sika 221 onto the perimeter of the step.
5. Install step and press with hands. If Sika overflows, clean with Sika 208. Repeat previous stages for each step if applicable.
6. Remove protective film from double-coated self adhesive tape located underneath step nosing, position step nosing then press. Drill and fix using screws.



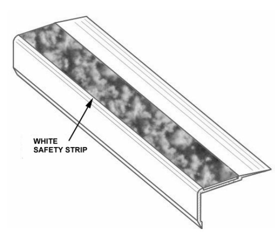
7. Clean top of step nosing using Sika 205 (refer to Section B).



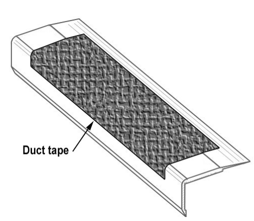
8. Apply some Sika 221 onto white safety strip, spread with a spatula to cover the whole surface.



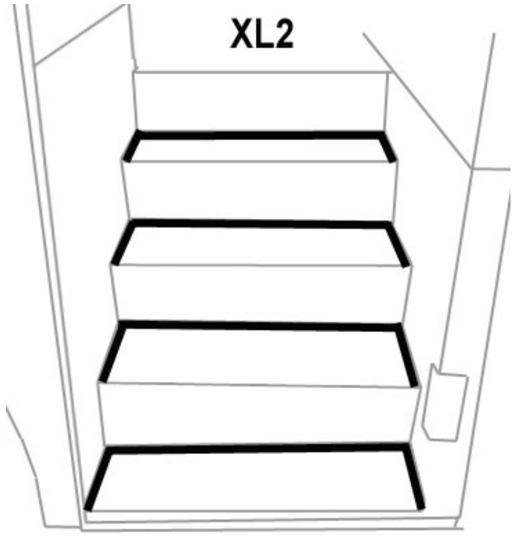
9. Position white safety strip then press using hands. If Sika overflows, clean with Sika 208.



10. Temporarily fix white safety strip with a piece of duct tape, leaving 1 to 2 inches free at each end.



11. Apply some masking tape onto the step perimeter, clean using Sika 205 (refer to Section B) then apply a bead of Sika 252 black. Smooth out the joints then remove masking tape.
12. Install weights onto the steps. Minimum waiting time: 2 hours.



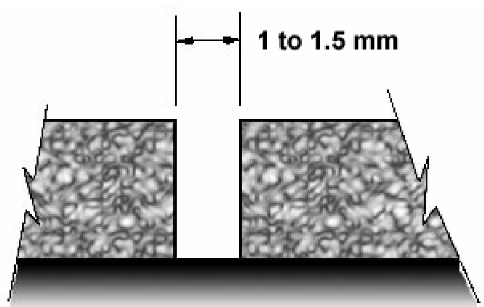
16.2 WELDING OF JOINT BETWEEN WHITE SAFETY STRIP AND “TARABUS” FLOOR COVERING

1. Pre-heat welding torch;

   Set welding torch to position #4.5 (temperature of 500 °C),

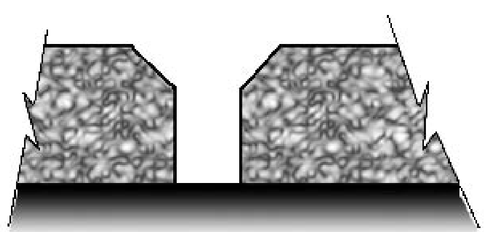
   Heating time: 5 minutes.

2. Before welding, visually ensure that a 1 to 1.5 mm gap exists between white safety strip and “Tarabus” floor covering. Use a knife if this is not the case.



NOTE
There should be no excess of adhesive on top of surfaces, clean if required using “All-Sol”.

3. Chamfer the joint.



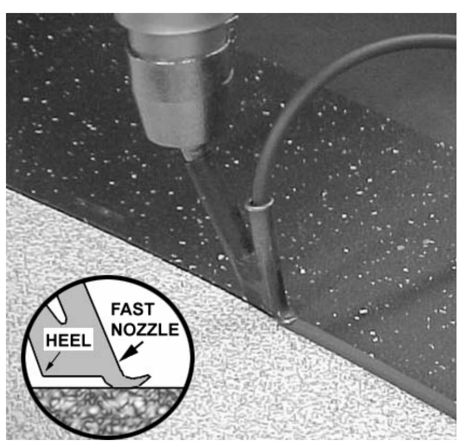
NOTE
The chamfer width must always be less than the filler bead diameter (between 2.5 and 3 mm).

4. Use chamfer knife. **Be careful not to overcut or to cut to the side to prevent damaging "Tarabus" covering.**

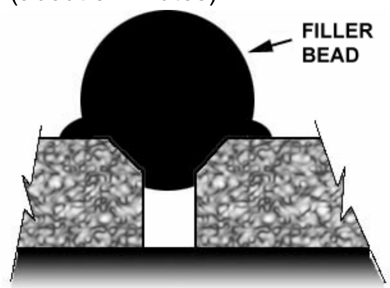
5. Add (about 6 inches) some length to the required length of filler bead to make the joint then cut.
6. Take position with welding torch. The proper position is with a slight slope to the rear.

7. Once the welding torch is ready, insert the filler bead into the nozzle and immediately start welding. Move in a regular manner while pressing slightly with torch.

8. The heel of the fast nozzle must not lean against "Tarabus" covering (always parallel to the surface).

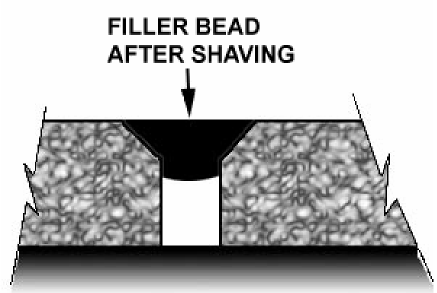


9. Allow cooling down of filler bead (about 5 minutes).



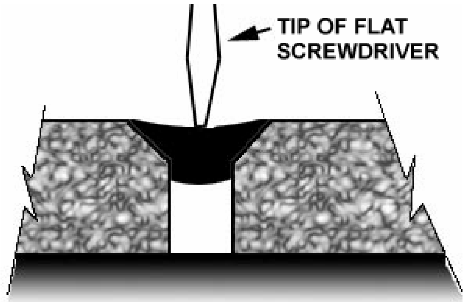
10. Shave filler bead to make it level to the floor. Use supplied knife designed for that purpose.

NOTE
To facilitate the cut, you can spray some soapy water onto the joint.

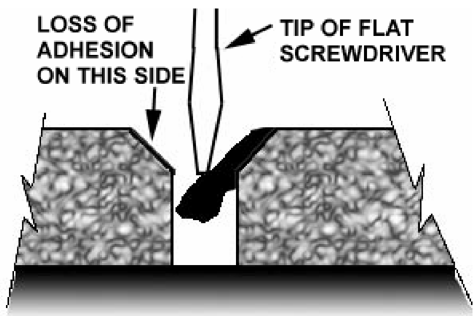


⚠ CAUTION ⚠
The procedure for turning the torch off must absolutely be followed. If this step is not taken, the element may burn.

11. Set temperature potentiometer to “0” position. Fan will evacuate residual heat. Leave the torch in operation as it is for 3 minutes.
12. Perform adhesion test using the tip of a flat screwdriver; apply a slight pressure on the joint.



13. If welding was not performed properly, there will a loss of adhesion on one side. If this is the case, repair the joint.



16.3 REPAIR OF A WELDED JOINT

NOTE
In wintertime, condensation and cold temperature may greatly influenced bonding parameters. Working area must be at a temperature sufficient to prevent reaching condensation point. Mechanically preheat working area (heat lamp or heat gun) or wait until vehicle reaches room temperature.

1. Using a knife, remove portion of joint to be repaired.

NOTE
Loss of adhesion may be local. If this is the case, repair may also be local.

2. Chamfer the joint again as indicated in paragraph 12.2, Section: WELDING OF JOINT BETWEEN WHITE SAFETY STRIP AND “TARABUS” FLOOR COVERING.
3. Re-weld the joint as indicated in paragraphs 6, 7 and 8. Use your thumb to hold the filler bead end.

WARNING
Nozzle is hot.

4. Always add an extra inch of filler bead at the beginning and at the end of repair.
5. Perform steps indicated in paragraphs 9, 10 and 11.

17 VEHICLE JACKING POINTS

The vehicle can be lifted by applying pressure under body jacking points or front end and drive axle jacking points. When it is necessary to lift the vehicle, care should be taken to ensure that the pressure is applied only on the specified areas. Equipment for lifting the front of the vehicle must have a combined lifting capacity of at least 20,000 lb. (9 100 kg). Equipment for lifting the rear of the vehicle must have a combined lifting capacity of at least 40,000 lb. (18 200 kg).

CAUTION
DO NOT tow or jack vehicle with people on board.

WARNING
When it is necessary to raise the vehicle, care should be taken to ensure that pressure is applied only at the points indicated in figures 47 to 53.

WARNING
Extra lift capacity may be required if luggage or any other type of load are onboard the vehicle.

CAUTION
The suspension of the vehicle must be in the normal ride position before jacking.

Twelve jacking points are located on the vehicle: three are located on each side of the frame and two are located under each axle. Refer to the following illustrations for the location of jacking points.

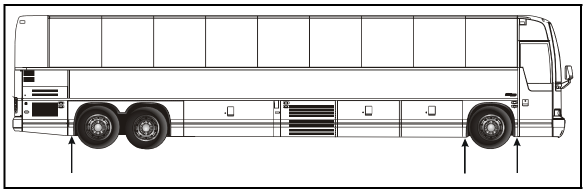


FIGURE 47: JACKING POINTS ON FRAME 18618

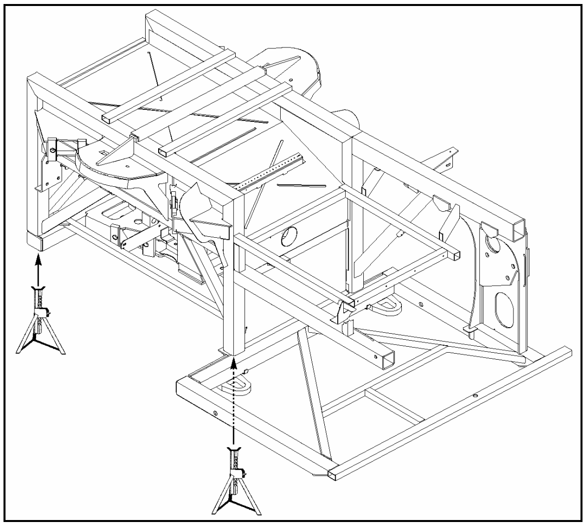


FIGURE 48: FRONT END JACKING POINTS 18592

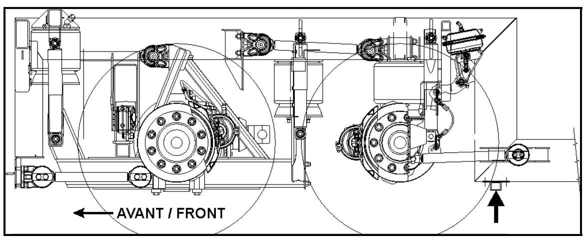


FIGURE 49: REAR END JACKING POINTS 16166

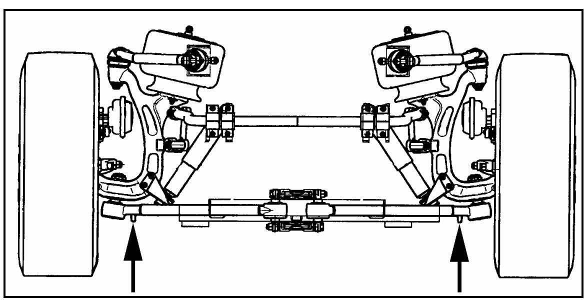


FIGURE 50: JACKING POINTS ON IND. SUSPENSION 16139

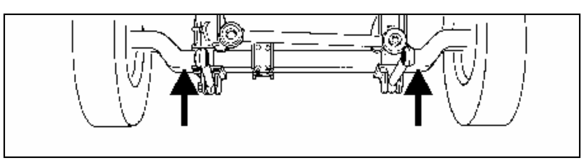


FIGURE 51: JACKING POINT ON FRONT AXLE 10005

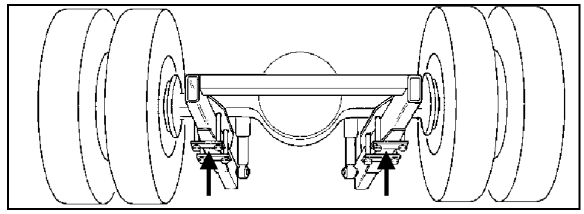


FIGURE 52: JACKING POINTS ON DRIVE AXLE 11005

⚠ WARNING ⚠

Always unload or retract the tag axle before jacking the vehicle from the front and drive axle jacking points to prevent damage to suspension components.

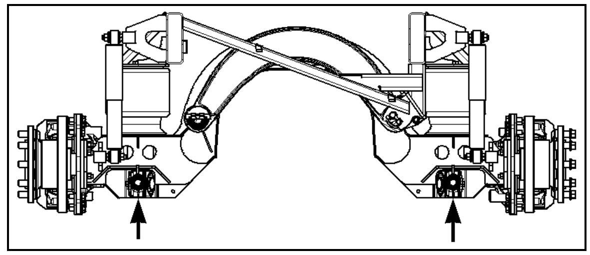


FIGURE 53: JACKING POINTS ON TAG AXLE 11029

⚠ WARNING ⚠

The jacking points on the tag axle must be used for raising the tag axle only.

Several kinds of hydraulic jacks can be used. Only jack at the specified jacking points. Jack must support the following capacities:

Front end: 20,000 lb. (9 100 kg);

Drive axle: 40,000 lb. (18 200 kg).

17.1 HYDRAULIC JACK

To raise: turn release valve clockwise. Insert handle in socket and raise by pumping.

To lower: remove handle and turn the release valve slowly counterclockwise.

Always keep ram and extension screw retracted when jack is not in use.

Service: Check oil level when jack fails to raise to full height. Lower ram completely with release valve open and jack in upright position, remove filler plug and refill to level of filler hole with hydraulic jack oil. Never use brake fluid.

⚠ WARNING ⚠

Jack is intended for lifting only. Do not get under the vehicle or load for any reason unless it is properly supported with safety stands and securely blocked.

WARNING

Do not overload jack above rated capacity. Prevent "side loading", make sure load is centered on ram. Do not push or tilt load off jack.

18 TOWING THE VEHICLE

The vehicle can be transported on a low bed semi-trailer of adequate gross axle weight capacity. When transporting a vehicle, apply parking brake and shut down the engine. Block all wheels and secure vehicle with tie-downs. Check that overall height will clear obstacles on the route to follow, and obtain required permits.

The vehicle can also be towed by lifting the front axle or by towing from the front with all wheels on the ground. These two methods are described below under their respective headings. Whatever the method used, the vehicle should be towed by truck operators authorized and experienced in towing highway coaches.

Observe normal precautions including, but not limited to, the ones listed below when towing the vehicle:

- Make sure the parking brake is released before towing.
- Do not allow passengers to ride onboard the towed vehicle.
- Tow the vehicle at a safe speed as dictated by road and weather conditions.
- Accelerate and decelerate slowly and cautiously.

To prevent damage to the vehicle, use the two tow eyes located under the back bumper and/or fixed to the vehicle's frame between the front axle and the front bumper. Use only a solid link tow bar and a safety chain to tow the vehicle. If required, connect an auxiliary air supply to the vehicle so brakes can be operated while towing.

CAUTION

To prevent damage to the vehicle structure, it is not recommended to tow the vehicle from the rear. In case of damage to the drive train components, use a low bed semi-trailer to support the rear end.

WARNING

During a towing operation, the driver should be alone inside the vehicle.

CAUTION

To prevent damage to the drive train components, disconnect axle shafts or driveshaft before towing. Do not attempt to push or pull-start a vehicle equipped with an automatic transmission.

CAUTION

Make sure axle shafts or driveshaft are installed correctly after towing. Tighten axle shaft and driveshaft nuts to the correct torque settings. Do not invert shafts

18.1 LIFTING AND TOWING

The towed vehicle must be lifted from under the front axle only. The tow truck must be equipped with the proper lifting equipment to reach under the front axle since no other lifting points are recommended. Lifting and towing from any other point are unauthorized as it may cause serious damage to the structure. Do not unload or raise the tag axle when lifting and towing to prevent overloading the drive axle.

1. Remove both drive axle shafts to prevent damage to the transmission. Plug axle tube to prevent oil loss. Refer to Arvin Meritor *"Maintenance Manual no.5"* annexed at the end of Section 11, Rear axle, in this manual for correct procedure.

CAUTION

Transmission lubrication is inadequate when towing. With automatic, semi-automatic or manual transmission, the drive axle shafts must be removed to avoid serious damage to the transmission.

2. Operate the engine when towing to maintain brake system air pressure. If the engine cannot be operated, connect an external air pressure line from the tow truck to the emergency fill valve in the engine compartment.
3. The emergency fill valve in the front service compartment does not supply air pressure to the brake system. The air pressure must be 75 psi (520 kPa) minimum, and the line should be attached to the air line with a clip-on chuck.

⚠ CAUTION ⚠

Do not tow the vehicle without external air pressure applied to the emergency fill valve if the engine does not operate. Without brake system air pressure, the brakes may apply automatically if system air drops below 40 psi (275 kPa). If failure prevents releasing the parking brakes with air pressure, disengage the parking brakes mechanically.

4. Lift the vehicle from under the front axle, and adequately secure the underside to the tow vehicle lifting attachment with chains.
5. Observe safety precautions when towing.

18.2 TOWING WITHOUT LIFTING

⚠ CAUTION ⚠

When towing vehicle without lifting, use only a tow truck with a solid link tow bar and related equipment. All other means of towing are unauthorized. Tow only from the front of the vehicle.

1. Remove both drive axle shafts to prevent damage to the transmission. Plug axle tube to prevent oil loss. Refer to Arvin Meritor *"Maintenance Manual no.5"* annexed at the end of Section 11, Rear axle, in this manual for correct procedure.

⚠ CAUTION ⚠

Transmission lubrication is inadequate when towing. With automatic, semi-automatic or manual transmission, the drive axle shafts must be removed to avoid serious damage to the transmission.

2. Operate the engine when towing to maintain brake system air pressure. If the engine cannot be operated, connect an external air pressure line from the tow truck to the emergency fill valve in the engine compartment. The emergency fill valve in the front service compartment does not supply air pressure to the brake system. The air pressure must be 75 psi (520 kPa) minimum, and the line should be attached to the air line with a clip-on chuck.

⚠ CAUTION ⚠

Do not tow the vehicle without external air pressure applied to the emergency fill valve if the engine does not operate. Without brake system air pressure, the brakes may apply automatically if system air drops below 40 psi (275 kPa). If failure prevents releasing the parking brakes with air pressure, disengage the parking brakes mechanically.

3. Position the tow truck so that the tow bar contacts the front bumper of the vehicle.
4. Attach the tow truck chains only in the tow eyes of the vehicle under the bumper and take up all the slack.
5. Attach safety chains as applicable.
6. Observe safety precautions when towing.

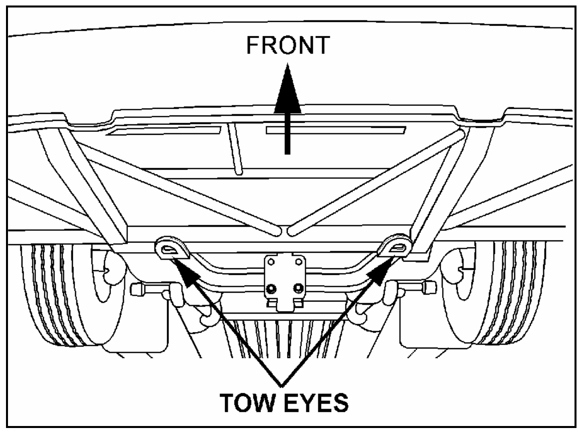


FIGURE 54: TOW EYES 18401

19 SPECIFICATIONS

Door cylinder
Manufacturer .... Bimba
Type .... Pneumatic
I.D. .... 1½" (mm)
Stroke .... 8" (mm)
Prévost number 780595

Damper
Manufacturer .... Koni
Prévost number 780565

Lock cylinder (upper)
Manufacturer .... Bimba
Type .... Air, single action, 1/8 NPT, hexagonal rod
I.D. .... 7/8" (22 mm)
Stroke .... 1" (25 mm)
Supplier number D-51127-A
Prévost number 641392

Lock cylinder (central)
Manufacturer .... Bimba
Type .... Air, single action, ¼ NPT
I.D. .... 1¾" (45 mm)
Stroke .... 1" (25 mm)
Supplier number 241-P
Prévost number 641209

Manifold solenoid
Manufacturer .... Norgren
Type .... 4 ports, 1/8 NPT
Voltage .... 24 VDC
Power consumption .... 6 watts
Maximum pressure .... 150 psi (1035 kPa)
Prévost number 641448

Solenoid valve (Latching valve)
Manufacturer .... Humphrey
Model 310
Operating range .... 0 to 125 psi (0 to 860 kPa)
Voltage .... 24 VDC
Voltage tolerance .... +10%, -15% of rated voltage
Power consumption .... 4 watts
Leak rate (max allowed) .... 0.245 in3/min @ 100 psi (4cc/min @ 690 kPa)
Type of operation .... Direct solenoid
Lubrication .... Not required (factory pre-lubed)
Filtration .... 40 micron recommended
Prévost number 641412

Pressure switch assembly
Prévost number 452831

SECTION 07: TRANSMISSION

CONTENTS

ILLUSTRATIONS

1. DESCRIPTION

X3 Series coaches may be provided with either an Allison automatic transmission or a ZF-AsTronic transmission.

1.1 ALLISON AUTOMATIC TRANSMISSION

The B500 and B500R (with retarder) Allison Transmissions have 6 speeds with two top range (fifth and sixth) overdrives. Total coverage is determined by dividing the highest gear ratio by the lowest gear ratio. Total coverage expresses the transmission gear ratio versatility. Transmissions with larger total coverage number have a wider variety of available ratios.

An electronic control allows the transmission to shift at exactly the right point on the engine's fuel consumption curve for best economy. Early lockup maintains the highest possible mechanical efficiency through the closely-spaced gear steps, culminating in two overdrive ratios. This combination allows progressive shifting techniques, where engine speeds are reduced for higher efficiency and lower fuel consumption.

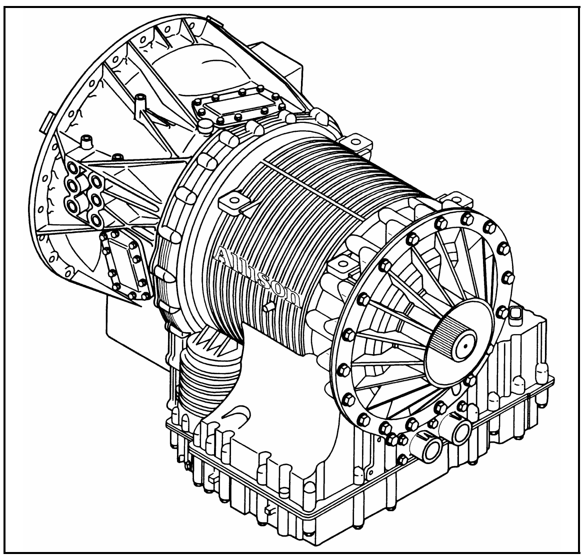


FIGURE 1: ALLISON TRANSMISSION 07136

Gear selection and torque converter modes are controlled by a microcomputer-based electronic transmission management system. It is fed information regarding throttle position, operator range selection, engine speed, turbine speed, transmission output speed and various system pressures from special electronic sensors. With this information, it computes shift points and clutch pressures to meet immediate needs. Using closed loop adaptive logic; the electronic control looks at a number of parameters during the shift, and makes minute adjustments to match the shift to desired profile stored in its memory. It then looks at these adjustments and resets the parameters, which allow the transmission to quickly compensate for variations in load, terrain or environment and to adjust for clutch wear and engine power changes. A Diagnostic Data Reader can be connected to the electronic control unit to provide a self-check of all systems in the transmission. Five-digit trouble codes greatly reduce the time it takes to pinpoint potential problems. (Refer to paragraph *"10. TROUBLESHOOTING"* in this section).

1.1.1 Retarder (if applicable)

This optional auxiliary braking device for the automatic transmission is integrated into the basic envelope of the transmission and transmits its braking force directly to the propeller shaft. It requires no additional length and adds only 75 pounds (34 kg) of weight. Operation of the retarder is controlled electronically by the driver's use of the brake and/or by hand control lever.

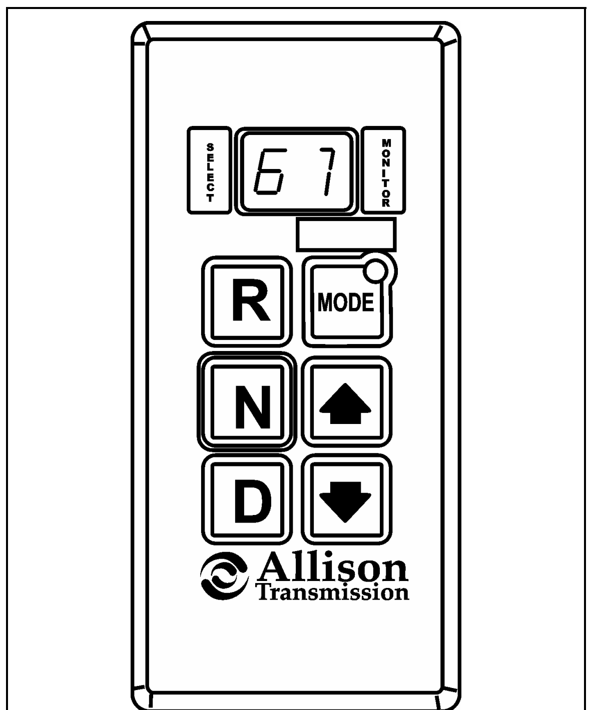


FIGURE 2: ALLISON TRANSMISSION CONTROL PAD 07025

When activated, fluid enters a cavity and provides resistance to the turning of rotor blades revolving with the output shaft. This effectively slows the vehicle to the point where the service brakes are needed only for final stopping. The retarder is fully modulated and is compatible with ABS.

1.2 ZF-ASTRONIC TRANSMISSION

The *AS* TRONIC gear shift system is a combination of an electro-pneumatically shifted constant-mesh gearbox and an automated dry clutch.

If the *AS* TRONIC transmission system is to be used, the vehicle must have an electronic engine control unit as well as CAN communication. Since the clutch is automated (clutch pedal no longer fitted), the driver no longer has to activate the clutch.

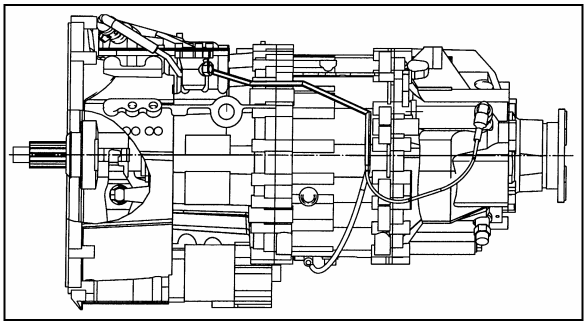


FIGURE 3: ZF-ASTRONIC TRANSMISSION 07078

The actual shift procedure is performed by the electronic transmission control unit. The driver has the option of driving the vehicle in both semi-automatic mode as well as fully automatically. When in semi-automatic mode, manual shifting with the range selector is made easier.

When in fully automatic mode, gears are selected and shifts made by the electronic control unit. The driver can still intervene if he wishes to. All system functions required are shown on the display, e.g. neutral, gear change, clutch overload and diagnosis information.

2. WELDING PROCEDURES

These procedures are intended only for vehicles equipped with transmission electronic controls. When frame or other welding is required on the vehicle, precautions are to be taken to protect the electronic control components. Refer to section 00: GENERAL INFORMATION, paragraph 3: “Precautions to be observed before welding” for complete procedure.

3. MAINTENANCE

3.1 ALLISON TRANSMISSION

To gain access to the dipstick, open the engine compartment rear doors; dipstick is located on the radiator side of the engine (Fig. 4).

To check the transmission oil level, a cold check and a hot check must be performed. A cold check must be made between 60ºF (16ºC) and 140ºF (60ºC). The transmission oil temperature gauge indicates the operating temperature; it is located in the MCD dashboard integrated Liquid Crystal Display and can be viewed when selecting the Gauge Mode (refer to ‘’Operator’s Manual’’ for added information).

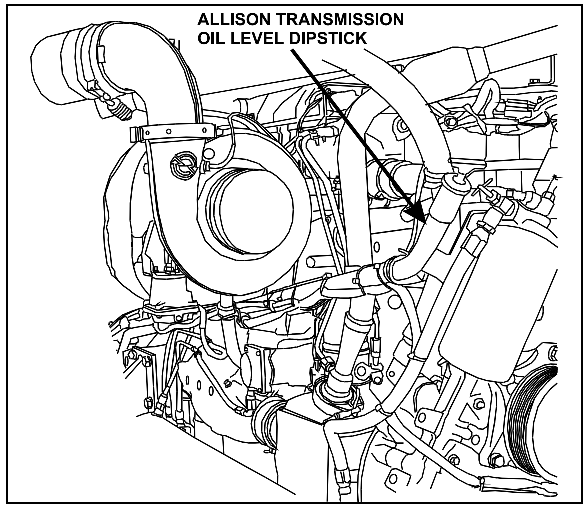


FIGURE 4: OIL LEVEL DIPSTICK (AUTO. TRANS.) 07113

NOTE
Perform the cold check first to verify the transmission oil level before performing the hot check.

The hot check can be performed when the transmission oil reaches the normal operating temperature of 160ºF (71ºC) to 200ºF (93ºC).

Clean all dirt from around the end of the oil filler tube before removing the dipstick. Dirt or foreign matter must not be permitted to enter the oil system since it will cause valves to stick, undue wear of transmission parts, and clogged passages. Check the oil level in accordance with the following procedures and record any abnormal level on your *"Maintenance Records".*

⚠ WARNING ⚠

When checking the oil level, be sure that the parking brake and/or emergency brakes are set and properly engaged, and the wheels are chocked. Unexpected and possible sudden vehicle movement may occur if these precautions are not taken.

- **Special care must be taken not to touch the engine coolant tubing and/or exhaust pipe, since this could cause severe burns.**
- **Do not wear loose clothing and, stay away from rotating parts during procedure; personal injury could occur.**

Always check the oil level reading at least twice when the engine is running. Consistency is important in maintaining the accuracy of the reading. If inconsistent readings persist, check the transmission breather to ensure it is clean and free of debris.

3.1.1 Cold Check

The purpose of the **Cold Check** is to determine if the transmission has enough fluid to be operated safely until a **Hot Check** can be made.

1. If the engine has been shut down for an extended period of time, park the vehicle on a level surface and apply the parking brake.

⚠ CAUTION ⚠

The oil level rises as sump temperature increases. DO NOT fill above the "Cold Run" band if the transmission oil is below normal operating temperature.

2. Run the engine for at least one minute. Shift to Drive (D) and operate the engine for 30 seconds at 1000-1500 rpm; then shift to Reverse (R) to clear the hydraulic system of air. Finally shift to Neutral (N) and allow the engine to idle (500 - 800 rpm).
3. While the engine is running, remove the dipstick from the tube and wipe it clean (Figs. 4 & 5).

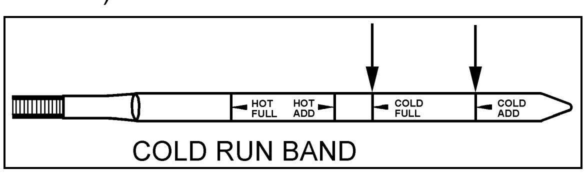


FIGURE 5: COLD CHECK 07050

4. Insert the dipstick into the tube and then remove, checking the oil level reading (Fig. 4). Repeat the check procedure to verify the reading. If the oil reading is within the "Cold Run" band, the level is satisfactory for operating the transmission until the oil is hot enough to perform a "Hot Run" check. If the oil reading is not within the "Cold Run" band, add or drain oil as necessary to bring the level within the "Cold Run" band.
5. Perform a **Hot Check** at the first opportunity after the normal operating temperature of 160ºF (71ºC) to 200ºF (93ºC) is attained.

⚠ CAUTION ⚠

An accurate fluid level check cannot be made unless the engine is idling (500-800 rpm) in Neutral, the transmission fluid is at the proper temperature, and the vehicle is on a level surface.

3.1.2 Hot Check

⚠ CAUTION ⚠

The oil must be hot to ensure an accurate check for this procedure. The oil level rises as temperature increases.

1. Operate the transmission in Drive (D) range until normal operating temperature is reached 160ºF (71ºC) to 200ºF (93ºC).
2. Park the vehicle on a level surface and shift to Neutral (N). Apply the parking brake and allow the engine to idle (500 - 800 rpm).
3. While the engine is running, remove the dipstick from the tube and wipe it clean.
4. Insert the dipstick into the tube and then remove, checking the oil level reading. Repeat the check procedure to verify the reading.

The safe operating level is anywhere within the "Hot Run" band on the dipstick (Fig. 5).

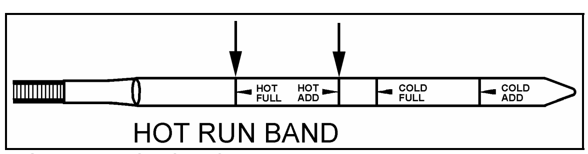


FIGURE 6: HOT CHECK 07049

If the oil level is not within the "Hot Run" band, add or drain oil as necessary to bring the oil level within the band.

NOTE
The Cold Check is more appropriate for verifying the oil level after the first fill-up. In case of conflict, the Hot Check has priority over the Cold Check; the automatic system of verification via the shift selector has priority over the Hot Check.

3.1.3 Fluid Level Check Using the Pushbutton Shift Selector

Oil level codes are obtained as follows:

1. Park vehicle on a level surface, select «N» (neutral) on the pushbutton shift selector and apply parking brake.
2. Press simultaneously the ⬆ (Up) and ⬇ (Down) arrow buttons once.
3. Oil level codes are displayed in 2 minutes (e.g. display will flash and 8, 7, 6, 5, ...; countdown will occur during the 2 minutes) once the following parameters are met:

- **Waiting time, vehicle must be stationary for at least 2 minutes to allow the oil to settle;**
- **Engine at idle;**
- **Oil at normal operating temperature, between 140°F (60°C) and 220°F (104°C);**
- **Transmission in «N» (Neutral);**
- **Transmission output shaft stopped;**
- **Oil level sensor present and working.**

After 2 minutes, the display will flash one of the codes shown below:

CODE	CAUSE OF CODE
O L…O K	Oil level is correct
O L…L O…01	One quart low
O L…L O…02	Two quarts low
O L…H I…01	One quart high
O L…H I…02	Two quarts high

NOTE
Failure to meet one of the above parameters will stop the two minute countdown. One of the codes shown hereafter will indicate the cause of the countdown interruption. Once all parameters are met, the countdown will continue from where it left off.

CODE	CAUSE OF CODE
OL…0X	Waiting time too short
OL…50	Engine speed (rpm) too low
OL…59	Engine speed (rpm) too high
OL…65	Neutral must be selected
OL…70	Sump oil temperature too low
OL…79	Sump oil temperature too high
OL…89	Output shaft rotation
OL…95	Sensor failure

To exit the Oil Level Display Mode, press any range button: «R», «N» or «D».

3.1.4 Importance of Proper Fluid Level

It is important that the proper fluid level be maintained at all times because the transmission fluid cools, lubricates, and transmits hydraulic power. If the fluid level is too low, the converter and clutches do not receive an adequate supply of fluid. If fluid level is too high, the fluid can aerate, causing the transmission to shift erratically or overheat.

3.1.5 Keeping Oil Clean

Oil must be handled in clean containers, fillers, etc., to prevent foreign material from entering the transmission. Place the dipstick on a clean surface area while filling the transmission.

⚠ CAUTION ⚠
Containers or fillers that have been used to handle antifreeze or engine coolant must NEVER be used for handling transmission fluid. Antifreeze and coolant solutions contain ethylene glycol that, if introduced into the transmission, can cause the clutch plates to fail.

3.1.6 Oil Recommendations

Hydraulic fluids used in the transmission are important influences on transmission performance, reliability and durability. **Castrol TranSynd™ Synthetic Fluid** and **DEXRON-III®** fluids are recommended for on-highway applications.

- **TranSynd™** is a full synthetic transmission fluid developed by Allison Transmission and Castrol Ltd. This fluid meets Allison specifications for Severe Duty and Extended Drain Intervals. TranSynd™ is fully qualified to the Allison TES295 specifications and is available through Allison distributors and dealerships.
- To be sure a fluid is qualified for use in Allison transmission, check for the **DEXRON-III®** license numbers on the container or consult the lubricant manufacturer. Consult your Allison Transmission dealer or distributor before using other fluid types.

The Transmission Fluid Operating Temperature Requirements table lists the minimum fluid temperatures at which the transmission may be safely operated without preheating. Preheat with auxiliary heating equipment or by running the equipment or vehicle with the transmission in «N» (Neutral) for a minimum of 20 minutes before attempting range operation.

Transmission Fluid Operating Temperature Requirements

Fluid type	**Minimum operating temperature**	
	Celsius	**Fahrenheit**
TranSynd™	-30	-22
DEXRON-III®	-25	-13

⚠ CAUTION ⚠
Disregarding minimum fluid temperature limits can result in transmission malfunction or reduced transmission life.

NOTE
The use of an arctic preheat kit is recommended at temperatures below -25ºF (-32ºC). If a preheat kit is not available, the TCM will restrict full operation until the sump temperature is increased.

3.1.7 Oil Contamination

At each oil change, examine the drained oil for evidence of dirt or water. A nominal amount of condensation will emulsify during operation of the transmission. However, if there is evidence of water, check the cooler (heat exchanger) for other signs of leakage. This, however, may also indicate leakage from the engine oil system.

3.1.8 Metal Particles

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

⚠ CAUTION ⚠

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

3.1.9 Coolant Leakage

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

TABLE 1: Recommended Fluid and Filter Change Intervals (Non-TranSyndTM/Non-TES 295/Mixture)

Coaches equipped with retarder				Coaches without retarder			
Fluid	Filters			Fluid	Filters		
	Main: Initial Break-in 5,000 miles (8,000 km)	Internal	Lube/ Auxiliary		Main: Initial Break-in 5,000 miles (8,000 km)	Internal	Lube/ Auxiliary
12,000 Miles (20 000 km) 6 Months	12,000 Miles (20 000 km) 6 Months	Overhaul	12,000 Miles (20 000 km) 6 Months	25,000 Miles 40 000 km 12 Months	25,000 Miles 40 000 km 12 Months	Overhaul	25,000 Miles (40 000 km) 12 Months

TABLE 2: Recommended Fluid and Filter Change Intervals (TranSyndTM/TES 295 Approved Fluid)
2 inch Control Module (1.75 approximately) – Requires filter kit P/N 29540493

Coaches equipped with retarder				Coaches without retarder			
Fluid	Filters			Fluid	Filters		
	Main: Initial Break-in 5,000 miles (8,000 km)	Internal	Lube/ Auxiliary		Main: Initial Break-in 5,000 miles (8,000 km)	Internal	Lube/ Auxiliary
50,000 Miles (80 000 km) 24 Months	50,000 Miles (80 000 km) 24 Months	Overhaul	50,000 Miles (80 000 km) 24 Months	150,000 Miles 240 000 km 48 Months	50,000 Miles 80 000 km 24 Months	Overhaul	50,000 Miles (80 000 km) 24 Months

3.1.10 Oil and Filter Change

Allison transmissions are now factory fill with TranSynd fluid. Oil change must be performed with the vehicle on a flat and level surface and with parking brake applied. Oil and oil filter change frequency is determined by the severity of service and operating conditions of the transmission and by the filter equipment installed. See *"Table 1 and 2"* for oil and filter change intervals. More frequent changes may be required when operations are subject to high levels of contamination or overheating.

The procedure for changing the transmission oil and oil filters is as follows:

Drain

1. The transmission should be at an operating temperature of 160ºF (71ºC) to 200ºF (93ºC) when the oil is drained. This will ensure quicker and more complete fluid drainage.

NOTE
Remove transmission protective panel located underneath transmission for easier access.

2. Remove the drain plug from under the transmission (Fig. 7) and allow the oil to drain into a suitable container. Check the condition of the oil as described previously.
3. To replace the integral filters, remove twelve bolts (6 on each cover), two filter covers, two O-rings, two square cut seals and the two filters from the bottom of the control module (Fig. 7).
4. To install filters, pre-lube and install the two O-rings, the two square cut seals followed by the filters (lube the O-ring in filter cartridge only) into the filter compartment. Index each filter/cover assembly to holes in channel plate/sump. Push the cover assembly in by hand to seat the seals.

⚠ CAUTION ⚠
Do not use bolts to draw the cover to sump. This can damage the cover, seal, or sump.

5. Install twelve bolts and both covers, and then tighten to 38-45 lbf-ft (51-61 Nm).
6. Inspect the drain plug and O-ring. Replace if necessary. Reinstall the drain plug and tighten to 18-24 lbf-ft (25-32 Nm).
7. Reinstall transmission protective panel

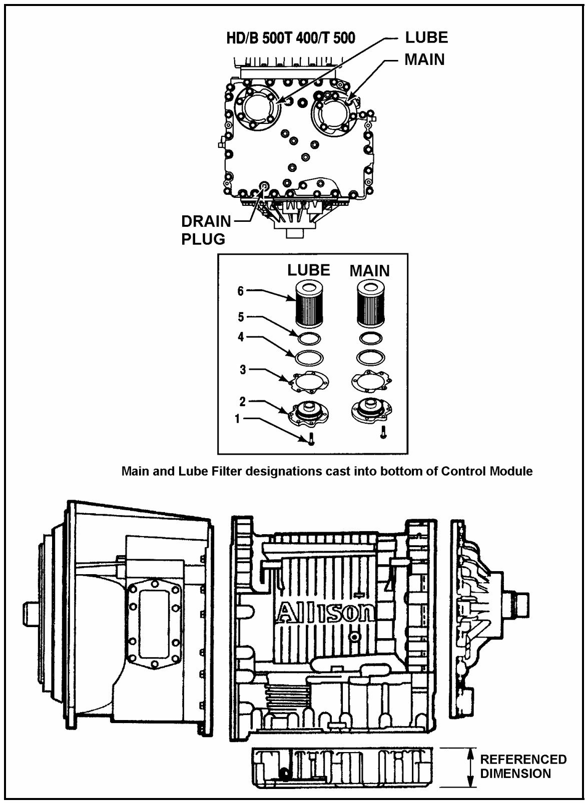


FIGURE 7: DRAIN PLUG AND FILTERS 07074

Refill

Using the oil level dipstick filler tube, refill with 24 US qts (23 liters) [28 US qts (26.5 liters) if equipped with retarder] and check the oil level using the previously described procedure. The refill amount is less than the initial filling because some of the oil remains in the external circuits and transmission cavities.

NOTE
Quantities listed above are approximations and do not include external oil cooler lines.

3.2 ZF AS-TRONIC TRANSMISSION

All information needed for the removal /installation or maintenance of the ZF transmission is included in the documents annexed at the end of this section.

3.2.1 Oil Change

Approximately 11 liters is needed for a complete oil change.

3.2.2 ZF AS-TRONIC / SACHS Clutch Installation Procedure

Important Note:

The clutch hub splines, input shaft, release bearing, clutch fork, and clutch push rod ends all come pre-lubed from the factory.

- Clean the flywheel, clutch disc, and pressure plate surfaces, removing any grease prior to assembly.
- Slide the clutch disk onto the transmission input shaft to check for smooth engagement. Remove clutch disk.
- Apply a very thin coating of Optimol Olista Longtime synthetic grease to the transmission input shaft. Slide the clutch disk along the full length of the input shaft to transfer grease to the clutch hub splines. Remove clutch disc, and remove any excess grease from the exterior of the clutch disc hub. **It is very important that no excess grease is left on the exterior of the clutch hub or clutch disk!**
- Install two temporary pilot studs (7/16-14, 3" long), placing them on the same diameter, 180^{o} apart. These are used to aid in the alignment of the clutch pressure plate.
- Verify that the pilot bearing is seated properly in the flywheel. Insert a clutch alignment tool (SAE 2" DIA, 10 Spline) through the clutch disc and into the pilot bearing. PLEASE NOTE: the direction matters – the large side of the hub should face the clutch pressure plate. The clutch disc hub should be marked "flywheel side" – this side should face the flywheel.
- Use the clutch alignment tool to keep the clutch disc in the proper position and align the clutch cover with the two studs. Push the cover in place in the direction of the flywheel and start installing the clutch bolts. Use Lock-Tite for each bolt. Install, but do not torque, the 10 bolts. Remove the two pilot studs and in their place install the remaining 2 bolts.
- When the bolts are hand tight, be sure that the clutch cover fits into the flywheel centering ring. Tighten each bolt a little at a time, in a crisscross pattern, until the pressure plate cover contacts the flywheel face. Once the cover has touched the face of the flywheel, torque the clutch bolts to 55 ft-lbs, again in a crisscross fashion.
- Remove the clutch alignment tool. If the installation was successful, it should slide out smoothly.
- Ensure that the release bearing retaining clip (located on the "fingers" of the pressure plate) is closed. Refer to figure 8.
- Remove the Clutch Inspection Cover from the bottom of the transmission.
- The transmission should have been shipped in gear. This will allow the installer to rotate the output shaft in order to align the input shaft with the clutch disc hub. If the transmission is in neutral, a "strap wrench" (with a rubber or leather strap) can be used to align the input shaft. Do not use a wrench of the "chain" variety, as damage to the input shaft may result. When aligned, push the transmission towards the engine. Be sure that the bell housing contacts the flywheel housing.

Warning!

- Insure that the transmission moves in a straight line. It can very easily go off center relative to the clutch disc and pilot bearing.
- Insure that the bell housing interfaces evenly with the flywheel housing. Even surface contact should be attained before tightening bolts.
- Do not try to correct relative position of the bell housing and flywheel housing by pulling the transmission into place with the bell housing bolts. The transmission bell housing should seat into the flywheel housing freely.
- When the bell housing and flywheel housing surfaces and bolt holes are aligned, install the transmission bolts. Only hardened steel flat washers should be used, **SERRATED LOCK WASHERS ARE NOT ALLOWED**. Torque the transmission bolts to 55 ft-lbs. in a crisscross fashion.
- From underneath, push the clutch release bearing forward (in the direction of flywheel) using the release fork. Use force to snap the bearing into the retaining clip located on the "fingers" of the pressure plate. The installer

should be able to both hear and feel the bearing seat into place. Refer to figure 8.

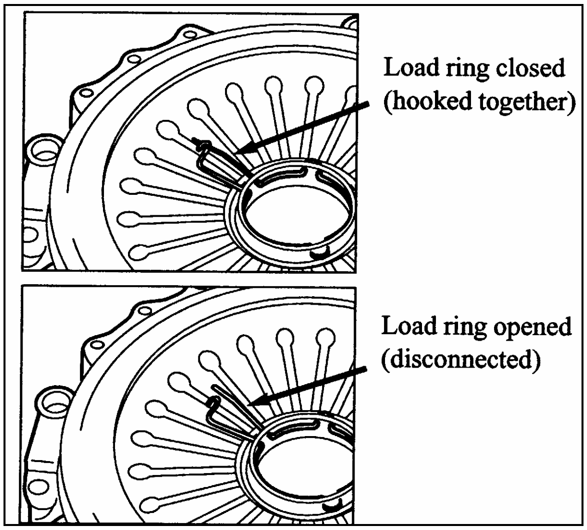


FIGURE 8: RELEASE BEARING RETAINING CLIP 07112

- Install the Clutch Actuator inspection cover.
- The clutch/transmission installation is now complete.

4. INSTALLATION OF ZF OR ALLISON TRANSMISSION BRACKETS

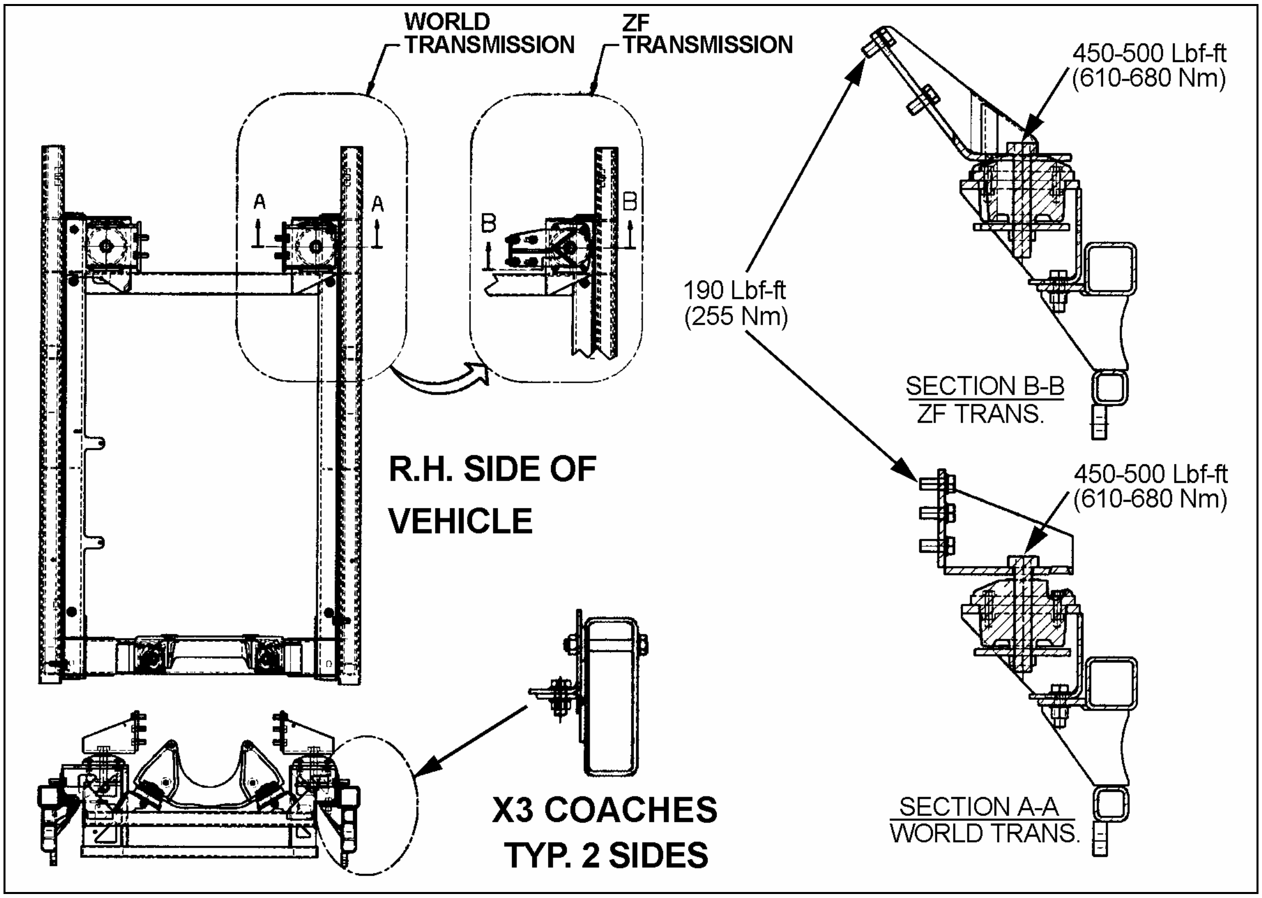


FIGURE 9: ZF OR ALLISON TRANSMISSION BRACKETS 07131

5. ALLISON TRANSMISSION REMOVAL

The following procedure deals with the removal of the Allison transmission without removing the power plant cradle from vehicle. The methods used to support the transmission and engine depend upon conditions and available equipment.

1. Select transmission's "NEUTRAL" position, apply parking brake, then set battery master switch to the "OFF" position.
2. Jack up vehicle, then place safety supports underneath body.

> **⚠ CAUTION ⚠**
>
> **Only the recommended jacking points must be used as outlined in Section 18, "BODY".**

> NOTE
>
> *For more clearance between the tag axle and transmission, the tag axle may be unloaded and jacked up or retracted (if applicable).*

3. Remove engine splash guards and protective panels surrounding transmission.
4. Remove cross member from under transmission.
5. Remove the transmission drain plug and allow oil to drain. Inspect the drain plug washer and replace it if necessary. Reinstall the drain plug and tighten to 33-41 lbf-ft (45-56 Nm) (see *"3.2.9 Oil and Filter Change"* in this section.

> **⚠ WARNING ⚠**
>
> **It is better to drain oil when it is still warm. Avoid contact with oil since it can be very hot and cause personal injury.**

6. Remove transmission dipstick and filler tube.
7. Disconnect propeller shaft from transmission and remove its safety guard. Refer to Section 09, *"PROPELLER SHAFT"*.
8. Disconnect the two oil cooler hoses from transmission. Cover hose ends and fittings to prevent fluid contamination.

> **⚠ WARNING ⚠**
>
> **A significant amount of oil may drain from oil lines when they are disconnected.**

9. Disconnect all sensors on L.H. side of the transmission.
10. Disconnect main wiring harness.
11. Disconnect the air supply line (steel-braided hose) from retarder control valve (if applicable).
12. Remove any locking tie, clamp and bracket that may interfere with the removal of transmission.
13. Support transmission using a suitable transmission jack.
14. Remove the access plug from the flywheel housing on the R.H. side below starter. From access plug, remove the 12 converter-to-flexible plate attaching screws. Cranking the engine to gain access to the attaching screws may be done by turning the crankshaft pulley using a suitable adapter (fig. 10).

> **⚠ CAUTION ⚠**
>
> **Do not rotate alternator shaft clockwise to avoid removing tension on belt.**

15. Remove the 12 screws retaining the torque converter housing to the flywheel housing.

> **⚠ CAUTION ⚠**
>
> **Make sure transmission-to-engine alignment is maintained when removing screws to avoid damaging torque converter housing.**

16. Slowly pull transmission straight out to clear the engine.
17. Remove the transmission.

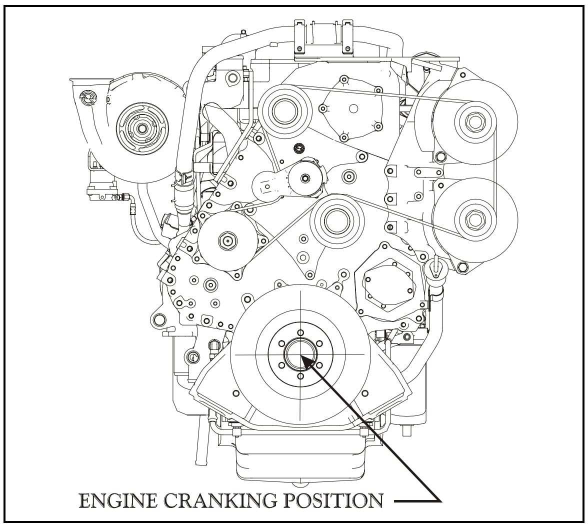


FIGURE 10: ENGINE CRANKING POSITION 01153

6. TRANSMISSION OIL COOLER REMOVAL

6.1 TRANSMISSION WITHOUT RETARDER

Stop engine and allow engine to cool. Close both heater line shutoff valves (refer to Section 05 *''Cooling''*).

To drain the cooling system, proceed as per Section 05 *''Cooling''*, paragraph 5: Draining. If the cooling system is contaminated, flush system as per Section 05 *''Cooling''*, paragraph 7: Flushing.

1. Disconnect and remove the engine air intake duct mounted between the air cleaner housing and the turbocharger inlet.

⚠ CAUTION ⚠

To avoid damage to turbocharger, cover the turbocharger inlet opening to prevent foreign material from entering.

2. Disconnect the two transmission hoses from oil cooler. Cover hose ends and fittings to prevent fluid contamination.

⚠ WARNING ⚠

A significant amount of oil may drain from oil lines when they are disconnected.

3. Unfasten the constant-torque hose clamps and remove the two hoses.

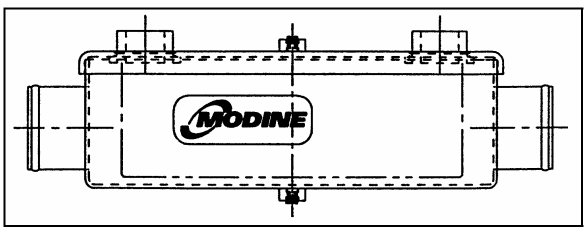


FIGURE 11: MODINE OIL COOLER 07072

4. Unscrew the four holding nuts and remove the U-bolts, remove the oil cooler from engine compartment.
5. Reinstall transmission oil cooler by using reverse procedure.

6.2 TRANSMISSION WITH RETARDER

Stop engine and allow engine to cool. Close both heater line shutoff valves (refer to Section 05 *''Cooling''*).

1. To drain the cooling system, proceed as per Section 05 *''Cooling''*, paragraph 5: Draining. If the cooling system is contaminated, flush system as per Section 05 *''Cooling''*, paragraph 7: Flushing.
2. Disconnect and remove the engine air intake duct mounted between the air cleaner housing and the turbocharger inlet.

⚠ CAUTION ⚠

To avoid damage to turbocharger, cover the turbocharger inlet opening to prevent foreign material from entering.

3. Disconnect the transmission hoses from oil cooler. Cover hose ends and fittings to prevent fluid contamination.

⚠ WARNING ⚠

A significant amount of oil may drain from oil lines when they are disconnected.

4. Unfasten the constant-torque hose clamps and remove the two hoses.
5. Unscrew the holding bolts and nuts and remove the oil cooler from engine compartment.

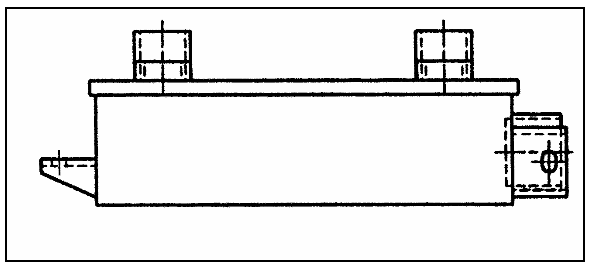


FIGURE 12: COOLER WITH RETARDER 07073

6. Reinstall transmission oil cooler by using reverse procedure.

7. CLEANING AND INSPECTION OF THE TRANSMISSION

7.1 ALLISON AUTOMATIC TRANSMISSION

The exterior of the transmission should be cleaned and inspected at regular intervals. The length of service and severity of operating conditions will determine the frequency of such inspections. Inspect the transmission for:

1. Loose bolts (transmission and mounting components);

2. Oil leaks (correct immediately);
3. Loose, dirty, or improperly adjusted throttle sensor linkage;
4. Damaged or loose oil lines;
5. Worn or frayed electrical harnesses, improper routing;
6. Worn or out of phase drive line U-joint and slip fittings.

⚠ CAUTION ⚠
DO NOT pressure wash the transmission electrical connectors. Water and detergent will cause the contacts to corrode or become faulty.

7.1.1 Breather

The breather is located on the engine, flywheel side near the valve cover. It serves to prevent pressure build-up within the transmission and must be cleaned to keep the passage opened. The prevalence of dust and dirt will determine the frequency at which the breather requires cleaning. Use care when cleaning the engine. Spraying steam, water or cleaning solution directly at the breather can force the water or solution into the transmission. Always use care when removing the hose connector from transmission to prevent the entry of foreign matter.

8. ALLISON TRANSMISSION INSTALLATION

NOTE
For more clearance between the tag axle and transmission, the tag axle may be unloaded and jacked up, or retracted (if applicable).

1. With the access plug removed, align one of the 12 attaching screw holes in the flexible plate with the access opening (starter side).
2. Place the transmission on a transmission jack.
3. Install a headless guide bolt into one of the 12 threaded holes for flexible plate attaching screws in the flywheel.
4. Lubricate the flywheel center pilot boss with molybdenum disulfide grease (Molycote G, or equivalent).
5. Raise transmission and position the flywheel pilot boss into the flexible plate adapter. Align the guide bolt previously installed in the flywheel with the flexible plate hole facing the access opening in the flywheel housing.

⚠ WARNING ⚠
Severe damages and/or personal injury can occur if transmission is not adequately supported.

6. Seat the transmission against the engine flywheel housing. NO FORCE IS REQUIRED. If interference is encountered, move the transmission away from engine, then investigate the cause.

⚠ CAUTION ⚠
The torque converter housing must be seated against the flywheel housing prior to tightening any screws. DO NOT USE SCREWS TO SEAT THE HOUSING.

7. Start all torque converter housing screws, and then tighten four of them gradually and in a criss-cross sequence around the housing. Tighten the 12 remaining screws. Recommended torque is between 42-50 lbf-ft (57-68 Nm).
8. Remove the guide bolt through the access opening in the flywheel housing. Replace it with a self-locking screw, finger-tighten then start the remaining screws; tighten to 17-21 lbf-ft (23-28 Nm). Place a wrench on the crankshaft pulley attaching screw to turn the converter to gain access to the threaded holes.
9. Reinstall the access plug.
10. Remove jack from under transmission.
11. Connect all sensors.
12. Connect the main wiring harness.
13. Connect the air supply line (steel-braided hose) to the retarder control valve (if applicable).
14. Connect the two transmission oil cooler hoses as they were previously.
15. Reinstall clamps and brackets, and replace locking ties previously removed during removal procedure.

16. Install propeller shaft and its safety guard. Refer to Section 09, *"PROPELLER SHAFT".*
17. Install transmission dipstick and filler tube.
18. Install cross member under transmission.
19. Install engine splash guards.
20. Adjust the retarder pressure to 80 ± 3 psi with the air pressure regulator. For more information refer to Section 12, *"BRAKE AND AIR SYSTEM*", under heading *"AIR PRESSURE REGULATOR".* The air pressure regulator is located near the Webasto in engine compartment, on R.H. side (Fig. 13).
21. Make sure that the drain plug is in place, and then remove the transmission dipstick and pour approximately 24 US quarts (23 L) of automatic transmission fluid through the filler tube. Check and adjust oil level.

⚠ CAUTION ⚠

Do not overfill the transmission. Overfilling can cause oil aeration (milky appearance) and overheating. If overfilling occurs, drain oil as required to bring it to the proper level.

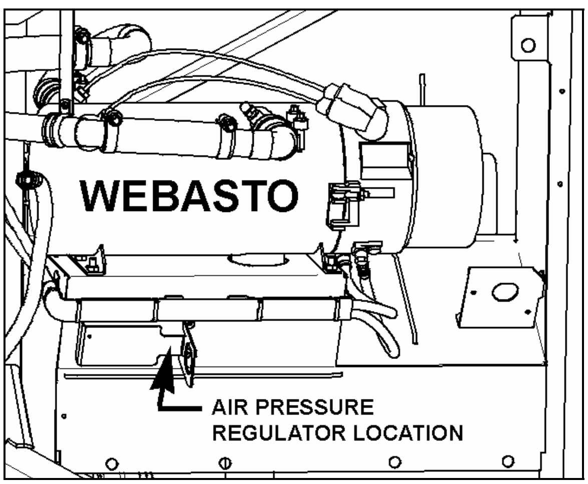


FIGURE 13: AIR PRESSURE REGULATOR (TYPICAL) 07130

9. ALLISON TRANSMISSION PRINCIPLES OF OPERATION

Refer to *"Allison Transmission, MD Series, Principles of Operation, SA 2454".*

10. TROUBLESHOOTING

10.1 ALLISON AUTOMATIC TRANSMISSION

For complete information about Allison transmission troubleshooting, refer to "Allison 4th Generation Controls – Troubleshooting Manual: 3000 and 4000 Product families (TS3989)".

10.1.1 4th Generation Transmission Control Module

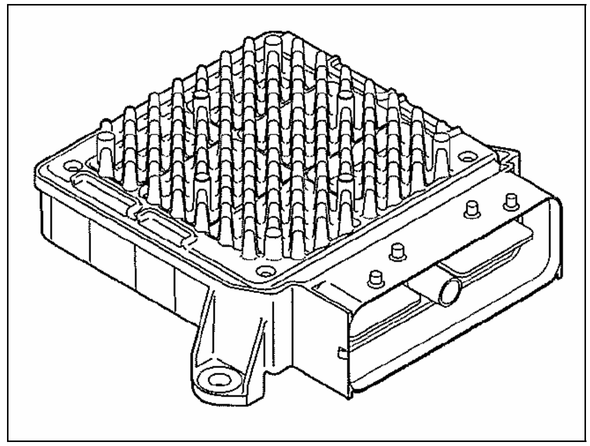


FIGURE 14: TRANSMISSION CONTROL MODULE 07140

The Allison transmission has a new Transmission Control Module (TCM) which involves specific diagnostic incident codes. The TCM unit is located in the coach rear electrical compartment.

TCM Replacement

The TCM is a non-serviceable electronic device. When it fails, it must be replaced using the following procedure:

- Open the coach rear baggage compartment then remove the rear electrical compartment door in order to get access to the TCM;
- Remove the electrical cable connectors;
- Unscrew the TCM unit;
- Replace by reversing the procedure.

⚠ CAUTION ⚠

Place the battery master switch to the "OFF" position.

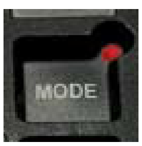
10.1.2 Diagnostic Troubleshooting Codes (DTC) — Allison 4th Generation Controls

Diagnostic codes (DTC) are numerical indications relating to a malfunction in transmission operation. These codes are logged in a list in the TCM memory with the most severe or most recent code listed first. A maximum of five codes (numbered d1 to d5) may be listed in memory at one time. As codes are added, the oldest inactive code is dropped from the list. If all codes are active, the code with the lowest priority that is not included on the severity list is dropped from the list.

Diagnostic codes (DTC) and code information may be accessed through the pushbutton shift selector or using an Allison DOC™ diagnostic tool.

The TCM separately stores the active and inactive codes. An active code is any code that is current in the TCM decision-making process. Inactive codes are codes that are retained in the TCM memory and will not necessary affect the TCM decision-making process. Inactive codes are useful in determining if a problem is:

- Isolated ;
- Intermittent ;
- Result from a previous malfunction.



The TCM may automatically delete a code from memory if it has not recurred. If the MODE INDICATOR (LED) is not illuminated, the displayed code is not active. An illuminated MODE INDICATOR (LED) during normal operation signifies secondary shift mode operation.

10.1.3 Diagnostic Codes – Allison 4th Generation Controls

When the diagnostic mode is entered, the first code (position d1) is displayed as follows:

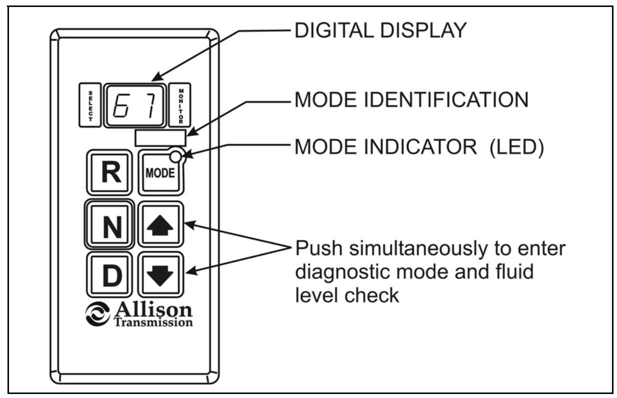
Example: Code P0722

Displayed as: **d1**…**P**…**07**…**22**

The code list position is the first item displayed, followed by the DTC. Each item is displayed for about one second. The display cycles continuously until the next code list position is accessed by pressing the **MODE** button. The following example shows how DTC P0722 is displayed on the pushbutton shift selector.

SELECT	d	1	MONITOR
		P	
	0	7	
	2	2	

- d1 (code list position) – The position which a code occupies in the list. Positions are displayed as « d1 » through « d5 » (code list position 1 through code list position 5).
- P0722 (DTC) – The diagnostic troubleshooting code number referring to the general condition or area of fault detected by the TCM.



10.1.4 Diagnostic Code Display And Clearing Procedure – Allison 4th Generation Controls

Diagnostic codes can be read and cleared by two methods:

- ○ Using an Allison DOC™ diagnostic tool. For specific instructions on how to use an Allison DOC™ diagnostic tool, refer to the User Guide.
- ○ Using the pushbutton shift selector.

To begin the diagnostic process:

1. Bring the vehicle to a stop at a safe location.
2. Apply the parking brake.

To display stored codes:

1. Simultaneously press the ⬆ (Up) and ⬇ (Down) arrow buttons twice to access the Diagnostic Display Mode.

NOTE
To access the Oil Level Display Mode, simultaneously press the ⬆ *(Up) and* ⬇ *(Down)* arrow buttons *once. Consult paragraph: « ALLISON TRANSMISSION OIL LEVEL CHECK USING THE PUSHBUTTON SHIFT SELECTOR » at the end of this section.*

2. Observe the digital display for code (d1).
3. Press the MODE button to see the next code (d2) – repeat for subsequent codes (d3, d4 & d5).

NOTE
Be sure to record all codes displayed before they are cleared. This is essential for troubleshooting.

NOTE
The Diagnostic Display Mode can be entered for viewing codes at any speed. Codes can only be cleared when the output speed = 0 and no output speed sensor failure is active

Active indicators (MODE INDICATOR LED) and inactive codes can be cleared manually, while in the diagnostic display mode, after the condition causing the code is identified.

To clear active indicators and inactive codes:

1. While in Diagnostic Display Mode, press and hold the MODE button for 10 seconds to clear both active indicators and inactive codes.
2. Begin operating as normal. Have the transmission checked at the earliest opportunity by an Allison Transmission distributor or dealer.

NOTE
All active indicators are cleared at TCM power down. *Some codes will clear their active indicator when the condition causing the code is no longer detected by the TCM.*

The Diagnostic Display Mode can be exited by any of the following methods:

- Press simultaneously the ⬆ (Up) and ⬇ (Down) arrow buttons at the same time on the pushbutton shift selector.
- Press any range button «D», «N» or «R» on the pushbutton shift selector (the shift will be commanded if it is not inhibited by an active code).
- Wait until the calibrated time (approximately 10 minutes) has passed. The system will automatically return to the normal operating mode.
- Turn off power to the TCM (shut off the engine using the ignition key).

NOTE
If clearing a code while locked in a «D» (Drive) or «R» (Reverse) position (fail-to-range), the transmission will still be in «D» (Drive) or «R» (Reverse) when the clearing procedure is completed. «N» (Neutral) must be manually selected.

10.1.5 Diagnostic Code Response

The following responses are used in the "Diagnostic Troubleshooting Code List and Inhibited Operation Description" table to command safe operation when diagnostic codes are sent.

DNS - Do Not Shift Response

Release lock up clutch and inhibit lock up operation.
Inhibit all shifts.
Turn *ON* the CHECK TRANS light.
Display the range attained.
Ignore any range selection inputs from the shift selector.

DNA - Do Not Adapt Response

The TCM stops adaptive shift control while the code is active.

SOL OFF - SOLenoid OFF Response

All solenoids are commanded *OFF* (turning solenoids “A” and “B” off electrically cause them to be on hydraulically).

RPR - Return to Previous Range Response

When the speed sensor ratio or C3 pressure switch test associated with a shift not successful, the TCM commands the same range as commanded before the shift.

NNC - Neutral No Clutches Response

When certain speed sensor ratio or C3 pressure switch tests are not successful, the TCM commands a neutral condition with no clutches applied.

10.1.6 Diagnostic Troubleshooting Codes (DTC) List - Allison 4th Generation Controls

DTC	Description	CHECK TRANS Light	Inhibited Operation Description
C1312	Retarder Request Sensor Failed Low	No	May inhibit retarder operation if not using J1939 datalink
C1313	Retarder Request Sensor Failed High	No	May inhibit retarder operation if not using J1939 datalink
P0122	Pedal Position Sensor Low Voltage	No	Use default throttle values. Freezes shift adapts.
P0123	Pedal Position Sensor High Voltage	No	Use default throttle values. Freezes shift adapts.
P0218	Transmission Fluid Over Temperature	No	Use hot mode shift schedule. Holds fourth range. TCC is inhibited. Freezes shift adapts.
P0602	TCM Not Programmed	Yes	Lock in Neutral
P0610	TCM Vehicle Options (Trans ID) Error	Yes	Use TID A calibration
P0613	TCM Processor	No	All solenoids off
P0614	Torque Control Data Mismatch - ECM/TCM	Yes	Allows operation only in reverse and second range.
P0634	TCM Internal Temperature Too High	Yes	SOL OFF (hydraulic default)
P063E	Auto Configuration Throttle Input Not Present	Yes	Use default throttle values
P063F	Auto Configuration Engine Coolant Temp Input Not Present	No	None
P0658	Actuator Supply Voltage 1 (HSD1) Low	Yes	DNS, SOL OFF (hydraulic default)
P0659	Actuator Supply Voltage 1 (HSD1) High	Yes	DNS, SOL OFF (hydraulic default)
P0702	Transmission Control System Electrical (TransID)	Yes	Use TID A calibration
P0703	Brake Switch Circuit Malfunction	No	No Neutral to Drive shifts for refuse packer. TCM inhibits retarder operation if a TPS code is also active.

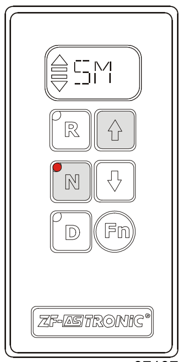
DTC	Description	CHECK TRANS Light	Inhibited Operation Description
P0708	Transmission Range Sensor Circuit High Input	Yes	Ignore defective strip selector inputs
P070C	Transmission Fluid Level Sensor Circuit – Low Input	No	None
P070D	Transmission Fluid Level Sensor Circuit – High Input	No	None
P0711	Transmission Fluid Temperature Sensor Circuit Performance	Yes	Use default sump temp
P0712	Transmission Fluid Temperature Sensor Circuit Low Input	Yes	Use default sump temp
P0713	Transmission Fluid Temperature Sensor Circuit High Input	Yes	Use default sump temp
P0716	Turbine Speed Sensor Circuit Performance	Yes	DNS, Lock in current range
P0717	Turbine Speed Sensor Circuit No Signal	Yes	DNS, Lock in current range
P0719	Brake Switch ABS Input Low	No	TCM assumes ABS is OFF
P071A	RELS Input Failed On	Yes	Inhibit RELS operation
P071D	General Purpose Input Fault	Yes	None
P0721	Output Speed Sensor Circuit Performance	Yes	DNS, Lock in current range
P0722	Output Speed Sensor Circuit No Signal	Yes	DNS, Lock in current range
P0726	Engine Speed Sensor Circuit Performance	No	Default to turbine speed
P0727	Engine Speed Sensor Circuit No Signal	No	Default to turbine speed
P0729	Incorrect 6th Gear Ratio	Yes	DNS, Attempt 5th, then 3rd
P0731	Incorrect 1st Gear ratio	Yes	DNS, Attempt 2nd, then 5th
P0732	Incorrect 2nd Gear ratio	Yes	DNS, Attempt 3rd, then 5th
P0733	Incorrect 3rd Gear ratio	Yes	DNS, Attempt 4th, then 6th
P0734	Incorrect 4th Gear ratio	Yes	DNS, Attempt 5th, then 3rd
P0735	Incorrect 5th Gear ratio	Yes	DNS, Attempt 6th, then 3rd, then 2nd
P0736	Incorrect Reverse Gear ratio	Yes	DNS, Lock in Neutral
P0741	Torque Converter Clutch System Stuck Off	Yes	None
P0776	Pressure Control Solenoid 2 Stuck Off	Yes	DNS, RPR
P0777	Pressure Control Solenoid 2 Stuck On	Yes	DNS, RPR
P0796	Pressure Control Solenoid 3 Stuck Off	Yes	DNS, RPR
P0797	Pressure Control Solenoid 3 Stuck On	Yes	DNS, RPR
P0842	Transmission Pressure Switch 1 Circuit Low	Yes	DNS, Lock in current range
P0843	Transmission Pressure Switch 1 Circuit High	Yes	DNS, Lock in current range
P0880	TCM Power Input Signal	No	None
P0881	TCM Power Input Signal Performance	No	None
P0882	TCM Power Input Signal Low	Yes	DNS, SOL OFF (hydraulic default)
P0883	TCM Power Input Signal High	No	None
P0894	Transmission Component Slipping	Yes	DNS, Lock in first
P0960	Pressure Control Solenoid Main Mod Control Circuit Open	Yes	None
P0962	Pressure Control Solenoid Main Mod Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)
P0963	Pressure Control Solenoid Main Mod Control Circuit High	Yes	None
P0964	Pressure Control Solenoid 2 (PCS2) Control Circuit Open	Yes	DNS, SOL OFF (hydraulic default)
P0966	Pressure Control Solenoid 2 (PCS2) Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)
P0967	Pressure Control Solenoid 2 (PCS2) Control Circuit High	Yes	DNS, SOL OFF (hydraulic default)
P0968	Pressure Control Solenoid 3 (PCS3) Control Circuit Open	Yes	DNS, SOL OFF (hydraulic default)

DTC	Description	CHECK TRANS Light	Inhibited Operation Description
P0970	Pressure Control Solenoid 3 (PCS3) Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)
P0971	Pressure Control Solenoid 3 (PCS3) Control Circuit High	Yes	DNS, SOL OFF (hydraulic default)
P0973	Shift Solenoid 1 (SS1) Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)
P0974	Shift Solenoid 1 (SS1) Control Circuit High	Yes	DNS, SOL OFF (hydraulic default)
P0975	Shift Solenoid 2 (SS2) Control Circuit Open	Yes	7-speed: Allow 2 through 6, N, R
P0976	Shift Solenoid 2 (SS2) Control Circuit Low	Yes	7-speed: Allow 2 through 6, N, R Inhibit TCC operation
P0977	Shift Solenoid 2 (SS2) Control Circuit High	Yes	7-speed: Allow 2 through 6, N, R
P0989	Retarder Pressure Sensor Failed Low	No	None
P0990	Retarder Pressure Sensor Failed High	No	None
P1739	Incorrect Low Gear Ratio	Yes	Command 2nd and allow shifts 2 through 6, N, R
P1891	Throttle Position Sensor PWM Signal Low Input	No	Use default throttle values
P1892	Throttle Position Sensor PWM Signal High Input	No	Use default throttle values
P2184	Engine Coolant Temperature Sensor Circuit Low Input	No	Use default engine coolant values
P2185	Engine Coolant Temperature Sensor Circuit High Input	No	Use default engine coolant values
P2637	Torque Management Feedback Signal (SEM)	Yes	Inhibit SEM
P2641	Torque Management Feedback Signal (LRTP)	Yes	Inhibit LRTP
P2670	Actuator Supply Voltage 2 (HSD2) Low	Yes	DNS, SOL OFF (hydraulic default)
P2671	Actuator Supply Voltage 2 (HSD2) High	Yes	DNS, SOL OFF (hydraulic default)
P2685	Actuator Supply Voltage 3 (HSD3) Low	Yes	DNS, SOL OFF (hydraulic default)
P2686	Actuator Supply Voltage 3 (HSD3) High	Yes	DNS, SOL OFF (hydraulic default)
P2714	Pressure Control Solenoid 4 (PCS4) Stuck Off	Yes	DNS, RPR
P2715	Pressure Control Solenoid 4 (PCS4) Stuck On	Yes	DNS, SOL OFF (hydraulic default)
P2718	Pressure Control Solenoid 4 (PCS4) Control Circuit Open	Yes	DNS, SOL OFF (hydraulic default)
P2720	Pressure Control Solenoid 4 (PCS4) Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)
P2721	Pressure Control Solenoid 4 (PCS4) Control Circuit High	Yes	DNS, SOL OFF (hydraulic default)
P2723	Pressure Control Solenoid 1 (PCS1) Stuck Off	Yes	DNS, RPR
P2724	Pressure Control Solenoid 1 (PCS1) Stuck On	Yes	DNS, RPR
P2727	Pressure Control Solenoid 1 (PCS1) Control Circuit Open	Yes	DNS, SOL OFF (hydraulic default)
P2729	Pressure Control Solenoid 1 (PCS1) Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)
P2730	Pressure Control Solenoid 1 (PCS1) Control Circuit High	Yes	DNS, SOL OFF (hydraulic default)
P2736	Pressure Control Solenoid 5 (PCS5) Control Circuit Open	Yes	Inhibit retarder operation
P2738	Pressure Control Solenoid 5 (PCS5) Control Circuit Low	Yes	Allow 2 through 6, N, R. Inhibit retarder and TCC operation
P2739	Pressure Control Solenoid 5 (PCS5) Control Circuit High	Yes	Inhibit retarder operation
P2740	Retarder Oil Temperature Hot	No	None
P2742	Retarder Oil Temperature Sensor Circuit – Low Input	No	Use default retarder temp values
P2743	Retarder Oil Temperature Sensor Circuit – High Input	No	Use default retarder temp values
P2761	TCC PCS Control Circuit Open	Yes	Inhibit TCC operation
P2763	TCC PCS Control Circuit High	Yes	Inhibit TCC operation
P2764	TCC PCS Control Circuit Low	Yes	7-speed: Allow 2 through 6, N, R. Inhibit TCC operation

DTC	Description	CHECK TRANS Light	Inhibited Operation Description
P278A	Kickdown Input Failed ON	No	Inhibit kickdown operation
P2793	Gear Shift Direction Circuit	Yes	Ignores PWM input from shift selector
P2808	Pressure Control Solenoid 6 (PCS6) Stuck Off	Yes	DNS, RPR
P2809	Pressure Control Solenoid 6 (PCS6) Stuck On	Yes	DNS, RPR
P2812	Pressure Control Solenoid 6 (PCS6) Control Circuit Open	Yes	DNS, SOL OFF (hydraulic default)
P2814	Pressure Control Solenoid 6 (PCS6) Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)
P2815	Pressure Control Solenoid 6 (PCS6) Control Circuit High	Yes	DNS, SOL OFF (hydraulic default)
U0001	Hi Speed CAN Bus Reset Counter Overrun (IESCAN)	No	Use default values, inhibit SEM
U0010	CAN BUS Reset Counter Overrun	No	Use default values, inhibit SEM
U0100	Lost Communications with ECM/PCM (J1587)	Yes	Use default values
U0103	Lost Communication with Gear Shift Module (Shift Selector) 1	Yes	Maintain range selected, observe gear shift direction circuit
U0115	Lost Communication with ECM	Yes	Use default values
U0291	Lost Communication with Gear Shift Module (Shift Selector) 2	Yes	Maintain range selected, observe gear shift direction circuit
U0304	Incompatible Gear Shift Module 1 (Shift Selector) ID	Yes	Ignore shift selector inputs
U0333	Incompatible Gear Shift Module 2 (Shift Selector) ID	Yes	Ignore shift selector inputs
U0404	Invalid Data Received From Gear Shift Module (Shift Selector) 1	Yes	Maintain range selected, observe gear shift direction circuit
U0592	Invalid Data Received From Gear Shift Module (Shift Selector) 2	Yes	Maintain range selected, observe gear shift direction circuit

11. ZF-ASTRONIC TRANSMISSION SYSTEM FAULTS AND ERROR MESSAGES

11.1 SYSTEM FAULTS (ERROR MESSAGES)



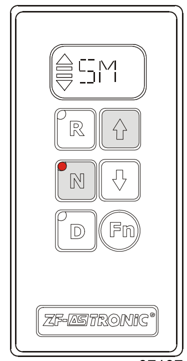
07107

If the “**SM**” symbol appears in the display, a system error has occurred.

- **Stop the vehicle**
- **Vehicle may no longer be driven**

Error messages and the reactions resulting from these errors can be deleted with the vehicle at a standstill and the “Ignition OFF”. (Wait until the display goes out). If the display does not go out once the ignition has been turned “OFF”, set the battery master switch to the **OFF** position. Switch the ignition back on. If the error message is still in place, the transmission has to be repaired. The transmission is inoperative. The vehicle will have to be taken to a service point. The error number(s) must be specified when the service point is contacted.

Calling up error numbers

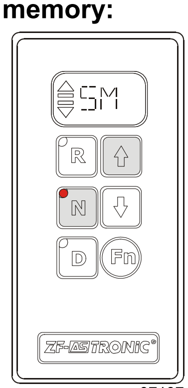


07107

- Switch on ignition
- Depress “**N**” key
- Hold down “ ⇧ ” key

* One or more error numbers appear on the display. These correspond to the errors presently active in the system.

Calling up error numbers from the error memory:



07107

- Switch on ignition
- Press “**N**” key and at the same time depress the foot-operated brake
- Hold down the foot-operated brake and depress and hold down “ ⇧ ” key

* The errors stored in the transmission ECU are shown on the display one after another.

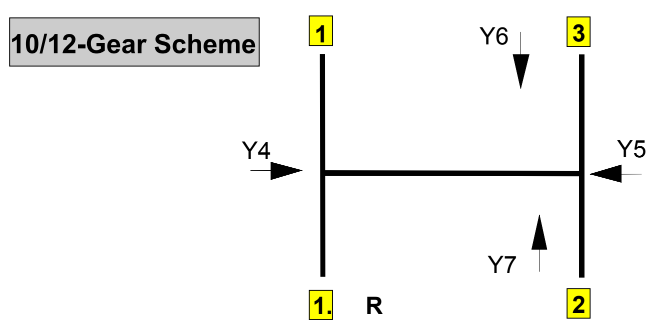
ERROR CODES

Remark to titles in table:

ZF fault number: defined by ZF.
Display SM-Symbol : (0=NO, 1=YES) Display shows “**SM**“(severe failure)
Warning lamp : (0=NO, 1=YES) Telltale panel warning lamp “**check trans**“(less severe failure)

Shift schemes of transmissions:

Y2 Splitter K2
Y3 Splitter K1
Y8 Range (GP) low
Y9 Range (GP)



ON MESSAGES CENTER DISPLAY (MCD) SAE-J1587 Codes	ON SHIFT SELECTOR DISPLAY	ISO CODES WITH TESTMAN TOOL	DESCRIPTION
8, 7	8	161	Easy Start, Brake doesn't open completely
8, 14	8	162	Easy Start, Not Available
20,6	14	22	Short circuit to ground at output ACC (wakeup control signal for ZMTEC, keep alive signal for voltage doubler, and power signal for speed sensor #2)
20,5	14	54	Interruption at output ACC (wakeup control signal for ZMTEC, keep alive signal for voltage doubler, and power signal for speed sensor #2)
20,3	14	86	Short circuit to positive at output ACC (wakeup control signal for ZMTEC, keep alive signal for voltage doubler, and power signal for speed sensor #2)
21,2	15	127	Error on ECU temperature sensor signal
21,0	15	193	ECU temperature too high
31,3	1F	137	No range change group (GP) sensor signal (Short circuit to positive)
31,6	1F	138	No range change group (GP) sensor signal (Short circuit to ground)
31,5	1F	139	No range change group (GP) sensor signal (Interruption)
31,13	1F	140	Self adjustment error of range change group sensor in position fast
31,7	1F	159	Range-change group sensor signal leaves engaged position during driving
32,3	20	141	No splitter group (GV) sensor signal (Short circuit to positive)
32,6	20	142	No splitter group (GV) sensor signal (Short circuit to ground)
32,5	20	143	No splitter group (GV) sensor signal (Interruption)
32,13	20	144	Splitter group (GV) sensor self adjustment error
32,7	20	160	Splitter sensor signal leaves engaged position during driving
33,14	21	107	Stabilised voltage supply at output AU (clutch sensor supply) too high or too low
33,13	21	117	Error in clutch self-adjustment process
33,2	21	124	Error on clutch travel signal
34,7	22	120	Mechanical failure of small clutch disengagement valve
34,7	22	121	Mechanical failure of large clutch disengagement valve
34,7	22	122	Mechanical failure of small clutch engagement valve
34,7	22	123	Mechanical failure of large clutch engagement valve
34,6	22	18	Short circuit to ground at output stage to small disengagement clutch valve
34,6	22	19	Short circuit to ground at output stage to small engagement clutch valve
34,6	22	20	Short circuit to ground at output stage to large disengagement clutch valve
34,6	22	21	Short circuit to ground at output stage to large engagement clutch valve
34,5	22	50	Interruption at output stage to small disengagement clutch valve
34,5	22	51	Interruption at output stage to small engagement clutch valve

ON MESSAGES CENTER DISPLAY (MCD) SAE-J1587 Codes	ON SHIFT SELECTOR DISPLAY	ISO CODES WITH TESTMAN TOOL	DESCRIPTION
34,5	22	52	Interruption at output stage to large disengagement clutch valve
34,5	22	53	Interruption at output stage to large engagement clutch valve
34,3	22	82	Short circuit to positive at output stage to small disengagement clutch valve
34,3	22	83	Short circuit to positive at output stage to small engagement clutch valve
34,3	22	84	Short circuit to positive at output stage to large disengagement clutch valve
34,3	22	85	Short circuit to positive at output stage to large engagement clutch valve
35,5	23	41	Interruption at output stage to Y9 (Valve Range)
35,3	23	73	Short circuit to positive at output stage to Y9 (Valve range)
35,6	23	9	Short circuit to ground at output stage to Y9 (Valve Range)
36,5	24	40	Interruption at output stage to Y8 (Valve Range)
36,3	24	72	Short circuit to positive at output stage to Y8 (Valve range)
36,6	24	8	Short circuit to ground at output stage to Y8 (Valve Range)
37,6	25	2	Short circuit to ground at output stage to Y2 (Valve Splitter)
37,5	25	34	Interruption at output stage to Y2 (Valve Splitter)
37,3	25	66	Short circuit to positive at output stage to Y2 (Valve Splitter)
38,6	26	3	Short circuit to ground at output stage to Y3 (Valve Splitter)
38,5	26	35	Interruption at output stage to Y3 (Valve Splitter)
38,3	26	67	Short circuit to positive at output stage to Y3 (Valve Splitter)
39,5	27	36	Interruption at output stage to Y4 (Valve Select)
39,6	27	4	Short circuit to ground at output stage to Y4 (Valve Select)
39,3	27	68	Short circuit to positive at output stage to Y4 (Valve Select)
40,5	28	38	Interruption at output stage to Y6 (Valve Shift)
40,6	28	6	Short circuit to ground at output stage to Y6 (Valve Shift)
40,3	28	70	Short circuit to positive at output stage to Y6 (Valve Shift)
43,2	2B	175	Error on ”Ignition lock” signal (terminal 15)
48,3	30	129	No shift sensor signal (Short circuit to positive)
48,6	30	130	No shift sensor signal (Short circuit to ground)
48,5	30	131	No shift sensor signal (Interruption)
48,13	30	132	Self adjustment error of shift sensor
48,7	30	157	Selector sensor signal leaves position during driving
48,7	30	158	Engage sensor signal leaves engaged position during driving
50,5	32	37	Interruption at output stage to Y5 (Valve Select)

ON MESSAGES CENTER DISPLAY (MCD) SAE-J1587 Codes	ON SHIFT SELECTOR DISPLAY	ISO CODES WITH TESTMAN TOOL	DESCRIPTION
50,6	32	5	Short circuit to ground at output stage to Y5 (Valve Select)
50,3	32	69	Short circuit to positive at output stage to Y5 (Valve Select)
51,5	33	39	Interruption at output stage to Y7 (Valve Shift)
51,6	33	7	Short circuit to ground at output stage to Y7 (Valve Shift)
51,3	33	71	Short circuit to positive at output stage to Y7 (Valve Shift)
54,6	36	17	Short circuit to ground at output stage to Y1 (inertia brake valve)
54,5	36	49	Interruption at output stage to Y1 (inertia brake valve)
54,3	36	81	Short circuit to positive at output stage to Y1 (inertia brake valve)
55,7	37	114	Clutch engaged unintentionally at standstill, gear engaged
55,7	37	118	Clutch does not disengage
55,7	37	119	Clutch does not engage / does not transmit engine torque
56,7	38	145	Range change group (GP) disengagement error
56,7	38	146	Changeover error during range change group (GP) shifting
56,7	38	147	Range change group (GP) does not engage
57,2	39	108	Error in shift lever
57,14	39	110	ZF CAN timeout (can also means shift lever error through ZMP06400.hex)
58,7	3A	154	Main transmission gear does not disengage
58,7	3A	155	Main transmission gear does not engage
58,7	3A	156	Wrong gear shifting
59,7	3B	151	Selector cylinder does not disengage
59,7	3B	152	Change over error during gate selection procedure
59,7	3B	153	Selector cylinder does not engage
60,3	3C	133	No gate select sensor signal (Short circuit to positive)
60,6	3C	134	No gate select sensor signal (Short circuit to ground)
60,5	3C	135	No gate select sensor signal (Interruption)
60,13	3C	136	Gate select sensor self adjustment error
61,7	3D	148	Splitter (GV) does not disengage
61,7	3D	149	Change over error during splitter shifting
61,7	3D	150	Splitter (GV) does not engage
63,14	3F	100	Error on output speed signal 2
106,0	6A	125	Error on pressure reduction valve
106,14	6A	126	Error on pressure sensor signal

ON MESSAGES CENTER DISPLAY (MCD) SAE-J1587 Codes	ON SHIFT SELECTOR DISPLAY	ISO CODES WITH TESTMAN TOOL	DESCRIPTION
150,14	96	59	Acknowledge fault of PTO 1
150,14	96	60	Acknowledge fault of PTO 2
150,7	96	61	Disengagement fault of PTO 1
150,7	96	62	Disengagement fault of PTO 2
150,7	96	63	Engagement fault of PTO1
150,7	96	64	Engagement fault of PTO2
151,14	97	102	Plausibility error between transmission input speed and output speed
152,6	98	10	Short circuit to ground at output stage to Y10 (Main valve)
152,5	98	42	Interruption at output stage to Y10 (Main valve)
152,3	98	74	Short circuit to positive at output stage to Y10 (Main valve)
153,14	99	-	Error on ISO 14320 communications line
154,14	9A	101	Error on both output speed signals
161,14	A1	98	Error on transmission input speed signal
177,2	B1	128	Error on oil temperature sensor signal
191,14	BF	194	Both sources of vehicle speed are faulty
191,14	BF	99	Error on output speed signal 1
230,14	E6	166	Permanent idle signal
230,14	E6	168	No idle signal or error on ”idle signal switch” signal (EEC2)
230,14	E7	103	Error on ”Wheel-based vehicle speed” signal (CCV
231,7	E7	163	Engine does not react on torque intervention
231,14	E7	164	Error on ”Drivers demand engine percent torque” (EEC1)
231,14	E7	165	Error on ”Accelerator pedal position” (EEC2)
231,14	E7	167	Error on ”Percent load at current speed” signal (EEC2)
231,14	E7	171	Error on ”Actual engine percent torque” signal (EEC1)
231,14	E7	172	Permanent engine brake request signal
231,14	E7	173	Error on ”Brake switch” signal (CCVS)
231,14	E7	177	System-CAN Busoff error
231,11	E7	178	CAN error frames
231,11	E7	179	CAN queue overrun
231,14	E7	180	CAN EEC1 timeout
231,14	E7	181	CAN EEC2 timeout
231,14	E7	182	CAN CCVS timeout

ON MESSAGES CENTER DISPLAY (MCD) SAE-J1587 Codes	ON SHIFT SELECTOR DISPLAY	ISO CODES WITH TESTMAN TOOL	DESCRIPTION
231,14	E7	183	CAN ERC1_ER timeout
231,14	E7	197	Error on "Front axle speed" (WSI)
231,14	E7	198	Error on "Relative wheel speeds" (WSI)
231,14	E7	199	CAN WSI timeout
231,14	E7	26	CAN engine configuration timeout
231,14	E7	27	Error on ”engine configuration message” (engine configuration)
231,14	E7	31	Error on ”Actual engine retarder - percent torque” signal (ERC1_ER)
231,14	E7	32	Error on ”Engine retarder configuration message” (Engine retarder configuration)
231,14	E7	33	CAN ”Engine retarder configuration” timeout
231,14	E7	91	CAN EBC1 timeout
231,14	E7	92	Error on ”ABS active” signal (EBC1)
231,14	E7	93	Error on ”ASR engine control active” signal (EBC1)
231,14	E7	94	Error on ”ASR brake control active” signal (EBC1)
231,14	E7	95	Error on ”Cruise control active” signal (CCVS)
231,14	E7	96	Error on ”Cruise control set speed” (CCVS)
231,14	E7	97	Error on ”Engine speed” signal (EEC1)
-	EE	-	Communication error between GS3 and ZMTEC on display line
248,6	F8	25	Short circuit to ground at output SD to display
248,3	F8	89	Short circuit to positive at output SD to display

12. SPECIFICATIONS

ALLISON AUTOMATIC TRANSMISSION WITH OR WITHOUT RETARDER

X3 Coaches
Gross input power (maximum)....500 HP (373 kW)
Gross input torque (maximum) ....1525 Lbf-ft- (2068 Nm)
Rated input speed (minimum-maximum) ....1600-2300 rpm

Mounting:
Engine....SAE #1 flywheel housing, flex disk drive

Torque converter:
Type .... One stage, three element, polyphase
Stall torque ratio ....TC 551-1.8
Lockup clutch with torsional damper .... Integral/standard

Gearing:
Type .... Patented, constant mesh, helical, planetary

Ratio:
First 3.51:1
Second....1.91:1
Third 1.43:1
Fourth....1.00:1
Fifth 0.74:1
Sixth 0.64:1
Reverse 4.80:1

Ratio coverage:
6 speed 5.48:1

*** Gear ratios do not include torque converter multiplication.**

Oil System:
Oil type....TRANSYND, DEXRON III
Capacity (excluding external circuits) ....Initial fill 47 US qts (45 liters)
Oil change.... 24 US qts (23 liters)
Oil change (with retarder).... 27.6 US qts (26 liters)

Oil Filters:
Make .... Allison Transmission
Type .... Disposable cartridge
Supplier number 29503829
Prévost number 57-1687

SECTION 11: REAR AXLES

CONTENTS

ILLUSTRATIONS

1. DRIVE AXLE

1.1 DESCRIPTION

The Meritor drive axle is equipped with a single reduction standard carrier mounted in front of the axle housing. The carrier consists of a hypoid drive pinion, a ring gear set and gears in the differential assembly.

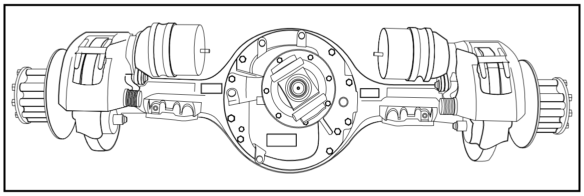


FIGURE 1: DRIVE AXLE 11019

A straight roller bearing (spigot) is mounted on the head of the drive pinion. All other bearings in the carrier are tapered roller bearings. When the carrier operates, there is a normal differential action between the wheels all the time.

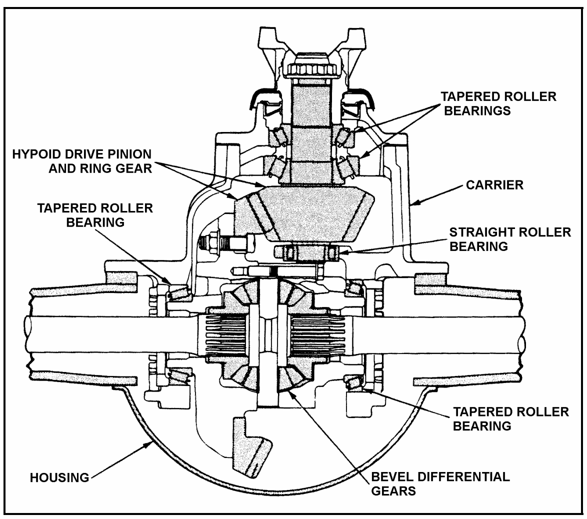


FIGURE 2: DIFFERENTIAL ASSEMBLY 11024

Several speed ratios are available for the drive axle. These ratios depend upon the motor and transmission. Also, special applications may suggest slightly different gear ratios.

1.2 DCDL (DRIVER-CONTROLLED MAIN DIFFERENTIAL LOCK)

Meritor Single-reduction carriers with driver-controlled main differential lock (DCDL) have the same type of gears and bearings as the standard-type carriers. The differential lock is operated by an air actuated shift assembly that is mounted on the carrier.

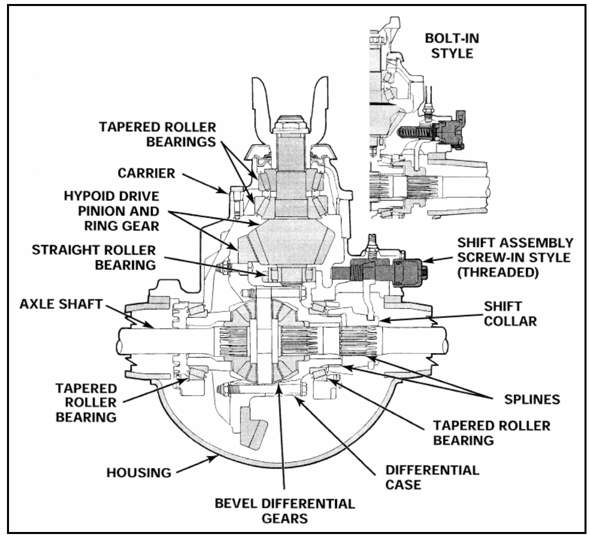


FIGURE 3: DRIVER-CONTROLLED DIFFERENTIAL LOCK
11028

1.3 DRIVE AXLE LUBRICATION

Additional lubrication information is covered in the Meritor Technical Bulletin TP-9539: “Approved Rear Drive Axle Lubricants” annexed to this section. During initial stage of normal operation, tiny metal particles originating from moving parts can be found on mating surfaces. These particles are carried by the lubricant through the assembly and act as lapping compound, which accelerates wear of all parts. To ensure maximum life of the differential and prevent premature failure, the original "factory fill" lubricant should be drained. Change break-in oil before 3,000 miles (4 800 km) of initial operation (drain the unit while it is still warm from operation), in accordance with the lubrication and servicing schedule.

Change differential oil and clean the breathers, magnetic fill and drain plugs, every 100,000 miles (160 000 km) or once every two years, whichever comes first.

Use Multigrade gear oil MIL-L-2105-D. Use the 75W90-gear oil for northern climates and the 80W140 for southern climates. In extreme conditions, or for better performance, fill with synthetic gear oil. Check oil level and add (if necessary) every 6,250 miles (10 000 km) or twice a year, whichever comes first (Fig. 4).

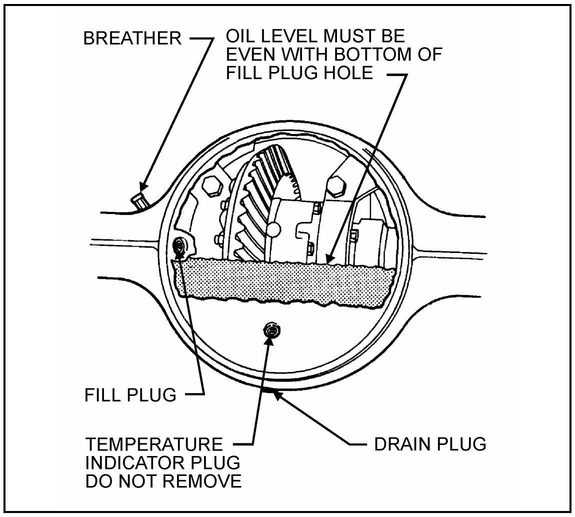


FIGURE 4: DIFFERENTIAL HOUSING BOWL 11007

1.4 MAINTENANCE

Proper vehicle operation begins with preventive maintenance, such as good differential use. The most common types of drive axle carrier failures are spinout, shock, fatigue, overheating and lubrication. Avoid neglecting these points since they would be the first steps to improper maintenance, expensive repairs, and excessive downtime.

Inspect the pinion oil seal, axle shaft flange and carrier housing gaskets for evidence of lubricant leakage. Tighten the bolts and nuts, or replace the gaskets and seals to correct leaks. Maintenance of the axle mountings consists primarily in a regular and systematic inspection of the air suspension units and radius rods, as directed in Section 16, *"Suspension".*

1.4.1 Checking and Adjusting the Oil Level

⚠ WARNING ⚠
Before servicing, park safely over a repair pit, apply parking brake, stop engine and set battery master switch to the "OFF" position.

1. Make sure the vehicle is parked on a level surface.

⚠ WARNING ⚠
Check the oil level when the axle is at room temperature. When hot, the oil temperature may be 190ºF (88ºC) or more and can cause burns. Also, a correct reading is not obtained when the axle is warm or hot.

2. Make sure the axle is "cold" or at room temperature.
3. Clean the area around the fill plug. Remove the fill plug from the differential axle housing bowl (Fig. 4).
4. The oil level must be even with the bottom of the hole of the fill plug.
   a. If oil flows from the hole when the plug is loosened, the oil level is high. Drain the oil to the correct level.
   b. If the oil level is below the bottom of the hole of the fill plug, add the specified oil.
5. Install and tighten the fill plug to 35-50 lbf-ft (48-67 Nm).

1.4.2 Draining and Replacing the Oil

⚠ WARNING ⚠
Before servicing, park safely over a repair pit, apply parking brake, stop engine and set battery master switch to the "OFF" position.

1. Make sure the vehicle is parked on a level surface. Put a large container under the axle's drain plug.

NOTE
Drain the oil when the axle is warm.

2. Remove the drain plug from the bottom of the axle. Drain and discard the oil in an environment friendly manner.
3. Install and tighten the drain plug to 35-50 lbf-ft (48-67 Nm).
4. Clean the area around the fill plug. Remove the fill plug from the differential housing bowl.
5. Add the specified oil until the oil level is even with the bottom of the hole of the fill plug. Allow the oil to flow through the axle and check the oil level again (lube capacity 41 pints [13,3 liters]).

⚠ CAUTION ⚠
The differential overheats when the oil temperature rises above 250ºF (120ºC).

6. Install and tighten the fill plug to 35-50 lbf-ft (48-67 Nm).

1.4.3 Speed Sensors (Anti-Lock Brake system, ABS)

For removing and installing the drive axle speed sensors (for anti-lock brake systems, ABS), refer to Section 12: *''Brake and Air System''* and to Rockwell WABCO Maintenance Manual: *"Anti-Lock Brake Systems For Trucks, Tractors and Buses"*, annexed at the end of section 12.

1.5 REMOVAL AND REINSTALLATION

The following procedure deals with the removal of the drive axle assembly and its attachments as a unit. The method used to support the axle during removal and disassembly depends upon local conditions and available equipment.

1. Raise vehicle by its jacking points on the body (fig. 5 or see Section 18, *"Body"* under heading *"Vehicle Jacking Points")*. Place jack stands under frame. Remove drive axle wheels (if required, refer to Section 13, *"Wheels, Hubs And Tires"*.

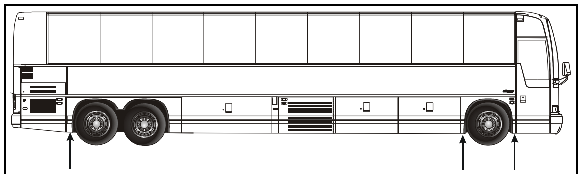


FIGURE 5: JACKING POINTS ON FRAME 18618

2. Exhaust compressed air from the air supply system by opening the drain cock on each air reservoir.
3. Disconnect the propeller shaft as directed in Section 9, *"Propeller Shaft",* in this manual.
4. On both sides of the vehicle, unscrew fasteners retaining front wheel housing plastic guards, and remove them from vehicle.
5. Disconnect both height control valve links from air spring mounting plate brackets then move the arm down to exhaust air suspension.
6. Remove cable ties securing the ABS cables (if vehicle is so equipped) to service brake chamber hoses. Disconnect the ABS cable plugs from the drive axle wheel hubs.

NOTE
When removing drive axle, if unfastening cable ties is necessary for ease of operation, remember to replace them afterwards.

7. Disconnect the brake chamber hoses.

NOTE
Position the hoses so they will not be damaged when removing the axle.

8. Install jacks under the axle jacking points to support the axle weight (refer to figure 6).

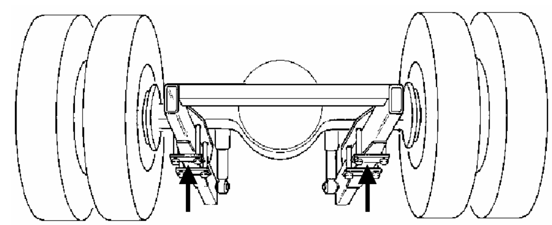


FIGURE 6: JACKING POINTS ON DRIVE AXLE 11005

9. Remove the four shock absorbers as outlined in Section 16, *"Suspension"* under heading *"Shock Absorber Removal".*
10. Remove the sway bar.
11. Remove the lower and upper longitudinal radius rod supports from vehicle sub-frame as outlined in Section 16, *"Suspension",* under heading *"Radius Rod Removal".*
12. Remove the transversal radius rod support from the vehicle sub-frame.
13. Remove the two retaining nuts from each of the four air bellows lower mounting supports.
14. Use the jacks to lower axle. Carefully pull away the jacks axle assembly from underneath vehicle.
15. Reverse removal procedure to reinstall drive axle.

NOTE
Refer to Section 16, "Suspension" for suspension components' proper tightening torques.

NOTE
Refer to section 13 "Wheels, Hubs And Tires" for correct wheel bearing adjustment procedure.

1.6 DISASSEMBLY AND REASSEMBLY

Disassembly and re-assembly procedures are covered under applicable headings in Meritor's *"MAINTENANCE MANUAL, NO. 5"*, annexed to this section.

1.7 GEAR SET IDENTIFICATION

Gear set identification is covered under applicable heading in Meritor's *"MAINTENANCE MANUAL NO. 5"*, annexed to this section.

1.8 ADJUSTMENTS

Adjustments are covered under applicable headings in Meritor's *"MAINTENANCE MANUAL NO. 5"*, annexed to this section.

1.9 FASTENER TORQUE CHART

A differential fastener torque chart is provided in Meritor's *"MAINTENANCE MANUAL NO. 5"*, annexed to this section.

1.10 TIRE MATCHING

Drive axle tire matching is covered under the applicable heading in Section 13, *"Wheels, Hubs And Tires"* in this manual.

1.11 DRIVE AXLE ALIGNMENT

NOTE
For *drive axle alignment specifications, refer to paragraph 3: "Specifications" in this section.*

The drive axle alignment consists in aligning the axle according to the frame. The axle must be perpendicular to the frame. The alignment is achieved with the use of shims inserted between the lower longitudinal radius rod supports and the frame.

Drive axle alignment is factory set and is not subject to any change, except if the vehicle has been damaged by an accident or if there are requirements for replacement.

If the axle has been removed for repairs or servicing and if all the parts are reinstalled exactly in the same place, the axle alignment is not necessary. However, if the suspension supports have been replaced or altered, proceed with the following instructions to verify or adjust the drive axle alignment.

NOTE
When drive axle alignment is modified, tag axle alignment must be re-verified.

1.11.1 Procedure

1. Park vehicle on a level surface, then chock front vehicle wheels.
2. Using two jacking points (which are at least 30 inches [76 cm] apart) on drive axle, raise the vehicle sufficiently so that wheels can turn freely at about ½ inch from ground. Secure in this position with safety stands, and release parking brake.
3. Install wheel mount sensors on front end and drive axle wheels (fig. 7).

NOTE
See reference numbers on wheel mount sensors (fig.7).

NOTE
Select axle specifications in the appropriate chart

DRIVE AXLE ALIGNMENT

- With the system installed as in figure 7, adjust drive axle according to specifications' chart below.

DRIVE AXLE ALL VEHICLES			
Alignment / value	Minimum value	Nominal value	Maximum value
Thrust angle (deg.)	-0.04	0	0.04

TAG AXLE ALIGNMENT

- Remove and reinstall all wheel mount sensors on the drive and tag axles (fig. 8);

NOTE
For an accurate alignment, the tag axle must be aligned with the drive axle.

NOTE
Reinstall wheel mount sensors as shown in figure 8.

- Adjust tag axle according to specifications' chart below in reference with drive axle.

TAG AXLE ALL VEHICLES			
Alignment / value	Minimum value	Nominal value	Maximum value
Parallelism (deg.)	-0.02	0	0.02

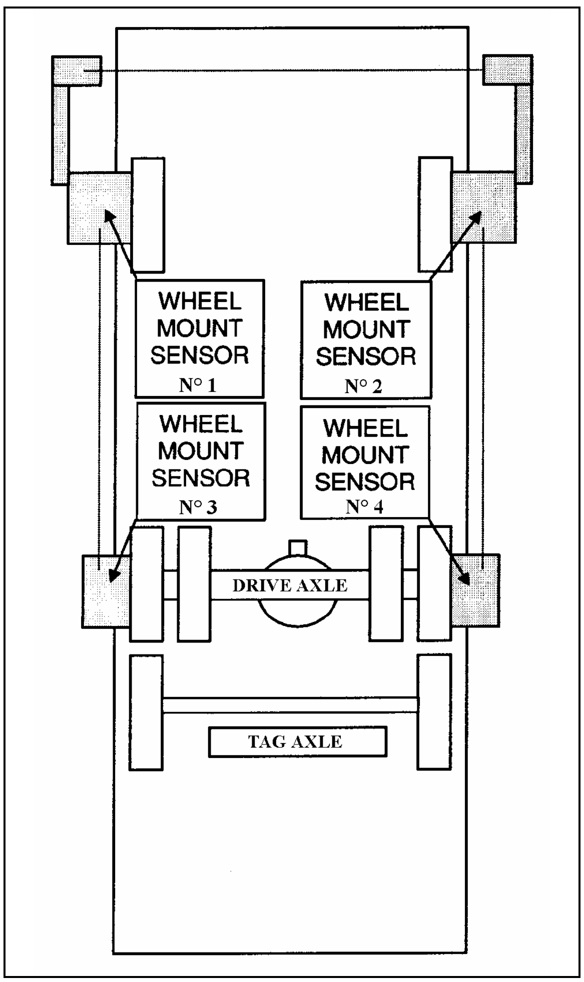


FIGURE 7: FRONT & DRIVE AXLE ALIGNMENT 11025

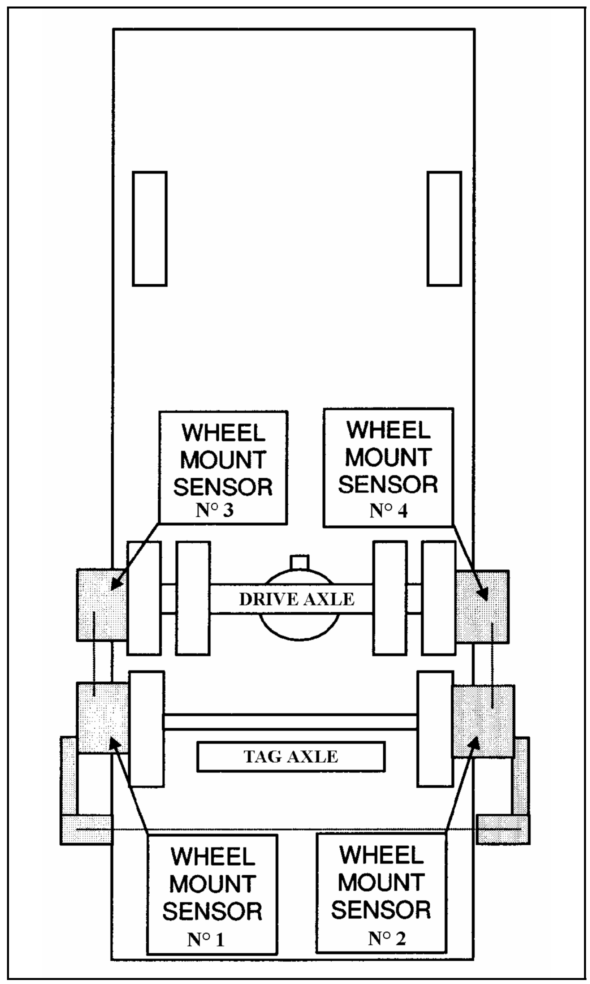


FIGURE 8: TAG AXLE ALIGNMENT 11026

NOTE
Refer to Section 16, "Suspension", for proper torque tightening of the longitudinal radius rod support nuts.

NOTE
When the drive alignment is changed, the tag alignment must also be adjusted.

1.12 AXLE SHAFT SEALING METHOD

The following method is to be used to ensure that axle shaft installation is fluid-tight:

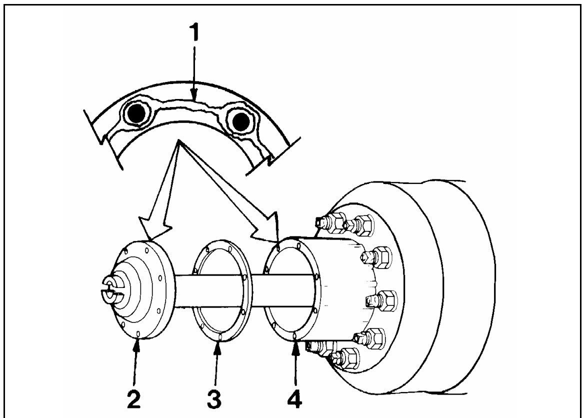


FIGURE 9: AXLE SHAFT INSTALLATION 11003

1 .... Silicone sealant*
2 .... Axle shaft
3 .... Gasket
4 .... Wheel hub

1. Clean the mounting surfaces of both the axle shaft flange and wheel hub where silicone sealant will be applied. Remove all old silicone sealant, oil, grease, dirt and moisture. Dry both surfaces.
2. Apply a continuous thin bead of silicone sealant* (Prévost P/N 680053) on the mounting surfaces and around the edge of all fastener holes of both the axle shaft flange and wheel hub.

* *GENERAL ELECTRIC Silicone Rubber Adhesive Sealant RTV 103 Black.*

⚠ WARNING ⚠
Carefully read cautions and instructions on the tube of silicone sealant and its packing.

3. Assemble components immediately to permit the silicone sealant to compress evenly between parts.
   a. Place a new gasket, then install the axle shaft into the wheel hub and differential carrier. The gasket and flange of the axle shaft must fit flat against the wheel hub.
   b. Install the tapered dowels at each stud and into the flange of the axle shaft. Use a punch or drift and hammer if needed.
   c. Install the lock washers and nuts on the studs. Tighten nuts to the correct torque value.

NOTE
Torque values are for fasteners that have a light application of oil on the threads (refer to Meritor Maintenance Manual).

9/16-18 plain nut: 110 - 165 lbf-ft (149 -224 Nm)

5/8-18 plain nut: 150 - 230 lbf-ft (203 - 312 Nm)

2. TAG AXLE

The tag axle is located behind the drive axle. It carries a single wheel and tire on each side. One system is installed as standard equipment on the vehicle and enables unloading and raising of the tag axle (refer to the *"OPERATOR'S MANUAL"* for location of controls). This system has been designed for the following purposes:

1. Shortening of wheelbase, thus allowing tighter turning in tight maneuvering areas such as parking lots or when making a sharp turn.
2. Transferring extra weight and additional traction to the drive wheels on slippery surfaces.

⚠ CAUTION ⚠
Never exceed 30 mph (50 km/h) with tag axle up and unloaded and resume normal driving as soon as possible.

The tag axle service brakes operate only when the axle is in normal driving (loaded) position.

2.1 GREASE LUBRICATED WHEEL BEARINGS

The unitized hub bearings used on the NDS range of axles, are non-serviceable items. Bearings are pre-adjusted, lubricated and have seals fitted as part of the manufacturing process. The bearings are greased for life and there is no need or facility for re-lubrication

Front and tag axle hub bearings need to be checked every 30,000 miles (48 000 km).

NOTE
For more information on front and tag axle wheel hub, refer to "DANA SPICER Maintenance Manual Model NDS and Maintenance Manual NDS Axles" annexed at the end of this Section.

2.2 REMOVAL AND REINSTALLATION

The following procedure deals with the removal of the tag axle assembly along with the suspension components. The method used to support the axle and suspension components during removal and disassembly depends upon local conditions and available equipment.

1. Raise vehicle by its jacking points on the body (fig. 5 or see Section 18, *"Body"* under heading: *"Vehicle Jacking Points"*). Place jack under frame. Remove drive axle wheels (if required, refer to Section 13, *"Wheels, Hubs And Tires"*).
2. Exhaust compressed air from the air supply system by opening the drain cock on each air reservoir and deplete air bags by moving leveling valve arm down.
3. Install jacks under tag axle jacking points to support the axle weight (refer to figure 10).

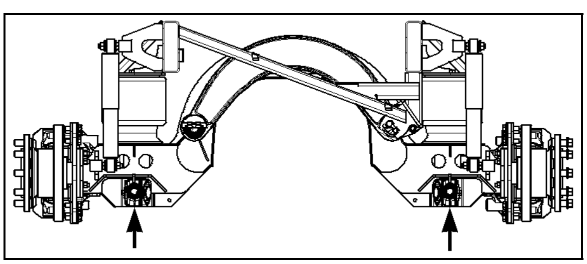


FIGURE 10: JACKING POINTS ON TAG AXLE 11029

4. <u>Applies only to vehicles equipped with retractable tag axles:</u> Disconnect tag axle lifting chain collars from lower longitudinal radius rods.
5. Remove the propeller shaft as directed in Section 9, *"Propeller Shaft",* in this manual.
6. Disconnect the tag axle brake chamber hoses.

⚠ CAUTION ⚠
Position the hoses so they will not be damaged when removing axle.

7. Disconnect hose from the air spring upper mounting plate.
8. Remove the two shock absorbers as outlined in Section 16, *"Suspension",* under *"Shock Absorber Removal".*
9. Disconnect the lower longitudinal radius rods as outlined in Section 16, *"Suspension",* under *"Radius Rod Removal".*
10. Disconnect the transversal radius rod.
11. Disconnect the upper longitudinal radius rod.
12 Remove the air bellows retaining nuts from each of the two upper mounting plates.
13. Use the jacks to move the axle forward to clear the axle off the transmission. Lower the axle.

⚠ CAUTION ⚠
On vehicles equipped with an automatic transmission (with or without the output retarder), move tag assembly very carefully. Pay special attention to the U-shaped section, as the transmission end components may be easily damaged through a false maneuver.

14. Reverse removal procedure to reinstall tag axle.

NOTE
Refer to Section 16, "Suspension", for proper torque tightening of suspension components.

NOTE
Refer to section 13 "Wheels, Hubs And Tires" for correct wheel bearing adjustment procedure.

2.3 TAG AXLE ALIGNMENT

The tag axle alignment consists in aligning the tag axle parallel to the drive axle position. Before aligning the tag axle, proceed with the drive axle alignment (paragraph 1.11). Tag axle alignment is achieved with the use of shims inserted between the lower longitudinal radius rod supports and axle. Tag axle alignment is factory set and is not subject to any change, except if vehicle has been damaged by an accident or if there are requirements for parts replacement.

⚠ CAUTION ⚠

If this setting is altered significantly, it will cause excessive tire wear.

NOTE

It may be necessary to adjust the axle TOE as well as its alignment. In this case, insert shims (7 min. - P/N 121203 or 15 min. - P/N 121240) in between mounting plate and spindle, as required.

If axle has been removed for repair or servicing and if all parts are reinstalled exactly in their previous locations, axle alignment is not necessary. However, if the suspension supports have been replaced or have changed position, proceed with the following instructions to verify or adjust the tag axle alignment.

3. SPECIFICATIONS

Drive Axle

Make .... Meritor
Drive track .... 76.7 inches (1 949 mm)
Gear type .... Hypoid
Axle type .... Full floating
Lube capacity .... 41 pints (19,3 liters)

Drive axle ratio

World Transmission	ZF Transmission
4.30:1 Standard	3.73:1 Standard
4.10:1 Optional	3.42:1 Optional
4.56:1 Optional	3.58:1 Optional
4.88:1 Optional	

NOTE

The drive axle alignment consists in aligning the axle with reference to the frame. The axle must be perpendicular to the frame.

Tag Axle

Make .... Prévost
Rear track .... 83.6 inches (2 124 mm)
Axle type .... Dana Spicer Europe TS8U Hub Unit

NOTE

The tag axle alignment consists in aligning the tag axle parallel to the drive axle.

CONTENTS

ILLUSTRATIONS

1. ENGINE

This vehicle is powered by a 6-cylinder, four-cycle, Detroit Diesel series 60 engine equipped with an electronic control system (DDEC V).

One engine displacement is used in the X3 Coaches Series 60 engines: 12.7 liters. Summary information on the Electronic Control System is given in this section.

Complete maintenance and repair information on the engine will be found in the current DDEC V Service Manual. This maintenance manual covers engine accessories, controls and related components.

Procedures for engine removal and installation are given at the end of this section. The DDEC system is self-diagnostic. It can identify faulty components and other engine-related problems by providing the technician with a diagnostic code.

Refer to DDEC Troubleshooting Guide published by Detroit Diesel for more complete information on diagnosis of components and system problems.

DDEC V (**D**etroit **D**iesel **E**lectronic **C**ontrol) controls the timing and quantity of fuel injected by the electronic unit injectors (EUI). The system also monitors several engine functions using electrical sensors, which send electrical signals to the Electronic Control Module (ECM). The ECM computes the electrical signals and determines the correct fuel output and timing for optimum power, fuel economy and emissions. The ECM also has the ability to display warnings or shut down the engine completely (depending on option selection) in the event of damaging engine conditions, such as low oil pressure, low coolant level, or high oil temperature.

Two categories divide system components: engine-mounted components and engine-related components.

2. ENGINE-MOUNTED COMPONENTS

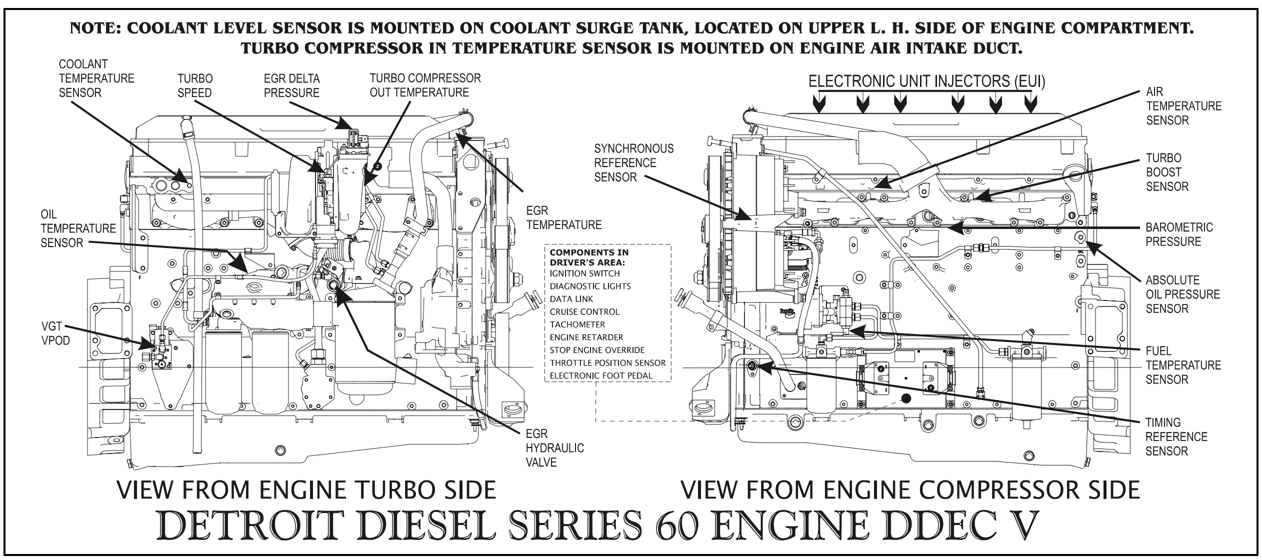


FIGURE 1: DETROIT DIESEL SERIES 60 ENGINE (TYPICAL) 01150

Engine-mounted components are as follows:

- Electronic Control Module
- Electronic Unit Injector
- Synchronous Reference Sensor
- Timing Reference Sensor
- Turbo Boost Pressure Sensor
- Coolant Temperature Sensor
- Fuel Temperature Sensor
- Air Temperature Sensor
- Absolute Oil Pressure Sensor
- Oil Temperature Sensor
- Barometric Pressure
- EGR Delta Pressure
- EGR Temperature
- Turbo Speed
- Turbo Compressor Out Temperature
- Turbo Compressor In Temperature

2.1 ELECTRONIC CONTROL MODULE

The Electronic Control Module is mounted, on the starter side of the engine (Fig. 2). Considered the *"Brain"* of the DDEC V system, it provides overall monitoring and control of the engine. It does so by comparing input data from the various sensors to a set of calibration data stored in the EEPROM (**E**lectrically **E**rasable, **P**rogrammable, **R**ead-**O**nly **M**emory) within the Electronic Control Module. After comparing the input data with the calibration data, the ECM sends high-current command pulses to the Electronic Unit Injectors (EUI) to initiate fuel injection. The ECM also receives feedback regarding the start and end of injection for a given cylinder. The EEPROM within the Electronic Control Module is factory programmed by Detroit Diesel. Reprogramming must be done at a Detroit Diesel authorized service center. However, some changes may be performed to the cruise control and road speed limiter using a diagnostic data reader (see paragraph "DDEC V Diagnostic Codes" in this section).

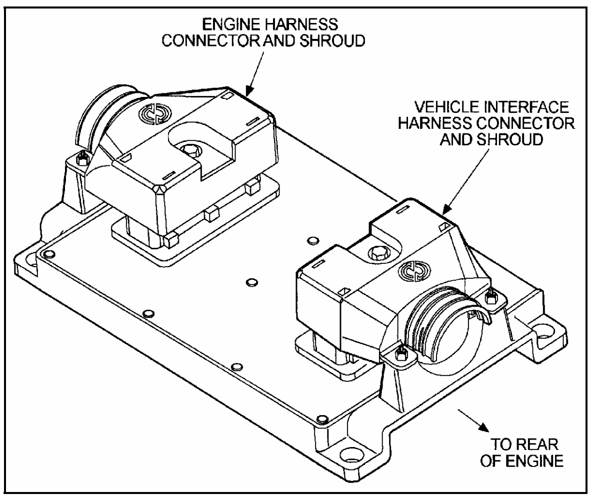


FIGURE 2: ELECTRONIC CONTROL MODULE (ECM) 01145

2.2 N3 ELECTRONIC UNIT INJECTOR

The N3 Electronic Unit Injector (EUI) is a compact device that injects diesel fuel directly into the combustion chamber (Fig. 3). The amount of fuel injected and injection timing is determined by the Electronic Control Module (ECM). The ECM sends a command pulse, which activates the injector solenoid. The EUI performs four functions:

- Creates the high-fuel pressure required for efficient injection;
- Meters and injects the exact amount of fuel required to handle the load;
- Atomizes the fuel for mixing with the air in the combustion chamber;
- Permits continuous fuel flow for component cooling**.**

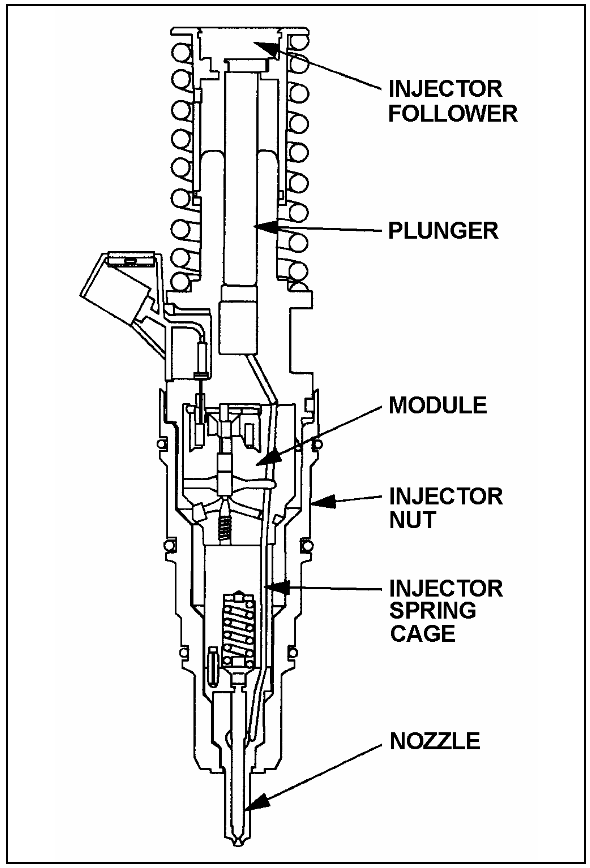


FIGURE 3: UNIT INJECTOR CROSS SECTION 01146

2.3 VPOD

There is one air-operated Variable Pressure Output Device (VPOD) that controls the Variable Geometry Turbo (VGT). The location of the VPOD is to the left of the engine oil filters (Fig. 4). Pneumatic system supplies air pressure.

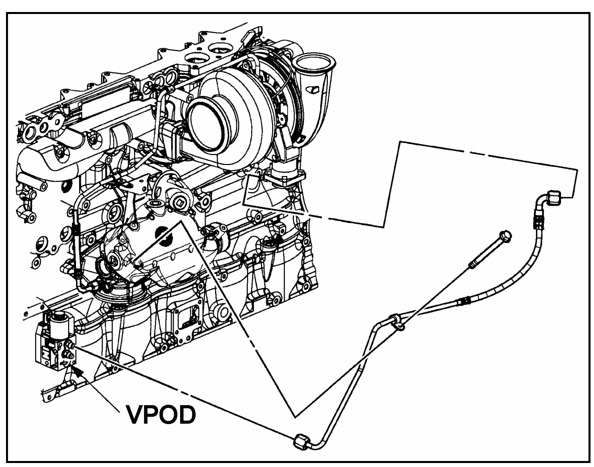


FIGURE 4: VPOD LOCATION 01149

2.3.1 VPOD Removal

1. Remove airline from VPOD.
2. Unplug harness connection.
3. Remove two bolts and one stud holding VPOD assembly and bracket to engine block.

2.3.2 VPOD Installation

1. Align VPOD assembly and bracket to threaded holes in engine block; install two bolts and one stud. Torque the M10 bolts and M10 stud to 43-54 Lbf-ft (58-73 Nm). Torque the M8 bolt to 22-28 Lbf-ft (30-38 Nm).
2. Connect airline to VPOD and tighten.
3. Plug harness connection into VPOD assembly.

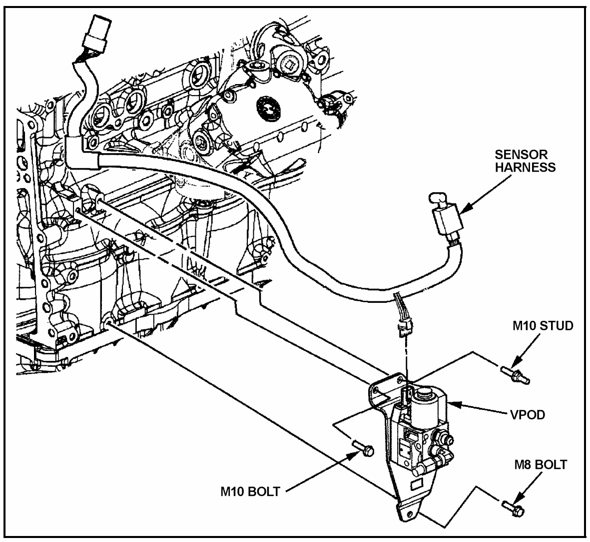


FIGURE 5: VPOD INSTALLATION 01147

NOTE
VPOD assembly is not serviceable, remove and replace only.

2.4 EGR HYDRAULIC VALVE

The hydraulic valve that controls the Exhaust Gas Recirculation (EGR) system is located on the same side as the VPOD but near the EGR cooler (Fig. 1 & 6).

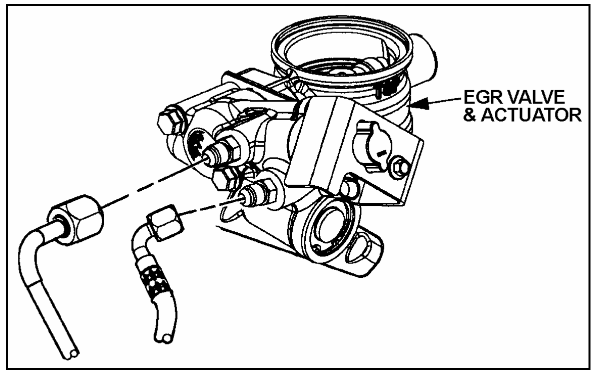


FIGURE 6: EGR VALVE & ACTUATOR ASSEMBLY 01148

2.5 SYNCHRONOUS REFERENCE SENSOR

The Synchronous Reference Sensor (SRS) is an electronic component, mounted to the rear of the gear case (Fig. 1). The SRS senses a raised metal pin on the rear of the camshaft idler gear and sends a signal to the ECM via a black connector wire. The SRS sensor extends through a hole in the gear case. It is positioned near the rear of the idler gear. A bolt, inserted through a hole in the SRS bracket, secures the SRS assembly to the gear case.

The idler gear pin passes by the SRS as piston number one crank pin reaches 45° before Top-Dead-Center. The ECM uses this information to determine engine speed.

The SRS is non-serviceable and must be replaced as a unit. No adjustment is required.

2.6 TIMING REFERENCE SENSOR

The Timing Reference Sensor (TRS) is an electronic component mounted on the left side of the gear case (right side of coach), near the crankshaft centerline. The TRS is positioned near the timing wheel gear teeth and extends through an opening in the gear case. A bolt, inserted through a hole in the TRS bracket, secures the TRS assembly to the gear case. The TRS connector is gray. The TRS sends a signal to the ECM, this signal is generated by a series of evenly spaced special teeth on the timing wheel. A tooth passes by the TRS as each cylinder crank pin reaches 10° before Top-Dead-Center.

The ECM uses these signals to determine injector solenoid operation time. The TRS is non-serviceable and must be replaced as a unit. No adjustment is required.

2.7 TURBO BOOST PRESSURE SENSOR

The Turbo Boost Pressure Sensor is located on the intake manifold. This device is a pressure sensor that sends an electrical signal to the ECM. The ECM uses this information to compute the volume of air entering the engine. Turbo boost sensor information regulates fuel supply to control engine exhaust.

The turbo boost pressure sensor is non-serviceable and must be replaced as an assembly. No adjustment is required.

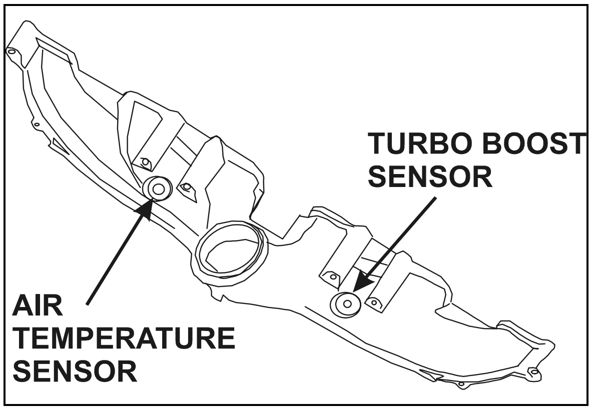


FIGURE 7: TURBO BOOST PRESSURE SENSOR 01138

2.8 COOLANT TEMPERATURE SENSOR

The coolant temperature sensor (Fig. 1) is mounted on the engine's radiator side (turbo side). The sensor helps protect the engine against overheating by sensing coolant temperature.

2.9 FUEL TEMPERATURE SENSOR

The Fuel Temperature Sensor (FTS) is installed underneath the fuel pump (Fig. 8).

The FTS sends an electrical signal to the ECM indicating fuel inlet temperature. The ECM uses this information to calculate fuel consumption.

The FTS is non-serviceable and must be replaced as a unit. No adjustment is required.

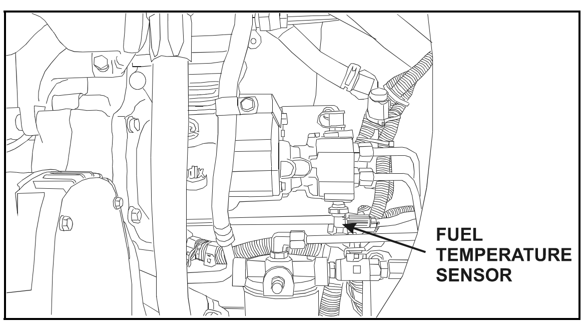


FIGURE 8: FUEL TEMPERATURE SENSOR 03053B

2.10 AIR TEMPERATURE SENSOR

The Air Temperature Sensor (Fig. 1 & 7) located on the intake manifold provides input data to vary hot idle speed and injection timing. This helps to improve cold starts and reduces white exhaust smoke.

2.11 TURBO COMPRESSOR IN TEMPERATURE SENSOR

The Turbo Compressor In Temperature Sensor is located on the engine air intake pipe (Fig. 9).

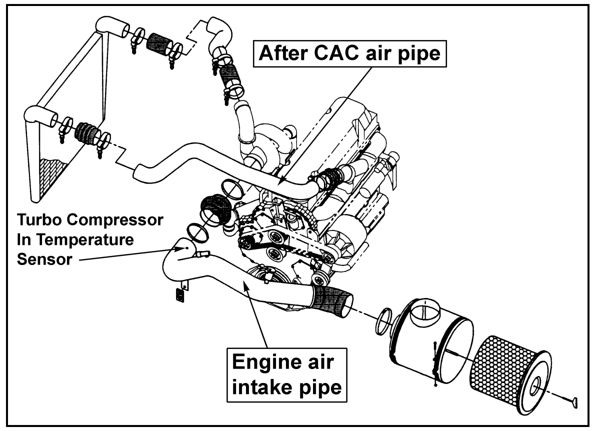


FIGURE 9: TURBO COMPRESSOR IN TEMPERATURE SENSOR LOCATION 01170

2.12 ABSOLUTE OIL PRESSURE SENSOR

The Absolute Oil Pressure Sensor (OPS) is installed in the main engine-oil gallery. A typical location is the left rear corner of the cylinder block (Fig. 10). The OPS sends an electrical signal to the ECM indicating the engine oil pressure at any given speed. A low oil pressure signal exceeding seven seconds is used by the ECM to begin the stop engine or warning function. The OPS is non-serviceable and must be replaced as a unit. No adjustment is required.

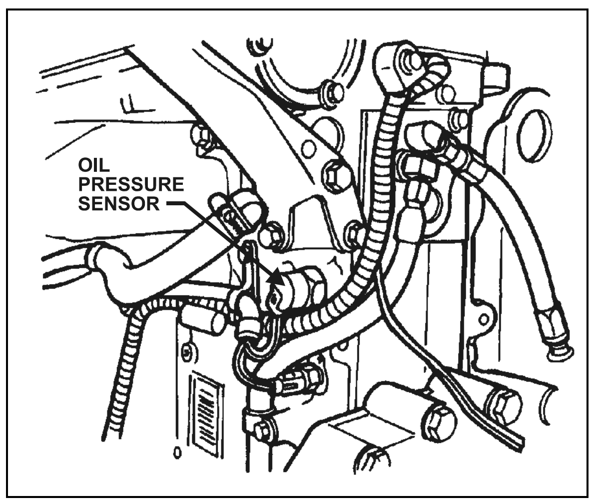


FIGURE 10: ENGINE OPS 01025B

2.13 OIL TEMPERATURE SENSOR

The Oil Temperature Sensor (OTS) is installed behind the engine oil filters manifold (Fig. 1). The

OTS sends an electrical signal to the ECM indicating engine oil temperature. The ECM uses this information to modify engine speed for better cold weather starts and faster warm-ups. Oil temperatures exceeding engine specifications for two seconds or more will illuminate the Check Engine Light.

The OTS is non-serviceable and must be replaced as a unit. No adjustment is required.

3. ENGINE-RELATED COMPONENTS

Engine-related components include:

- Coolant Level System (CLS)
- Electronic Foot Pedal Assembly (EFPA) and Throttle Position Sensor
- Cruise Control Switch (CCS)
- Diagnostic System Accessories (DSA)

3.1 COOLANT LEVEL SYSTEM (CLS)

The coolant level system consists of a conductivity probe mounted in the surge tank and an electronic interface module located inside the rear junction box. Coolant level is determined by the change in impedance of the probe and its brass mount when immersed in coolant. The electronic device in the module conditions the signal to levels compatible with DDEC. A low coolant level will trigger the engine warning functions.

The probe and electronic interface module are non-serviceable items and should be replaced as units, if found defective. No adjustment is required.

3.2 ELECTRONIC FOOT PEDAL ASSEMBLY (EFPA) & THROTTLE POSITION SENSOR

The Electronic Foot Pedal Assembly (EFPA) connects the accelerator pedal to a Throttle Position Sensor (TPS). The (TPS) is a device, which sends an electrical signal to the Electronic Control Module (ECM). The TPS signal varies in voltage depending on how far the pedal is depressed. The system is installed in the space normally occupied by a mechanical foot pedal. The (EFPA) has maximum and minimum stops that are built into the unit during manufacturing (Fig. 11). The (TPS) converts the operator's foot pedal input into a signal for the ECM. The (EFPA) is shown in Figure 11.

When installed by the equipment manufacturer, the TPS should not require adjustment. If the TPS is suspected of being misadjusted, confirm that the sensor is installed in accordance with the manufacturer's specifications. It is recommended that the idle count be at 50 or higher with a full throttle count of up to 200.

The TPS is self-calibrating and therefore has no optimum closed throttle or wide open throttle count value. If the counts are within the 50 to 200 range, the sensor is properly set.

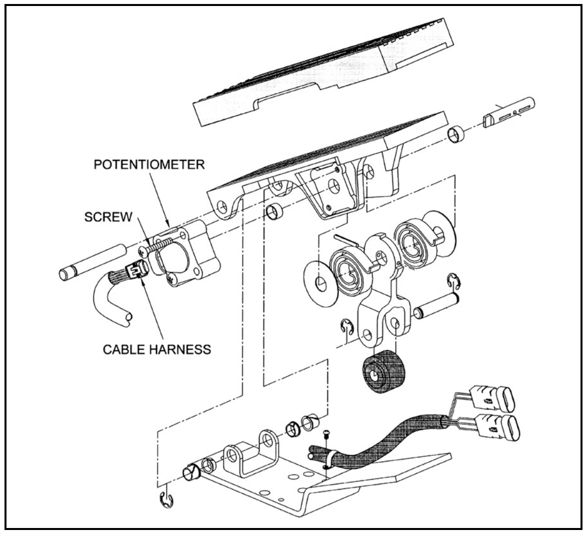


FIGURE 11: ELECTRONIC FOOT PEDAL ASSEMBLY 03035

Monitor the (TPS) at the controls as you move it through its full stroke. Be sure there is no misalignment or obstruction preventing the smooth movement of the TPS through the full stroke. Using a diagnostic data reader, check that the idle and full throttle position counts do not fall within the error zones. The error zones occur when the idle position is less than 14 counts, or when the full throttle position is more than 233 counts. Should these conditions occur, the ECU will signal diagnostic codes of 21-12 for idle error and 21-23 for wide-open throttle error.

3.3 CRUISE CONTROL SWITCHES (CCS)

The four cruise control switches are located in the driver's area on the L.H. side control panel.

1. **Cruise:** This is the main switch that actuates the ECM memory in order to use the speed-regulating mode.
2. **Set:** This switch is used to set the cruise control speed or to decrease the set speed by 2 MPH at each application.

NOTE
Cruise control system will not accept speed settings, nor will the "Resume" switch operate below 20 mph (32 km/h) and the engine speed must be above 1100 RPM.

3. **Resume:** Each time this switch is actuated, the speed will be increased by 2 mph (3,5 km/h). This switch allows the driver return to the last regulated speed following a brake or *"DECEL"* switch application.

NOTE
On-off switch must be in the "ON" position in order to return to the last regulated speed.

4. **Decel:** Will cancel the cruise temporarily and let the vehicle coast. Set speed is still in memory for resume.

For additional information, see the "Operator's Manual" or the "Owner's Manual".

3.4 DIAGNOSTIC SYSTEM ACCESSORIES (DSA)

The DDEC V engine Diagnostic System Accessories includes the following:

- Check Engine telltale light;
- Stop Engine telltale light;
- Stop Engine Override switch;
- Diagnostic Data Link (DDL) connectors.

3.4.1 Check Engine Telltale Light

The Check Engine telltale, mounted on the telltale light panel indicates that a problem has been detected and that a code has been stored in the ECM memory. This light also has a 5-second bulb check when the ignition is first turned on. The Check Engine telltale illuminates when the temperature at coolant sensors exceeds 217°F (103°C) and the temperature at oil sensors exceeds 260°F (127°C). When sensors reach those temperatures, DDEC starts to decrease engine power linearly.

3.4.2 Stop Engine Telltale Light

This light, also mounted on the telltale light panel, illuminates to indicate that a major engine problem is occurring (with the exception of a 5-second bulb check when the ignition is first turned on). The Stop Engine Light illuminates when the temperature at coolant sensors exceeds 222°F (106°C) and the temperature at oil sensors exceeds 239°F (115°C). When sensors detect such temperatures, DDEC shuts the engine down after a 30 seconds grace period. This 30-second delay may be extended another 30 seconds (if absolutely necessary) by using the STOP ENGINE OVERRIDE switch.

NOTE
Once engine is stopped, it cannot be restarted until the malfunction is corrected.

3.4.3 Stop Engine Override Switch

This switch, mounted on the dashboard, may be used to extend the 30-second delay period before engine shutdown when the Stop engine telltale light is illuminated. This switch can be repeatedly depressed in order to move the vehicle out of traffic.

NOTE
The stop engine override switch will be operative only if it has been depressed before the end of the 30 second delay period.

⚠ CAUTION ⚠
The OVERRIDE switch must be used only in emergency cases, such as to move the vehicle out of traffic. Excessive use of this switch can cause serious damage to the engine.

This switch is also used for DDEC diagnostic code requests. Press this switch with the engine at idle or off but with the ignition in the "ON" position and active codes will be flashed on the CHECK ENGINE and STOP ENGINE telltale lights alternately. Refer to “DDEC V DIAGNOSTIC CODES” in this section for more information.

3.4.4 Diagnostic Data Link (DDL) Connectors

A connector is mounted on the L.H. footwell wall. Another connector is located in the rear electric compartment. They allow the connection of the Diagnostic Data Reader (DDR) to read the codes or to access pertinent data on the condition of the engine. This enables a more complete analysis of any defect found in the DDEC system operation. For more information, see Detroit Diesel Troubleshooting Guide.

4. DDEC V DIAGNOSTIC CODES

4.1 READING DIAGNOSTIC CODES - FLASHING LIGHT METHOD:

DDEC V makes use of two types of codes: Active and inactive. The difference between the two types of codes is as follows:

Active Codes: Codes that are currently keeping the Check Engine or Stop Engine telltale light illuminated. Active codes are flashed via the Stop Engine Light when checked with the stop-engine-override switch.

Inactive Codes: These are all the codes logged in the ECM (whether or not they are currently turning on the Stop or Check Engine Light). Inactive codes are flashed via the Check Engine telltale light when checked with the stop-engine-override switch. In most instances, only the DDR can provide the information necessary for a quick diagnosis of the problem.

If you just need to read out codes, however, and do not have a DDR available, the following procedure will let you read out codes. Make sure the rear-starting switch (located in the engine compartment) is in the normal position. With the ignition ON, the engine idling or engine shut-off, momentarily depress the Stop Engine Override switch. Active codes will be flashed on the stop engine telltale, followed by the inactive codes being flashed on the check-engine telltale panel. The cycle repeats itself until the operator depresses the stop engine override switch again.

A code "43" consists of four flashes, followed by a short pause, then three flashes in quick succession.

Refer to DDEC Troubleshooting Manual for more information and SAE codes.

NOTE

Active codes are flashed in ascending numerical flash code order. Inactive codes are flashed in most recent to least recent order.

NOTE

Fault codes can only be cleared using the DDR.

NOTE

The listed codes may not be used in all applications. A default value in the normal operating range is used by the ECM to provide for engine operation if a sensor failure is present.

DDEC V Code	PID	SID	FMI	DESCRIPTION
11	187	--	4	Variable Speed Governor Sensor Voltage Low
11	187	--	7	Variable Speed Governor Switch System Not Responding
12	187	--	3	Variable Speed Governor Sensor Voltage High
13	111	--	4	Coolant Level Sensor Input Voltage Low
13	111	--	6	Add Coolant Level Sensor Input Voltage Low
13		146	6	EGR Valve Current too High
14	52	--	3	Intercooler Coolant Temperature Sensor Input Voltage High
14	110	--	3	Coolant Temperature Sensor Input Voltage High
14	175	--	3	Oil Temperature Sensor Input Voltage High
15	52	--	4	Intercooler Coolant Temperature Sensor Input Voltage Low
15	110	--	4	Coolant Temperature Sensor Input Voltage Low
15	175	--	4	Oil Temperature Sensor Input Voltage Low
16	111	--	3	Coolant Level Sensor Input Voltage High
16	111	--	5	Add Coolant Level Sensor Input Voltage High
16		146	5	EGR Valve Current too Low
17	51	--	3	Throttle Plate Position Sensor Input Voltage High
17	72	--	3	Blower Bypass Position Input Voltage High
17	354	--	3	Relative Humidity Sensor Circuit Failed High

DDEC V Code	PID	SID	FMI	DESCRIPTION
18	51	--	4	Throttle Plate Position Sensor Input Voltage Low
18	72	--	4	Blower Bypass Position Input Voltage Low
18	354	--	4	Relative Humidity Sensor Circuit Failed Low
21	91	--	3	Throttle Position Sensor Input Voltage High
22	91	--	4	Throttle Position Sensor Input Voltage Low
23	174	--	3	Fuel Temperature Sensor Input Voltage High
23	--	65	3	Oxygen Content Circuit Input Voltage High
24	174	--	4	Fuel Temperature Sensor Input Voltage Low
24	--	65	4	Oxygen Content Circuit Input Voltage Low
25	--	--	--	Reserved for ‘‘No Codes"
26	--	25	11	Aux. Shutdown #1 Active
26	--	61	11	Aux. Shutdown #2 Active
27	105	--	3	Intake Manifold Temperature Sensor Input Voltage High
27	171	--	3	Ambient Air Temperature Sensor Input Voltage High
27	172	--	3	Air Temperature Sensor Input Voltage High
28	105	--	4	Intake Manifold Temperature Sensor Input Voltage Low
28	171	--	4	Ambient Air Temperature Sensor Input Voltage Low
28	172	--	4	Air Temperature Sensor Input Voltage Low
29	351	—	4	TCI Temperature Circuit Failed Low
29	404	—	4	Turbo Compressor Temperature Out Sensor Input Voltage Low
31	--	51	3	Aux. Output #3 Open Circuit (High Side) – Pin E-49
31	--	51	4	Aux. Output #3 Short To Ground (High Side) – Pin E-49
31	--	51	7	Aux. Output #3 Mechanical System Fail - Pin E-49
31	--	52	3	Aux. Output #4 Open Circuit (High Side) - Pin E-48
31	--	52	4	Aux. Output #4 Short to Ground (High Side) - Pin E-48
31	--	52	7	Aux. Output #4 Mechanical System Failure - Pin E-48
31	--	260	3	Aux. Output #12 Open Circuit (High Side) - Pin E-46
31	--	260	4	Aux. Output #12 Short to Ground (High Side) - Pin E-46
31	--	260	7	Aux. Output #12 Mechanical System Failure - Pin E-46
31	--	261	3	Aux. Output #13 Open Circuit (High Side) - Pin E-47
31	--	261	4	Aux. Output #13 Short to Ground (High Side) - Pin E-47
31	--	261	7	Aux. Output #13 Mechanical System Failure - Pin E-47
31	--	262	3	Aux. Output #14 Open Circuit (High Side) - Pin E-50
31	--	262	4	Aux. Output #14 Short to Ground (High Side) - Pin E-50
31	--	262	7	Aux. Output #14 Mechanical System Failure - Pin E-50
31	--	263	3	Aux. Output #15 Open Circuit (High Side) - Pin E-51

DDEC V Code	PID	SID	FMI	DESCRIPTION
31	--	263	4	Aux. Output #15 Short to Ground (High Side) - Pin E-51
31	--	263	7	Aux. Output #15 Mechanical System Failure - Pin E-51
31	--	264	3	Aux. Output #16 Open Circuit (High Side) - Pin E-52
31	--	264	4	Aux. Output #16 Short to Ground (High Side) - Pin E-52
31	--	264	7	Aux. Output #16 Mechanical System Failure - Pin E-52
31	--	265	3	Aux. Output #17 Open Circuit (High Side) - Pin E-53
31	--	265	4	Aux. Output #17 Short to Ground (High Side) - Pin E-53
31	--	265	7	Aux. Output #17 Mechanical System Failure - Pin E-53
32	--	238	3	RSL Short to Battery (+)
32	--	238	4	RSL Open Circuit
32	--	239	3	AWL Short to Battery (+)
32	--	239	4	AWL Open Circuit
33	102	--	3	Turbo Boost Pressure Sensor Input Voltage High
34	102	--	4	Turbo Boost Pressure Sensor Input Voltage Low
35	19	--	3	High Range Oil Pressure Sensor Input Voltage High
35	100	--	3	Oil Pressure Sensor Input Voltage High
36	19	--	4	High Range Oil Pressure Sensor Input Voltage Low
36	100	--	4	Oil Pressure Sensor Input Voltage Low
37	18	--	3	High Range Fuel Pressure Sensor Input Voltage High
37	94	--	3	Fuel Pressure Sensor Input Voltage High
37	95	--	3	Fuel Restriction Sensor Input Voltage High
38	18	--	4	High Range Fuel Pressure Sensor Input Voltage Low
38	94	--	4	Fuel Pressure Sensor Input Voltage Low
38	95		4	Fuel Restriction Sensor Input Voltage Low
39	—	146	2	EGR Leak- Boost Power
39	—	146	12	EGR Leak- Boost Jake
39	—	146	7	EGR Valve Not Responding
39	—	147	2	VNT Vanes Not Responding – Boost Power
39	—	147	11	VNT Vanes at Max – Jake
39	—	147	12	VNT Vanes Not Responding – Boost Jake
39	—	147	14	EGR Flow too low
39	—	147	7	VNT Vanes Not Responding – EGR
41	--	21	0	Too Many CKP Sensor (missing CMP Sensor)
42	--	21	1	Too few CKP Sensor (missing CKP Sensor)
43	111	--	1	Coolant Level Low
44	52	--	0	Intercooler Coolant Temperature High
44	105	--	0	Intake Manifold Temperature High

DDEC V Code	PID	SID	FMI	DESCRIPTION
44	105	--	14	Engine Power Derate Due to Intake Manifold Temperature
44	110	--	0	Coolant Temperature High
44	110	--	14	Engine Power Derate Due to Coolant Temperature
44	172	--	0	Air Inlet Temperature High
44	175	--	0	Oil Temperature High
45	19	--	1	High Range Oil Pressure Low
45	100	--	1	Oil Pressure Low
46	168	--	1	ECM Battery Voltage Low
46	--	155		Injector V (reg) Voltage Failed Low
46	--	211	1	Sensor Supply Pins V-11/V-12 Low
46	--	212	4	Injector V (slope) Voltage Failed Low
46	--	214	1	RTC Backup Battery Voltage Low, Pin E-59
46	--	221	4	Injector I (pull-in) Voltage Failed Low
46	--	232	1	Sensor Supply Voltage Low, Pin E-12/E-26
47	18	--	0	High Range Fuel Pressure High
47	94	--	0	Fuel Pressure High
47	102	--	0	Turbo Boost Pressure High
47	102	--	14	Engine Power Derate Due to Turbo Boost Pressure
47	106	--	0	Air Inlet Pressure High
47	164	--	0	Injection Control Pressure High
48	18	--	1	High Range Fuel Pressure Low
48	94	--	1	Fuel Pressure Low
48	106	--	1	Air Inlet Pressure Low
48	164	--	1	Injection Control Pressure Low
48	351	--	1	TCI Temperature Low
48	404	—	1	Turbo Compressor Temperature Out Low
48	404	--	14	Engine Power Derate Due to Turbo Compressor Out Temperature
48	411	--	1	EGR Differential Pressure Low
48	412	--	1	EGR Temperature Low
49	351	--	0	TCI Temperature High
49	404	--	0	Turbo Compressor Out Temperature High
51	351	--	3	TCI Temperature Circuit Failed High
51	404	--	3	Turbo Compressor Out Temperature Sensor Input Voltage High
52	--	254	12	A/D Conversion Fail
53	--	253	2	Nonvolatile Checksum Incorrect
53	--	253	12	EEPROM Write Error

DDEC V Code	PID	SID	FMI	DESCRIPTION
53	--	253	13	Out of Calibration
54	84	--	12	Vehicle Speed Sensor Fault
55	--	216	14	Other ECU Fault (This fault is logged in conjunction with another fault to indicate missing information from another ECU.)
55	--	231	12	J1939 Data Link Fault
55	--	248	8	Proprietary Data Link Fault (Master)
55	--	248	9	Proprietary Data Link Fault (Receiver)
56	--	250	12	J1587 Data Link Fault
57	--	249	12	J1922 Data Link Fault
58	92	--	0	Torque Overload
61	--	xxx	0	Injector xxx Response Time Long
62	--	26	3	Aux. Output #1 Short to Battery (+) – Pin V-4
62	--	26	4	Aux. Output #1 Open Circuit - Pin V-4
62	—	26	7	Aux. Output #1 Mechanical System Not Responding Properly - Pin V-4
62	--	40	3	Aux. Output #2 Short to Battery (+) - Pin V-5
62	--	40	4	Aux. Output #2 Open Circuit - Pin V-5
62	—	40	7	Aux. Output #2 Mechanical System Not Responding Properly – Pin V-5
62	--	53	3	Aux. Output #5 Short to Battery (+) - Pin V-6
62	--	53	4	Aux. Output #5 Open Circuit - Pin V-6
62	—	53	7	Aux. Output #5 Mechanical System Not Responding Properly - Pin V-6
62	--	54	3	Aux. Output #6 Short to Battery (+) - Pin V-7
62	--	54	4	Aux. Output #6 Open Circuit - Pin V-7
62	--	54	7	Aux. Output #6 Mechanical System Not Responding Properly - Pin V-7
62	--	55	3	Aux. Output #7 Short to Battery (+) - Pin V-40
62	--	55	4	Aux. Output #7 Open Circuit - Pin V-40
62	—	55	7	Aux. Output #7 Mechanical System Not Responding Properly - Pin V-40
62	--	56	3	Aux. Output #8 Short to Battery (+) – Pin V-53
62	--	56	4	Aux. Output #8 Open Circuit - Pin V-53
62	--	56	7	Aux. Output #8 Mechanical System Not Responding Properly - Pin V-53
62	--	257	3	Aux. Output #9 Open Circuit – Pin V-54
62	--	257	4	Aux. Output #9 Short to Gnd – Pin V-54
62	--	257	7	Aux. Output #9 Mechanical System Failure – Pin V-54
62	--	258	3	Aux. Output #10 Open Circuit – Pin V-55
62	--	258	4	Aux. Output #10 Short to Gnd – Pin V-55

DDEC V Code	PID	SID	FMI	DESCRIPTION
62	--	258	7	Aux. Output #10 Mechanical System Failure – Pin V-55
62	--	259	3	Aux. Output #11 Open Circuit – Pin E-13
62	--	259	4	Aux. Output #11 Short to Gnd – Pin E-13
62	--	259	7	Aux. Output #11 Mechanical System Failure – Pin E-13
63	--	57	0	PWM #1 Above Normal Range, Pin V-53
63	--	57	1	PWM #1 Below Normal Range, Pin V-53
63	--	57	3	PWM #1 Short to Battery (+), Pin V-53
63	--	57	4	PWM #1 Open Circuit, Pin V-53
63	--	58	0	PWM #2 Above Normal Range, Pin V-46
63	--	58	1	PWM #2 Below Normal Range, Pin V-46
63	--	58	3	PWM #2 Short to Battery (+), Pin V-46
63	--	58	4	PWM #2 Open Circuit, Pin V-46
63	--	59	0	PWM #3 Above Normal Range, Pin E-3
63	--	59	1	PWM #3 Below Normal Range, Pin E-3
63	--	59	3	PWM #3 Short to Battery (+), Pin E-3
63	--	59	4	PWM #3 Open Circuit, Pin E-3
63	--	60	0	PWM #4 Above Normal Range, Pin E-4
63	--	60	1	PWM #4 Below Normal Range, Pin E-4
63	--	60	3	PWM #4 Short to Battery (+), Pin E-4
63	--	60	4	PWM #4 Open Circuit, Pin E-4
63	--	267	0	PWM #5 Above Normal Range - Pin E-8
63	--	267	1	PWM #5 Below Normal Range - Pin E-8
63	--	267	3	PWM #5 Short to Battery (+) - Pin E-8
63	--	267	4	PWM #5 Open Circuit - Pin E-8
63	--	267	7	PWM #5 Mechanical System Failed - Pin E-8
63	--	268	0	PWM #6 Above Normal Range - Pin E-11
63	--	268	1	PWM #6 Below Normal Range - Pin E-11
63	--	268	3	PWM #6 Short to Battery (+) - Pin E-11
63	--	268	4	PWM #6 Open Circuit - Pin E-11
63	--	268	7	PWM #6 Mechanical System Failed - Pin E-11
64	103	--	0	Turbo Overspeed
64	103	--	8	Turbo Speed Sensor Input Failure – Abnormal Period
65	51	--	0	Throttle Plate Position Above Normal Range
65	51	--	1	Throttle Plate Position Below Normal Range
65	51	--	2	Throttle Plate Position Erratic
65	51	--	7	Throttle Plate Not Responding
65	107	--	3	Air Filter Restriction Sensor Voltage High

DDEC V Code	PID	SID	FMI	DESCRIPTION
65	107	--	4	Air Filter Restriction Sensor Voltage Low
66	99	--	3	Oil Filter Restriction Sensor Voltage High
66	99	--	4	Oil Filter Restriction Sensor Voltage Low
66	--	76	0	Engine Knock Level Above Normal Range
66	--	76	3	Engine Knock Level Sensor Input Voltage High
66	--	76	4	Engine Knock Level Sensor Input Voltage Low
66	--	76	7	Engine Knock Level Sensor Not Responding
67	20	--	3	High Range Coolant Pressure Sensor Input Voltage High
67	20	--	4	High Range Coolant Pressure Sensor Input Voltage Low
67	106	--	3	Air Inlet Pressure Sensor Input Voltage High
67	106	--	4	Air Inlet Pressure Sensor Input Voltage Low
67	109	--	3	Coolant Pressure Sensor Input Voltage High
67	109	--	4	Coolant Pressure Sensor Input Voltage Low
68	--	230	5	TPS Idle Validation Circuit Fault (open circuit)
68	--	230	6	TPS Idle Validation Circuit Fault (short to ground)
71	--	xxx	1	Injector xxx Response Time Short
72	84	--	0	Vehicle Overspeed
72	84	--	11	Vehicle Overspeed (Absolute)
72	--	65	0	Oxygen Content Too High
72	--	65	1	Oxygen Content Too Low
73	107	--	0	Air Filter Restriction High
73	--	77	0	Gas Valve Position Above Normal Range
73	--	77	1	Gas Valve Position Below Normal Range
73	--	77	3	Gas Valve Position Input Voltage High
73	--	77	4	Gas Valve Position Input Voltage Low
73	--	77	7	Gas Metering Valve Not Responding
74	70	--	4	Optimized Idle Safety Loop Short to Ground
74	99	--	0	Oil Filter Restriction High
75	168	--	0	ECM Battery Voltage High
75	--	155	3	Injector V (reg) Voltage Failed High
75	--	211	0	Sensor Supply Pins V-11/V-12 Voltage High
75	--	212	3	Injector V (slope) Voltage Failed High
75	--	221	3	Injector V (pull-in) Voltage Failed High
75	--	214	0	RTC Backup Battery Voltage High
75	--	232	0	Sensor Supply Voltage High, Pin E-26
76	121	--	0	Engine Overspeed With Engine Brake
77	19	—	0	High Range Oil Pressure High

DDEC V Code	PID	SID	FMI	DESCRIPTION
77	20	—	0	High Range Coolant Pressure High
77	21	—	0	ECU Temperature Above Range
77	21	—	1	ECU Temperature Below Range
77	21	—	3	ECU Temperature Above Failed High
77	21	—	4	ECU Temperature Above Failed Low
77	72	—	0	Blower Bypass Door Position High
77	72	—	1	Blower Bypass Door Position Low
77	73	—	1	Fire Pump Pressure Low
77	81	—	0	Exhaust Back Pressure High
77	81	—	1	Exhaust Back Pressure Low
77	81	—	3	Exhaust Back Pressure Sensor Voltage High
77	81	—	4	Exhaust Back Pressure Sensor Voltage Low
77	81	—	12	Exhaust Back Pressure at Rampdown Threshold
77	95	—	1	Fuel Filter Differential Pressure Low
77	99	—	1	Oil Filter Differential Pressure Low
77	100	—	0	Engine Oil Pressure High
77	102	—	1	Turbo Boost Pressure Low
77	105	—	1	Inlet Manifold Temperature Low
77	107	—	1	Air filter Restriction Pressure Low
77	108	—	0	Barometric Pressure High
77	108	—	1	Barometric Pressure Low
77	109	—	0	Coolant Pressure High
77	110	—	1	Coolant Temperature Low
77	111	—	0	Coolant Level High
77	171	—	0	Ambient Air Temperature High
77	171	—	1	Ambient Air Temperature Low
77	172	—	1	Air Inlet Temperature Low
77	174	—	0	Fuel Temperature High
77	174	—	1	Fuel Temperature Low
77	175	—	1	Engine Oil Temperature Low
77	222	—	14	Anti-Theft Fault Present
77	251	—	10	Clock Module Abnormal Rate of Change
77	251	—	13	Clock Module Failure
77	252	—	10	Clock Module Abnormal Rate of Change
77	252	—	13	Clock Module Failure
77	354	—	0	Relative Humidity Above Range
77	354	—	1	Relative Humidity Below Range

DDEC V Code	PID	SID	FMI	DESCRIPTION
77	446	—	0	Cylinder Head Temperature Above Range
77	—	151	11	Service Now Lamp Fault Expiration
78	86	--	14	Cruise Control/Adaptive Cruise Control Fault
81	98	--	3	Oil Level Sensor Input Voltage High
81	101	--	3	Crankcase Pressure Sensor Input Voltage High
81	153	--	3	Extended Crankcase Pressure Input Voltage High
81	164	--	3	Injection Control Pressure Sensor Input Voltage High
81	173	--	3	Exhaust Temperature Sensor Input Voltage High
81	411	—	3	EGR Delta Pressure Sensor Circuit Failed High
81	412	—	3	EGR Temperature Circuit Failed High
81	412	—	9	EGR Temperature Network Sensor Not Responding
81		20	3	Timing Actuator Failed High
81		20	4	Timing Actuator Failed Low
81	--	129	3	Exhaust Port Temperature #1 Sensor Voltage High
81	--	130	3	Exhaust Port Temperature #2 Sensor Voltage High
81	--	131	3	Exhaust Port Temperature #3 Sensor Voltage High
81	--	132	3	Exhaust Port Temperature #4 Sensor Voltage High
81	--	133	3	Exhaust Port Temperature #5 Sensor Voltage High
81	--	134	3	Exhaust Port Temperature #6 Sensor Voltage High
81	--	135	3	Exhaust Port Temperature #7 Sensor Voltage High
81	--	136	3	Exhaust Port Temperature #8 Sensor Voltage High
81	--	137	3	Exhaust Port Temperature #9 Sensor Voltage High
81	--	138	3	Exhaust Port Temperature #10 Sensor Voltage High
81	--	139	3	Exhaust Port Temperature #11 Sensor Voltage High
81	--	140	3	Exhaust Port Temperature #12 Sensor Voltage High
81	--	141	3	Exhaust Port Temperature #13 Sensor Voltage High
81	--	142	3	Exhaust Port Temperature #14 Sensor Voltage High
81	--	143	3	Exhaust Port Temperature #15 Sensor Voltage High
81	--	144	3	Exhaust Port Temperature #16 Sensor Voltage High
81	—	277	9	EGR Rate Sensor not Responding
81	—	277	12	EGR Rate Sensor Failed
82	98	--	4	Oil Level Sensor Input Voltage Low
82	101	--	4	Crankcase Pressure Sensor Input Voltage Low
82	153	--	4	Extended Crankcase Pressure Input Voltage Low
82	164	--	4	Injection Control Pressure Sensor Input Voltage Low
82	173	--	4	Exhaust Temperature Sensor Input Voltage Low
82	411	—	4	EGR Delta Pressure Sensor Circuit Failed Low

DDEC V Code	PID	SID	FMI	DESCRIPTION
82	412	—	4	EGR Temperature Circuit Failed Low
82	412	—	12	EGR Temperature Network Sensor Failed
82	--	129	4	Exhaust Port Temperature #1 Sensor Voltage Low
82	--	130	4	Exhaust Port Temperature #2 Sensor Voltage Low
82	--	131	4	Exhaust Port Temperature #3 Sensor Voltage Low
82	--	132	4	Exhaust Port Temperature #4 Sensor Voltage Low
82	--	133	4	Exhaust Port Temperature #5 Sensor Voltage Low
82	--	134	4	Exhaust Port Temperature #6 Sensor Voltage Low
82	--	135	4	Exhaust Port Temperature #7 Sensor Voltage Low
82	--	136	4	Exhaust Port Temperature #8 Sensor Voltage Low
82	--	137	4	Exhaust Port Temperature #9 Sensor Voltage Low
82	--	138	4	Exhaust Port Temperature #10 Sensor Voltage Low
82	--	139	4	Exhaust Port Temperature #11 Sensor Voltage Low
82	--	140	4	Exhaust Port Temperature #12 Sensor Voltage Low
82	--	141	4	Exhaust Port Temperature #13 Sensor Voltage Low
82	--	142	4	Exhaust Port Temperature #14 Sensor Voltage Low
82	--	143	4	Exhaust Port Temperature #15 Sensor Voltage Low
82	--	144	4	Exhaust Port Temperature #16 Sensor Voltage Low
82	—	277	12	EGR Rate Sensor Failed
82	412	—	9	EGR Temperature Smart Sensor not Responding
82	412	—	12	EGR Temperature Smart Sensor failed
83	73	—	0	Pump Pressure High
83	98	--	0	Oil Level High
83	101	--	0	Crankcase Pressure High
83	153	--	0	Extended Crankcase Pressure High
83	173	--	0	Exhaust Temperature High
83	411	—	0	EGR Delta Pressure High
83	412	—	0	EGR Temperature High
83	--	129	0	Exhaust Port Temperature #1 High
83	--	130	0	Exhaust Port Temperature #2 High
83	--	131	0	Exhaust Port Temperature #3 High
83	--	132	0	Exhaust Port Temperature #4 High
83	--	133	0	Exhaust Port Temperature #5 High
83	--	134	0	Exhaust Port Temperature #6 High
83	--	135	0	Exhaust Port Temperature #7 High
83	--	136	0	Exhaust Port Temperature #8 High
83	--	137	0	Exhaust Port Temperature #9 High

DDEC V Code	PID	SID	FMI	DESCRIPTION
83	--	138	0	Exhaust Port Temperature #10 High
83	--	139	0	Exhaust Port Temperature #11 High
83	--	140	0	Exhaust Port Temperature #12 High
83	--	141	0	Exhaust Port Temperature #13 High
83	--	142	0	Exhaust Port Temperature #14 High
83	--	143	0	Exhaust Port Temperature #15 High
83	--	144	0	Exhaust Port Temperature #16 High
84	98	--	1	Oil Level Low
84	101	--	1	Crankcase Pressure Low
84	153	--	1	Extended Crankcase Pressure Low
85	190	--	0	Engine Overspeed
85	190	--	14	Engine Overspeed Signal
86	73	--	3	Pump Pressure Sensor Input Voltage High
86	108	--	3	Barometric Pressure Sensor Input Voltage High
87	73	--	4	Pump Pressure Sensor Input Voltage Low
87	108	--	4	Barometric Pressure Sensor Input Voltage Low
88	20	--	1	High Range Coolant Pressure Low
88	109	--	1	Coolant Pressure Low
89	95	--	0	Fuel Restriction High
89	111	--	12	Maintenance Alert Coolant Level Fault

5. ENGINE OIL LEVEL

Check the oil level daily with the engine stopped. If the engine has just been stopped and is warm, wait at least 10 minutes to allow the oil to drain back to the oil pan before checking. Wipe the dipstick clean then check oil level. The level should always be within the safe range on the dipstick (Fig. 12). Add the proper grade of oil to maintain the correct level on the dipstick. All diesel engines are designed to consume some oil, so a periodic addition of oil is normal.

⚠ WARNING ⚠

Touching a hot engine can cause serious burns.

⚠ CAUTION ⚠

Do not overfill. Oil may be blown out through the crankcase breather if the crankcase is overfilled.

⚠ CAUTION ⚠

Clean end of tube before removing the dipstick to prevent oil contamination.

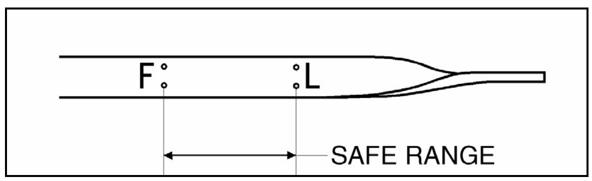


FIGURE 12: ENGINE OIL LEVEL DIPSTICK 01027

⚠ CAUTION ⚠

If the oil level is constantly above normal and excess lube oil has not been added to the crankcase, consult with an authorized Detroit Diesel service outlet for the cause. Fuel or coolant dilution of lube oil can result in serious engine damage.

The vehicle may be provided with an oil reserve tank in the engine compartment. To adjust oil level, open the oil reserve tank drain valve and allow oil to discharge into the engine until the "Full" mark on the dipstick is reached then close the valve. Check oil reserve tank level and pour oil in the reserve tank if necessary (Fig. 13).

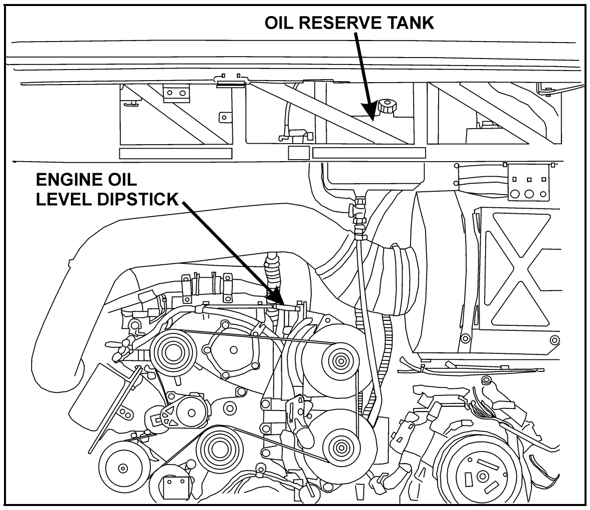


FIGURE 13: OIL RESERVE TANK 01167

6. ENGINE OIL AND FILTER CHANGE

Both the oil and filter should be changed every 12,500 miles (20,000 km) or once a year, whichever comes first. However, changes that are more frequent may be required when the engine is subject to high levels of contamination and/or overheating. Change intervals may be decreased or gradually increased with experience on specific lubricants until the most practical service condition has been established. Always refer to the lubricant manufacturer's recommendations (analysis of drained oil can be helpful).

⚠ CAUTION ⚠

Do not use solvents to dilute the engine oil when draining. Dilution of fresh oil can occur which may be detrimental to the engine.

Change engine oil with the vehicle on a flat and level surface and with the parking brake applied. It is best to drain the oil when the engine is still warm.

1. From under the vehicle, remove the engine drain plug on the oil pan. Allow oil to drain (Fig. 14).

⚠ WARNING ⚠

Hot engine oil can cause serious burns. Wear coveralls with sleeves pulled down and gloves to protect hands.

2. Reinstall the drain plug.
3. Remove the spin-on filter cartridge using a ½" drive socket wrench and extension.
4. Dispose of the used oil and filter in an environmentally responsible manner in accordance with state and/or federal (EPA) recommendations.

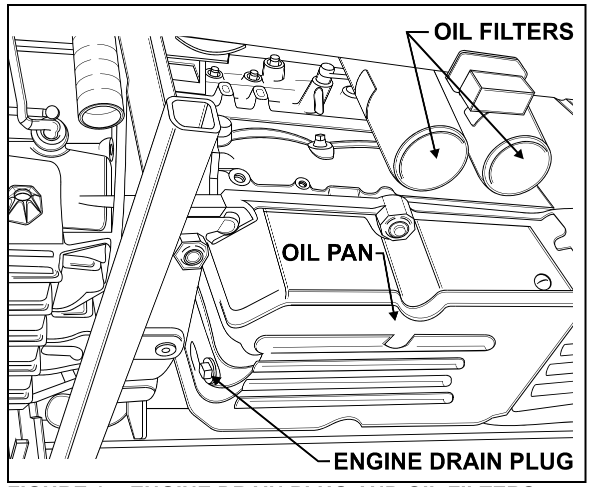


FIGURE 14: ENGINE DRAIN PLUG AND OIL FILTERS 01029

5. Clean the filter adapter with a clean rag.
6. Lightly coat the filter gasket (seal) with clean engine oil.
7. Install the new filter on the adapter and tighten manually until the gasket touches the mounting adapter head. Tighten full-flow filters an additional two-thirds of a turn manually. Then, manually tighten bypass filter one full turn.

⚠ CAUTION ⚠

Overtightening may distort or crack the filter adapter.

8. Remove the engine-oil filler cap and pour oil in the engine until it reaches the "FULL" mark on the dipstick (Fig. 12).
9. Start and run the engine for a short period and check for leaks. After any leaks have been corrected, stop the engine long enough for oil from various parts of the engine to drain back to the crankcase (approximately 20 minutes).
10. Add oil as required to bring the level within the safe range on the dipstick (Fig. 12).

7. RECOMMENDED ENGINE OIL TYPE

To provide maximum engine life, lubricants shall meet the following specifications: SAE Viscosity Grade: 15W-40 API Classification: CI-4.

NOTE

Monograde oils should not be used in these engines regardless of API Service Classification.

NOTE
The use of supplemental oil additives is discouraged from use in Detroit Diesel Engines.

Synthetic oils: Synthetic oils may be used in Detroit Diesel engines provided they are API-licensed and meet the performance and chemical requirements of non-synthetic oils outlined previously. Synthetic oils do not permit extension of recommended oil drain intervals.

Lubricant Selection World Wide: Oils meeting API CD or CC specifications may be used if they also meet military specification MIL-L-2104 D or E. Oils which meet European CCMC D4 specifications may also be used.

Modification of drain interval may be necessary, depending on fuel quality. Contact Detroit Diesel Corporation for further guidance.

8. POWER PLANT ASSEMBLY REMOVAL

To access the engine or engine-related components, the vehicle power plant assembly must be removed as a whole unit by means of a slide-out cradle. The power plant assembly includes the engine, transmission (including retarder if so equipped), air compressor, alternator and transmission oil cooler.

Remove the power plant assembly as follows:

⚠ CAUTION ⚠
Tag hoses and cables for identification before disconnecting in order to facilitate reinstallation. Plug all openings to prevent dirt from entering the system.

NOTE
No parts within the ECM are serviceable. If found defective, replace the complete ECM unit.

1. Disconnect the battery or batteries from the starting system by removing one or both of the battery cables from each battery system. With the electrical circuit disrupted, accidental contact with the starter button will not produce an engine start. In addition, the Electronic Unit Injectors (EUI) will be disabled, preventing any fuel delivery to the injector tips.

⚠ WARNING ⚠
Due to the heavy load of the rear bumper assembly, it must be adequately supported before attempting to remove it.

2. Remove the rear bumper assembly from the vehicle. Refer to Section 18, BODY, under "REAR BUMPER REMOVAL ".
3. Drain the engine cooling system. Refer to Section 05, COOLING under "DRAINING COOLING SYSTEM".

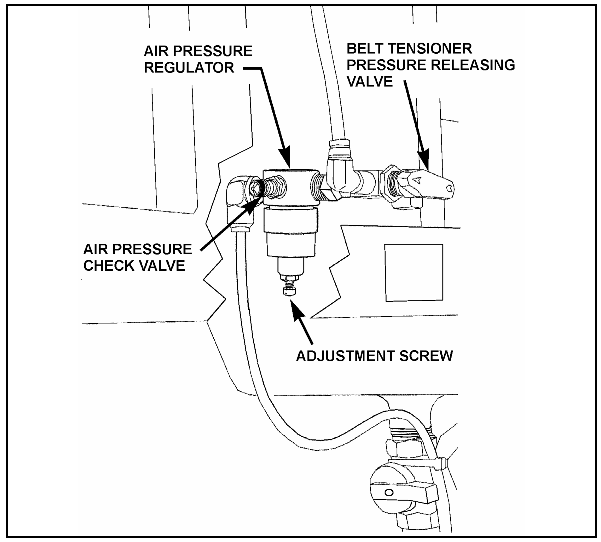


FIGURE 15: BELT TENSIONER VALVE 12200

4. Locate the belt tensioner pressure releasing valve (Fig. 15). Turn pressure releasing valve handle counterclockwise in order to release pressure in belt-tensioner air bellows and loosen belts. Remove the belts.
5. To release all pressure from the air system. Refer to Section 12, BRAKES & AIR SYSTEM for instructions.
6. Disconnect and remove the engine-air intake duct mounted between air cleaner housing and turbocharger inlet (1, Fig.16).

⚠ CAUTION ⚠
To avoid damage to turbocharger, cover the turbocharger inlet opening to prevent foreign material from entering.

7. Disconnect and remove the air intake duct mounted between the air cooler outlet and the engine intake (2, Fig.16).
8. Disconnect and remove section of coolant pipe assembly mounted between the radiator outlet and the water pump inlet (3, Fig.16).
9. Disconnect the coolant delivery hose located close to the water pump.
10. Disconnect the electric fan-clutch connector located near the gearbox (Fig. 16).

11. Dismantle the air bellows from the upper bracket of the fan-drive assembly tensioner. Remove the upper bracket (4, Fig.16).
12. If necessary, remove the fan drive from the engine compartment by removing the four retaining bolts, washers and nuts securing the fan drive to the floor.
13. Disconnect and remove the air intake duct mounted between the turbocharger outlet and the air cooler inlet (5, Fig. 16).
14. Disconnect two vent hoses from the thermostat housing and from the coolant pipe assembly.
15. Disconnect and remove a section of coolant pipe assembly mounted between the thermostat housings and the radiator inlet.
16. Disconnect and remove the small hose connected to the heater line valve and to the water pump.
17. Disconnect the small heater hose located on the cylinder head at the back of the engine.
18. Disconnect and remove the exhaust pipe mounted between the turbocharger outlet and the exhaust bellows. If necessary, refer to Section EXHAUST SYSTEM under MUFFLER REMOVAL AND INSTALLATION".

⚠ CAUTION ⚠
To avoid damage to turbocharger, cover the turbocharger outlet opening to prevent foreign material from entering.

19. Disconnect the steel-braided airline from the A/C compressor air bellows.
20. Disconnect the power steering pump supply and discharge hoses. Cap hose openings immediately to limit fluid loss. Remove retaining clips from cradle (6, Fig. 16).
21. Disconnect the oil delivery hose from the valve located at the reserve tank drain (7, Fig. 16).
22. Disconnect the block heater connector located near the power steering pump if applicable.
23. Close engine fuel supply shutoff valve on primary fuel filter. Disconnect the fuel line connected to inlet port. On vehicles equipped with the optional water-separator-fuel-filter, disconnect the connector and remove cable ties from cradle.
24. Disconnect the air compressor discharge, governor steel-braided airlines and manual filling airlines from compressor. Remove retaining clips.
25. Disconnect the hose connecting the compressor head to the sump tank.
26. Disconnect ground cables from rear subframe ground-stud located close to the starter motor.
27. Disconnect positive cable (red terminal) from starting motor solenoid.
28. Disconnect the power plant wiring-harness main connectors from ECM and remove retaining clips from engine compartment backwall.
29. On vehicles equipped with an automatic transmission provided with a hydraulic output retarder, disconnect steel-braided airline from pressure regulator output. The pressure regulator is mounted in the upper section of engine compartment backwall and is accessible through the engine compartment R.H. side door.
30. Disconnect fuel return line from bulkhead fixed on engine cylinder head end.
31. On vehicles equipped with an electrically operated cold-starting aid, disconnect the delivery hose from the starting-aid cylinder solenoid valve. Remove cable ties securing hoses.
32. Disconnect turbo boost pressure gauge airline from engine air intake.
33. Disconnect connectors from transmission. On the left side: four on rear side with one close to yoke. On right side: close to the solenoid valve of the output retarder.
34. From under the vehicle, disconnect the propeller shaft as detailed in Section 09, under heading "Propeller Shaft Removal".
35. Inspect the power plant assembly to ensure that nothing will interfere when sliding out the cradle. Check for connections or hoses not mentioned in this list as some vehicles are equipped with special or aftermarket components.
36. Remove the six retaining bolts, washers and nuts securing the power plant cradle to the vehicle rear subframe (Fig. 17).

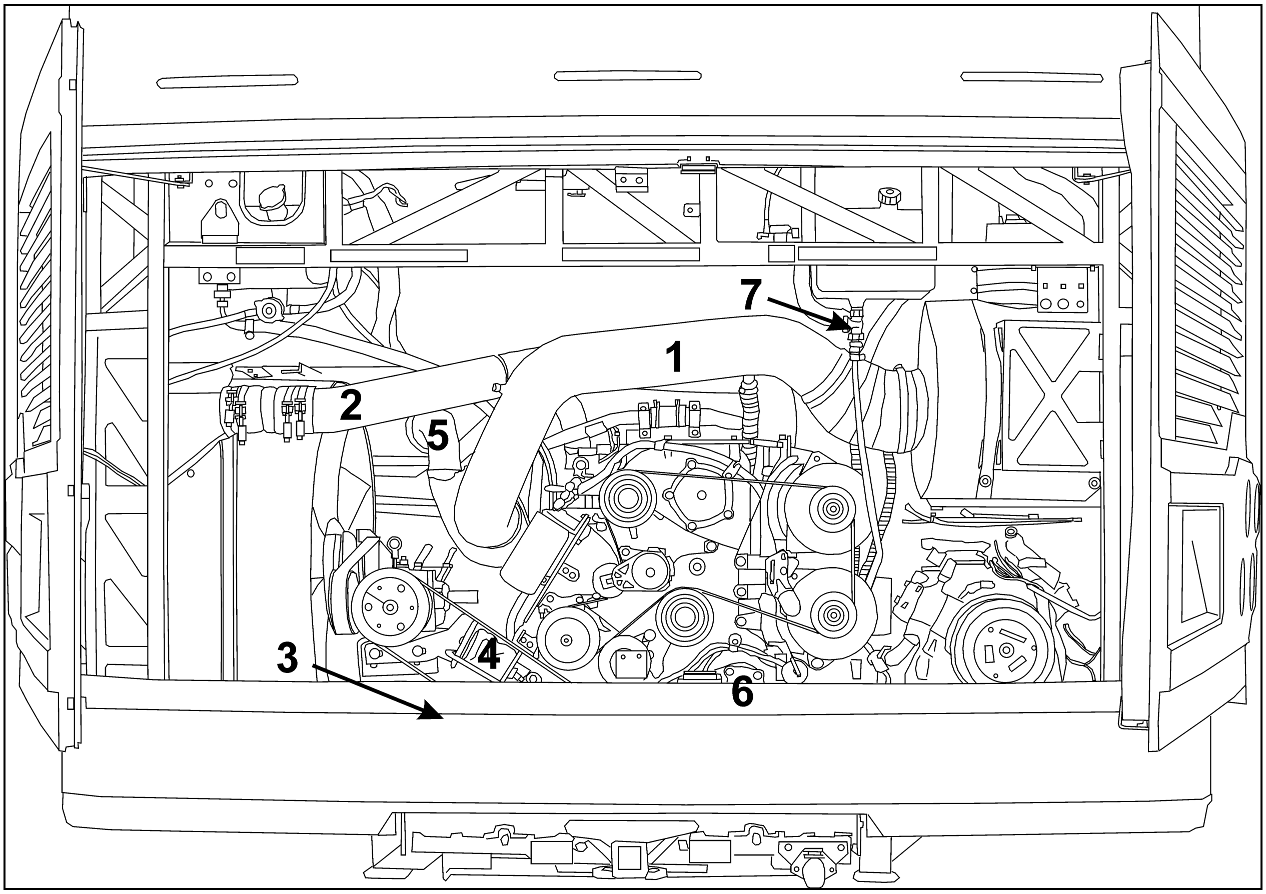


FIGURE 16: ENGINE COMPARTMENT X3 COACHES (TYPICAL) 01168

NOTE
Check if any spacer(s) have been installed between power plant cradle and vehicle rear subframe, and if so, note position of each washer for reinstallation purposes.

37. Using a forklift, with a minimum capacity of 4,000 lbs (1 800 kg), slightly raise the power plant cradle.
38. Pull engine out slowly from the engine compartment. Make sure all lines, wiring and accessories are disconnected and are not tangled.

⚠ CAUTION ⚠
Due to the minimum clearance between the power plant equipment and the top of the engine compartment, extreme care should be used to raise the power plant cradle, just enough to free the cradle. Clearance between power plant cradle and mounting rail should range between ¼" and ½" (6-12 mm).

9. POWER PLANT ASSY. INSTALLATION

To install a power plant assembly, follow the same procedure as in "Power Plant Assembly Removal" except in reverse order, then proceed with the following:

1. Torque the power plant cradle mounting bolts to 190 lbf-ft (255 Nm).
2. If fan drive has been removed, reinstall and align as per Section 05, COOLING SYSTEM, under "FAN DRIVE ALIGNMENT".
3. Refill cooling system with saved fluid (refer to Section 05, COOLANT SYSTEM).
4. Once engine fuel system has been drained, it will aid restarting if fuel filters are filled with fuel oil (refer to Section 03, FUEL SYSTEM).
5. Start engine for a visual check. Check fuel, oil, cooling, pneumatic and hydraulic system connections for leakage. Test operation of engine controls and accessories.

10. VALVE COVER REMOVAL

Refer to the series 60 Detroit diesel service manual for injectors and valves adjustment.

Wait until engine is cold prior to working on vehicle.

1. Remove air intake pipe.
2. Remove the after CAC (Charger-Air-Cooler) air pipe.
3. Disconnect ventilation pipe from valve cover.
4. Remove last seat to access trap door located in the middle rear end of vehicle.
5. Remove engine cover.
6. Adjust Jake brakes (if applicable), injectors and valves using Detroit Diesel service manual for series 60 engines.
7. Verify engine cover gasket and replace if necessary.

NOTE
New gasket must be ordered directly from Detroit Diesel.

8. Reinstal engine cover with a tightening torque of 18-22 Lbf-ft (25-30 Nm).
9. Connect ventilation pipe to engine cover.
10. Reinstall air intake and after CAC air pipes.
11. Reinstall trap door.

11. JAKE BRAKE

Refer to both "The Jake Brake Troubleshooting and Maintenance Manual" and "Installation Manual for Model 790 Engine Brakes" for troubleshooting and installation procedures. They are annexed at the end of this section.

12. ENGINE MOUNTS

The power plant assembly is mounted to the cradle by means of rubber mounts.

Two rubber mounts are used at the front of the engine while two others are mounted on each side of the flywheel housing (Fig. 17).

It is recommended that new rubber mounts be installed at each major overhaul.

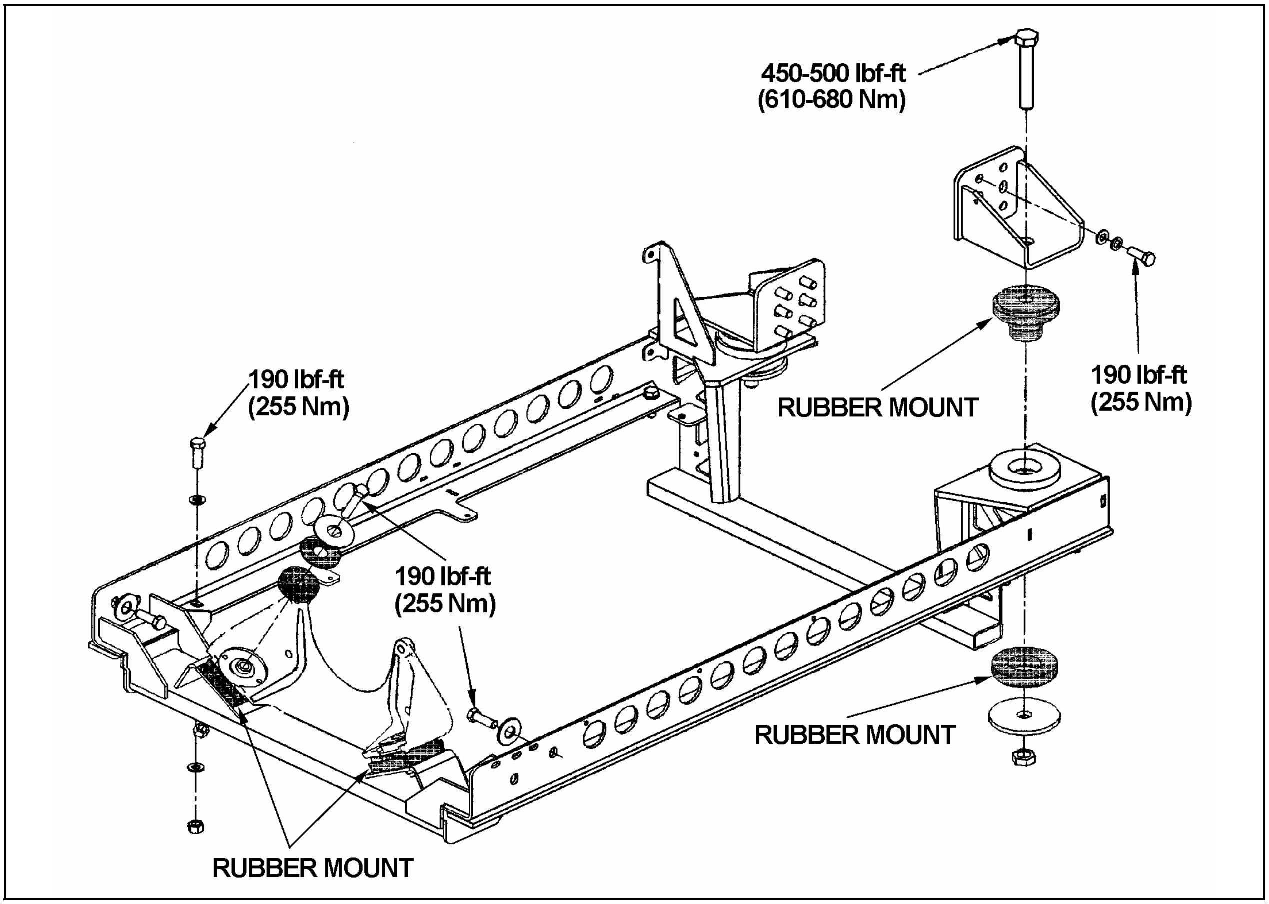
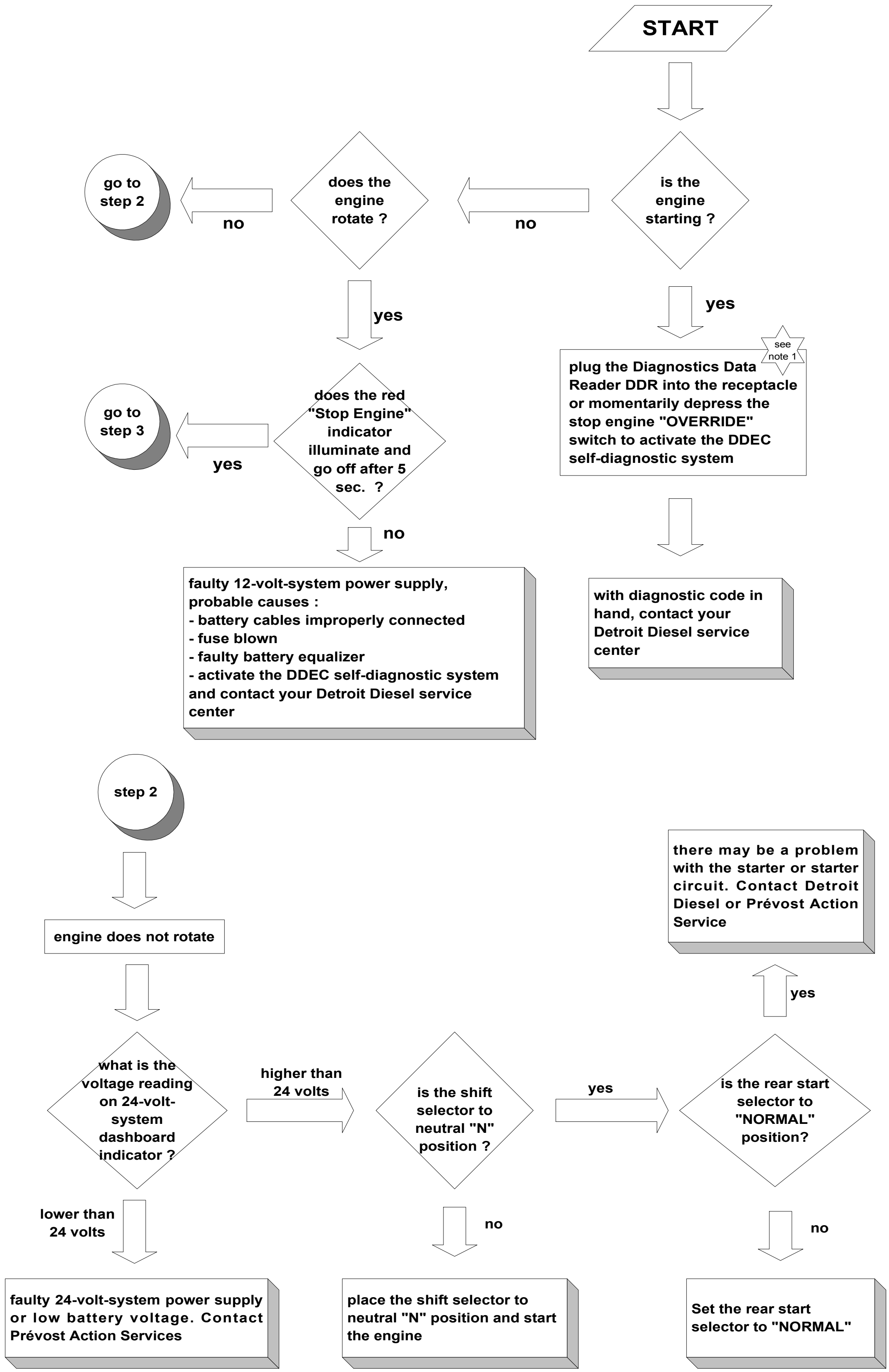
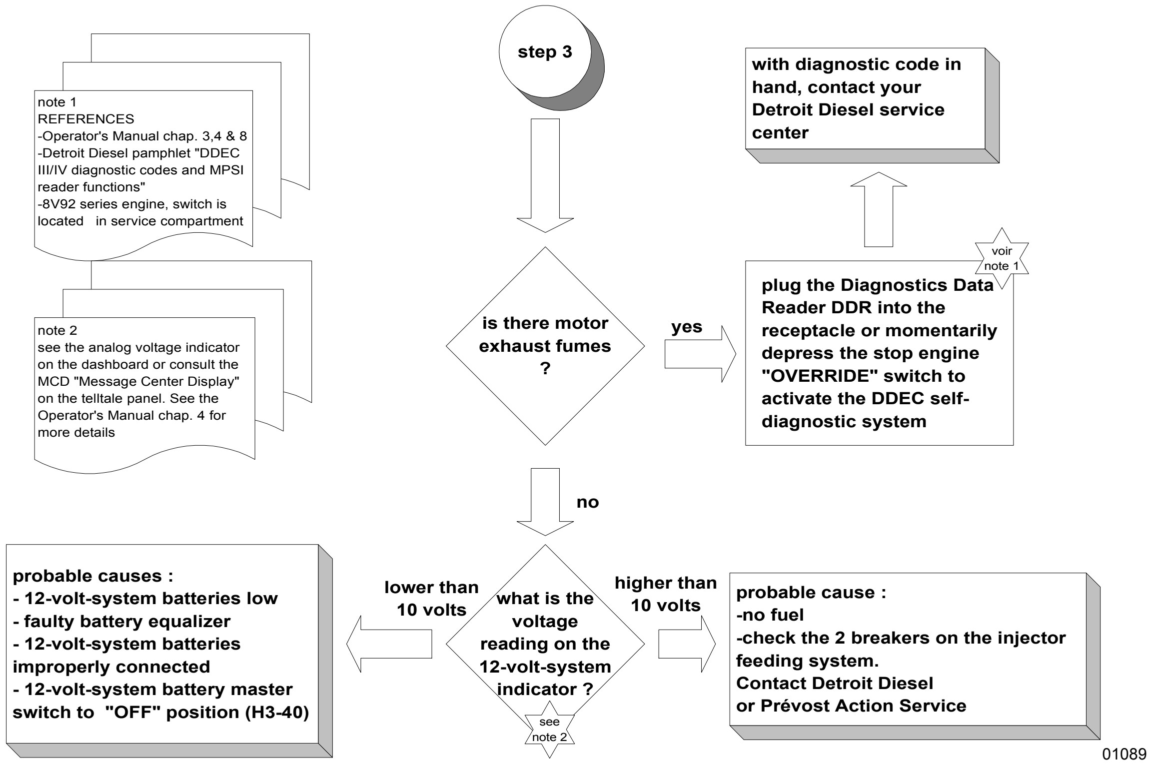


FIGURE 17: POWER PLANT CRADLE INSTALLATION 01140

13. ENGINE TROUBLESHOOTING GUIDE





14. SPECIFICATIONS

Series 60 Engine

Make .... Detroit Diesel

Type .... Diesel four cycle/in-line engine

Description .... Turbo/Air to air charge cooled

No. of cylinders 6

Operating range .... 1200-2100 RPM

Maximum RPM 2100

Lubricant

Heavy-duty engine oil SAE Viscosity Grade 15W-40, API Classification CI-4. Synthetic oil may be used if it meets the performance and chemical requirements of non-synthetic oils outlined previously. Some engine operating conditions may require exceptions to this recommendation.

⚠ **CAUTION** ⚠

To avoid possible engine damage, do not use single grade (Monograde) lubricants in Detroit Diesel four-cycle Series 60 engines, regardless of API classification.

Detroit Diesel Series 60 engine ratings

Series 60 engine ratings used in Prevost Car Models are listed in the following tables. The standard engine ratings are written in bold, customer may easily switch from one rating to another within the same table by having the DDEC V system reprogrammed.

Coach Standard Engine (12.7L)	
380 HP	**@1800 rpm; 1350 lb-ft @1200 rpm**

Coach Optional Engines (12.7L)	
435 HP	**@1800 rpm; 1450 lb-ft @1200 rpm**
445 HP	**@1800 rpm; 1450 lb-ft @1200 rpm**

Capacity

Oil reserve tank .... 8.4 US qts (8.0 L)

Engine oil level quantity

Oil Pan Capacity, Low Limit .... 26 quarts/25 liters

Oil Pan Capacity, High Limit .... 32 quarts/30 liters

Total Engine Oil Capacity with Filters .... 38 quarts/36 liters

Lubricating oil filter elements

Make .... AC Rochester Div. GMC # 25014505

Make .... A/C Filter # PF-2100

Type .... Full Flow

Prévost number 510458

Torque specification

Engine oil filter .... Tighten 2/3 of a turn after gasket contact

Filters

Engine Air Cleaner Filter

Make .... Nelson # 70337-N

Prévost number 530197

Engine Coolant Filter/Conditioner

Make .... Nalco Chemical Company # DDF3000

Make .... Detroit Diesel # 23507545

Prévost number 550630

NOTE
For primary and secondary fuel filters, refer to Specifications in section 03

SECTION 22: HEATING AND AIR CONDITIONING

CONTENTS

ILLUSTRATIONS

1. HEATING AND AIR CONDITIONING

The coach's interior is pressurized by its Heating, Ventilation, Air Conditioning (HVAC) units. Air flow and controls divide the vehicle in two areas: driver's area and passengers' area. The interior of vehicle should always be slightly pressurized to prevent dust and moisture from entering vehicle. Each section has its own fresh air, returning air and discharge air ducting. The exhaust is mainly done through the lavatory ventilator and through normal air-tightness losses.

2. AIR CIRCULATION

2.1 DRIVER'S AREA

Fresh air is taken from a plenum underneath the front service compartment and enters the mixing box through an ON/OFF damper. Return air is taken through the base of the dashboard panel utility compartments into the mixing box. Mixed air goes through cooling and heating coils, fans and discharge ducts.

Both right and left discharge ducts defrost one half of the windshield. The driver can also divert some air flow to the console, from which he can direct air to his knees and/or upper body with adjustable HVAC air registers and to his feet with the appropriate button (see Fig. 1 and Operator's manual). The coach is also equipped with a windshield upper section de-icing system.

One additional air register is located in the driver's area but supplied by the passengers' air ducting system. It is installed in the stepwell for step de-icing.

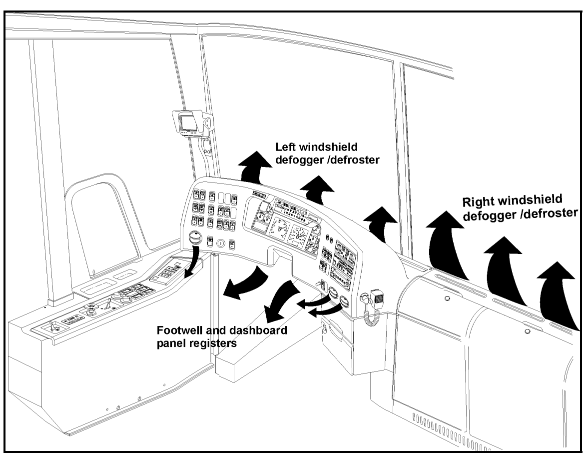


FIGURE 1: DRIVER'S AIR CIRCULATION 22307

2.2 PASSENGERS' AREA

Fresh air enters the vehicle on the L.H. side, through the recirculation damper located inside the evaporator compartment door (Fig. 2). The damper can be fully opened for normal operation or closed for extreme weather or highly polluted areas (Refer to the X3 Operator's Manual for more details). The recirculation REC button is located on the HVAC control unit. Press down the button to partially close the fresh air damper. Return air is drawn from inside the vehicle through the register duct located amidships on L.H. side of vehicle (Fig. 3).

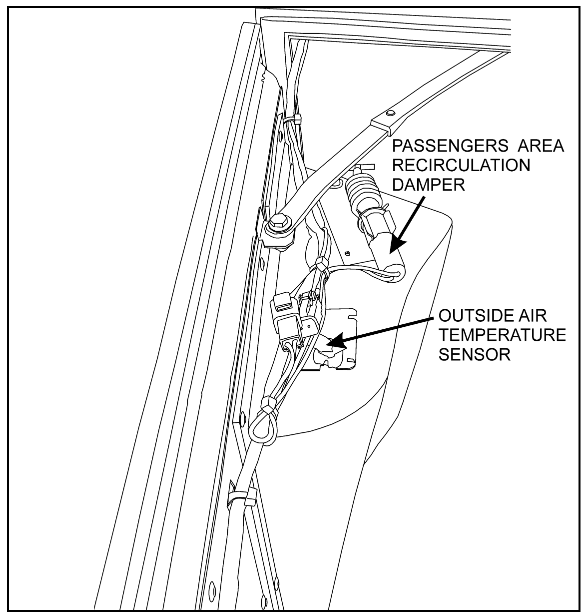
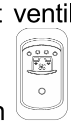


FIGURE 2: PASSENGERS' AREA RECIRCULATION DAMPER 22302

A double blower fan unit, which is activated by the evaporator motor, draws mixed air through an air filter, cooling and heating coils, then forces this air in the ventilation ducts along the walls, and finally exhausts it just below side windows.

X3 coaches are also equipped with an overhead compartment ventilation system, a three-position rocker switch  (0FF - 1st speed - 2nd speed) located on R.H. dashboard panel controls the speed of both fans. Return air is drawn just below the middle side windows through an air filter into the overhead compartment fan; discharge air is fed to the rotating registers through the ventilation duct (Fig. 4).

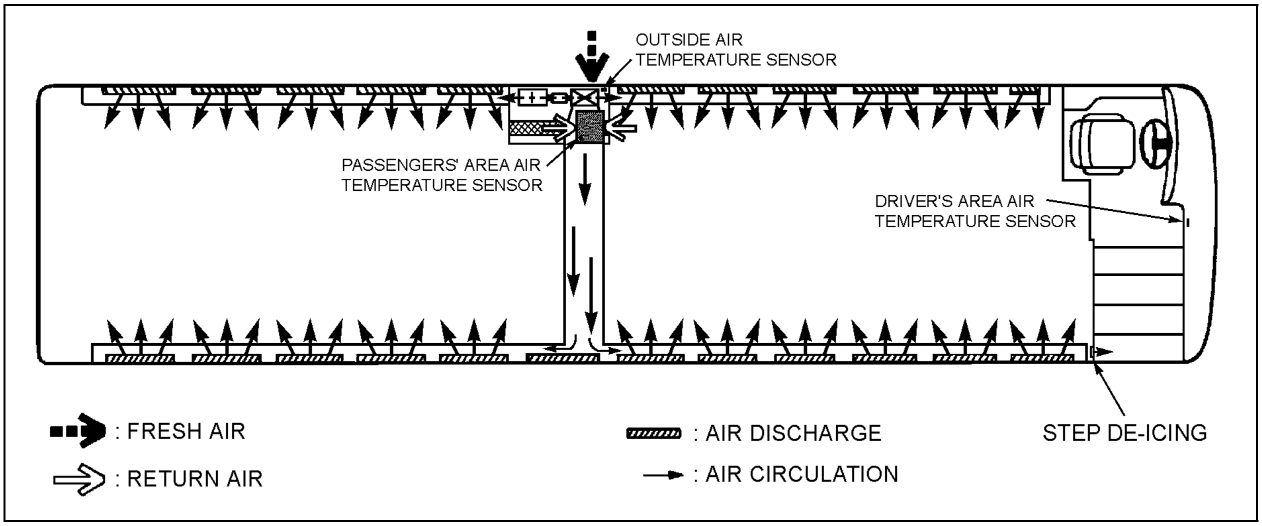


FIGURE 3: CENTRAL HVAC SYSTEM AIR CIRCULATION 22308

The overhead compartment air registers are used to control air flow for the passenger seats. One register per seat direct air flow by pointing or rotating register. Open or close register to adjust air flow.

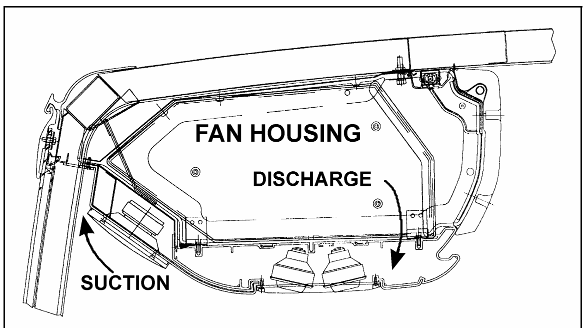


FIGURE 4: PASSENGERS OVERHEAD COMPARTMENT VENTILATION SYSTEM 22211

3. CENTRAL HVAC SYSTEM OPERATION

To operate the air conditioning system when coach is stationary, engine should run at fast idle. During operation of the air conditioning system, windows should be kept closed and door not left open longer than necessary. In order to prevent battery discharge, HVAC system will not operate if vehicle charging system is not working properly.

3.1 DRIVER'S SECTION OPERATION

The temperature control in the driver's area is provided directly by the L.H. portion of the HVAC control unit mounted on the R.H. dashboard panel (Fig. 5).

The driver's HVAC section piping is paralleled with the passengers HVAC section piping. Both sections use the same refrigerant and coolant, and are linked to the same condenser and compressor, even if they are individually controlled. It requires the passengers HVAC section to engage the A/C compressor magnetic clutch. Consequently, the driver's section cannot be operated in the A/C mode alone.

NOTE
The driver's HVAC section turns on automatically at starting of the engine and uses the settings that were kept in memory before turning off of the system.

The A/C compressor starts automatically when the two following conditions are satisfied:

1. The outside temperature is above 32°F (0°C).
2. The passenger's area temperature has reached 7°F (4°C) under the set point.

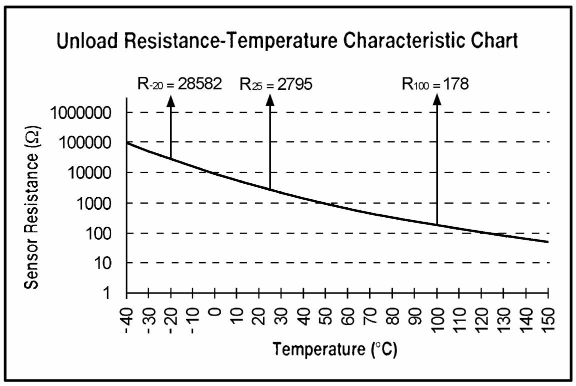
Using the Up/Down type switch  sets the fan speed and the speed chosen is illustrated on the window display.

NOTE
Upon starting, if the outside temperature is above 32°F *(0°C) and then drops below* 32°F *(0°C), the compressor will keep running up to a temperature of 15°F (-9°C) to prevent condensation from forming on the windows.*

NOTE
To perform a test of the driver's section windshield defroster, it is possible to run the system without running the engine.

The following 2% error chart and table can be used to troubleshoot the driver's area air temperature sensor and the outside air temperature sensor.

NOTE
The driver's area air temperature sensor is located behind the grill of the R.H. side console (Refer to fig.12).



Temp °C	Temp °F	Resistance Ohms
-40	-40	100865
-35	-31	72437
-30	-22	52594
-25	-13	38583
-20	-4	28582
-15	5	21371
-10	14	16120
-5	23	12261
0	32	9399
5	41	7263
10	50	5658
15	59	4441
20	68	3511
25	77	2795
30	86	2240
35	95	1806
40	104	1465
45	113	1195
50	122	980
55	131	808
60	140	670
65	149	559
70	158	468
75	167	394
80	176	333
85	185	283
90	194	241
95	203	207
100	212	178
105	221	153
110	230	133
115	239	115
120	248	100
125	257	88
130	266	77
135	275	68
140	284	60
145	293	53
150	302	47

3.2 PASSENGERS' SECTION OPERATION

The R.H. portion of the HVAC control unit enables the selection of the temperature in the passenger's area (refer to the Operator's Manual for details).

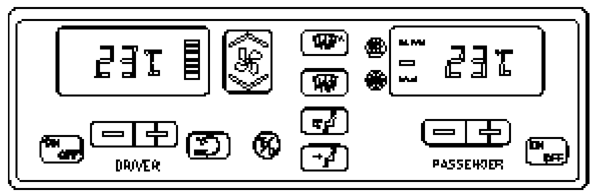


FIGURE 5: CENTRAL HVAC SYSTEM CONTROL UNIT 22296

Temperature control is provided in conjunction with a thermistor sensor inside register duct, located amidships on L.H. side of vehicle (Figs. 3 & 6).

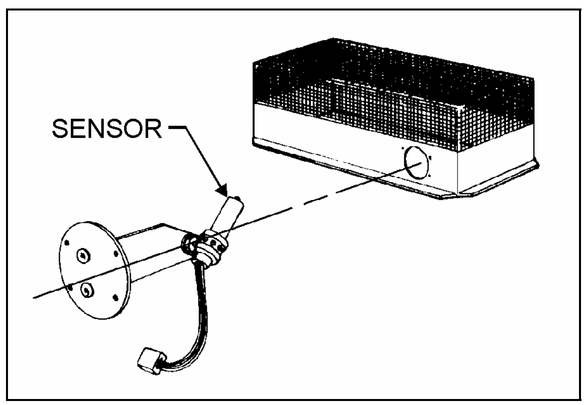


FIGURE 6: THERMISTOR SENSOR 22064

The flow of water to the vehicle's main heater core is controlled by a pneumatic water valve which varies the cycling rate depending on selected temperature. A red LED, located on HVAC control unit, illuminates when heating mode is selected. A green LED illuminates when compressor clutch is in operation.

The evaporator fan motor, located in the evaporator compartment, is protected by a 90 amps, manually-resettable (CB3) circuit breaker located on the rear junction panel of the rear electrical compartment (refer to Section 06, *"Electrical System"* in this manual for details).

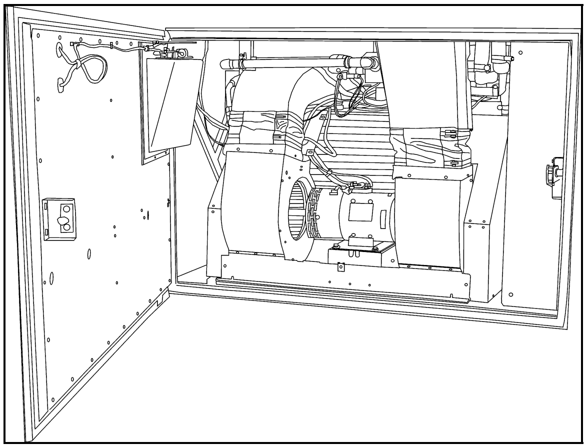


FIGURE 7: EVAPORATOR COMPARTMENT 22301

The condenser coil mounted on the opposite side of the evaporator is ventilated by four axial fans. The fan motors are protected by a manually-resettable 70 amp circuit breaker (CB 7) mounted on the rear junction panel of the rear electrical compartment.

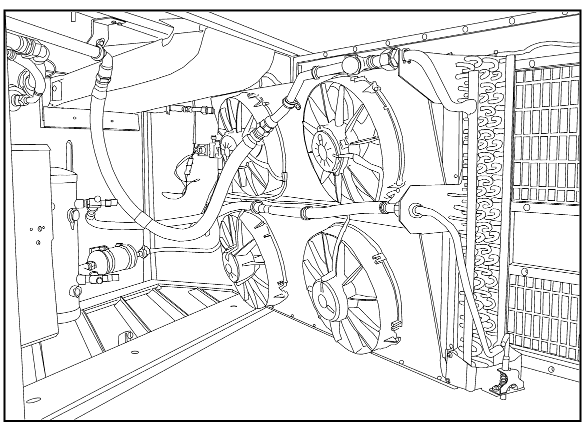


FIGURE 8: CONDENSER COMPARTMENT 22299

3.3 OVERHEAD COMPARTMENT A/C

Optional small A/C evaporator coils may be added to both overhead compartments existing air system. These auxiliary A/C system components are separate and completely independent of central system and permit a wider temperature range in the passenger's area. The three-position rocker switch used to control the fans also controls the A/C system.

4. HVAC UNIT MAINTENANCE

No special maintenance is required on the passengers, driver's and auxiliary HVAC units, with the exception of cleaning their respective coils and air filters, plus periodic inspection for broken drains, hoses and charging of system.

NOTE
Squeeze rubber hose located underneath the appropriate compartment to eliminate the accumulated water and dirt when you make routine maintenance.

4.1 COIL CLEANING

Check the external surface of the coil at regular intervals for dirt or any foreign matter.

For the driver's HVAC unit, remove the grill and the access panels and back flush the coil from inside.

For the passengers' section evaporator coil, remove the access panel and back flush the coil (Fig. 9 & 10) every 12,500 miles (20 000 km) or once a year, whichever comes first.

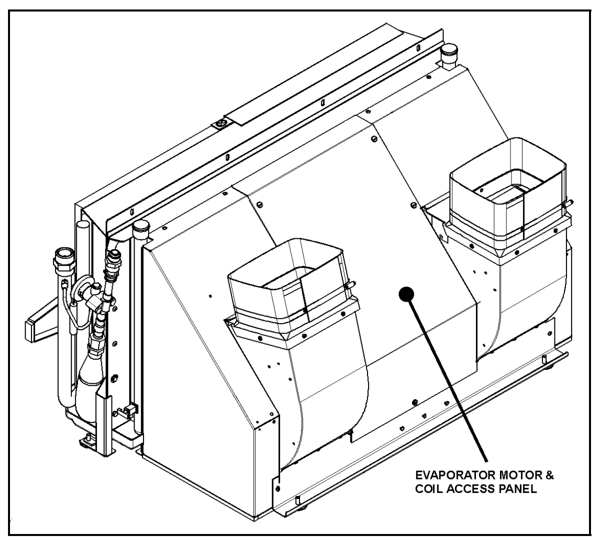


FIGURE 9: EVAPORATOR MOTOR & COIL ACCESS PANEL 22309

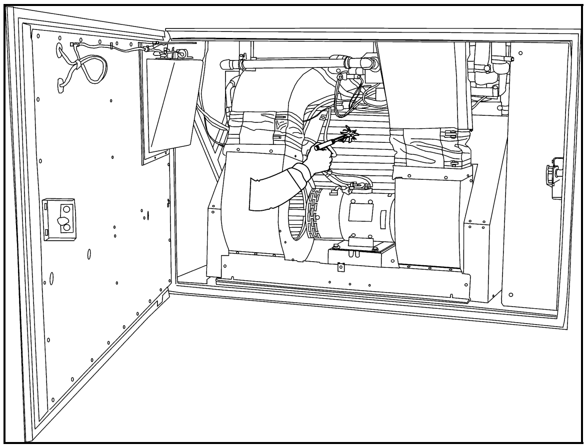


FIGURE 10: EVAPORATOR COIL CLEANING 22310

For the condenser coil, back flush the coil (Fig. 11) every 6,250 miles (10 000 km) or twice a year, whichever comes first.

CAUTION

Use a water jet or water mixed with low air pressure to clean the coil.

CAUTION

Direct the pressure straight through the coil to prevent bending of fins and do not use extremely high pressure. Do not use hot water, steam or caustic soap.

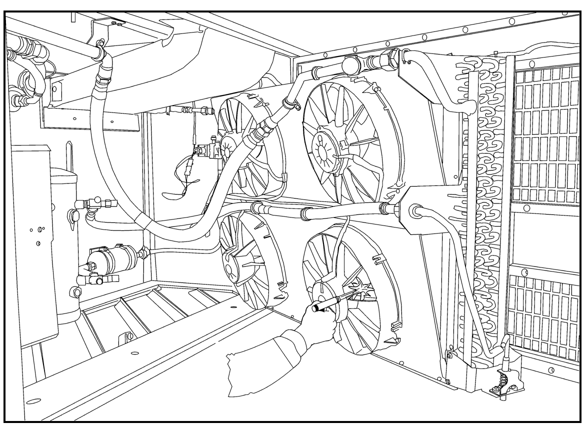


FIGURE 11: CONDENSER COIL CLEANING 22311

4.2 DRIVER'S SECTION AIR FILTERS

The driver HVAC system is located behind the dashboard's R.H. side lateral plastic panel. To gain access to the A/C filters, unscrew the R.H. lateral console's grill located at the top step of the entrance door steps. Slide out the recirculating air and fresh air filters. To clean filters back flush with water, then dry with air, every 12,500 miles (20 000 km) or once a year, which-ever comes first (Fig. 12 & 13).

NOTE

If the windshield is continuously fogged, check that the driver's air filter is not clogged.

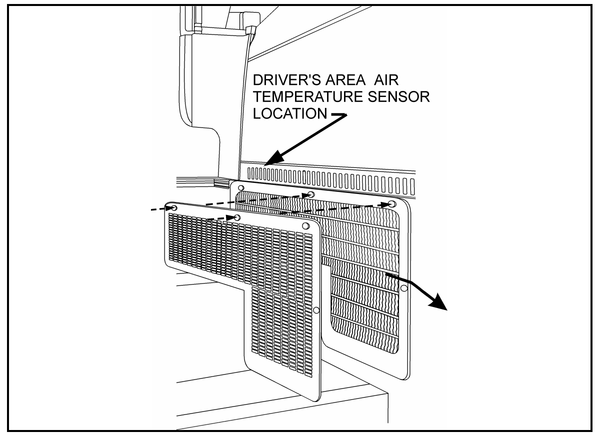


FIGURE 12: DRIVER'S SECTION ACCESS GRILL 22312

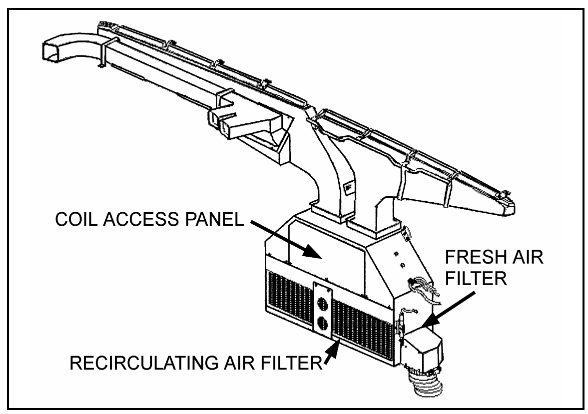


FIGURE 13: DRIVER'S SECTION AIR FILTERS 22171

4.3 PASSENGERS' SECTION AIR FILTER

The passengers' section air filter is located in the evaporator compartment. To access the filter on X3 coaches, open baggage compartment door located in front of the evaporator compartment (L.H. side). Open access panel by turning the three screws of panel ¼ of a turn, unsnap both fasteners on top of filter, and slide out filter (Fig. 14). To clean filter, back flush with water or soapy water, then dry with air every 12,500 miles (20 000 km) or once a year, whichever comes first.

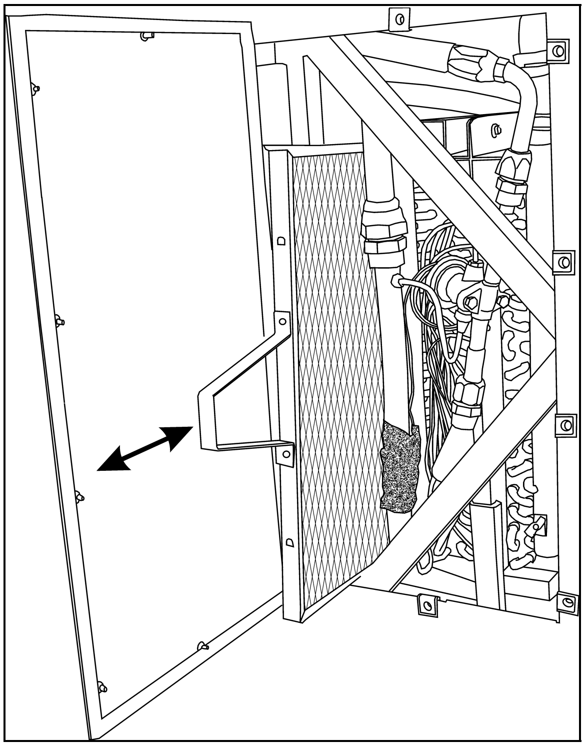


FIGURE 14: PASSENGERS' SECTION AIR FILTER 22306

⚠ CAUTION ⚠

Do not use high pressure water jet to avoid damaging filter.

⚠ CAUTION ⚠

Be sure not to reverse filter upon installation.

4.4 OVERHEAD COMPARTMENT FAN AIR FILTER

A/C evaporator coils may be installed in both overhead compartment air systems. Only the air filters are serviceable. The air filters are accessible from inside the overhead compartments. Slide out the filters, then back flush with water, dry with air and replace. This procedure should be done every 12,500 miles (20,000 km) or once a year, whichever come first.

If A/C units were installed, ball valves are added on supply and return lines in the engine compartment. They have service port to evacuate the A/C overhead compartment circuit. When work has to be done on an evaporator coil unit, it will be easier to remove it and repair it on a bench.

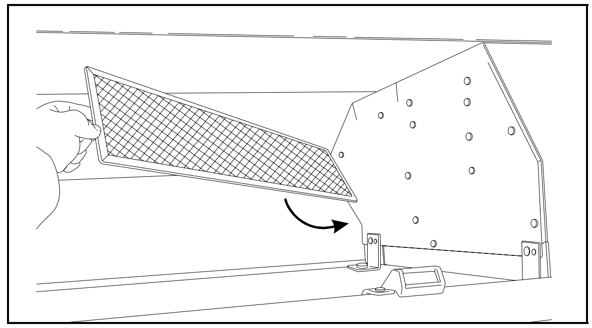


FIGURE 15: OVERHEAD COMPARTMENT FAN AIR FILTER 22201

5. HVAC SYSTEM PARTICULARITIES, TESTING AND TROUBLESHOOTING

Before undertaking any troubleshooting on the HVAC system, study the appropriate wiring diagrams to get a complete understanding of the HVAC components circuitry, read and understand section 06:ELECTRICAL of this manual under "Troubleshooting And Testing The Multiplex Vehicles" and "Test Mode For Switches And Sensors". The information included in these paragraphs is necessary for troubleshooting the HVAC system on Multiplex vehicles.

5.1 HVAC SYSTEM AND TEST MODE FOR SWITCHES AND SENSORS

When in switch/sensor test mode (see Section 06: ELECTRICAL for complete information), the A/C compressor HI and LO pressure values are displayed one after the other instead of the outside temperature in the telltale panel LCD display. This feature can be used when the vehicle is traveling to check the A/C compressor pressure values.

NOTE

When starting the A/C compressor wait 5 seconds before checking pressures in order to give the system a chance to build its pressure. During the first 5 seconds after startup, the compressor is active on 6 cylinders and the A/C valve is open regardless of the pressure readings.

In test mode, with the parking brake applied and the passenger set point set to a value higher than 64°F (18°C), the hot water circulating pump is not set to OFF as it would normally do when the outside temperature gets above 50°F

(10°C). This feature allows verification of the pump when inside a garage. This is also useful when working on the heating system to remove air pockets trapped in the system.

When performing an A/C cooling test and having the water pump shut off in switch/sensor test mode is required, just set the passenger set point temperature to the minimum 64°F (18°C) to shut off the pump.

5.2 HVAC SYSTEM AND TEST MODE FOR ELECTRIC MOTORS

The test mode allows testing the motors and electric contactors without the need to have the engine running (see Section 06: ELECTRICAL under "TEST MODE FOR ELECTRICAL MOTORS" for complete information).

Use this test mode for testing of the condenser motors, the A/C compressor clutch activation, left and right unloaders, evaporator motor, water pump, hot water solenoid valve and overhead compartment air register fan.

5.3 PARTICULARITIES

Conditions for engaging the 2nd speed on the evaporator motor (cooling demand).	The 2nd speed engages if the passenger's area temperature is 1 degree above the set point and it revert to speed 1 if the temperature gets equal or below the set point.
Conditions for hot water recirculating pump activation (heating demand).	The pump turns to OFF if the outside temperature is above 50°F (10°C), when there is less demand for heating. Note: To test a working pump, it is possible to keep it active even if the outside temperature is above 50°F (10°C). See paragraph 5.2 HVAC SYSTEM AND TEST MODE FOR ELECTRIC MOTORS.
The compressor unloaders are working based on pressure and also on the difference between the passenger's area temperature and the set point.	**2 left compressor cylinders:** Stop if: Passenger's area temperature is at less than 0.4°C degree above the set point or if the compressor output is above 280 psi, or if the compressor input is below 26 psi. Restart if: Passenger's area temperature is 0.9°C or more above the set point and the compressor pressure output is less than 220 psi and the compressor pressure input is above 34 psi. **2 right compressor cylinders:** Stop if: Passenger's area temperature is at less than 0.2°C above the set point or if the compressor input falls below 23 psi. Restart if: Passenger's area temperature is 0.7°C or more above the set point and the compressor input pressure is above 32 psi.
The A/C deactivation pressure is 320 psi.	In case of high pressure, the analog pressure sensor connected to the Multiplex module deactivates the compressor. There is also a « Pressure switch » adjusted to 350 PSI that acts to stop the compressor in the instance that the Multiplex module fails.

5.4 HVAC SYSTEM TROUBLESHOOTING

Problem/Symptom	Probable Causes	Actions
No temperature control in the passenger area Passenger temperature display indicates two dashes "--"	Problem with the temperature sensor located in the evaporator compartment air intake or the sensor wiring	Instruct the driver to manually control the temperature by playing with the passenger set point. Set above 22°C (72°F) to heat and below 22° C (72°F) to cool
Defroster fan not functioning	Module A47 is not powered or is faulty	1. Check the SYSTEM DIAGNOSTIC menu of the message center display (MCD). Select FAULT DIAGNOSTIC and ELECTRICAL SYSTEM. The message “Voltage Module A47, Value too Low, Active” confirms a power problem on the module 2. Check / reset circuit breaker CB6 3. Check / replace fuse F5 4. Use the air release valves near the entrance door and in the front service compartment to lock / unlock the door
HVAC condenser fans not functioning in speed 1	Circuit breaker CB7 was manually tripped and not reset Seized bearing Brush problem Bad wiring	Check / reset circuit breaker CB7
HVAC condenser fans not functioning in speed 1	Module A54 is not powered or is faulty	1. Check the SYSTEM DIAGNOSTIC menu of the message center display (MCD). Select FAULT DIAGNOSTIC and ELECTRICAL SYSTEM. The message “Voltage Module A54, Value too Low, Active” confirms a power problem on the module 2. Check / reset circuit breaker CB5 3. Check / replace fuse F67 , F68
HVAC condenser fans not functioning in speed 2	Circuit breaker CB7 was manually tripped and not reset Seized bearing Brush problem Bad wiring	Check / reset circuit breaker CB7
Defroster fan is functioning but no heat or cooling available in the driver’s area	Module A46 is not powered or is faulty Faulty speed control Bad wiring	1. Check the SYSTEM DIAGNOSTIC menu of the message center display (MCD). Select FAULT DIAGNOSTIC and ELECTRICAL SYSTEM. The message “Voltage Module A46, Value too Low, Active” confirms a power problem on the module.

Problem/Symptom	Probable Causes	Actions
		2. Check / reset circuit breaker CB1 3. Check / replace fuse F12
The A/C compressor clutch does not engage	Module A52 is not powered or is faulty	1. Check the SYSTEM DIAGNOSTIC menu of the message center display (MCD). Select FAULT DIAGNOSTIC and ELECTRICAL SYSTEM. The message “Voltage Module A52, Value too Low, Active” confirms a power problem on the module 2. Check / reset circuit breaker CB5 3. Check / replace fuse F65
Evaporator fan not functioning	Circuit breaker CB3 tripped Module A54 is not powered or is faulty Brush problem	1. Check / reset circuit breaker CB3 2. Check the SYSTEM DIAGNOSTIC menu of the message center display (MCD). Select FAULT DIAGNOSTIC and ELECTRICAL SYSTEM. The message “Voltage Module A54, Value too Low, Active” confirms a power problem on the module 3. Check / reset circuit breaker CB5 4. Check / replace fuse F67 , F68

6. CENTRAL AIR CONDITIONING SYSTEM

The schematic of Figure 16 shows the central and auxiliary A/C systems and their components. The central system is equipped with a 6 cylinder, 05G Twin Port Carrier compressor with an air conditioning capacity of 7½ tons. The receiver tank and filter dryer are mounted inside the condenser compartment.

X3 Coaches may be supplied with an auxiliary A/C system (Fig. 16). Auxiliary A/C system comes with a 6 cylinder, TM-16HD Seltec compressor with an air conditioning capacity of 2 tons.

6.1 A/C CYCLE

Refrigeration may be defined as "the transfer of heat from a place where it is not wanted to a place where it is unobjectionable". Components required for a closed circuit refrigeration system are shown in Figure 16.

The air conditioning system used on X3 series coaches is of the *"Closed"* type using *"R-134a".*

1. The refrigerant flowing to the compressor is compressed to high pressure and reaches a temperature higher than the surrounding air. It is passed through the air-cooled fins and tubes of the condenser causing the hot, high pressure gas to be condensed into a liquid form.
2. The liquid refrigerant flows to the receiver tank, then passes through a filter dryer where moisture, acids and dirt are removed and then through a moisture indicator which indicates if any moisture is present in the system.
3. By its own pressure, the liquid refrigerant flows through a thermal expansion valve where the pressure drop causes the refrigerant to vaporize in a vapor-liquid state at a low temperature pressure.
4. The cold low pressure refrigerant passes through the passengers and the driver’s evaporator coils which absorbs heat from the air passing over the fins and tubes, and changes into gas. In this form, the refrigerant is drawn into the compressor to repeat the air conditioning cycle.

5. The success of the air conditioning system depends on retaining the conditioned air within the vehicle. All windows and intake vents should be closed. An opening of approximately 8 in^2 (5162 mm^2) could easily neutralize the total capacity of the system.
6. Other causes of inadequate cooling are dirty coils or filter. Dirt acts as insulation and is also serves as a restriction to the air flow.
7. The refrigeration load is not constant and varies. It is also affected by outside temperature, relative humidity, passenger load, compressor speed, the number of stops, etc.
8. The compressor will load or unload depending on operating conditions.

6.2 REFRIGERANT

The A/C system of this vehicle has been designed to use Refrigerant 134a as a medium. Regardless of the brand, only R-134a must be used in this system. The chemical name for this refrigerant is Ethane, 1, 1, 1, 2-Tetrafluoro.

⚠ WARNING ⚠

Refrigerant in itself is nonflammable, but if it comes in contact with an open flame, it will decompose.

6.2.1 Procurement

Refrigerant is shipped and stored in 30 and 100 pound (13,6 and 45 kg) metal cylinders. Approximately 24 pounds (10,9 kg) are used in the central system. If vehicle is equipped with an auxiliary A/C system, then approximately 5.5 lbs (2,5 kg) will be needed.

It will be impossible to draw the entire refrigerant out of the cylinder. However, the use of warm water when charging the system will assure the extraction of a maximum amount of refrigerant from the cylinder.

6.2.2 Precautions in Handling Refrigerant

1. Do not leave refrigerant cylinder uncapped.
2. Do not subject cylinder to high temperatures, do not weld or steam clean near system or cylinder.
3. Do not fill cylinder completely.
4. Do not discharge vapor into an area where a flame is exposed.
5. Do not expose the eyes to liquid refrigerant.

All refrigerant cylinders are shipped with a heavy metal screw cap. The purpose of the cap is to protect the valve and safety plug from damage. It is a good practice to replace the cap after each use of the cylinder for the same reason. If the cylinder is exposed to the sun's radiant heat pressure increase resulting may cause release of the safety plug or the cylinder may burst.

For the same reason, the refrigerant cylinder should never be subjected to excessive temperature when charging a system. The refrigerant cylinder should be heated for charging purposes by placing it in 125°F (52°C) water. Never heat above 125°F (52°C) or use a blowtorch, radiator, or stove to heat the cylinder. Welding or steam cleaning on or near any refrigerant line or components of the A/C system could build up dangerous and damaging pressures in the system.

If a small cylinder is ever filled from a large one, never fill the cylinder completely. Space should always be allowed above the liquid for expansion. Weighing cylinders before and during the transfer will determine the fullness of the cylinders.

⚠ WARNING ⚠

One of the most important precautions when handling refrigerant consists in protecting the eyes. Any liquid refrigerant which may accidentally escape is approximately -40°F (-40°C). If refrigerant comes in contact with the eyes, serious injury could result. Always wear goggles to protect the eyes when opening refrigerant connections.

6.2.3 Treatment in Case of Injury

If liquid refrigerant comes in contact with the skin, treat the injury as if the skin was frost-bitten or frozen. If liquid refrigerant comes in contact with the eyes, consult an eye specialist or doctor immediately. Give the following first aid treatment:

1. Do not rub the eyes. Splash eyes with cold water to gradually bring the temperature above the freezing point.
2. Apply drops of sterile mineral oil (obtainable at any drugstore) in the eyes to reduce the possibility of infection. The mineral oil will also help in absorbing the refrigerant.

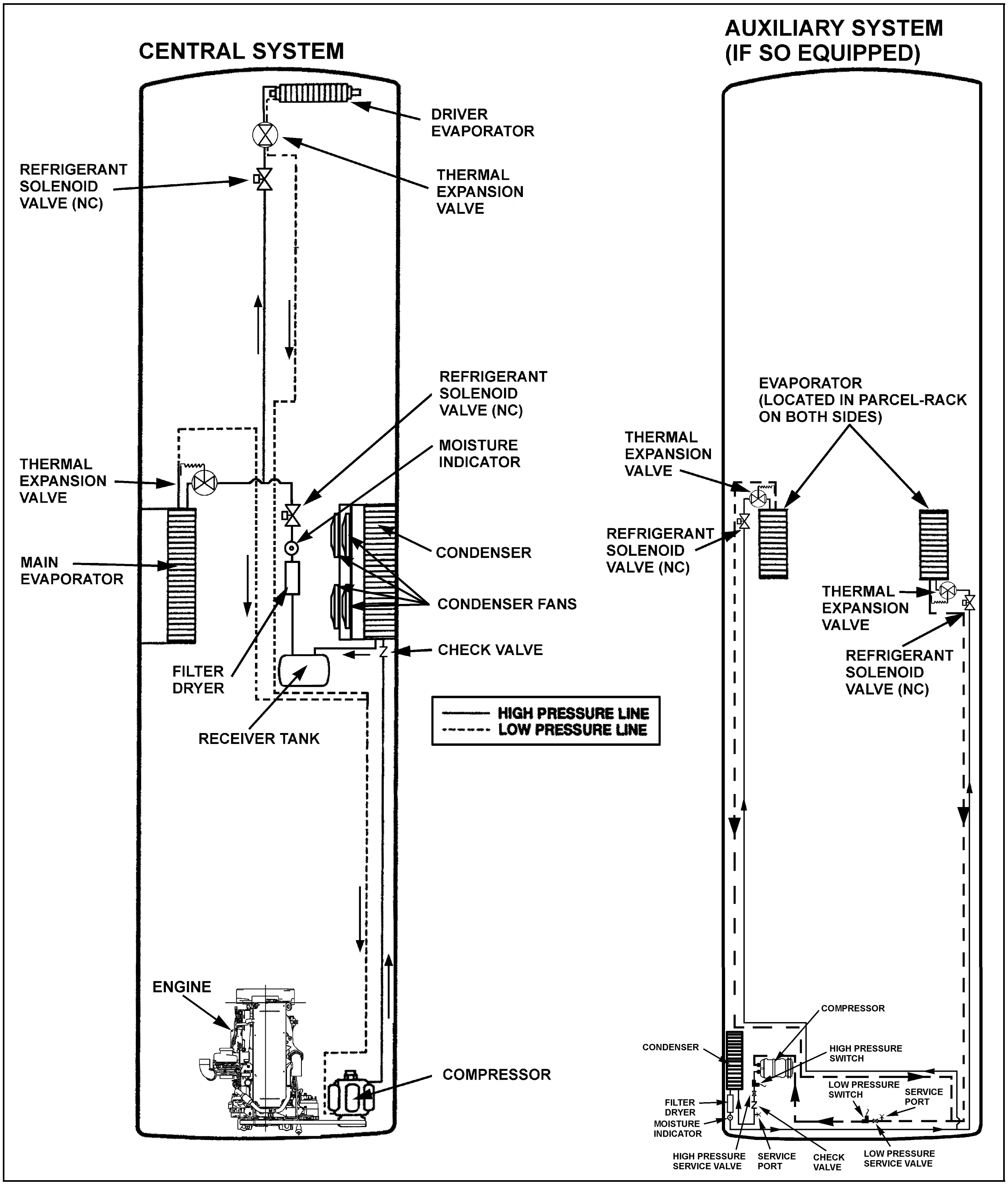


FIGURE 16: REFRIGERANT CIRCUIT (CENTRAL AND AUXILIARY SYSTEMS) 22313

6.2.4 Precautions in Handling Refrigerant Lines

1. All metal tubing lines should be free of kinks, because of the resulting restrictions on the flow of refrigerant. A single kink can greatly reduced the refrigeration capacity of the entire system.
2. The flexible hose lines should never be allowed to come within a distance of 2-½" (6,3 cm) from the exhaust manifold.
3. Use only sealed lines from parts stock.
4. When disconnecting any fitting in the refrigeration system, the system must first be discharged of all refrigerant. However, proceed very cautiously, regardless of gauge readings. If there happens to be liquid refrigerant in the line, disconnect fittings very slowly, keeping face and hands away so that no injury can occur. If pressure is noticed when fitting is loosened, allow it to bleed off very slowly.

WARNING

Always wear safety goggles when opening refrigerant lines.

5. In the event that any line is opened to the atmosphere, it should be immediately capped to prevent entrance of moisture and dirt.
6. The use of the proper wrenches when making connections on O-ring fittings is important. The use of improper wrenches may damage the connection. The opposing fitting should always be backed up with a wrench to prevent distortion of connection lines or components. When connecting the flexible hose connections, it is important that the swaged fitting and the flare nut, as well as the coupling to which it is attached, be held at the same time using three different wrenches to prevent turning the fitting and damaging the ground seat.
7. The O-rings and seats must be in perfect condition. The slightest burr or piece of dirt may cause a leak.
8. O-rings should be coated with refrigeration oil and installed on the line before the line is inserted into the fitting to prevent damaging the O-ring. If leaks are encountered at the couplings or connectors, no attempt should be made to correct the leaks by tightening the connections beyond the recommended torque. The O-rings are designed to seal at the specified torque and overtightening the connection does not result in a satisfactory and permanently sealed connection. The connection must be disassembled and the cause of the leak (damaged O-ring, defective lines, etc.) corrected. Use new O-ring.

6.2.5 Auxiliary System Refrigerant Lines

1. From the inside of the coach, remove the mirror located inside the lavatory to access the Y connector separating the system two sides. Also a small access panel located in front of the lavatory entrance door, near the ceiling enables to reach the R.H. side supply and return line fittings.
2. The L.H. side supply and return line fittings are accessible by removing the rearmost overhead storage compartment separator.

6.3 PUMPING DOWN

This procedure is intended to reduce refrigerant loss, on central system only, by isolating it in the compressor and the receiver tank, as well as in their connecting line, in order to carry out repairs on other sections of the air conditioning system (lines and components).

NOTE

Before attempting any repair between compressor and receiver tank, use a recovery unit to remove refrigerant from the system.

NOTE

On vehicles equipped with an auxiliary A/C system, refer to "Auxiliary Air Conditioning system and components": paragraph 8.9 "OIL RETURN OPERATION" and 8.3.4 "Refrigerant Recovery", further in this section.

WARNING

To prevent any injury, when air conditioning system must be opened, refer to previous paragraph "PRECAUTIONS IN HANDLING REFRIGERANT".

⚠ CAUTION ⚠

The filter dryer must be changed each time a line in the system is opened.

Procedure

1. Energize passengers ‘section liquid solenoid valve.
2. Run the system for 10 minutes, shut it OFF, then close the receiver tank outlet valve by turning it clockwise, backseat the suction service valve on the compressor, install an appropriate pressure gauge set, and turn the valve forward ¼ turn to enable a visual check of the suction pressure.
3. Disconnect the *“Low Pressure Switch”* connector (mounted near the A/C compressor, and install a jumper wire.

NOTE

This jumper wire will allow the clutch to remain engaged after pressure drops below 15 psi (103,5 kPa).

4. Start the engine, press the *“Passenger ON/OFF”* switch then adjust (lower) temperature control to maximum A/C.
5. Run the compressor until pressure reaches 1-2 psi (7-14 kPa).

NOTE

During this operation, care must be taken not to fill the receiver tank over the upper sight glass. If so, stop process immediately. Always allow refrigerant piping and units to warm up to the ambient air temperature before opening system or sweating will take place inside the lines.

6. Stop engine, and close compressor outlet valve by turning it clockwise until valve is properly seated.
7. Close compressor suction valve by turning it clockwise until it is properly seated.
8. Wait until pressure gauge reaches 1 to 2 psi (7 to 14 kPa). To accelerate procedure, lightly open compressor suction valve until pressure reaches this value.

6.4 ADDING REFRIGERANT (VAPOR STATE)

Use the suction service valve on the compressor to add a small quantity of refrigerant to the system. Backseat the valve and connect a charging line from the refrigerant cylinder to the valve. Tighten connection at level of refrigerant cylinder and open tank end slightly to purge air from the charging line. Tighten the charging line at the compressor. Screw in the stem of suction valve approximately two turns. Start the engine and run at fast idle. Add sufficient refrigerant to bring the level in lower sight glass of receiver tank to mid-point. Always charge the system with the cylinder upright and the valve on top to avoid drawing liquid out of the cylinder.

6.5 EVACUATING SYSTEM

1. Open both receiver valves by turning “out” (normal position).
2. Remove the caps from the two 90° adapters on the suction, discharge valves and connect two hoses to the vacuum.
3. Place the two compressor valves, suction and discharge, in neutral position by turning each one 3 to 4 turns “in” from the “out” position.
4. Open the solenoid valve by energizing or manually bypass.
5. Start the vacuum pump. Open the large (suction) shutoff valve and close the small vacuum gauge valve.
6. The pressure will drop to approximately 29 inches vacuum (14.2 psi or 97,9 kPa) (the dial gauge only gives a general idea of the absolute system pressure.
7. Backseat the compressor valves by turning “out” all the way.
8. Shut down the vacuum pump.
9. Remove the hoses.
10. Reinstall the caps at the suction valve take-off points.

6.5.1 Double Sweep Evacuation Procedure

1. Remove any remaining refrigerant from the system using a refrigerant recovery machine.
2. Connect the evacuation manifold, vacuum pump, hoses and micron gauge to the unit.
3. With the unit service valves closed (back seated) and the vacuum pump and the thermistor valves open, start the pump and draw the manifold and hoses into a very deep vacuum. Shut the vacuum pump off and see if the vacuum holds. This is to check the setup for leaks.
4. Midseat the system service valves.
5. Open the vacuum pump and the thermistor valves. Start the pump and evacuate to a system pressure of 2000 microns.
6. Close the vacuum pump and the thermistor valves, turn off the vacuum pump (closing the thermistor valve protect the valve from damage).
7. Break the vacuum with clean refrigerant (or dry nitrogen) and raise the pressure to approximately 2 PSIG. Monitor the pressure with the compound gauge.
8. Remove the refrigerant with the recovery machine.
9. Repeat steps #5 – 8 one time.

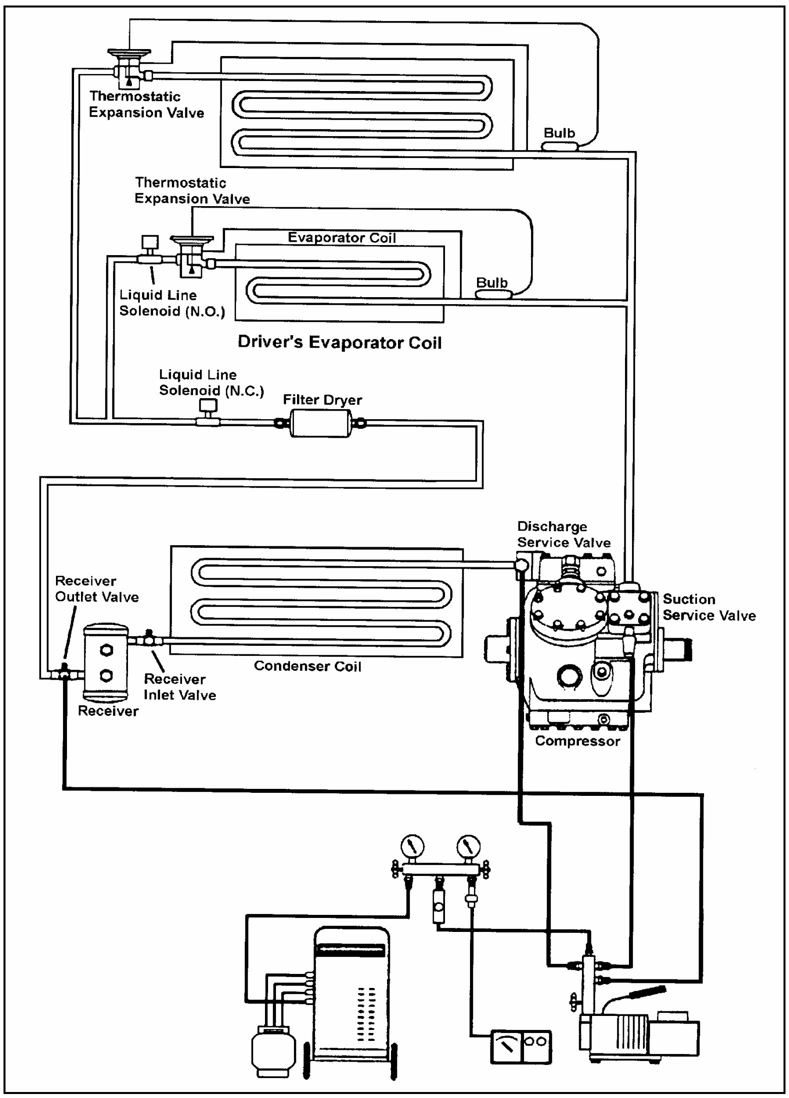


FIGURE 17: DOUBLE SWEEP EVACUATION SET-UP 22298

10. After the second “sweep”, change the filter drier (if you have not done so) and evacuate to 500 microns.
11. Evacuating the system below 500 microns on systems using the Carrier 05G compressor may risk drawing air into the system past the carbon shaft seal.
12. Check to insure that vacuum holds. (If the pressure continues to rise, it indicates a leak or moisture in the system).
13. Charge the system with the proper amount of refrigerant using recommended charging procedures.

NOTE
This method will aid in preventing unnecessary system failures by ensuring that the refrigeration system is free of contaminants.

6.6 CHARGING SYSTEM

When a system has been opened or if there are any questions about the air or moisture in the system, evacuate the system. Charging of an evacuated system may be accomplished by forcing liquid R-134a directly into the receiver tank. This may be accomplished by placing the refrigerant cylinder upside down on a scale with the valves at the bottom. This ensures that only liquid will enter the receiver tank.

When charging an empty system, weigh the amount of refrigerant put into the system. This will eliminate any possibility of overfilling. A nominal charge requires 24 pounds (10,9 kg). If the vehicle is equipped with an auxiliary system, a full charge requires 5.6 lbs (2,6 kg).

1. Backseat the two compressor shutoff valves ("out").
2. Install the test gauges at the shutoff valves noting that the 400 psi (2758 kPa) gauge is connected to the discharge.
3. Turn in the two shutoff valves 3 to 4 turns.
4. Open the lower receiver valve by turning “out” all the way.
5. Backseat the upper receiver valve by turning out all the way.
6. Remove the cover cap from the service fitting in the top receiver valve.
7. Attach a charging hose to the R-134a tank. Open the tank valve slightly permitting R-134a to escape thus purging the hose of air.
8. Connect the charging hose to the service fitting.
9. Open the R-134a tank valve.
10. To build up pressure in the receiver tank, heat the receiver tank with a heating blanket.
11. Turn in the upper receiver valve several turns. The R-134a will now enter the system.
12. The proper charge of R-134a is 24 lbs (10.89 kg). When the scale indicates this amount of charge, backseat the receiver valve and close the R-134a tank valve.
13. Disconnect the charging hose. Replace the cover caps.
14. The system is now ready for operation.

⚠ CAUTION ⚠
The evacuation of the system must be made by authorized and qualified personnel only. Refer to local laws for R-134a recuperation.

6.7 REFRIGERANT SYSTEM CLEAN-OUT AFTER COMPRESSOR FAILURE

Although the vast majority of reciprocating refrigerant compressors manufactured today are extremely reliable, a small percentage do fail. These failures usually result in minor or extensive system contamination depending on the severity of the failure. When an open type compressor becomes damaged internally, this provokes small particles of bearings, steel, brass, copper, and aluminum and, in severe cases, carbonized oil, which could contaminate the system. To prevent repeated failures, the problem which caused the failure should be corrected, and depending upon the severity of the failure, the system should be thoroughly cleaned out using one of the clean-out procedures mentioned.

6.7.1 Determining Severity of Failure

The severity of compressor failure can be categorized as minor or major. A failure is considered minor when the contamination is limited to the compressor with little or no system contamination. A major failure, or burnout, results in extensive system contamination as well as compressor damage. Extensive system contamination can be determined by withdrawing a small sample of compressor oil and checking its color, odor and acidity. A Virginia Chemical "TKO" one step acid test kit is one of several compressor oil test kits that may be used. A high acid content would indicate a major failure or burnout. A small amount of refrigerant gas may be discharged. A characteristic burned odor would also indicate severe system contamination.

6.7.2 Clean-out after Minor Compressor Failure

1. Be sure to correct the problem which caused the failure.
2. Change liquid line filter dryer.
3. Run the unit for 2 hours on high speed cool only.
4. Check compressor oil level to ensure compressor is not overcharged with oil. Sometimes a significant amount of oil is pumped out of the compressor to other parts of the system when a compressor fails. This oil will return to the replacement compressor when it is started, causing an overcharge of oil in the sump of the replacement compressor. In this case, it is important that the oil level be adjusted to the proper level.
5. Withdraw a sample of the compressor oil and check its color, odor, and acidity, using instructions supplied above. If the oil is contaminated, change the oil and filter dryer, and repeat the procedure until the system is clean.

6.7.3 Clean-out After Major Compressor Failure

1. Reclaim the refrigerant into a refrigerant bottle through a filter dryer to filter out contaminants.
2. Remove the failed compressor and repair it if possible.
3. Install new or repaired compressor.
4. Change the filter dryer.
5. Circulate clean R-134a or nitrogen with the reclaimer to clean out many of the contaminants collected in the coil valves, TXV (Thermal Expansion Valve), solenoid valves, check valves, and any other mechanical component that may have collected contaminants.
6. Evacuate and charge the system normally.
7. Run the unit for 8 hours and monitor the pressure drop across the filter dryer. Also check the liquid line dryer for signs of restriction. If the pressure drop across the filter dryer exceeds 12 to 14 psig (82,75 to 96,5 kPa) with a 40°F (5°C) evaporator coil temperature, stop the unit and change the liquid line and suction line filter dryer. After 4 or 5 hours of operation, stop the unit and replace the filter dryer.
8. After 8 hours of operation, stop the unit and remove a sample of the compressor oil and check its color, odor, and acidity, using instructions supplied above. If the oil is contaminated, replace the oil and repeat step 7. If the oil is not contaminated, change the filter dryer again and replace the moisture-liquid indicator.
9. After approximately 7 days of operation, recheck the compressor oil for cleanliness and acidity.

7. CENTRAL A/C SYSTEM COMPONENTS

7.1 COMPRESSOR (CENTRAL SYSTEM)

7.1.1 Belt Replacement

⚠ **WARNING** ⚠

Set the battery master switch to the “Off” position. For greater safety, set the engine starter selector switch in engine compartment to the “Off” position.

1. Open engine compartment rear doors and locate the belt tensioner pressure releasing valve (Fig. 18), mounted above the engine

R.H. side door next to the air pressure regulator, then turn handle clockwise in order to release pressure and tension on belts.

2. Slip the old belts off and the new ones on.
3. Reset belt tensioner pressure releasing valve (Fig. 18) to 50 psi (345 kPa) to apply tension on the new belts as explained in Section 12.

NOTE
Both belts must always be replaced simultaneously to ensure an equal distribution of load on each of them.

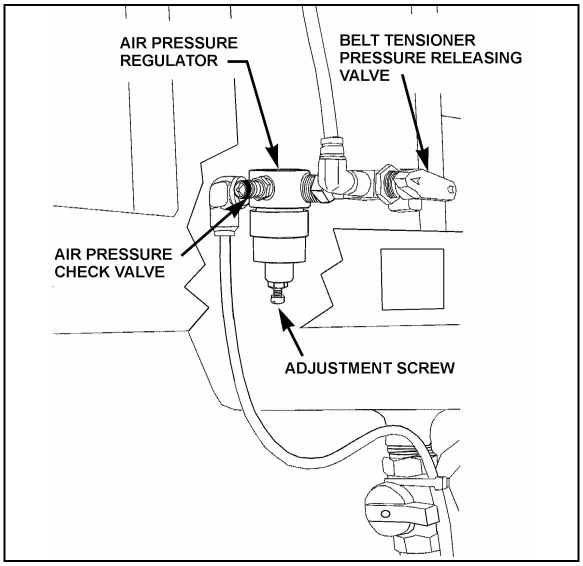


FIGURE 18: AIR PRESSURE REGULATOR 12200

NOTE
*For proper operation of the air bellows, adjust the **upper** tensioning bracket to provide a ¼ inch (7 mm) gap between stopper and bracket with the pneumatic system under normal pressure and the air pressure regulator set as per paragraph #3 (Fig. 19).*

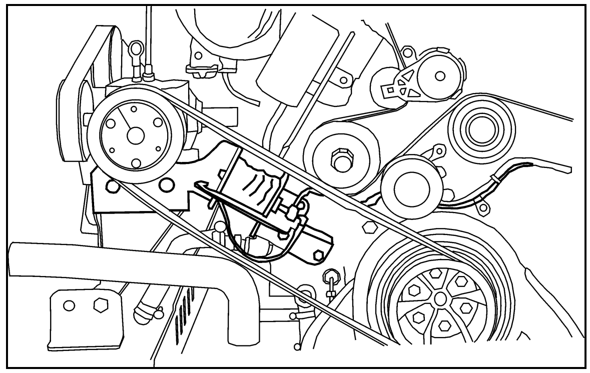


FIGURE 19: BELT TENSIONER 01169

7.1.2 Belt Play

After belt replacement or during normal maintenance, belt play between pulleys and belt must be checked to ensure proper operation. Refer to figure 20 for proper plays.

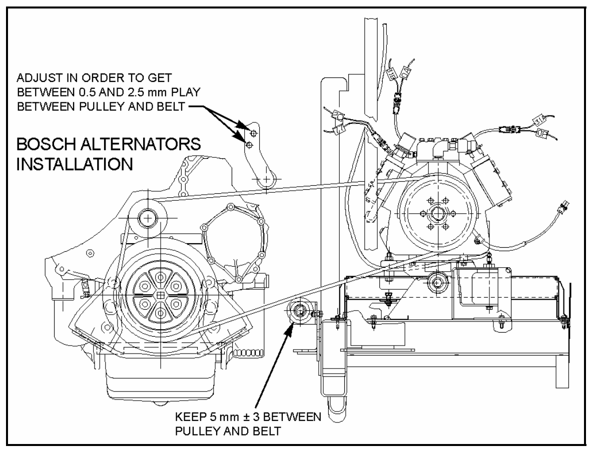


FIGURE 20: BELT PLAY 22288

7.1.3 Pulley Alignment

In order to avoid skipping, disengagement and a premature wear of compressor belt, it is necessary to align compressor pulley with the crankshaft pulley. Before performing the following procedure, release air from belt tensioners by means of the air pressure releasing valve. After completing these procedures reset belt tensioner air pressure regulator to 50 psi (345 kPa).

7.1.4 Longitudinal Compressor Alignment

1. Rest an extremity of a straight edge of approximately 46 inches (117 cm) against the upper part of the outer face of crankshaft

pulley, positioning the other end close to the compressor clutch pulley (Figs. 21 & 22).

2. Check the distance between each extremity of straight edge (1. Fig. 22) and the first drive belt. If they are different, loosen the compressor support bolts and with a hammer, knock support to slide it in order to obtain the same distance; then tighten bolts.

7.1.5 Horizontal Compressor Alignment

1. Rest an extremity of the straight edge against the upper part of the outer face of compressor pulley, positioning the other end close to the crankshaft pulley.
2. Check the distance between each extremity of straight edge (1, Fig. 22) and drive belt. If they are different, loosen the pillow block compressor bolts and with a hammer, knock compressor pillow block to slide it, in order to obtain the same distance; then tighten bolts.

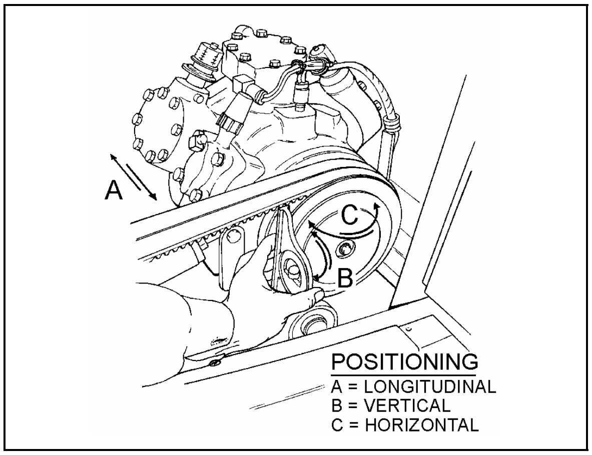


FIGURE 21: COMPRESSOR ALIGNMENT 22072

7.1.6 Vertical Compressor Alignment

Rest a short "angle and level indicator" on the outer side face of the crankshaft pulley, adjust the level indicator inclination at 0^o and check if the compressor pulley is at same angle (Fig. 21). If it is not the same, shim under the appropriate pillow block in order to obtain the correct angle.

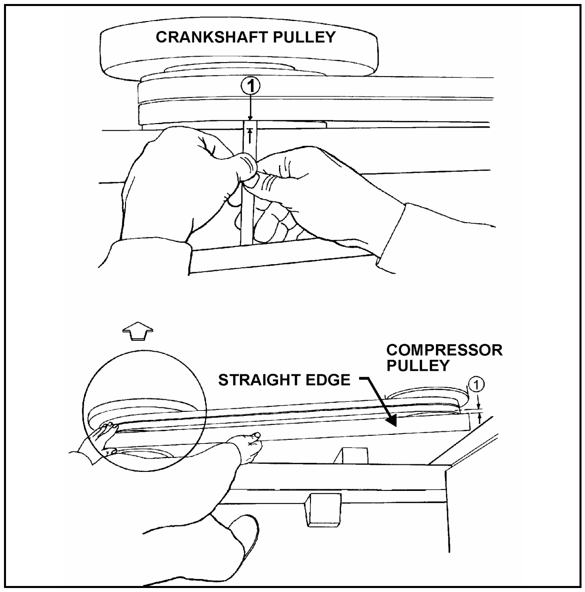


FIGURE 22: COMPRESSOR ALIGNMENT 22040

7.1.7 Compressor Maintenance

For the maintenance of the A/C compressor, see the *Carrier Compressor “WORKSHOP MANUAL* for MODEL 05G TWIN PORT COMPRESSOR” included at the end of this section.

⚠ CAUTION ⚠
Use only Castrol SW 68 (POE) oils with refrigerant 134a.

7.1.8 Troubleshooting Guide

A preliminary check may be made by simply feeling the cylinder heads with the unit in operation at ambient temperatures of 35^{o}F (2^{o}C) and over. The cylinder heads are internally divided into suction and discharge valves. The lower half of the cylinder head is the suction side, and it should be relatively cool to the touch, as opposed to the hot upper discharge side. If a valve plate or head gasket is blown, or a compressor unloader is stuck open, partially compressed refrigerant vapor will be circulated between the suction and discharge sides of the head. The affected cylinder head will then have a relatively even temperature across its surface and be neither as hot as the normal discharge temperature nor as cool as the normal suction temperature.

Blown Head Gaskets

Symptom:

* Loss of unit capacity at low temperature.
* Even cylinder head temperature.

Cause:

* Improperly torqued cylinder head bolts.
* Improperly positioned gasket at assembly.
* Warped cylinder head.
* Severe liquid refrigerant floodback.

Blown Valve Plate Gaskets

Symptom:

* Loss of unit capacity at medium and low temperatures.
* Very hot cylinder head surface.
* Higher than normal suction pressure.

Cause:

* Improperly torqued cylinder head bolts.
* Severe liquid refrigerant floodback.
* Oil slugging caused by an overcharge of oil or flood starts.
* Discharge valves not seated properly (liquid drainback during shutdown).

Broken Suction Valves

Symptom:

* Loss of unit capacity at all temperatures.
* Compressor unable to pull extremely low vacuum with suction service valve frontseated.

Cause:

* Repeated liquid refrigerant floodback.
* Flooded starts.
* Overcharge of oil.
* Discharge valves not seated properly (liquid drainback during shutdown).
* Expansion valve not controlling properly.

Unloader Valve Stuck Open

Symptom:

* Loss of unit capacity at all temperatures.
* Higher than normal suction pressure.
* Even cylinder head temperature.

Cause:

* Unloader body stem bent.
* Foreign material binding unloader piston or plunger.

7.2 MAGNETIC CLUTCH

Refer to Carrier service information entitled "Housing-Mounted Electric Clutch" at the end of this section for the description and maintenance of the magnetic clutch.

7.3 EVAPORATOR MOTOR

The evaporator motor is installed in the evaporator compartment (L.H. side of vehicle) (Fig. 23). It is a 27.5 volt, 2 HP (1.5 kW) motor which activates a double blower fan unit.

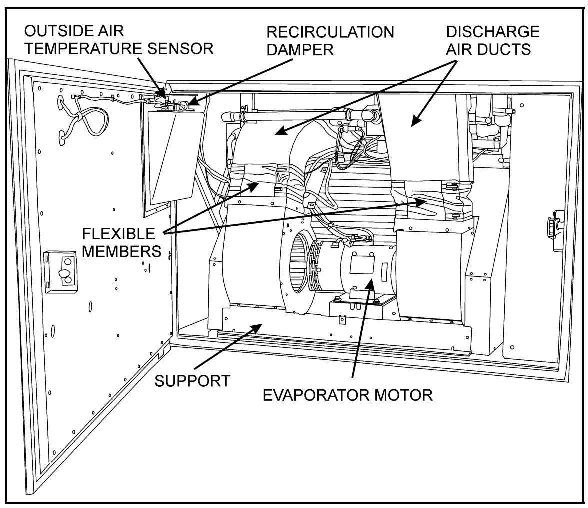


FIGURE 23: EVAPORATOR COMPARTMENT 22314

7.3.1 Removal

1. Set the battery master switch (master cut-out) to the *"OFF"* position.
2. Open the last L.H. side baggage compartment door. Pull the black release button located on the L.H. side in order to

unlock and open the evaporator compartment door.

3. Remove the evaporator motor and coil access panel.
4. Identify the L.H. side discharge duct inside compartment and remove the Phillips head screws retaining the flexible member to duct.
5. Repeat step 4 for the R.H. side air duct.
6. Disconnect the electrical motor speed control connections on the motor plate.
7. From under the vehicle, remove the eight bolts retaining the evaporator fan motor support. Remove the complete unit from the evaporator compartment (Fig. 24 & 25).

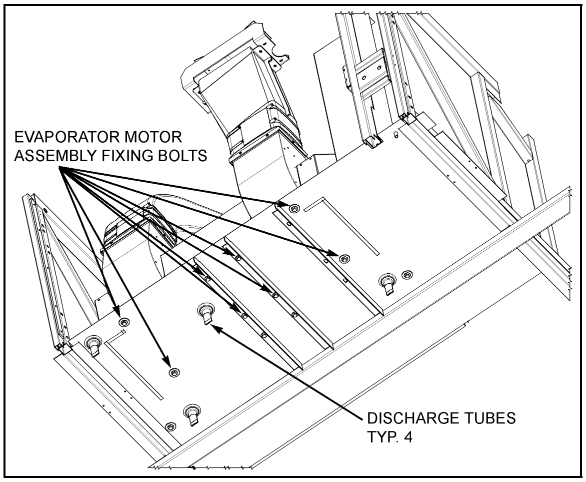


FIGURE 24: EVAPORATOR MOTOR ASSY FIXING BOLTS 22315

⚠ CAUTION ⚠

Never support evaporator motor by its output shafts while moving it.

8. On a work bench, unscrew the fan square head set screws, the Phillips head screws retaining cages to support and slide out the assemblies from the evaporator motor output shaft.

7.3.2 Installation

To reinstall the evaporator motor, reverse "Evaporator Motor Removal" procedure.

7.3.3 Checking Operation of Brush in Holder

Lift brush slightly 1/8 inch (3 mm) and release it. Brush must produce a dry noise.

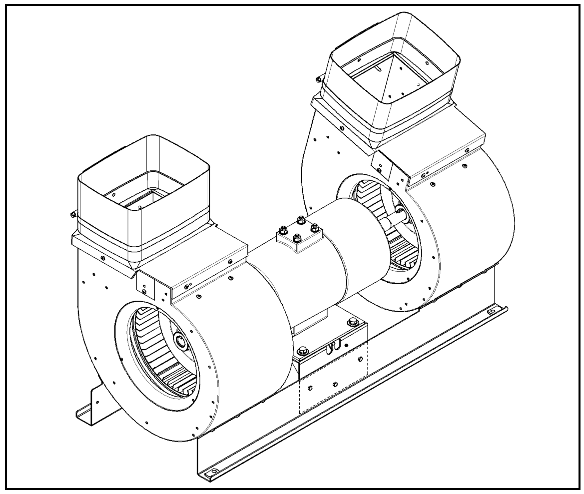


FIGURE 25: EVAPORATOR MOTOR ASSEMBLY 22316

7.3.4 Brush Wear Inspection and Replacement

⚠ CAUTION ⚠

Only use replacement brushes recommended by the manufacturer. Not doing so will void warranty.

Replace the brushes if less than ¾ inch (19 mm). New brush length is 1-¼ inch.

To replace brushes, proceed as follows:

1. Set battery master switch to the “OFF” position.
2. Remove the protective screen band from the motor housing by pulling down the spring loaded fastener.
3. Lift the spring, remove and replace brushes as per the following procedure: “SEATING BRUSHES”.
4. Reverse installation procedure.

7.3.5 Seating Brushes

Grinding consists in giving to the seating face of a new brush the exact curve of the commutator or ring so that good mechanical and electric contact of the brush is ensured upon startup.

For best results, remove oil and grease from commutator before applying brush seater.

NOTE

The new motor brushes are provided with preformed seating face, i.e. with curved face machined with the required radius. This curve is only approximate and does not exempt further grinding. The advantage of preforming is to appreciably shorten the time required for grinding.

Grinding is generally done on the machine itself, in accordance with various processes' and conformably to the importance and the type of machines:

a) Grinding with abrasive cloth medium grit (sandpaper) (grit 60) applied to a part of the commutator by hand. The new brushes installed in their brush holder and pressing against the cloth, one makes oscillate the rotor until complete grinding of the seating faces (Refer to figure 26). It is necessary to avoid raising the cloth under the brushes otherwise it would result, after grinding, to reduce and badly definite surfaces (Refer to figure 27).

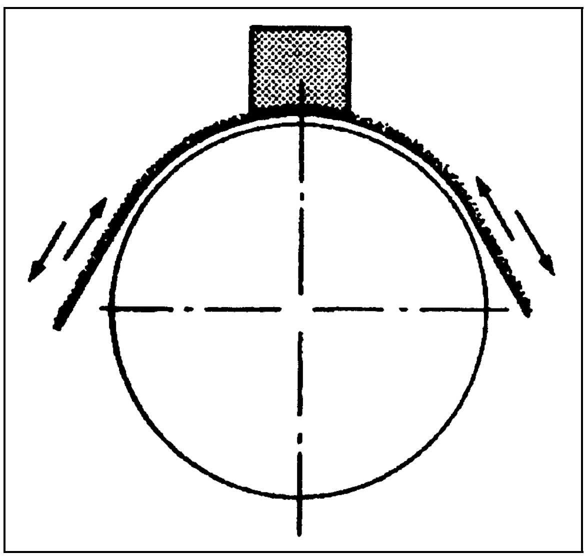


FIGURE 26: PROPER GRINDING TECHNIQUE 22317

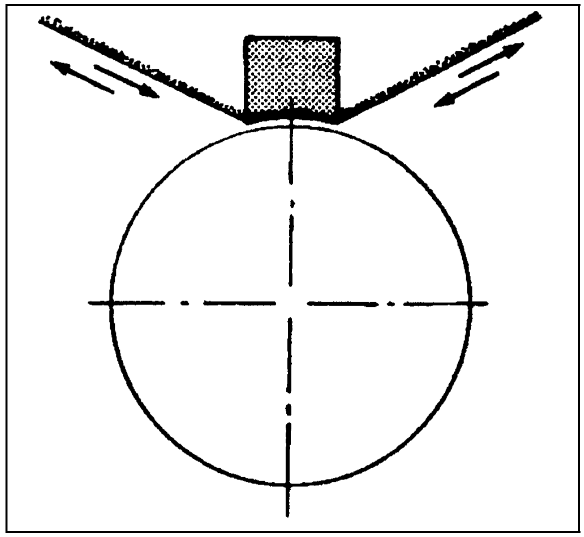


FIGURE 27: IMPROPER GRINDING TECHNIQUE 22318

⚠ CAUTION ⚠

If grinding with a brush seater, you must disconnect the time delay in order to keep the motor in 1st speed. If you prefer, you may also install a jumper on the evaporator motor between terminal E2 and A1 to bypass relay R60 and keep the motor in 1st speed as well.

b) Grinding with the brush seater stone is always done under no or much reduced voltage. Dust particles act like abrasive and wear down the brushes exactly with the profile of the commutator. **Do not misuse this method because grinding removes some metal from the commutator. It is applicable only to grinding requiring only reduced wear of the brushes.**

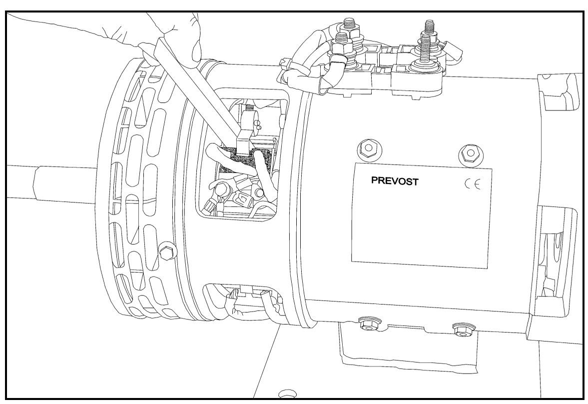


FIGURE 28: GRINDING WITH THE BRUSH SEATER STONE 22319

Repeat method a or b until brushes are fully seated. **Seating surface of the brush must be no less than 80% of the face (Refer to figure 29).**

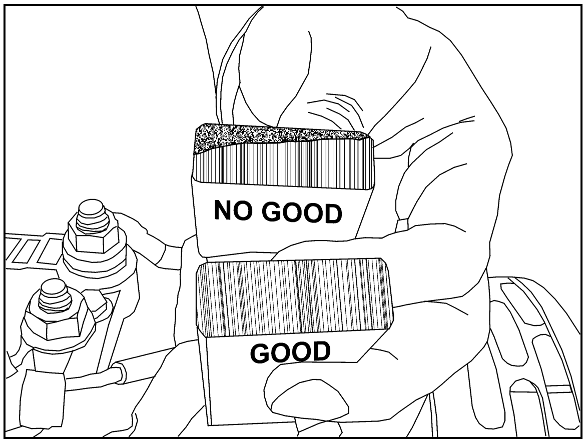


FIGURE 29: SEATING SURFACE OF THE BRUSH 22320

CAUTION

After grinding with the sandpaper or the seater stone, it is necessary to remove the brushes from the brush holders and vigorously clean with an air gun the commutator and the seating faces of the brushes to eliminate abrasive dust and dust from brushes.

WARNING

Use a dust mask to prevent inhalation of dust particles. Protect against electrical shock when working on energized equipment. Protect against falling or slipping when working on rotating equipment.

CAUTION

If grinding is not carried out or is carried out in an incorrect way, the brush may seat against a restricted zone only, which will support the entire load. The consequences risk to be serious for the commutator as for the brush and to seriously damage the motor.

After grinding is completed, it is necessary to check the evaporator motor amperage in 1st speed and in 2nd speed. **Make sure that the evaporator compartment door is closed and that the reading is 30 A ± 3 in 1st speed.**

Confirm that the reading is 64 A ± 4 (MAX 68 A) in 2nd speed.

7.3.6 Brush Holder Adjustment

NOTE

The brush holders are mounted on a support that can rotate. Rotating that rocker ring will move all the brush holders at the same time.

1. Remove the screws securing the grid and remove the grid. Locate the 2 bolts fixing the mechanism permitting the rotation of the brush rocker ring.
2. Loosen (do not remove) the bolts just enough to release the mechanism.
3. Move gently the exposed brush holder in order to have **30 A ± 3 in 1st speed and 64 A ± 4 in 2nd speed when the door is closed** and a maximum distance of 10 mm (3/8 inch) between the brush face and a reference line passing through the center of the 2 bolts on the motor housing.

CAUTION

If rotating the rocker ring is necessary, it is preferable to mark off the angular position of the rocker ring before unfastening the bolts fixing the mechanism in order to get back to the factory setting at the end of the operation.

NOTE

Take a final reading in 1st and in 2nd speed after tightening the brush holder bolts. The amperage may have changed.

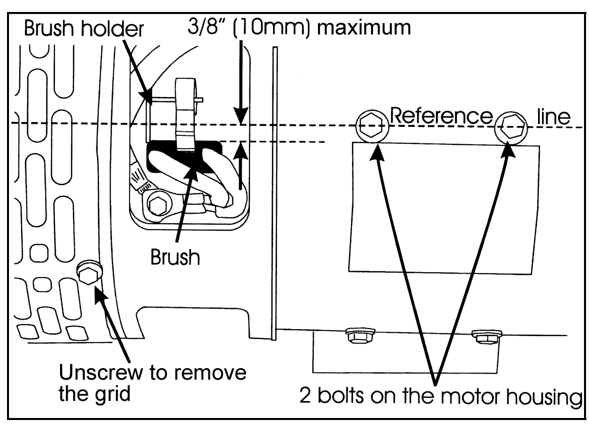


FIGURE 30: EVAPORATOR MOTOR 22321

⚠ CAUTION ⚠

To avoid damaging the motor, make sure all vehicle doors are closed when taking the readings.

7.3.7 Checking Commutator

The surface must be polished. A brown-black colored surface is normal and indicates a good switching. Ensure there is no evidence of arcing or metal chips.

7.4 CONDENSER

The central A/C system condenser coil is hinge mounted on the R.H. side of the vehicle on the A/C condenser door (Fig. 32). The condenser coil for vehicles equipped with an auxiliary A/C system is mounted on the outer face of engine radiator. Since condenser's purpose is to dissipate heat from the hot refrigerant, it is important to keep the cooling coils and fins clean. A clogged coil will cause high discharge pressure and insufficient cooling.

7.4.1 Condenser Fan Motors

Four brushless fan motors (Fig. 31), 28.5 V - (0.6 HP - 0.42 kW) are installed in the condenser compartment on R.H. side of vehicle in order to ventilate the condenser coil. They are mounted on a support, fastened to the door. The fans pull outside air through the condenser coil and discharge it through an opening at bottom of compartment. When temperature drops inside condenser, the pressure in the refrigerant line also drops and it is, therefore, no longer required to cool condenser. Consequently, when pressure drops to 130 psi, the motors will run at low speed and if the pressure continues to drop to 90 psi, a pressure switch stops the motors so that fans do not operate needlessly. When pressure rises to 120 psi, the pressure switch reactivates the motors. If the pressure rises to 170 psi, the motors will switch to high speed.

For details about electrical wiring, refer to *"A/C and Heat system"* in the master wiring diagram.

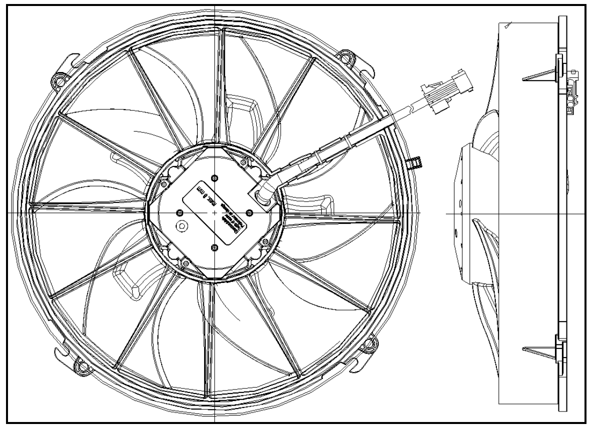


FIGURE 31: CONDENSER FAN MOTOR 22322

7.4.2 Condenser Fan Motor Removal

1. Set the battery master switch to the *"Off"* position.
2. Disconnect wiring from terminals on motor. Tag each wire to aid in identification at time of reconnection.
3. Remove the four *"Phillips"* head screws retaining the fan motor assembly to the mounting support.
4. Remove the motor.

7.5 RECEIVER TANK

The receiver tank is located in the condenser compartment (Fig. 32). The function of the receiver tank is to store the liquid refrigerant. During normal operation, the level of the refrigerant should be approximately at the mid-point of the lower sight glass.

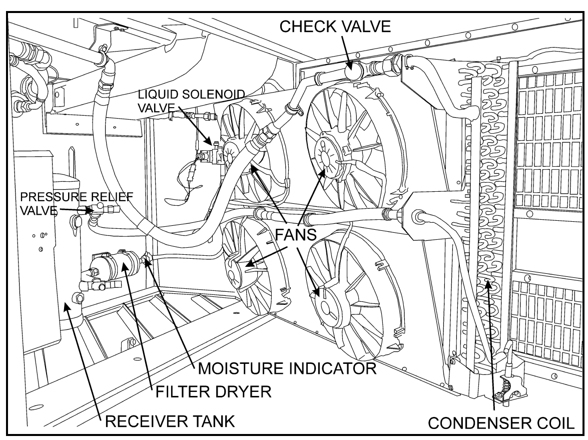


FIGURE 32: A/C CONDENSER COMPARTMENT 22323

In case of extreme pressure there will be a rise in the liquid receiver tank. A pressure relief valve will break at 450 psi (3103 kPa) and relieve the receiver tank pressure.

The receiver tank incorporates an inlet valve on the inlet side (upper section) which allows the tank to be isolated or serviced. An outlet valve on the outlet side (lower section) permits complete isolation from the rest of the system.

7.6 FILTER DRYER

A filter dryer, also located in the condenser compartment, is installed on the liquid refrigerant line after the receiver tank. It is used to absorb moisture and foreign matter from refrigerant before it reaches the expansion valves.

The filter should be replaced if the system has been opened or after a prolonged exposure, when the moisture indicator sight glass turns to pink.

A filter dryer, located close to the engine compartment L.H. side rear door, is installed on vehicles equipped with an auxiliary A/C system. Its function is similar to that of filter used on main systems. Replace only when system is opened or a problem occurs.

7.6.1 Replacement

The filter is of the disposable type. When replacement is required, remove and discard the complete unit and replace with a new unit of the same type according to this procedure:

1. Isolate the refrigerant in the receiver tank by following the “Pumping Down” procedure explained in this section
2. Change the filter dryer as a unit.
3. Add a small quantity of refrigerant R-134a to the low side of the system. Check for leaks. Return the system to normal operation.

⚠ **CAUTION** ⚠

Do not use carbon tetrachloride or similar solvents to clean parts. Do not use steam guns. Use mineral spirits or naphtha. All parts should be thoroughly cleaned. Use a stiff brush to wash dirt from grooves, holes, etc.

⚠ **WARNING** ⚠

Cleaning products are flammable and may explode under certain conditions. Always handle in a well ventilated area.

7.6.2 Moisture Indicator

The moisture sensitive element consists of a color changing ring which is reversible from pink to blue and vice versa as the moisture content in the refrigerant changes. Pink indicates a wet refrigerant, light violet (caution) and blue indicates a dry refrigerant.

Since temperature changes affect the solubility, color change will also vary with the refrigerant temperature. The above table shows the color change for R-134a at various moisture levels and liquid line refrigerant temperatures.

COLOR INDICATOR			
TEMPERATURE	BLUE (ppm)	LIGHT VIOLET (ppm)	PINK (ppm)
75°F (24°C)	Below 5	5-15	Above 15
100°F (38°C)	Below 10	10-30	Above 30
125°F (52°C)	Below 15	15-45	Above 45
p.p.m.= parts per million (moisture content)			

A moisture level of less than 15 p.p.m. for R-134a indicated in the blue color range of the above table is generally considered dry and safe. A color indication of light blue to light violet indicates the caution range of moisture level. For positive protection, the drying of the system should be continued until the color of the element turns to deep blue.

The liquid refrigerant is readily visible through the center opening of the moisture element where the presence of bubbles indicates a shortage of refrigerant or restriction in line.

Moisture is one of the main causes of chemical instability or contamination in air conditioning systems. If moisture is present, it can corrode the valves, condenser and evaporator coils, compressor and other components causing a malfunction and eventual failure of the system. Uncontrolled moisture in the system can result in very expensive multiple component replacements if not corrected at an early stage.

The moisture indicator permits an early detection of moisture in the system and when corrected by a desiccant charge, system contamination is greatly minimized.

7.7 LIQUID REFRIGERANT SOLENOID VALVE

The flow of liquid refrigerant to the driver's and main evaporators is controlled by a normally-closed solenoid valve. The driver's liquid solenoid valve is located on the ceiling of the spare wheel and tire compartment and is accessible through the reclining bumper.

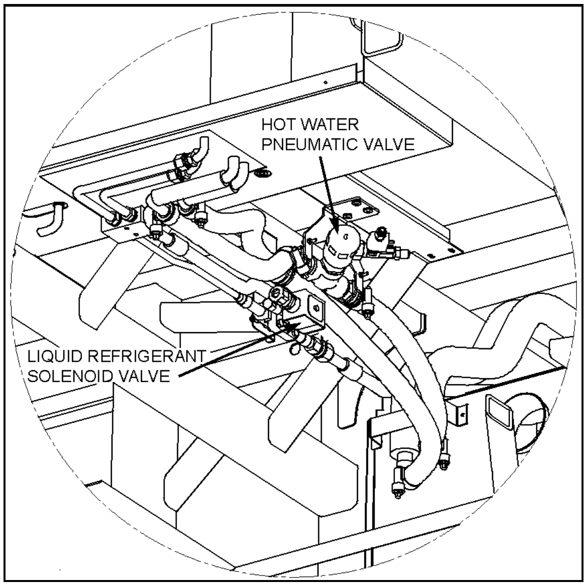


FIGURE 33: DRIVER'S EVAPORATOR LIQUID SOLENOID VALVE 22324

NOTE
An identical refrigerant solenoid valve is used on the auxiliary A/C system and is located near the auxiliary A/C unit.

7.7.1 Manual Bypass

This type of solenoid valve is equipped with a manual operating stem. The 3/16" square stem located on the bonnet is exposed when the seal cap is removed. To manually open valve, turn stem ½ turn counterclockwise. To manually close valve, turn stem clockwise until tight against seat. Manual stem must be in closed position for automatic electric operation.

7.7.2 Coil Replacement

1. Disconnect connector from the coil connector.
2. Take out the retaining screw at the top of the coil housing. The entire coil assembly can then be lifted off the enclosing tube.
3. Place the new coil and yoke assembly on the enclosing tube. Lay data identification plate in place.
4. Insert the coil retaining screw, rotate housing to proper position and tighten screw securely.
5. Connect connector from coil connector.

7.7.3 Valve Disassembly

1. Remove the coil as stated previously.
2. Pump down the system as stated earlier in this section.
3. Remove the four socket head screws which hold the body and bonnet together (Fig. 34).
4. Carefully lift off the bonnet assembly (upper part of the valve) so that plunger will not fall out. The diaphragm can now be lifted out.

NOTE
The above procedure must be followed before brazing solder-type bodies into the line.

⚠ CAUTION ⚠
Be careful not to damage the machined faces while the valve is apart.

7.7.4 Valve Reassembly

1. Place the diaphragm in the body with the pilot port extension up.
2. Hold the plunger with the synthetic seat against the pilot port.
3. Make sure the bonnet O-rings are in place. Lower the bonnet assembly over the plunger, making sure that the locating sleeve in the bonnet enters the mating hole in the body.

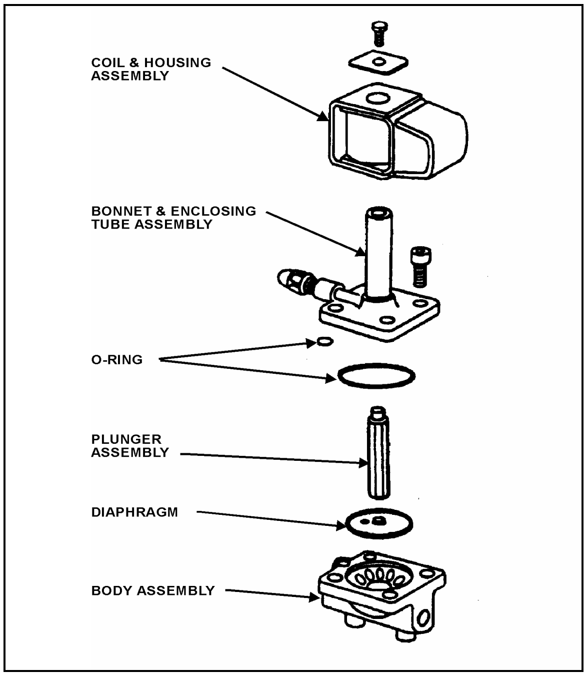


FIGURE 34: REFRIGERANT SOLENOID VALVE 22044

4. Insert the four socket head screws and tighten evenly.
5. Replace the coil as stated previously.
6. Add a small quantity of refrigerant R-134a to the low side of the system. Check for leaks. Return the system to normal operation.

7.8 EXPANSION VALVE

The expansion valve for the central system is a thermo-sensitive valve with a remote control bulb head attached to the evaporator outlet line and is accessible by the evaporator coil access door (Fig. 14 & 35). The valve regulates the flow of refrigerant liquid into the evaporator coils and is controlled by the suction gas temperature leaving the evaporator. The bulb head senses the refrigerant gas temperature as it leaves the evaporator. High temperature will cause expansion and pressure on the power head and spring. Such action causes the assembly valve to open, allowing a flow of refrigerant liquid into the evaporator.

The remote bulb and power assembly is a closed system. The pressure within the remote bulb and power assembly corresponds to the saturation pressure of the refrigerant temperature leaving the evaporator and moves the valve pin in the opening direction. Opposed to this force, on the under side of the diaphragm and acting in the closing direction, is the force exerted by the superheat spring. As the temperature of the refrigerant gas at the evaporator outlet increases above the saturation temperature corresponding to the evaporator pressure, it becomes superheated. The pressure thus generated in the remote bulb and power assembly surpasses the combined pressures of the evaporator pressure and the superheat spring, causing the valve pin to move in the opening direction. Conversely, as the temperature of the **refrigerant** gas leaving the evaporator decreases, the pressure in the remote bulb and power assembly also decreases and the combined evaporator and spring pressures cause the valve pin to move in the closing position.

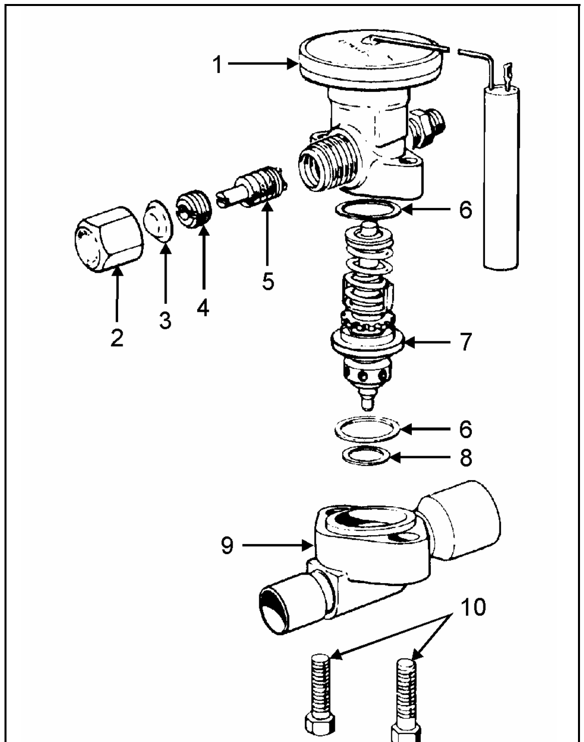


FIGURE 35: EXPANSION VALVE 22045

As the operating superheat is raised, the evaporator capacity decreases, since more of the evaporator surface is required to produce the superheat necessary to open the valve. It is obvious, then, that it is most important to adjust the operating superheat correctly and that a minimum change in superheat to move the valve pin to full open position, is of vital importance because it provides savings in both initial evaporator cost of operation. Accurate and sensitive control of the refrigerant liquid flowing to the evaporator is necessary to provide maximum evaporator capacity under load conditions. The spring is adjusted to give 12 to 16° F (-11.1 to -8.8 ° C) of superheat at the evaporator outlet.

This ensures that the refrigerant leaving the evaporator is in a completely gaseous state when drawn into the suction side of the compressor. Liquid would damage the compressor valve, piston and heads if allowed to return in the suction line.

A vapor is said to be superheated when its temperature is higher than the saturation temperature corresponding to its pressure. The amount of the superheat is, of course, the temperature increase above the saturation temperature at the existing pressure.

As the refrigerant moves along in the evaporator, the liquid boils off into a vapor and the amount of liquid decreases until all the liquid has evaporated due to the absorption of a quantity of heat from the surrounding atmosphere equal to the latent heat of vaporization of the refrigerant. The gas continues along in the evaporator and remains at the same pressure. However, its temperature increases due to the continued absorption of heat from the surrounding atmosphere. The degree to which the gas refrigerant is superheated is related to the amount of refrigerant being fed to the evaporator and the load to which the evaporator is exposed.

Superheat Adjustment

The starting method of adjusting the superheat is to unscrew completely the main evaporator expansion valve adjusting screw, then screw in 13 turns clockwise for 134A (Fig. 36). Afterwards, the following procedure should be followed:

1. Operate coach for at least one-half hour at fast idle with temperature control set at 82°F (27,7°C), Then set temperature to minimum to keep the compressor on 6 cylinders.

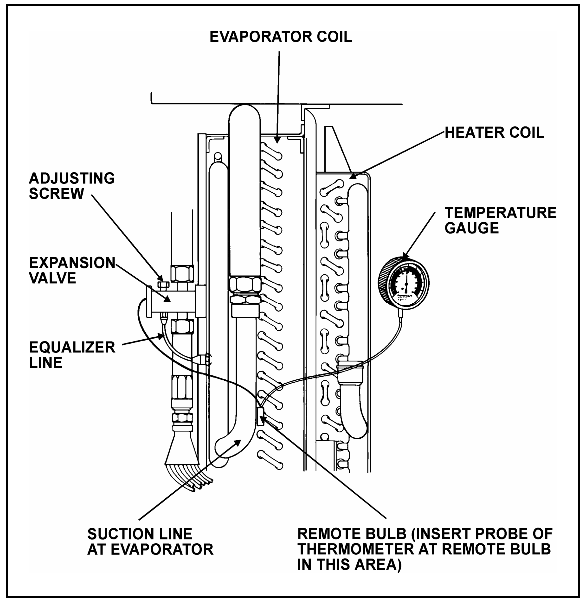


FIGURE 36: SUPERHEAT ADJUSTMENT INSTALLATION 22046

2. Install pressure gauge at the evaporator suction header. You may install the pressure gauge at compressor suction, but then add 3 psi to reading.
3. Install a remote reading thermometer to the evaporator outlet line near the existing remote bulb (Fig. 36).
4. Apply thermostatic tape around the bulb and evaporator outlet line to get a true reading of the line temperature.
5. Block condenser if necessary to keep pressure over 150 psi.

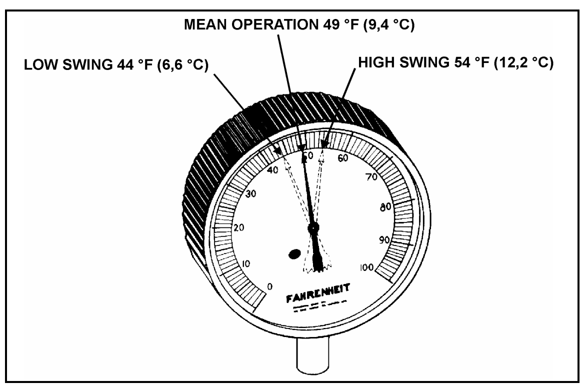


FIGURE 37: HIGH & LOW SWING TEMPERATURE AT REMOTE BULB 22047

6. Check approximately 5 readings of pressure at 2-minute intervals and convert to temperature using the temperatures & pressures table (page 36). Likewise check

the temperature reading at the remote bulb at the same 2-minute intervals and record the low and high swing readings of the needle (refer to Fig. 37).

Example of readings taken at fig. 37:

A/C pressure gauge converted to temperature at expansion valve fitting	Temperature on remote bulb	
40°F (4,4°C)	Low-swing 44°F (6,6°C)	High swing 54°F (12,2°C)
Formula for superheat 49°F-40°F=9°F (9,4°C-4,4°C = 5°C)	Average of low and high swing is 49°F (9,4°C)	

NOTE

The low swing of the superheat should be a minimum of 4°F (2,2°C) higher at the remote bulb and have an average of 8 to 12°F (4 to 6°C) higher range at the bulb than the fitting at the expansion valve.

NOTE

To reduce the superheat, flow of refrigerant is increased by turning adjusting screw of expansion valve lower evaporator temperature counterclockwise. To increase temperature or increase superheat, flow of refrigerant is reduced by turning adjustment screw of expansion valve clockwise.

6. Regulate suction pressure to temperature reading according to temperature chart or to the R-134a temperature scale on the pressure gauge.

Example: Suction pressure 30 psi (207 kPa) converted to 32°F (0°C) on chart. If temperature reading is 40°F (4,4°C), subtract 32°F (0°C) and the result will be 8°F (4,4°C) of superheat.

⚠ CAUTION ⚠

Before proceeding to the expansion valve adjustment, check for restriction on suction side for plugged filter dryer and partially open valves. These conditions will give a high superheat.

Maintenance

1. Pump down the system as previously indicated in this section.
2. Disconnect the external equalizer line from the under side of the power head, and unclamp the remote control bulb from the evaporator coil outlet line.
3. Remove the two cap screws holding the power assembly to the valve body flange. Lift off the power assembly and remove the cage assembly.
4. When reassembling, replace with the new gaskets in proper location. Make sure the two lugs on the cage assembly fit into grooves provided in the power assembly. Do not force the valves together. The cage must fit properly before tightening the body flange. Tighten bolts evenly.
5. Check for leaks.

Safety Instructions

1. Make sure the valve is installed with the flow arrow on the valve body corresponding to the flow direction through the piping system.
2. Before opening any system, make sure the pressure in the system is brought to and remains at the atmospheric pressure. Failure to comply may result in system damage and/or personal injury.

7.9 TORCH BRAZING

Use an electrode containing 35% silver.

⚠ CAUTION ⚠

When using heat near a valve, wrap with a water saturated rag to prevent overheating of vital parts.

⚠ WARNING ⚠

Before welding any part of refrigeration system, make sure the area is well ventilated.

7.10 TROUBLESHOOTING

7.10.1 Expansion Valve

PROBABLE CAUSE	PROBABLE REMEDY
LOW SUCTION PRESSURE-HIGH SUPERHEAT	
EXPANSION VALVE LIMITING FLOW:	
Gas in liquid line due to pressure drop in the line or insufficient refrigerant charge.	Locate cause of line flash and correct by use of any of the following methods. Add R-134a. Replace or clean filter dryer.
Inlet pressure too low from excessive low condensing temperature. Resulting pressure difference across valve too small.	Increase head pressure. Verify pressure switch for fan speed control.
Superheat adjustment too high.	Adjust superheat as outlined under "Superheat Adjustment".
Power assembly failure or partial loss of charge.	Replace power assembly or replace valve.
Air filter screen clogged.	Clean or replace air filter screen.
Plugged lines.	Clean, repair or replace lines.
LOW SUCTION PRESSURE-LOW SUPERHEAT	
Uneven or inadequate evaporator loading due to poor air distribution or liquid flow.	Balance evaporator load distribution by providing correct air or liquid distribution.
HIGH SUCTION PRESSURE-HIGH SUPERHEAT	
Compressor discharge valve leaking.	Replace or repair valve.
HIGH SUCTION PRESSURE-LOW SUPERHEAT (DEFECTIVE UNLOADER)	
Valve superheat setting too low.	Adjust superheat as outlined under "Superheat Adjustment".
Compressor discharge valves leaking.	Replace or repair discharge valve.
Incorrect superheat adjustment.	Superheat adjustment 12 to 16°F.
FLUCTUATING DISCHARGE PRESSURE	
Insufficient charge.	Add R-134a to system.

PROBABLE CAUSE	PROBABLE REMEDY
HIGH DISCHARGE PRESSURE	
Air or non-condensable gases in condenser.	Purge and recharge system.
Overcharge or refrigerant.	Bleed to proper charge.
Condenser dirty.	Clean condenser.

7.10.2 A/C

TROUBLE	CAUSE
Low suction pressure and frosting at dryer outlet.	Clogged filter.
Low Oil Level.	Check for oil leaks and for leaking oil seal. Do not attempt to check oil level unless system has been stabilized at least 20 minutes. See oil level verification.
Excessively cold suction line.	Loss of contact between the expansion valve bulb and the suction line or sticking of the expansion valve. Check for foreign matter and clean, repair or replace the valve.
Excessively cold suction line and noisy compressor.	Check superheat adjustment. Check remote bulb contact. Check expansion valve for sticking.
Compressor squeaks or squeals when running.	Check oil level. Replace oil seal.
Noisy or knocking compressor.	Check for broken internal parts. Overhaul if required.
Compressor vibrates.	Check and tighten compressor mounting bolts and belt tension.
Low refrigerant level	Check for refrigerant leaks and add refrigerant if required.
Suction pressure rises faster than 5 pounds per minute after shutdown.	Check compressor valve for breakage or damage.
Insufficient cooling.	Check for refrigerant leaks. Check condition of air filter and motors.
Insufficient air flow.	Dirty or iced evaporator. Dirty air filter. Blowers inactive. Clogged ducts.
No flow of refrigerant through expansion valve.	Filter dryer is clogged. Remote bulb has lost charge or expansion valve is defective.
Expansion valve hisses. Bubbles in moisture and liquid indicator.	Gas in liquid line. Add refrigerant.
Loss of capacity	Clogged filter. Obstructed or defective expansion valve.
Superheat too high.	Reset superheat adjustment. Check for clogged external equalizer line, or filter dryer.
Reduced air flow: a. Dirty or clogged air filter; b. Evaporator motor inoperative; or c. Plugged return air ducts.	Dirty or iced evaporator coil. Clean air filter screen. Check return ducts for obstructions. Check blower motor.

<table>
<tr><th>TROUBLE</th><th>CAUSE</th></tr>
<tr><td>Frequent starting and stopping on low pressure control switch.</td><td>Lack of refrigerant. Check for leaks. Recharge.</td></tr>
<tr><td>Compressor intermittently starts and stops.</td><td>Intermittent contact in electrical control circuit. Compressor valves not in operating position.</td></tr>
<tr><td>Non-condensable in the refrigeration system.</td><td>Leak on system, system in vacuum in low temp. Specific symptom, pressure in system will not correspond to ambient temperature on shutdown. Only non-condensable will cause this.

(Example: Pressure of idle R-134a system in 80°F (26.6°C) room should be 86.4 psi (595.7 kPa). See temperature chart in this section.)

An evaporator just does a proper cooling job without sufficient air. Shortage of air can be caused by the following:

* Dirty filters; or
* Dirty coils.</td></tr>
<tr><td colspan="2">Testing condenser pressure.

NOTE: R-134A pressure is function of the temperature variation.

Example, for an exterior temperature of 100°F.
Exterior temperature (100°F) + 30°F = 130°F. Refer to paragraph "10.11 Temperature & Pressure".
Note the corresponding pressure for a temperature of 130°F, 199.8 psi.
Read the condenser pressure, example 171.9 psi.
171.9 psi & 199.8 psi, the pressure in the condenser is inferior to the pressure corresponding to the exterior temperature, in this case the condenser pressure may be too low. Check for refrigerant leaks and add refrigerant if necessary. If the pressure corresponding to the condenser temperature is superior to the pressure corresponding to the exterior temperature, then the air cooled condenser pressure may be too high. Most frequent causes are:

Reduced air quantity. This may be due to:
* Non-condensable in system;
* Dirt on the coil;
* Restricted air inlet or outlet;
* Dirty fan blades;
* Incorrect rotation of fan;
* Fan speed too low;
* Fan motor going out on overload; or
* Prevailing winds.
* Too much refrigerant in system. Remove refrigerant if necessary.</td></tr>
</table>

7.11 TEMPERATURES & PRESSURES

VAPOR-PRESSURE			
TEMPERATURE		PRESSURE	
°F	°C	psi	kPa
-100	-73.3	27.8	191.7
-90	-67.8	26.9	185.5
-80	-62.2	25.6	176.5
-70	-56.7	23.8	164.1
-60	-51.1	21.5	148.2
-50	-45.6	18.5	127.6
-40	-40.0	14.7	101.4
-30	-34.4	9.8	67.6
-20	-29	3.8	26.2
-10	-23	1.8	12.4
0	-18	6.3	43.4
10	-12	11.6	80
20	-7	18.0	124.1
30	-1	25.6	176.5
40	4	34.5	237.9
50	10	44.9	309.6
60	16	56.9	392.3
70	21.1	70.7	487.5
80	27	86.4	595.7
90	32.2	104.2	718.5
100	38	124.3	857.0
110	43.3	146.8	1012.2
120	49	171.9	1185.3
130	54.4	199.8	1377.6
140	60	230.5	1589.3
150	65.6	264.4	1823.0
160	71	301.5	2078.8
170	76.7	342.0	2358.1

VAPOR-PRESSURE			
TEMPERATURE		PRESSURE	
°F	°C	psi	kPa
180	82.2	385.9	2660.8
190	87.8	433.6	2989.7
200	93.3	485.0	3344.1
210	98.9	540.3	3725.4

7.12 LEAK TESTING

Some methods such as nitrogen pressure, soap and electronic sniffer can be used for leak testing. However, the most common method used is a "Halide" torch consisting of an acetylene tank, a burner and a suction test hose. Proceed as follows:

WARNING

Do not inhale fumes from leak detector.

The flow of acetylene to the burner causes suction in the test line. Any gas refrigerant present will be drawn through the hose and into the burner where it decomposes into free acids.

These acids come in contact with the hot copper reaction plate in the burner, causing color reaction in the flame. A small concentration is indicated by a green tint and a large concentration by an intense blue. Do not confuse this change in color with the change caused by shutting off the air supply through the hose by holding the end too close to an object.

The procedure for testing is:

1. Adjust flame so that the top of the cone is approximately level or within one-half inch above the plate.
2. Probe end of suction test tube around all joints, valves, etc. When a leak has been found at a soldered joint, this section of the system must be pumped down. Do not solder as pressure will force hot solder out. If the system is empty, it is more economical to put in just enough R-134a to produce about 15 psi (103 kPa). The pressure can be raised to about 150 psi (1034 kPa) with dry nitrogen.

NOTE

This gas is put into the suction and discharge shutoff valves at the compressor. The receiver valves must be opened. If no leaks are found, dump this mixture, evacuate the system and fill with refrigerant.

8. AUXILIARY AIR CONDITIONING SYSTEM AND COMPONENTS

8.1 COMPRESSOR

MODEL	TM-16HD
TYPE	Swash-plate type
Number of cylinders	6
Bore	36 mm (1.42”)
Stroke	26.7 mm (1.05”)
Displacement	163 cm³ (10cu.in)
Permissible speed	700-6000 rpm
Refrigerant	HFC-134a
Lubricant	ZXL100PG 180 cm³
Mass	4.9 kg (10.9 lbs)

8.2 MAGNETIC CLUTCH

TYPE	Electromagnetic single-plate dry clutch
Rated Voltage	24 volts DC
Current consumption	3.75 amperes (max)
Stalling torque	49 Nm (36.1 Lbf-ft) min.
Rotation	CW/CCW
Mass	2.2 kg (4.9 lbs)

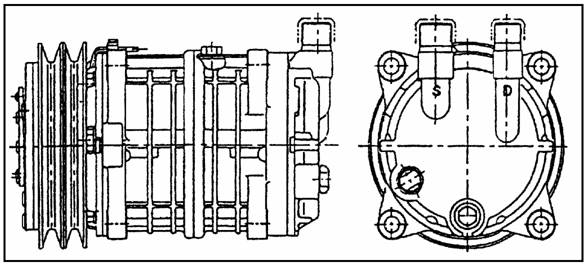


FIGURE 38: SELTEC TM-16HD COMPRESSOR 22250

8.3 MAINTENANCE PRECAUTIONS

8.3.1 Work Area

Because the components of air conditioning systems are especially sensitive to moisture, dirt and dust, always observe the following procedures:

* Work indoors whenever possible.
* Select a level work area.
* Keep work area clean.
* Select a work area with adequate ventilation.

⚠ WARNING ⚠

Refrigerant itself is not harmful, but excessive accumulation in a closed area can cause oxygen deficiency.

* Keep open flame and flammables away from the vehicle in which the air conditioning system is being serviced. **Open flame is especially dangerous during Freon leak testing.**

⚠ WARNING ⚠

Contact with flame and high temperatures can generate toxic gases.

8.3.2 Refrigerant Handling

Never directly heat refrigerant cylinder or put in hot water heated above 40°C (104°F) since it may cause release of the safety plug or the cylinder may burst. When it is necessary to heat refrigerant cylinder for charging in cold weather, use warm water at a temperature below 40°C (104°F).

⚠ WARNING ⚠

Do not put the charge valve in the warm water.

* Never store refrigerant cylinder in direct sunlight, near flame, or where the temperature exceeds 40°C (104°F). Always store refrigerant cylinder in a cool dry place.
* Never throw or strike refrigerant cylinder and never handle roughly.

8.3.3 PAG Oil Handling

Whenever a part replacement has to be done on the system, additional task about PAG oil will have to be performed.

The compressor has little reserve and is lubricated by the oil refrigerant mixture. To perform correctly, the compressor needs the mixture to be from 3% to 6% of Poly Alkaline Glycol (PAG) oil.

When a compressor has to be top off due to a severe lost, the amount of oil to be added should be evaluated with the refrigerant charge or a compressor oil change should be performed to rise up the compressor oil charge to 180 ml or the written charge on the nameplate.

* The oil should be free from moisture, dust, metal shavings, etc.
* Do not mix with other oils.
* The moisture content of the oil increases when exposed to the air for prolonged period. Therefore, after use, seal the container immediately.

DO NOT MIX PAG AND POE OR MINERAL OILS!

8.3.4 Refrigerant Recovery

Some air conditioning system refrigerant compounds are chlorofluorocarbons, and therefore may be damaging the earth's ozone layer. Consequently, the release of refrigerant into the atmosphere must be avoided. Whenever refrigerant is to be released from the air conditioning system, a refrigerant recovery unit must be used to recover the refrigerant. This refrigerant can then be recycled and reused, which is both environmentally safe and economical.

For complete system recovery, any of the High and Low service ports can be used (Refer to fig. 16). Energize liquid solenoid valve and measure the quantity of oil recovered. For the compressor only, use the service valve port and close the valves. The service valves open permits full flow of refrigerant to service port. Service valve closed permits flow of refrigerant from compressor to service port.

8.3.5 Compressor Handling

Do not strike, drop or turn the compressor upside down. If the compressor is knocked over or turned upside down, rotate the compressor's magnetic clutch 5 to 6 times by hand to circulate the oil which has settled in the cylinder. Sudden rotation with oil in the cylinder can cause valve damage and adversely affect durability.

8.4 COMPRESSOR REMOVAL

8.4.1 When the compressor is operational

* Perform the "OIL RETURN OPERATION" (Refer to paragraph 8.9).

8.4.2 When the compressor is inoperable

* Perform the "Refrigerant Recovery" operation (Refer to paragraph 8.3.4).
* Slacken bolts A (Refer to figure 39).
* Remove bolts B & C (Refer to figure 39).
* Remove the compressor.

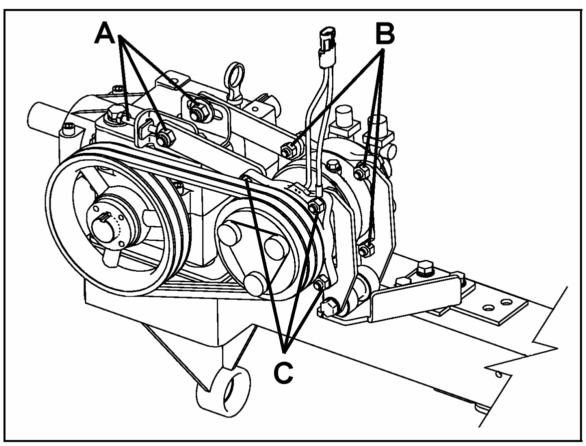


FIGURE 39: COMPRESSOR REMOVAL OR INSTALLATION 22285

8.5 INSTALLATION PRECAUTIONS

The new compressor is filled with the specified quantity of compressor oil and nitrogen gas (N²). When mounting the compressor on the vehicle, take the following steps:

* Loosen the discharge side connector's cap and gently release N² from compressor (Refer to figure 40).

NOTE
Take care not to let the oil escape.

* Slowly rotate the compressor's magnetic clutch several times by hand to distribute the oil which has settled in the cylinders (Refer to figure 41).

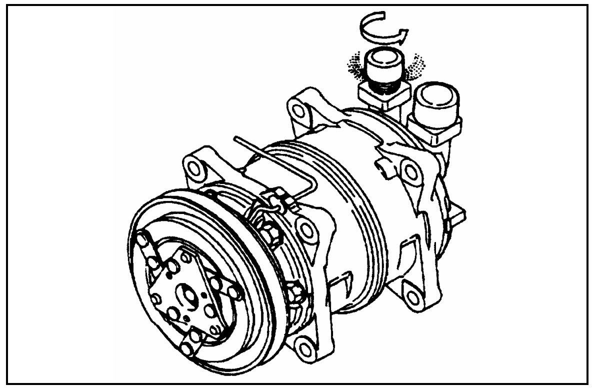


FIGURE 40: LOOSENING THE DISCHARGE SIDE CONNECTOR'S CAP 22252

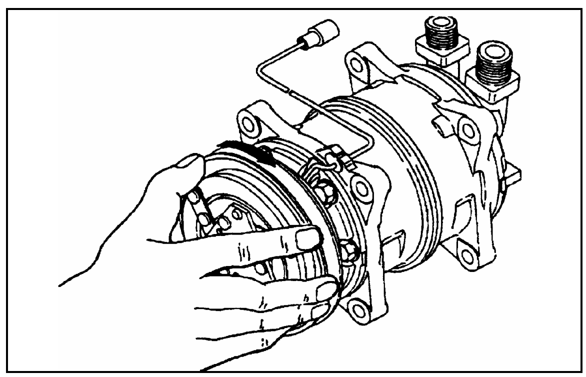


FIGURE 41: ROTATING MAGNETIC CLUTCH 22253

* When using the old compressor in the system, the compressor should be installed after changing the oil.

8.6 COMPRESSOR OIL CHANGE

Each compressor is delivered filled with the specified quantity of compressor oil, depending on the type of air conditioning system. A label describing the amount/type of compressor oil is attached to the compressor.

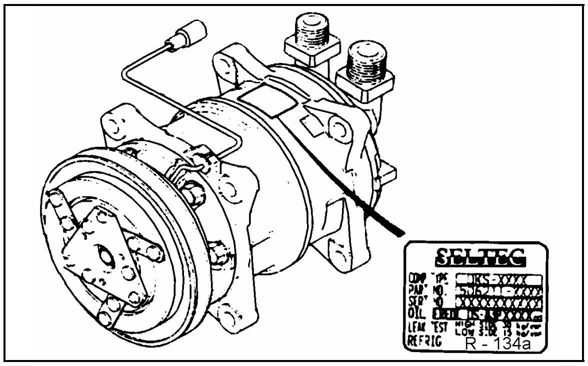


FIGURE 42: COMPRESSOR OIL LABEL 22255

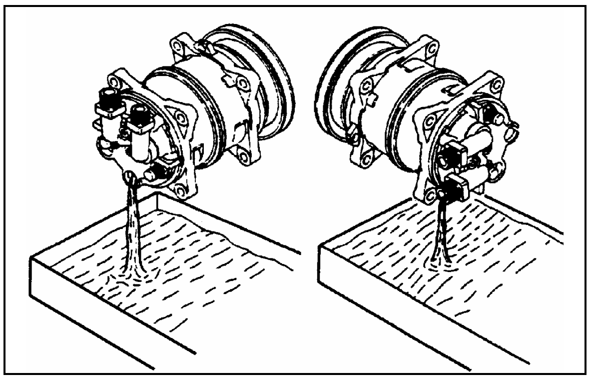


FIGURE 43: DRAINING THE OIL 22256

* Check oil for contamination. Refer to PARAGRAPH 8.8: "COMPRESSOR OIL CONTAMINATION".
* Tighten the oil drain plug with a new o-ring lightly coated with clean compressor oil to specified torque.

Torque: 13-15 Nm (9.4-10.8 Lbf-ft)

* Add new compressor oil through the suction-side connector with the amount specified on the label (180 ml).

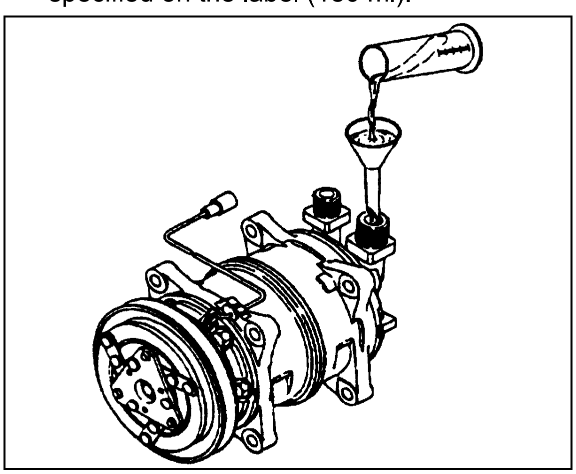


FIGURE 44: ADDING NEW COMPRESSOR OIL 22257

8.6.1 Evacuating System Before Adding Refrigerant (Auxiliary System)

When a system has been opened for repairs, change the filter dryer and evacuate the system. X3 coaches equipped with an auxiliary system must use high-pressure service port located on the other side of check valve and low-pressure port located alongside rear truss (Fig. 16). It would be good practice to open solenoid valve.

1. Connect two hoses equipped with a micron gauge between the high-pressure service port, the low-pressure service port and the vacuum pump.
2. With the unit service valves open and the vacuum pump valves open, start the pump and draw the manifold and hoses into a very deep vacuum (700 microns).
3. Close manifold valve
4. Shut down the vacuum pump.
5. Check to insure that vacuum holds. (If the pressure continues to rise, it indicates a leak or moisture in the system).
6. Charge the system with the proper amount of refrigerant through the service port near the check valve using recommended charging procedures.
7. Remove the hoses.

8.7 OIL ADDITION

The chart below shows the approximate amount of oil to be added to the system when replacing a component.

Component replaced	Typical amount of oil
Evaporator	50 cm³ (1.7 ozs)
Condenser	30 cm³ (1.0 ozs)
Filter-Dryer	10 cm³ (0.3 ozs)

The amount of oil recovered with the refrigerant recovery should be added at the same time.

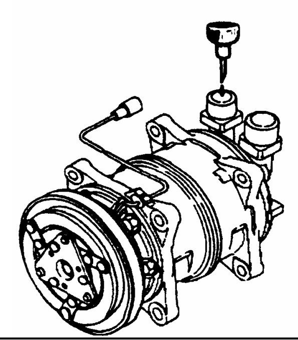


FIGURE 45: ADDING OIL AFTER REPLACING A COMPONENT 22258

8.8 COMPRESSOR OIL CONTAMINATION

Unlike engine oil, no cleaning agent is added to the compressor oil. Even if the compressor is run for a long time, the oil never becomes turbid as long as there is nothing wrong with the compressor or its method of use. Inspect the extracted oil for any of the following conditions:

* Dirt in the oil.
* Change to a varnish color.
* Presence of foreign substance, metal shavings, etc. in the oil. When the oil extracted from the compressor is as described above, replace the oil as follows:
  1. Clean the interior of the system with approved method.
  2. Replace the filter-dryer.
  3. Supply with new oil as specified in paragraph 8.6: “COMPRESSOR OIL CHANGE”.

8.9 OIL RETURN OPERATION

There is a close affinity between oil and refrigerant. During normal operation, part of the oil recirculates with the refrigerant in the system. Therefore, when checking the amount of oil in the system or replacing any system component, the compressor must be run in advance to ensure return. This procedure is as follows:

* If the amount of refrigerant in the system has decreased, charge to the proper amount.
* Start the engine and select fast idle.
* Set the fan speed to full air/full A/C and let run for 20 minutes.

8.10 OIL CHECK INTERVAL

Unlike engine oil, it is not necessary to frequently check or change the compressor oil. However, it is necessary to check and replenish or replace the compressor oil in the following cases:

* Whenever the compressor, evaporator, condenser or filter-dryer is replaced.
* Whenever refrigerant has leaked from the system, evaluate the amount of oily spot.
* Whenever refrigerant is suddenly released from the cooling cycle, replenish the compressor (180 ml) plus 150 ml.
* Whenever any oil-related problems occur in the cooling cycle.

8.11 LEAK TEST PROCEDURE WITH COMPRESSOR REMOVED

When a compressor is repaired, it must be checked prior to installation.

* Install the discharge and suction caps to the connector.

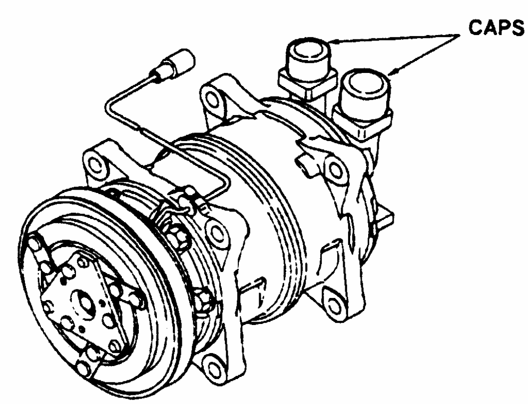


FIGURE 46: DISCHARGE AND SUCTION CAPS 22259

* Fill the compressor with refrigerant through connector’s suction port raising the pressure to at least 0.5 Mpa (70 psi).
* Check the compressor for leaks using a leak detector.

NOTE
Never leave the compressor upside down for longer than 30 seconds. This is because the oil inside the compressor will enter the cylinders, causing liquid compression which will damage the compressor’s suction and delivery valves.

8.12 TIGHTENING TORQUES

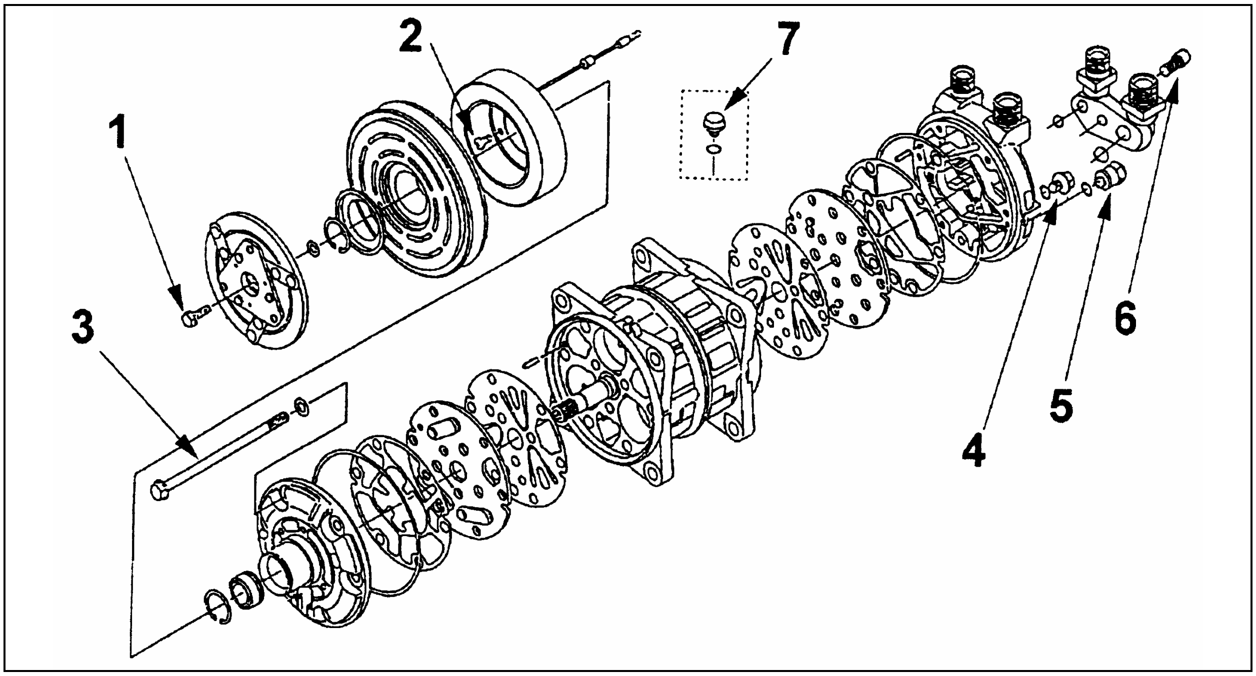


FIGURE 47: TIGHTENING TORQUES 22260

PART	THREAD SIZE	TIGHTENING TORQUE
1. Bolt Armature	M6 x 1.0	12 - 14 Nm (8.7 - 10.1 Lbf-Ft)
2. Field Coil Screw	M5 x 0.8	4 - 6 Nm (2.9 - 4.3 Lbf-Ft)
3. Body Bolt	M8 x 1.25	20 – 24 Nm (14.5 – 17.3 Lbf-Ft)
4. Oil Drain Plug	M8 x 1.25	13 – 15 Nm (9.4 – 10.8 Lbf-Ft)
5. Pressure Relief Valve	3/8 – 24UNF	13 – 15 Nm (9.4 – 10.8 Lbf-Ft)
6. Connector Bolt	M8 x 1.25	20 – 24 Nm (14.5 – 17.3 Lbf-Ft)
7. Oil Filler Plug	M8 x 1.25	13 – 15 Nm (9.4 – 10.8 Lbf-Ft)

9. HEATING SYSTEM

The schematic of figure 48 shows the central heating system with its components.

In addition to the normal heating provided by the engine, a preheating system (104,000 Btu/hr) (optional) may have been installed in the vehicle.

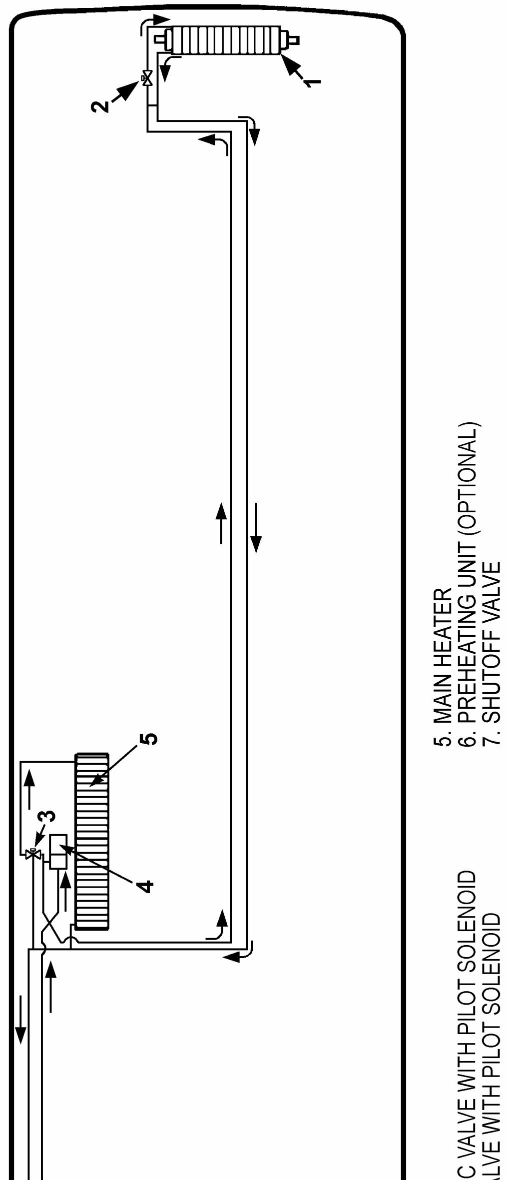


FIGURE 48: CENTRAL HEATING SYSTEM COMPONENTS 22325

9.1 DRAINING HEATING SYSTEM

To drain the entire system, refer to Section 05, *"Cooling"*. If only the driver's or main heater core must be drained, refer to the following instructions.

9.1.1 Draining Driver's Heater Core

1. Stop engine and allow engine coolant to cool.
2. Locate the normally open water pneumatic valve on the ceiling of the spare wheel compartment (Fig. 49), move the pilot-solenoid valve red tab to close the valve.

> **⚠ WARNING ⚠**
>
> **Before proceeding with the following steps, check that coolant has cooled down.**

3. Loosen hose clamp, install an appropriate container to recover coolant, and disconnect silicone hose from water solenoid valve.
4. From inside of vehicle, remove the two finishing panels in front of unit. Remove the three screws fixing the unit front panel. Open the manual vent located inside the HVAC unit, on the driver's side (Fig. 50) to ensure an efficient draining.

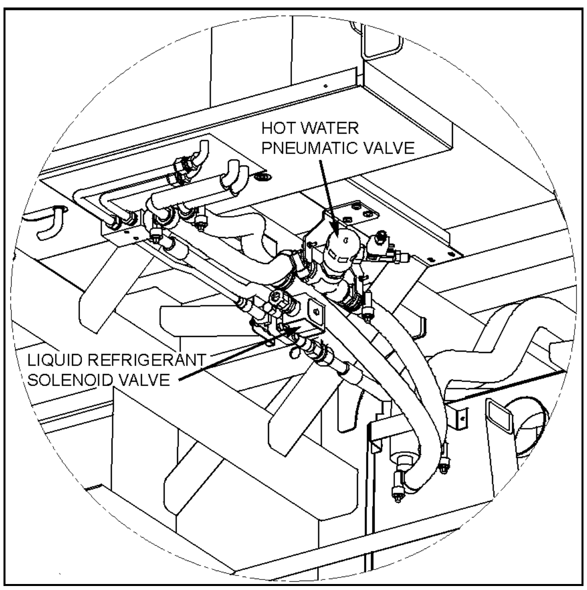


FIGURE 49: CEILING OF THE SPARE WHEEL COMPARTMENT 22324

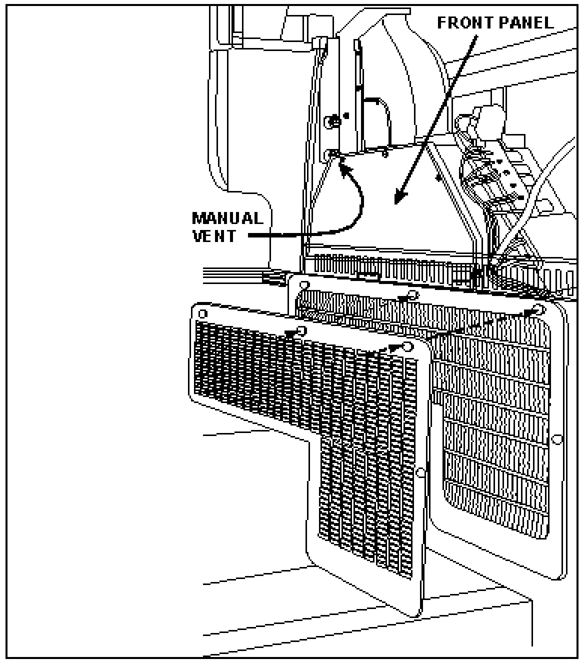


FIGURE 50: DRIVER'S HVAC UNIT 22328

9.1.2 Draining Main Heater Core

1. Stop engine and allow engine coolant to cool.
2. Close both heater line shutoff valves.

On X3 Coaches, the valves are located in engine compartment. One is on the L.H. side of compartment in front of the radiator and the other valve is located under the radiator fan gearbox (Fig. 51).

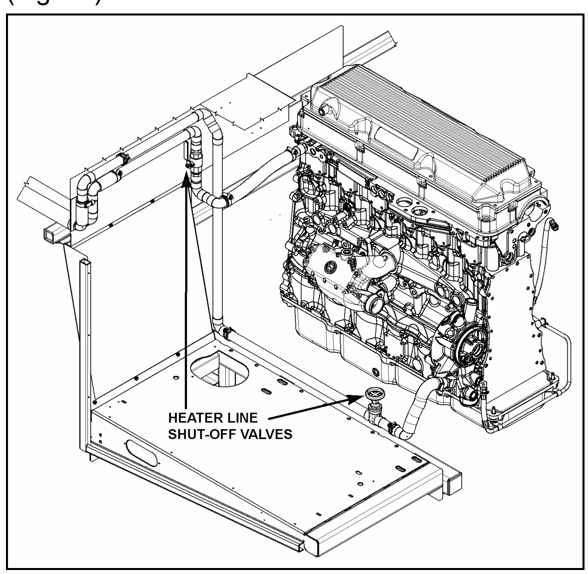


FIGURE 51: HEATER LINE SHUT-OFF VALVES 22326

3. The main heater core drain cock is located in the evaporator compartment. To access the valve on X3 coaches, open baggage compartment door located in front of the evaporator compartment (L.H. side). Open access panel by turning the three screws of panel ¼ of a turn.

⚠ WARNING ⚠

Before proceeding with the following step, check that coolant has cooled down.

4. Open drain cock in bottom of heater core, you can unfasten a hose connection on top of heater core (Fig.52) in order to allow air to enter while draining.

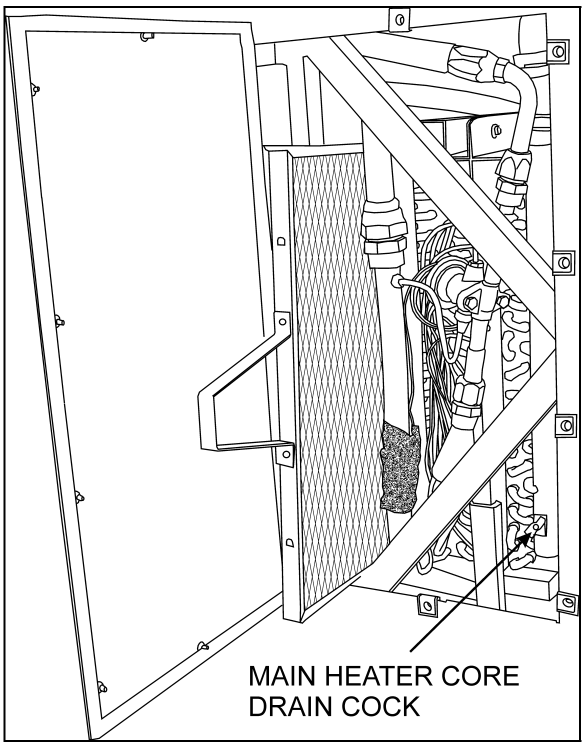


FIGURE 52: EVAPORATOR COMPARTMENT 22327

9.2 FILLING HEATING SYSTEM

1. Ensure that the drain hose is reconnected and the manual vent and drain cock are closed.
2. Open the surge tank filler cap and slowly fill the system to level of filler neck.
3. After initial filling, the water shut-off valves should be open and the water recirculating pump should be energized to assist in circulating coolant through the heating system. To perform this operation, start the engine, switch on the HVAC control unit, both driver and passenger sections, and set temperature to their maximum positions in order to request the heating mode in each of these sections.
4. When coolant level drops below the surge tank filler neck, slowly fill the system to level of filler neck.
5. Once the level has been stabilized, replace cap.

9.3 BLEEDING HEATING SYSTEM

Whenever the heating system has been drained and refilled, or the system has run low on coolant and coolant has been added, it is necessary to bleed air from heating system. Locate the manual vent illustrated in Figure 50, and open momentarily until no air escapes from the line.

9.4 SOLDERING

Before soldering any part of the system, make sure the area is well ventilated. Use (stay clean) flux sparingly and apply solder (95-5 round wire 1/8 inch [3,1 mm]). After completing repairs, test for leaks.

When using heat at or near a valve, wrap with a water saturated rag to prevent overheating of vital parts.

9.5 DRIVER'S HOT WATER PNEUMATIC VALVE ASSEMBLY

9.5.1 Description

The flow of hot water to the driver's heater core is controlled by a pneumatic NO water valve assembly. The valve, located at the ceiling of the spare wheel compartment, is designed so that the pilot solenoid valve, which is part of the assembly, opens and closes a port which directs air pressure to the actuator casing, thereby opening or closing the valve.

When the vehicle is operating with no current to the pilot solenoid valve, no air pressure is admitted to the actuator casing, the cylinder spring pushes up against the cylinder, thereby keeping the water valve open.

The driver's heater water valve requires a minimum amount of maintenance. The valve should be free of dirt sediment that might interfere with its operation. No other maintenance is needed unless a malfunction occurs.

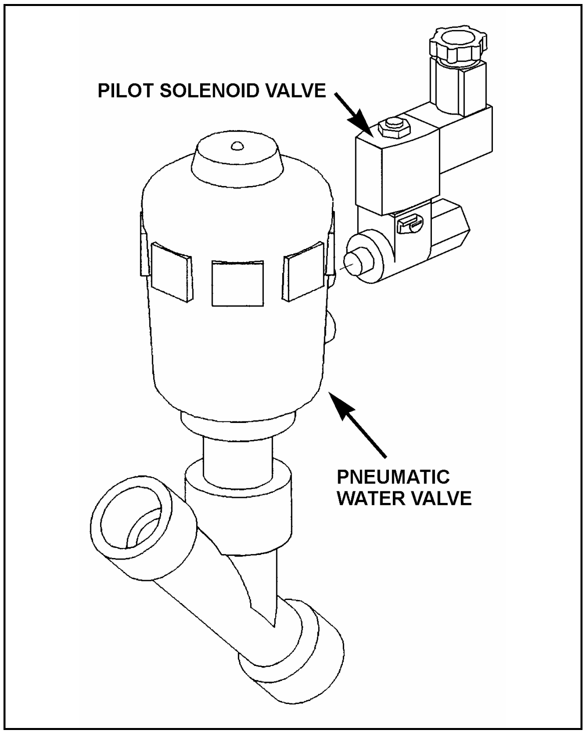


FIGURE 53: DRIVER'S HOT WATER PNEUMATIC VALVE ASSEMBLY 22240

9.5.2 Pneumatic Water Valve Disassembly

1. Shut off air supply pressure and electrical current to the pilot solenoid valve. Disconnect wires.
2. The water valve need not be removed from the line. Unscrew nipple, the actuator casing, tube, spindle and closure member can be removed (Fig. 54).
3. Remove the snap ring using a pair of pliers.
4. You can now access all seals for replacement

   Pneumatic water valve replacement seal kits:

   * Water Side: 871311
   * Actuator Side: 871312

9.5.3 Pneumatic Water Valve Reassembly

1. Assemble the actuator casing, tube, nipple, spindle and closure member.
2. Tighten the nipple in place in the body cavity as per figure 54. Fasten pilot solenoid vale to the pneumatic water valve. Reconnect air supply pressure and electrical current to the pilot solenoid valve.
3. Check for proper operation.

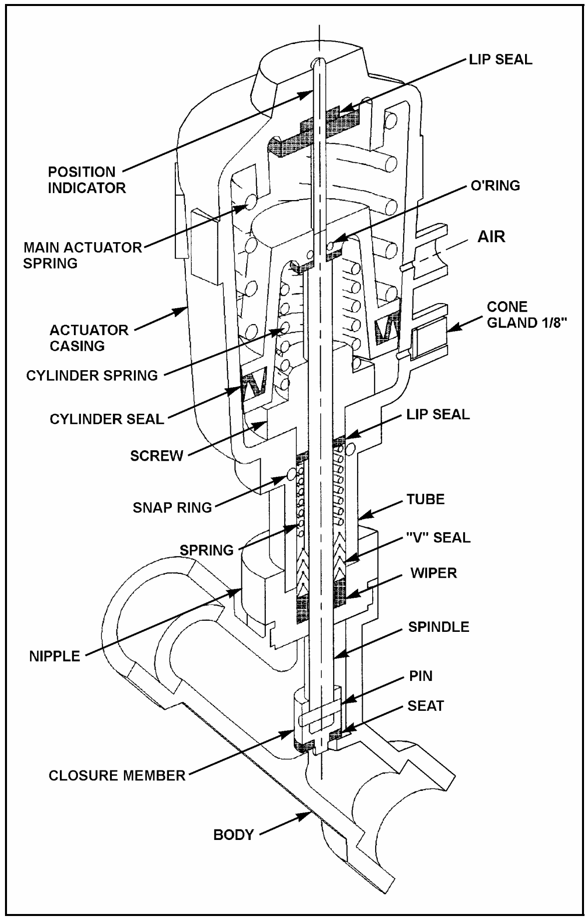


FIGURE 54: PNEUMATIC WATER VALVE 22241

9.5.4 Pilot Solenoid Valve

1. No maintenance is needed unless a malfunction occurs.
2. A pilot solenoid valve replacement seal kit is available: 871313.

9.5.5 Valve Troubleshooting

PROBLEM	PROCEDURE
Valve fails to close.	1. Check electrical supply with a voltmeter. It should agree with nameplate rating. 2. Check pressure at pilot solenoid valve inlet. It must be at least equal to the minimum pressure stamped on the nameplate. It should not go below minimum while valve is operating.
	1. Check that the closure member assembly, and that main actuator and cylinder springs are free to travel. 2. Check that there is no restriction to the air escaping from the actuator casing. 3. Make sure that pilot solenoid valve operates properly.

9.6 CENTRAL HOT WATER PNEUMATIC VALVE ASSEMBLY

9.6.1 Description

The flow of hot water to the vehicle's central heater core is controlled by a 3-way pneumatic water valve assembly. The valve, located in the evaporator compartment, is designed so that the pilot solenoid valve, which is part of the assembly, opens and closes a port which directs air pressure to the actuator casing, thereby allowing the hot water to enter the main heater core or bypassing it.

When the vehicle is operating with no current to the pilot solenoid valve, no air pressure is admitted to the actuator casing, the cylinder spring pushes up against the cylinder, thereby allowing the hot water to enter the main heater core.

The central heater water valve requires a minimum amount of maintenance. The valve should be free of dirt sediment that might interfere with its operation. No other maintenance is needed unless a malfunction occurs.

9.6.2 Pneumatic Water Valve Disassembly

1. Shut off air supply pressure and electrical current to the pilot solenoid valve. Disconnect wires.
2. The water valve need not be removed from the line. Unscrew nipple, the actuator casing, tube, spindle and closure member can be removed (Fig. 56).
3. Remove the snap ring using a pair of pliers.

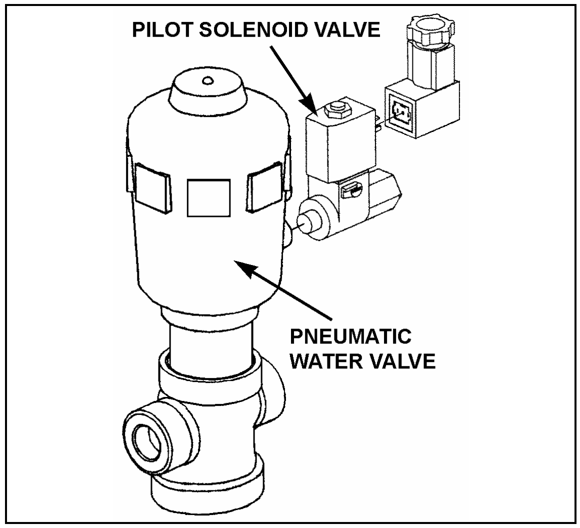


FIGURE 55: CENTRAL HOT WATER PNEUMATIC VALVE ASSEMBLY 22329

4. You can now access all seals for replacement

   Pneumatic water valve replacement seal kits:

   * Water Side: 871389
   * Actuator Side: 871388

9.6.3 Pneumatic Water Valve Reassembly

1. Assemble the actuator casing, tube, nipple, spindle and closure member.
2. Tighten the nipple in place in the body cavity as per figure 56. Fasten pilot solenoid vale to the pneumatic water valve. Reconnect air supply pressure and electrical current to the pilot solenoid valve.

3. Check for proper operation.

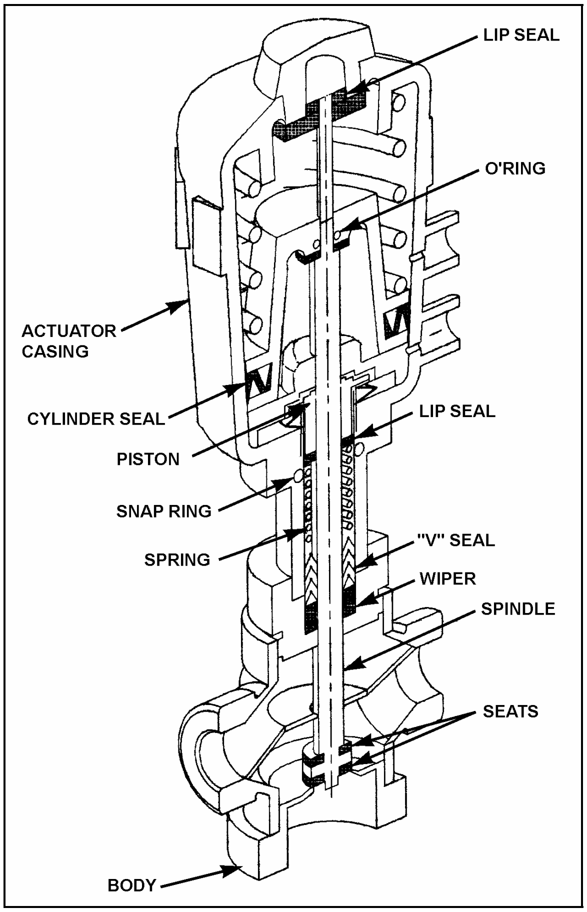


FIGURE 56: PNEUMATIC WATER VALVE 22330

9.6.4 Pilot Solenoid Valve

1. No maintenance is needed unless a malfunction occurs.
2. A pilot solenoid valve replacement seal kit is available: 871390.

9.6.5 Valve Troubleshooting

PROBLEM	PROCEDURE
Valve fails to close.	1. Check electrical supply with a voltmeter. It should agree with nameplate rating. 2. Check pressure at pilot solenoid valve inlet. It must be at least equal to the minimum pressure stamped on the nameplate. It should not go below minimum while valve is operating.
Valve fails to open.	1. Check that the closure member assembly, and that main actuator and cylinder springs are free to travel. 2. Check that there is no restriction to the air escaping from the actuator casing. 3. Make sure that pilot solenoid valve operates properly.

9.7 WATER RECIRCULATING PUMP

This vehicle is provided with a water recirculating pump which is located in the evaporator compartment (Fig. 57). The water recirculating pump consists of a centrifugal pump and an electric motor which are mounted in a compact assembly.

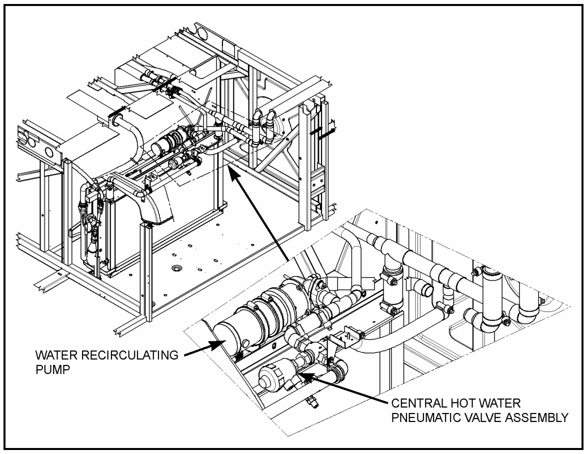


FIGURE 57: PUMP LOCATION (CENTRAL A/C) 22331

The (seal less) pump requires no periodic maintenance other than replacement of motor brushes. Replacement of motor brushes can be performed without removing the pump assembly. Inspection of the pump, to determine if the pump is working properly, should be made while the pump is in operation. If there is evidence that the pump is not operating as per specifications, the unit must be disassembled for corrective measures.

Disassembly of the pump will be necessary only in the case of a rotor failure or motor failure.

9.7.1 Removal

1. Stop engine and allow engine coolant time to cool.
2. Close shutoff valves. Refer to *"05 COOLING"* under heading *"Draining Cooling System"* for location of valves.
3. Disconnect the electrical wiring from the motor.

⚠ WARNING ⚠
Before proceeding with the following steps, check that coolant has cooled down.

4. Disconnect water lines from pump at flange connections. Place a container to recover the residual coolant in the line.
5. Remove the two clamps holding the pump motor to its mounting bracket. Remove the pump with the motor as an assembly.

9.7.2 Disassembly

1. Separate the housing (1) from the adapter (7) by first removing the 4 capscrews. Remove housing carefully to prevent damaging the O-ring (2).
2. Remove rotor assembly (4), washers (3) and shaft (5) from the adapter.

Inspection

Components removed from the recirculating pump and motor assembly should be compared with new parts to determine the degree of wear.

9.7.3 Brushes

1. When removing brushes, note the position of the brush in the tube. Brush life is shortened if the brushes are not replaced properly.
2. Examine brushes for the following:

   a. Wear
   Replace the brushes if less than 25% of the usable brush is left (less than 0.300 inch [8 mm]).

   b. Chipped edges
   Chips can be caused by improper handling or installation. Badly chipped brushes should be replaced regardless of their length.

   c. Annealed brush spring
   This can be detected by noting the resiliency of the spring. Annealing is caused by failing to tighten the brush caps properly, thus not providing a good low resistance contact between the terminal and the brush tube. Replace brushes showing evidence of annealed springs.

   d. Frayed or broken pigtail
   An improperly installed brush may have the pigtail (shunt) pinched under the terminal or between the coils of the spring. If the pigtail is badly frayed or broken, replace the brush.

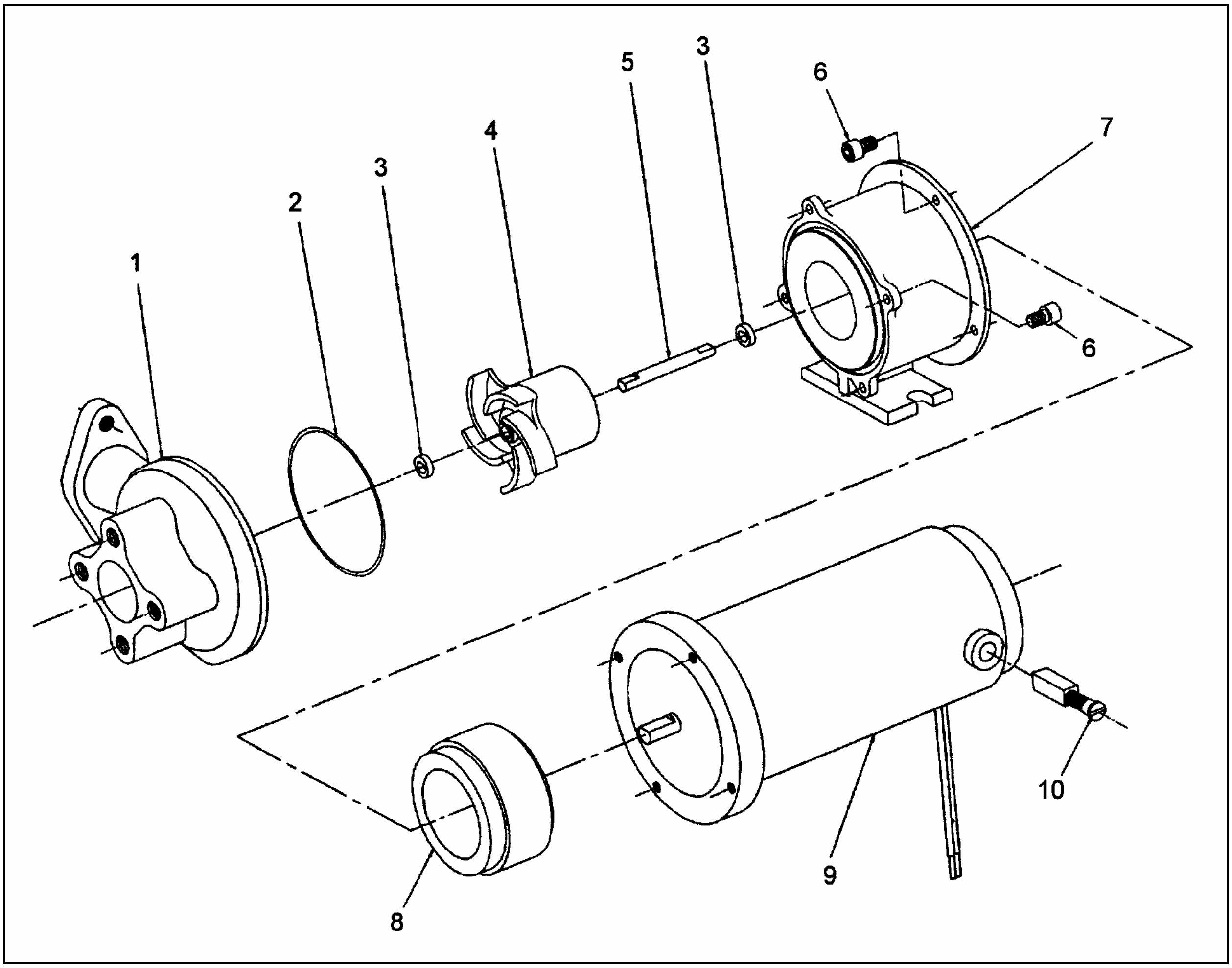


FIGURE 58: WATER RECIRCULATING PUMP (CENTRAL A/C) 22282

ITEM	DESCRIPTION	QTY.
1	Housing	1
2	O-Ring	1
3	Washer SS	2
4	Rotor Assembly	1
5	Shaft SS	1
6	Screw, Cap Hex Soc. Head 8-32 X 3/8	8
7	Adaptor	1
8	Drive Magnet	1
9	Motor Assembly 24V	1
10	Brush	2

3. Observe the following factors when replacing brushes:
   a. The face of a new brush is carefully cut to cause proper seating during the *"wear-in"* period.
   b. Improper installation can harm both the brush and the commutator.
   c. Replacement brushes should be of the proper grade.
   d. Brush performance will be affected if the spring and terminal are not properly placed in the brush tube. The spring should be free over its entire length and the terminal should make good contact with the metal brush tube insert.

9.7.4 Assembly

1. Install washer (3), shaft (5) and rotor assembly (4) into adapter (7).
2. Install O-ring (2) into housing (1) and assemble housing to the adapter.
3. Secure housing to adapter using 4 capscrews (6).

9.7.5 Installation

1. Apply gasket cement to the line flanges, put the two gaskets in place, and connect water lines to the pump at the flange connections. Position the pump and motor assembly on the mounting bracket. Position the mounting clamps over the motor and secure with mounting bolts.
2. Connect electrical wiring to the pump motor.
3. Open shutoff valve. Refer to *"05 COOLING"* under heading *"Draining Cooling System"* for location of valves.
4. Fill the cooling system as previously instructed in this section under *"9.2 Filling Heating System"*, then bleed the system as previously instructed in this section under *"9.3 Bleeding Heating System"*.

9.8 PREHEATING SYSTEM (OPTIONAL)

The preheater is located inside engine compartment and is accessible through engine compartment R.H. side door (refer to figure 59).

This Auxiliary Preheating System is used for preheating and retaining the heat of water-cooled engines. It can be used before starting the engine to ease its starting and to provide immediate inside heat upon operation of the heating system. It can also be used with engine running to maintain coolant heat and maintain the set temperature inside vehicle.

The heater operates independently from the vehicle engine. It is connected to the cooling and heating circuits, the fuel system and the electrical system of the vehicle.

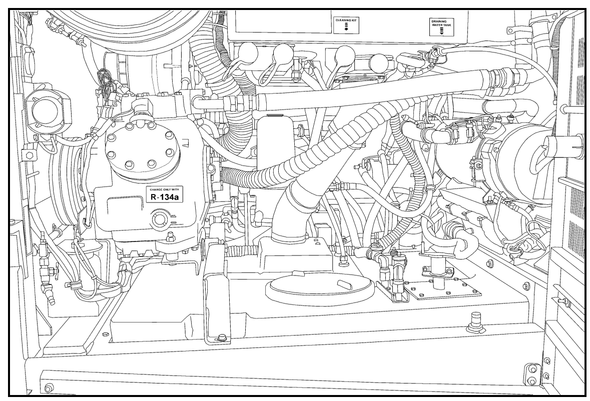


FIGURE 59: LOCATION OF PREHEATER 18607

The pilot lamp turns on when the heater is switched on. Combustion air flows in to flush out the combustion chamber and the water circulation pump is put into operation. The fuel metering pump conveys fuel in precise doses to the combustion chamber where fuel and combustion air form a combustible mixture which is ignited by the glow plug.

Once the flame sensor has signaled to the control unit that combustion has taken place correctly, the glow spark plug and ignition coil are switched off.

The hot combustion gases are diverted at the end of the flame pipe, then pass through the indirect heating surfaces of the heat exchanger and transmit their heat to the water passing through the heat exchanger.

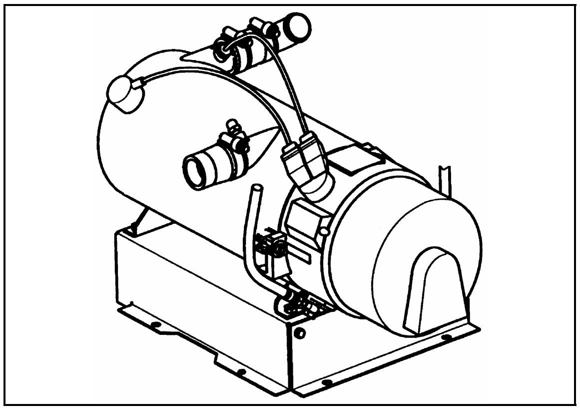


FIGURE 60: WEBASTO PREHEATER (104,000 BTU) 22224

The heat is thermostatically controlled and operates intermittently, i.e. the switched-on times of the burner vary depending on the heat requirement. The water temperature depends on the setting of the built-in water thermostat.

The water circulation pump remains in operation as long as the heater is operating, even in the regulation intervals and during the delayed cutout of the switched-off heater. The pump can also be operated independently from the heater by means of an appropriate circuit. The heater can be switched on at any time, even during the delayed cutout period. Ignition takes place once this delay time is over.

When the heater is switched off, the fuel supply is interrupted. The flame goes out, and at the same time a delayed cutout of some 2.5 minutes begins. The combustion air still flowing flushes the remaining combustion gases out of the chamber and cools off the hot parts on the exhaust side of the heat exchanger, while the water circulation pump, still running, transmits the heat present in the heat exchanger, thus preventing local overheats. Once the delayed cutout time is over, both the combustion air blower and the water circulation pump switch off automatically. A cutout will take place in case of any failure of the preheater.

9.8.1 Operation

Switch on the heater. The operation indicator lamp comes on and the heater motor and circulating pump begin to run. After about 10-25 seconds the solenoid valve opens and fuel is sprayed into the combustion chamber. At the same time, the electronic ignition unit produces high voltage (8000 V) and the mixture of fuel and air in the combustion chamber is ignited by the spark on the ignition electrodes. The flame is indicated by the flame detector, then the electronic ignition unit stops producing high voltage and combustion continues by itself (spark on electrodes is required only to ignite the flame). At this moment, the heater is working and producing heat.

If the heater is switched off by the on/off switch, the solenoid valve interrupts fuel supply, combustion stops and indicator lamp turns off. Combustion air fan still blows air, cleaning the combustion chamber of any fumes and cooling down the combustion chamber. Coolant circulation pumps coolant, making a purge cycle for approximately 2-3 minutes, thus protecting the heater against overheating.

If the heater is not switched off by the on/off switch, the control thermostat will switch off the heater when coolant temperature reaches 165° ± 6°F (75° ± 3°C) and turns it on at 154° ± 9°F (68° ± 5°C). During this time, the heater (combustion) is off and the indication lamp and coolant pump are on. Combustion air fan blows air for 2-3 minutes and then turns off.

9.8.2 Preheating System Timer

The timer, located on L.H. lateral console is used to program the starting and stopping time of the preheating system. The system indicator light, located on the timer, illuminates when the system is functional.

⚠ CAUTION ⚠
The preheating system should not operate for more than one hour before starting engine as this could discharge batteries.

⚠ WARNING ⚠
Preheating system must not operate when vehicle is parked inside or during fuel fill stops.

NOTE
Preheating system uses the same fuel as the engine.

In case of failure:

1. Shut off and turn on again.
2. Check main circuit breaker and overheat fuse.
3. Have system repaired in a specialized shop.

9.8.3 Timer Operating Instructions (Webasto)

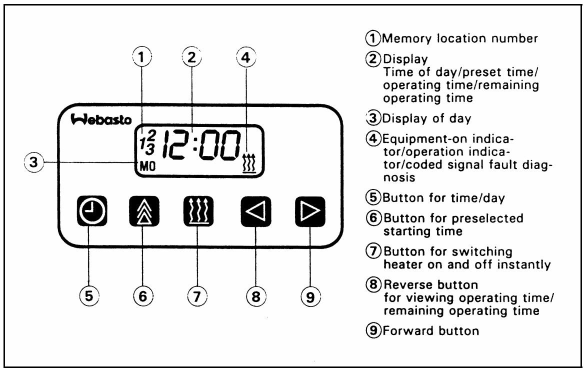


FIGURE 61: WEBASTO 22191

These instructions refer to the timer illustrated in figure 61. They are the same instructions provided in the Webasto instruction booklet, provided with your vehicle.

Remaining Operating Time

The remaining operating time refers to the period of time the heater still continues to remain in operation. It may be changed while the heater is in operation.

Setting the Digital Timer

After the power has been connected, all symbols on the digital display are flashing. The time of the day and the day of the week must be set.

All flashing symbols of the timer can be set by means of the Forward (9) or Reverse (8) buttons.

When buttons (8) and (9) are pressed for more than 2 seconds, the quick digit advance mode is activated.

Setting the Time and Day of the Week

1. Press button (5) for more than 2 seconds (time display flashes).
2. Press (8) or (9) button to set the time of day.
3. Wait 5 seconds. The time of day is stored (time of week flashes).
4. Press (8) or (9) button to set the correct day of week.
5. Wait 5 seconds. The day of week is stored.

Viewing the Time (Ignition ON)

Continuous display of current time and day of the week.

Viewing the Time (Ignition OFF)

Briefly press button (5) to display current time and day for 5 seconds.

SWITCHING HEATER ON (INSTANT HEATING)

With Ignition ON:

Press button (7). Heater is switched on (continuous operation) and continues to operate until button (7) is pressed again or ignition is switched off.

NOTE
If the ignition is switched off while heater is in operation, the remaining operating time of 5 minutes flashes on the display and the heater will continue to operate for this period of time.

With Ignition OFF:

Press button (7). Heater is switched on for preset operating time (the factory-set heater operating duration is 60 minutes)

SWITCHING HEATER OFF

Press button (7). The heater starts its after-run cycle and switches off thereafter.

Presetting Operating Duration

1. Press button (6). Memory location number flashes.

NOTE
By repeatedly pressing button (6), starting time 2 or 3 can be preset.

2. Press button (8) or (9) until correct startup time is set.
3. Wait 5 seconds. Preset starting time is stored and day of week flashes.
4. Press button (8) or (9) to select the correct startup day of week.
5. Wait 5 seconds. The startup day of week is stored.

The number of memory location remains on the display. The timer is now in the programmed mode and will switch the heater in at the preset time.

NOTE
We recommend that memory locations 1 and 2 be used for presetting times within 24 hours of setting the timer. Memory location 3 can be used for a starting time within the next 7 days of setting the timer.

Recalling Preset Times

Press (6) repeatedly until the desired memory location number and preset time are displayed.

Canceling Preset Time

Press button (6) repeatedly until no more memory location number is visible on the display.

Setting Operating Time

1. With heater off, press button (8). Operating time flashes.
2. Press button (8) or (9) to set the operating time (between 1 and 120 minutes).

The heater remains in operation for the preset time (except for continuous operation).

Setting the Remaining Operating Time

1. With heater in operation, press button (8). Remaining operating time flashes.
2. Set remaining time with button (8) or (9).
3. Wait 5 seconds. Remaining operating time is stored.

Operational Failure Symptoms via Fault/Flash code

On heaters equipped with a fault diagnosis system using coded light signals, the equipment-on indicator/operation indicator flashes. Refer to the following table.

Failure Symptom	Probable Cause	Check and Correct
1X Flash (F 01) No combustion after completion of start up sequence.	- Fuel system - Combustion air - Electronic ignition	- Fuel level - Type of fuel being used - Fuel filter - Fuel line connections (air bubbles in fuel lines) - Fuel nozzle plugged - Air intake or exhaust, restricted or plugged - Incorrect electrode gap
2X Flashes (F 02) Flame out during burner operation no restart possible	- Fuel supply (shortage of fuel)	- Restriction in the fuel system - Fuel filter - Fuel line connections (air bubbles in fuel lines) - Type of fuel being used
3X Flashes (F 03) Low voltage for more than 20 seconds	- Electrical system	- Load test batteries - Corrosion at connections - Loose connections
4X Flashes (F 04) Flame detector recognizes false flame signal during pre-start or shut-down cycle	- Defective flame detector	- Replace flame detector
5X Flashes (F 05) Flame detector	- Wiring - Defective flame detector	- Damaged wiring, open or short circuit - Replace flame detector

6X Flashes (F 06) Temperature sensor	- Wiring - Defective temperature sensor	- Damaged wiring, open or short circuit - Replace temperature sensor
7X Flashes (F 07) Fuel solenoid valve	- Wiring - Defective solenoid valve	- Damaged or corroded wiring, open or short circuit - Replace solenoid valve
8X Flashes (F 08) Combustion air fan motor	- Wiring - Wrong RPM - Defective combustion air fan motor	- Damaged wiring, open or short circuit - Replace combustion air fan - Replace combustion air fan
9X Flashes (F 09) Circulation pump motor	- Wiring - Defective circulation pump motor	- Damaged wiring, open or short circuit - Replace circulation pump motor
10X Flashes (F 10) Temperature limiter	- Overheat condition - Coolant flow - Wiring - Defective temperature limiter	- Reset temperature limiter - Coolant level or flow restriction - Air trapped in coolant circuit - Damaged or corroded wiring, open or short circuit - Replace temperature limiter
11X Flashes (F 11) Electronic ignition coil	- Wiring - Defective electronic ignition coil	- Damaged wiring, open or short circuit - Replace electronic ignition coil
12X Flashes (F 12) Heater lock out	- 3 repeated faults/flame-outs or 5 repeated start attempts	- Reinitialize control unit by switching heater on and disconnecting power.

9.8.4 Troubleshooting and Maintenance

Refer to the Webasto manual for more information.

NOTE

If there are no heater faults, the heater will go through a normal start cycle and regulate based on thermostat setting.

NOTE

Switch on the preheating system briefly about once a month, even during the warm season.

⚠ CAUTION ⚠

When welding on the vehicle, disconnect the preheater module connector in order to protect this system from voltage surges.

⚠ CAUTION ⚠

To avoid running down the batteries, do not turn on the preheating system for more than one hour before starting the engine.

⚠ WARNING ⚠

The preheating system uses the same fuel as the engine. Do not operate in a building or while refueling. Operate only in a well-ventilated area.

10. SPECIFICATIONS

Main evaporator motor

Make	US MOTOR
Type	T-17
Voltage	27.5 V DC
Current draw	68 amps
Horsepower	2
Revolution	1st :1400 rpm, 2nd : 1880 rpm nominal
Insulation	Class F
Motor Life	20 000 hours
Brush life	10 000 hours
Motor supplier number	D5092VPRC8
Motor Prevost number	563008
Brush Prevost number	562951

Condenser fan motors

Make	EBMPAPST
Type	AXIAL BRUSHLESS
Voltage	24 V DC
Qty	4
Prevost number	563461

Evaporator air filter (Central system)

Make	Permatron Corp.
Type	Polypropylene
Prevost number	874272

Driver's unit evaporator motors

Make	MCC
Voltage	24 V DC
Quantity	1
Supplier number	25-0250
Prevost number	871135

Driver's unit evaporator air filters

Make..MCC

TYPE..Recirculating air 6-¼" x 28" Washable

Supplier number..260593

Prevost number..871147

Make..MCC

TYPE..Fresh air 3-5/8" X 5-1/4" Washable

Supplier number..260594

Prevost number..871144

Refrigerant

Type..R-134a

Quantity (standard)..24 lbs (10.89 Kg)

Quantity (A/C Aux. system located in overhead compartments)..4 lbs (1.8 Kg)

Compressor (Central system)

Make..Carrier Transicold

Capacity, option R-134a..41 CFM

Capacity, option R-22..37 CFM

Model, option R-134..05G-134A

Model, option R-22..05G-22

No. of cylinders..6

Bore..2" (50,8 mm)

Operating speed..400 to 2200 rpm (1750 rpm. Nominal)

Minimum speed (for lubrification)..400 rpm

Nominal horsepower..15

Oil pressure at 1750 rpm..15 to 30 psi (103-207 kPa)

Oil capacity..1.13 U.S. gal (4,3 liters)

Weight..142 lbs (64,5 kg)

Approved oils

-Castrol..SW 68 (POE)

Supplier number, option R-134a..68PD541-104-38

Supplier number, option R-22..68PD537-104-39

Prevost number, option R-134a..950314

Prevost number, option R-22..950207

A/C Compressor (Auxiliary system)

Make……………………………………………………………………………………………..…….Seltec

Model………………………………………………………………………………….………..TM-16HD

Weight .... 10.9 lbs (4,9 kg)

Supplier number...18-00074-11

Prevost number... 950372

Approved oil .... ZXL100PG (PAG)

Prevost number... 950382

Compressor unloader valve

Make... Carrier Transicold

Type ....Electric (AMC)

Voltage .... 24 V DC)

Watts 15

Supplier number (without coil) 17-40407-20

Prevost number (without coil) 950095

Coil supplier number 22-50030 (1)

Coil Prevost numbert.. 950096

Magnetic clutch

Make... Carrier Transicold

Type ....Housing mounted 9” dia., 2-B grooves

Voltage .... 24 V DC

Coil resistance at 68 ^{o}F (20 ^{o}C)..5.15 – 5.69 ohms

Supplier number.. 50-01122-90

Prevost number... 950204

Compressor V belts

Make...Dayco

Model (matching set of 2) BX97

Prevost number (with Delco 270/300 Amp Alternator) 506664

Compressor V belt

Make...Dayco

Model.. BX100

Prevost number (with two BOSH Alternators) 506681

Condenser coil (Auxiliary system)

Make..Valeo
Supplier number..
Prevost number...

Condenser coil (Central system)

Make.. Carrier Transicold
Aluminum
Supplier number..68GF67-194-2
Prevost number.. 870654
Copper
Supplier number..68GF67-194-3
Prevost number.. 870729

Evaporator coil (Central system)

Make.. Carrier Transicold
Supplier number...68BE2-105
Prevost number.. 871070

Receiver tank (with sight glasses)

Make.. HENRY
Maximum pressure.. 450 psig
Supplier number...ARL-1217
Prevost number.. 950261

Moisture indicator

Make... Henry
Supplier number.. MI-30-7/8S
Prevost number.. 950029

Driver's refrigerant liquid solenoid valve

Make.. Parker
Type .... Normally closed with manual bypass
Voltage .... 24 V DC
Amperage draw.. 0.67 amps

Watts 16

Supplier number (without coil) RB9MP3-MM
Prevost number (without coil) 95-0054

Coil supplier number .... R23MM 24 V DC-CB

Coil Prevost number.. 950055

Repair kit Prevost number 950056

Hot water pneumatic valve (Central system)

Make.. Burkert

Type 3-WAY

Voltage .... 24 V DC

Prevost number.. 871381

Seal kit, Water Side.. 871389

Seal kit, Actuator Side.. 871388

Seal kit, Pilot Solenoid Valve 871390

Driver's hot water pneumatic valve

Make.. Burkert

Type .... Normally open

Voltage .... 24 V DC

Supplier number.. SYST-2000-456023-6012-427923B

Prevost number.. 871252

Seal kit, Water Side.. 871311

Seal kit, Actuator Side.. 871312

Seal kit, Pilot Solenoid Valve 871313

Water recirculating pump

Make.. M.P. pumps

Voltage .... 24 V DC

Supplier number.. 30011

Prevost number.. 871342

Water filter (small A/C system)

Make.. BRAUKMANN

Supplier number.. T300B

Prevost number.. 870807

Driver's expansion valve

Supplier number, option R-134a 26-0190
Supplier number, option R-22 26-0384
Prevost number, option R-134a 950221
Prevost number, option R-22 950282

Expansion valve (Central system)

Make .... Alco
Model .... TCLE 5-1/2
Supplier number 21059366
Prevost number 950320

Preheating system

Make .... WEBASTO
Model .... THERMO 300
Capacity .... 104 000 Btu/h (30 kW)
Heating medium .... Coolant
Rated voltage .... 24 V DC
Operating voltage .... 20-28 V DC
Electric power consumption (without coolant recirc. Pump) .... 110 watts
Fuel consumption .... 1,2 US gallons/hr (4,5 liters/hr)
Supplier number 9002092A
Prevost number 871202

CONTENTS

ILLUSTRATIONS

1. AUDIO AND VIDEO SYSTEM DESCRIPTION

The rack mounted components are gathered on the audio-video panel which is located in the first driver's side overhead compartment (Fig. 1). In addition to the power amplifier, options for AM/FM stereo radio and satellite radio, CD changer, karaoke, wireless microphone, DVD and videocassette player, scenic view and back-up camera system and GPS Navigation System module may be featured.

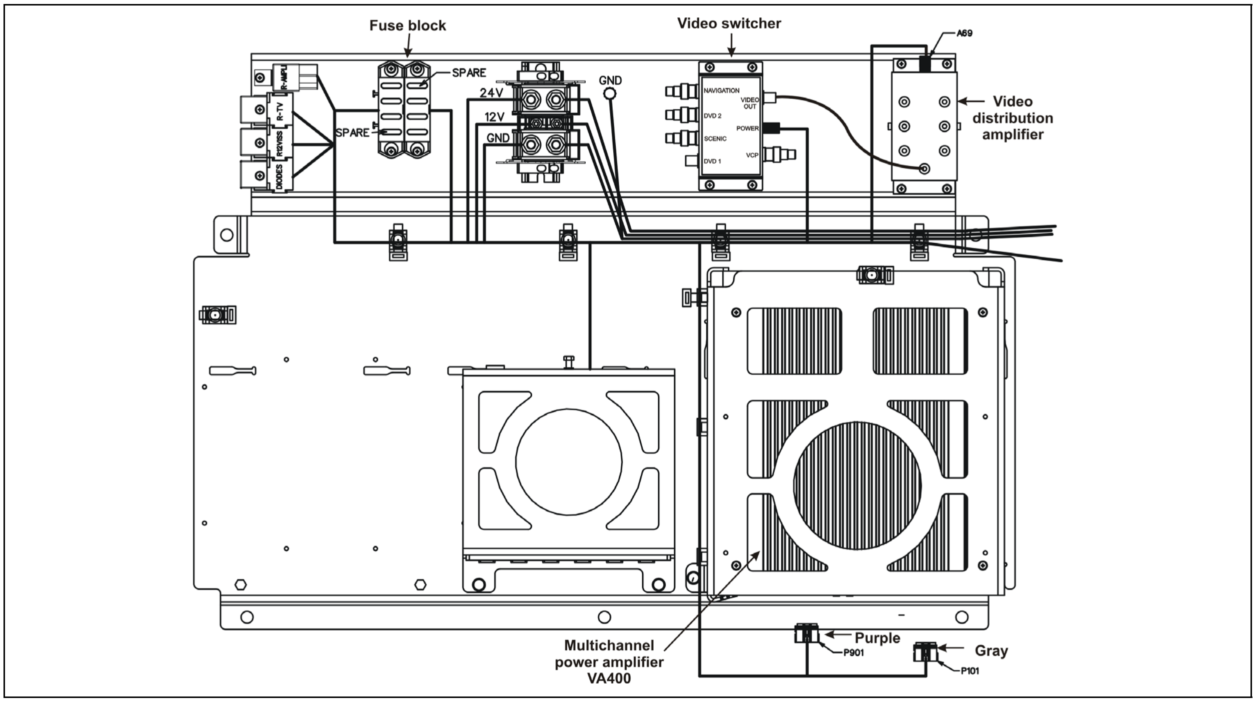


FIGURE 1 : AUDIO-VIDEO PANEL

Each service module mounted to the underside of the parcel racks contains a 40-watt speaker. The speakers in the passenger section are wired in stereo and are powered by the amplifier. A microphone outlet mounted in the driver's area is provided as standard equipment.

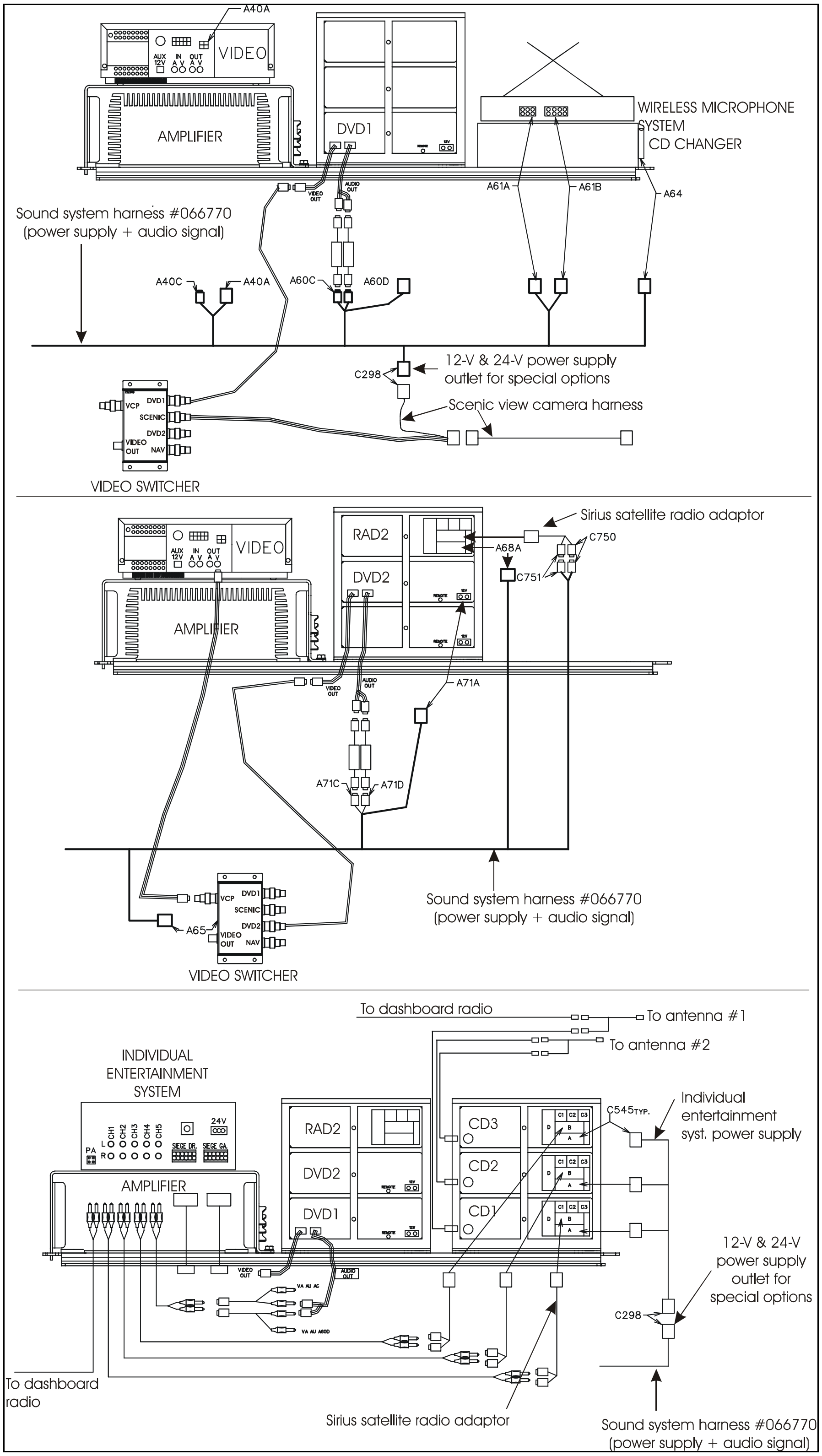


FIGURE 2: AUDIO & VIDEO CONNECTIONS

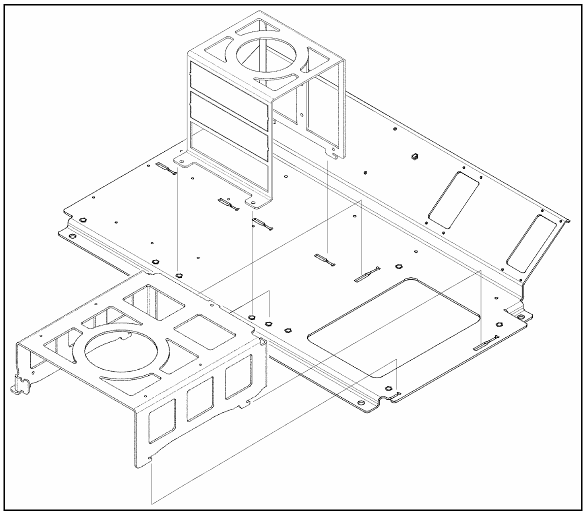


FIGURE 3: RACKS ON AUDIO-VIDEO PANEL 23059

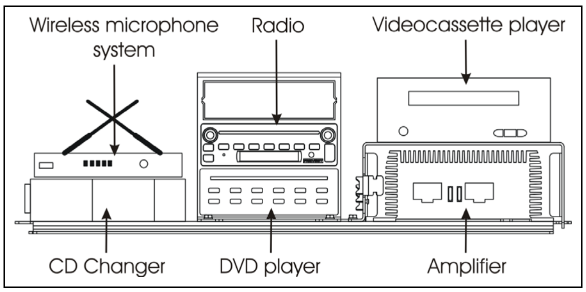


FIGURE 4: AUDIO-VIDEO PANEL

1.1 AM/FM RADIO

1.1.1 VR300 AM/FM Radio / CD Player

This AM/FM/WX (weather band) radio CD player model has external CD changer capability (Fig. 4).

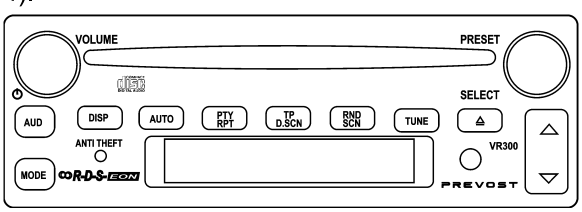


FIGURE 5: VR300 CD/AM/FM STEREO RECEIVER 23351

NOTE
Before attempting to solve an electrical problem on the sound system, refer to the wiring diagrams.

"VR300 Operating Instruction" manual is included at the end of this section. The radio is a serviceable component and should only be serviced by a qualified electronics technician.

Features:

- CD changer control
- Anti-theft
- Auto preset memory
- LED illumination
- Liquid crystal display
- Amber illumination
- Panel light dimming
- Quartz clock
- Mute function
- Search & repeat
- Track scan
- AUX input
- 4x20W power
- 4 low level outputs

1.1.2 Security Code

Your radio is protected by a security code. The security code can be found on a label delivered with the radio. The security code cannot be changed.

When the radio power is first turned on after power has been interrupted, "ID CHECK" and then "LOCK" is displayed for 3 seconds. Then "0000" is displayed.

To unlock the radio, enter the four-digit security code found on the removable label (refer to "VR300 Operating Instruction" manual).

If the code is entered correctly, the radio will switch to the last active mode (i.e. FM, CD, etc.) and is ready to use. If the code is entered incorrectly, you can try 2 more times. After 3 incorrect entries, the radio will display "LOCK."
You must turn the radio off, while leaving the ignition and battery on, for 1 continuous hour before attempting to unlock the radio again.

1.1.3 Removal

To remove the radio from its location, proceed as follows:

1. Place the ignition switch in the ''OFF'' position.
2. Remove the dashboard panel cover.
3. Disconnect the electrical cable connectors from radio and unfasten back plate securing nut.
4. To separate the radio from its support, insert the U shaped tool in the two pairs of holes found each side of the radio front panel.
5. Push the unit through the front dashboard panel.
6. Install a new unit by reversing the procedure.

NOTE
Remember that because power has been interrupted during removal, the radio must be unlocked by entering the four-digit security code after reinstallation.

1.1.4 DELPHI Premium Satellite Radio AM/FM/MP3 CD stereo (OPTIONAL)

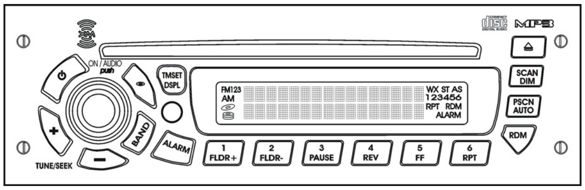


FIGURE 6: DELPHI PREMIUM SATELLITE RADIO 23355

This XM or SIRIUS satellite radio receiver can be located on the dashboard, replacing the standard radio or inside the first driver's side overhead compartment, where many radio can be installed.

Features:

- Satellite radio ready with weather band
- 7-channel weather band
- 18 FM & 6 AM presets
- Steering wheel control compatible
- Anti-theft
- Auto preset solutions
- MP3 playback capability
- LED illumination
- Liquid crystal display
- Quartz clock
- Single disc
- Random & repeat play modes
- SDARS receiver compatible
- AUX inputs
- 4x17W power

The complete operating instruction manual is included in your vehicle's *technical publications box*.

1.2 VSS-04 SOUND SELECTOR

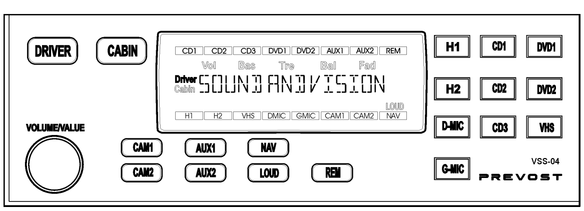


FIGURE 7: VSS-04 SOUND SELECTOR 23350

The VSS-04 Sound Selector enables the driver to select different audio or audio-video entertainment sources for the driver area and the passengers' area. The driver may be listening to the radio and watching the Navigation System route information on the monitor while the passengers may be watching a movie from the DVD player.

With this unit, you can adjust each audio source sound settings (e.g. volume, bass, treble, balance, fade).

Features:

7 audio sources

- Radios (2)
- Microphones (2)
- CD players (3)

5 audio-video sources

- DVD players (2)
- VCR (1)
- Auxiliary (2)

3 video sources

- cameras (2)
- GPS Navigation system (1)

1.2.1 Removal

To remove the Sound Selector from its location, proceed as follows:

1. Place the battery master switch in the ''OFF'' position.
2. Remove the dashboard panel cover.
3. Disconnect the electrical cable connectors from unit and unfasten back plate securing nut/screw.
4. To separate the Sound Selector from its support, insert a flat screwdriver each side of the unit front panel.
5. Push the unit through the front dashboard panel.
6. Install a new unit by reversing the procedure.

The operating instructions are included in your Operator's Manual.

1.3 VD-404 MOBILE DVD PLAYER

FIGURE 8: VD-404 MOBILE DVD PLAYER

The MOBILE DVD PLAYER is located in the first parcel compartment on the driver's side. Instructions for proper use of this unit are included at the end of this section.

Features:

- POWER
  Operating voltage: 12-volt DC

- COMPATIBILITY
  This DVD player can play the following disc formats:
  DVD, CD, VCD, DVCD, MP3, CD-R, CD-RW

- SYSTEM FUNCTIONS
  Video output system: system MULTI, NTSC or PAL switchable.

  1 L/R audio output
  1 L/R audio input
  1 AUX video output
  1 rear camera video input
  3 video outputs with one dedicated self switching rear view monitor

- ADDITIONAL VIDEO FEATURES

Multi-angle, multi-view, multi-audio function, multi-level forward and backward motion, play position memory, resume stop and repeat function.

1.4 MULTICHANNEL POWER AMPLIFIER VA400.8

This 400-watt, 6-channels brings an added dimension to your stereo equipment and increases the total output of the system.

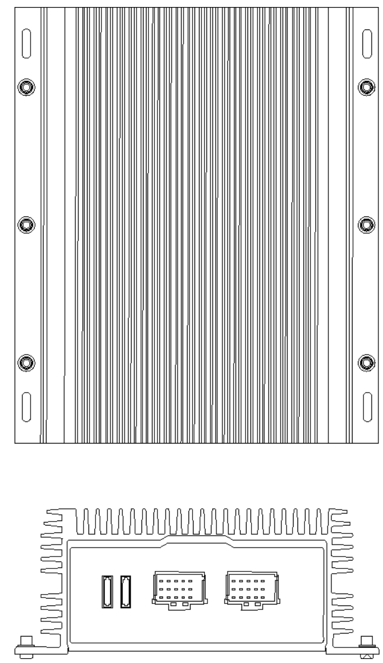


FIGURE 9: MULTICHANNEL POWER AMPLIFIER

For optimum sound quality, adjust the subwoofer crossover filter as shown on figure 10. This adjustment is necessary to balance the subwoofers volume in respect to the other speakers and also to cut high frequencies for a better sound quality.

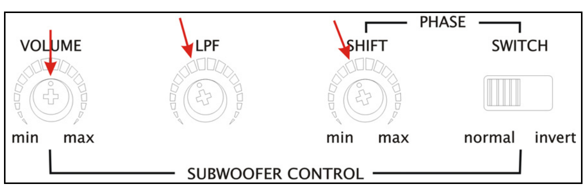


FIGURE 10: CROSSOVER ADJUSTMENT

1.5 SPEAKERS

Each passenger's overhead console mounted to the underside of the parcel racks contains a 20-watt Dual Cone 10cm speaker. The speakers in the passenger's section, wired in stereo and arranged in a delta configuration are powered by the amplifier.

FIGURE 11: 10cm DUAL CONE SPEAKER

The vehicle may be equipped with two additional Hi-Fi speakers in the driver's area, mounted one on each side. This arrangement provides the driver with clear stereo sound. Controls for the driver's audio allow selection between the radio and the auxiliary audio (independent of the passenger's speakers) or muting the speakers.

Two specially designed subwoofers may be fixed as an option under a passenger seat with anti-vibration supports.

1.6 VIDEO CASSETTE PLAYER (VCP)

The optional VCP is located on the audio-video panel in the first overhead compartment. Instructions for proper use of the VCP are provided in the technical publication box.

FIGURE 12: V3000 VIDEO CASSETTE PLAYER

1.6.1 Removal

1. Place the ignition switch in the ''OFF'' position.
2. Remove the VCP/VCR mounting locknuts from rubber mounts.
3. Disconnect wiring.
4. Remove VCP/VCR unit from parcel compartment.

1.6.2 Installation

1. Install VCP/VCR unit into parcel compartment aligning rubber mount studs with mounting holes. Insert mount studs through mounting holes.
2. Install locknuts on mount studs.
3. Reconnect wiring.
5. Place the battery master switch in the ''ON'' position.

1.7 BOOM-TYPE MICROPHONE

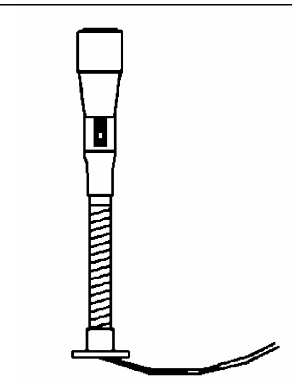


FIGURE 13: BOOM-TYPE MICROPHONE 23083

1.7.1 Removal

1. Place the ignition switch in the ''OFF'' position.
2. Remove the mounting screws at mounting flange.
3. Disconnect wiring.

1.7.2 Installation

1. Reconnect wiring.
2. Align mounting flange with holes and install screws.
3. Remove spacer block mounting screws.
4. Insert spacer block and install mounting screws.
5. Place the battery master switch in the ''ON'' position.

1.8 HANDHELD PRIORITY MICROPHONE

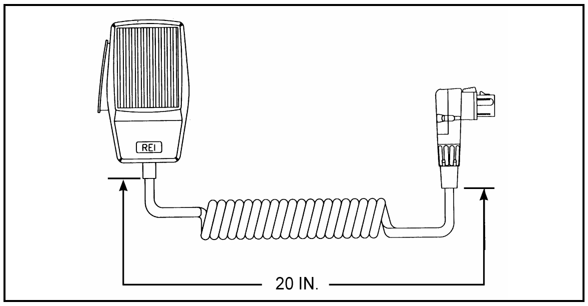


FIGURE 14: HANDHELD PRIORITY MICROPHONE 23216

1.9 WIRELESS MICROPHONE

The system 2000 16 channel wireless microphone, Receiver and Charging Cradle are custom designed units that allow for wireless PA communication from anywhere on the coach. The unit consists of a receiver mounted in the parcel area directly behind the driver, and a rechargeable hand-held microphone and charging unit. Instructions for proper use of the microphone are included in the *''REI Operating Manual''* which is provided in the technical publications box delivered with the vehicle.

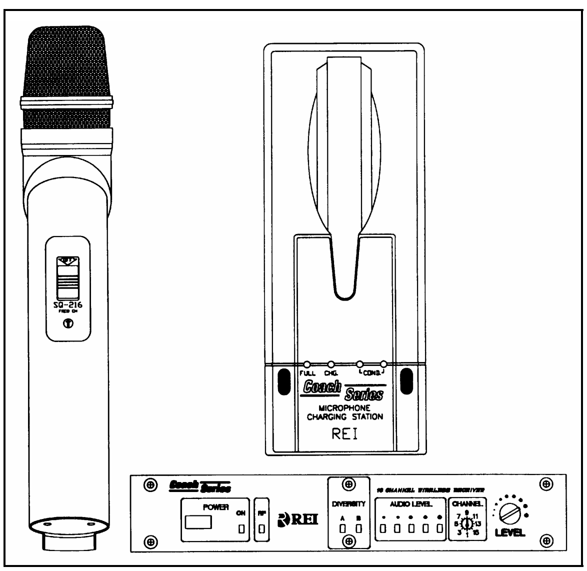


FIGURE 15: WIRELESS MICROPHONE

1.10 TV TUNER

For TV tuner control descriptions, refer to fig. 16.

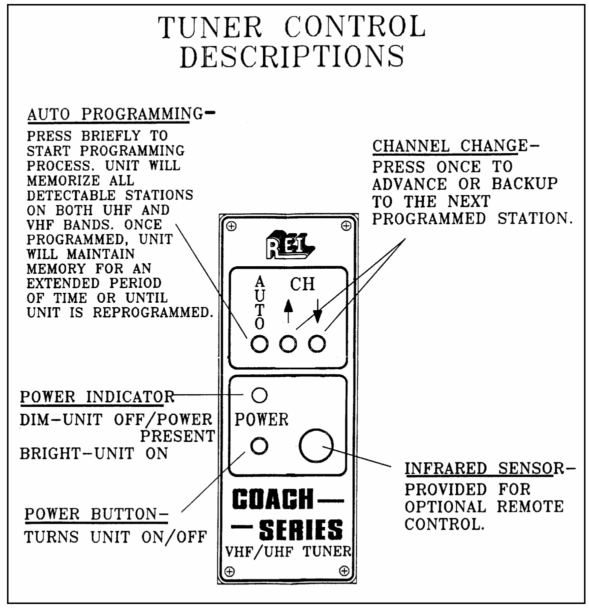


FIGURE 16: TUNER CONTROLS DESCRIPTION

1.11 KARAOKE

The modified Panasonic DVD Player powers up automatically when the video system is activated. The unit can be controlled with the plug-in remote control, or the control head, which has access to the PLAY and STOP commands.

If so equipped, instructions for proper use of the Karaoke system are included in the *''Operating Manual''* that is provided in the technical publications box delivered with the vehicle.

1.11.1 Karaoke Panasonic Sound System – MOBILE DVD PLAYER DV1500

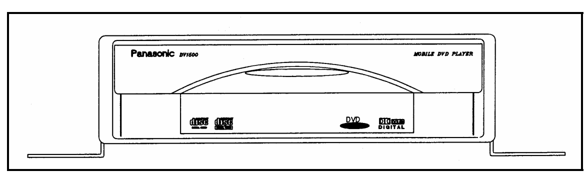


FIGURE 17: PANASONIC DV1500

1.12 DRIVER'S SPEAKERS

The driver's speakers are mounted one on each side. This arrangement provides the driver with clear stereo sound. Controls for the driver's audio allow selection between the radio and the auxiliary audio (independent of the passenger's speakers) or muting the speakers.

1.13 MONITOR

1. Place the ignition switch in the ''OFF'' position.
2. Unfasten the retaining screw located on the monitor R.H. side.
3. Slide the monitor to the right to release it from the mounting bracket.

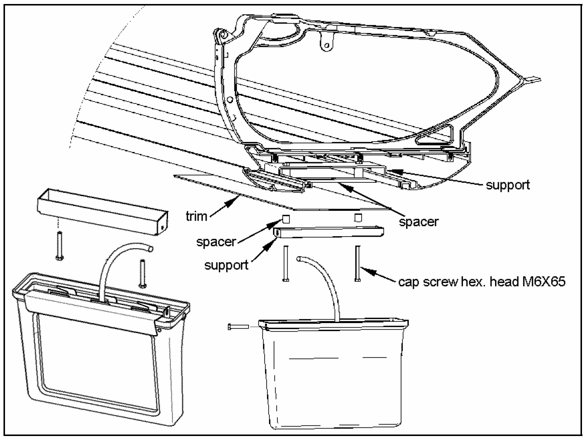


FIGURE 18: MONITOR MOUNTING 23221

1.14 SCENIC VIEWING SYSTEM

The scenic viewing system enables the passengers to view the road ahead of the vehicle. This system is composed of a camera, a dashboard mounted ON/OFF switch and the video switcher located on the audio-video panel (Figs. 1 & 19).

FIGURE 19: SCENIC VIEW CAMERA

1.15 ROOF ANTENNA INSTALLATION

1. Find the desire location and drill a hole according to specification.
2. To remove dirt and grease, wash hole edge with alcohol.
3. If so equipped, remove foam padding ring from antenna to free the metal surface (foam can produce air bulbs in new rubber seal).
4. With SIKA 205, wash the opening edge and the antenna base surface, wait at least two (2) minutes for chemical evaporation.
5. Apply new seal SIKA 221 on both, vehicle hole edge and antenna base.
6. Fix the antenna in place.
7. Remove excess seal and complete a finishing joint all around the antenna base.

2. HUBODOMETER

2.1 DESCRIPTION

An optional wheel hubodometer (Fig. 20) may have been installed on the R.H. side of the drive axle. It indicates the total distance in miles or kilometers covered by the coach since it has left the factory, including road testing.

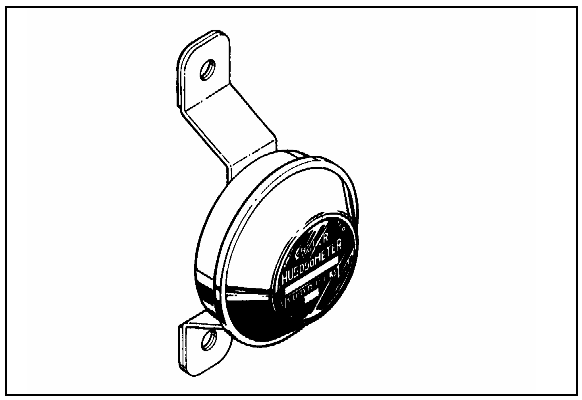


FIGURE 20: HUBODOMETER 23024

2.2 OPERATION

The hubodometer is calibrated for a specific wheel size (diameter). Wheel rotation causes a mechanism inside the hubodometer to record distance after a predetermined number of rotations. The unit should be serviced at a competent speedometer repair facility.

NOTE
Do not use paint, solvent or thinner on hubodometer face or on plastic hubcaps. Do not weld on hubodometer.

2.3 REMOVAL

To remove the unit, remove the two lock nuts and washers securing it to the wheel hub, and pull the unit off the studs.

2.4 INSTALLATION

Place the hubodometer unit over the wheel hub studs. Replace the lock washers and nuts. Torque stud nuts to 110-165 Lbf-ft·(150-225 Nm).

3. BACK-UP CAMERA AND MONITOR

An optional back-up camera is available which provides the driver with visual assistance when backing-up. The camera is automatically activated when the transmission is put in reverse gear and the ignition switch is "ON". The TV monitor is mounted on top of the dashboard. Refer to the Operator's Manual under "Controls & Instruments".

4. COLD STARTING AID (ETHER)

The vehicle can be equipped with an electrically-operated type ether cold starting aid designed to ease engine starting when temperature is low.

On vehicles equipped with cold starting aid, the system consists of the main following parts:

- Ether starting aid switch
- Ether cylinder
- Solenoid valve (24 V)
- Thermal cutout valve
- Atomizer

The control rocker switch is located on the dashboard. This switch is provided with a locking mechanism to avoid accidental use when engine is running. To activate the ether starting aid, proceed as follows:

1. Prior to cranking engine, press down rocker switch for three seconds to fill solenoid valve.
2. Release switch to discharge shot.
3. Allow three seconds for shot to discharge.
4. Start engine, use additional shots if necessary to keep engine running.

⚠ CAUTION ⚠

This practice should be performed only when absolutely necessary. Excessive use of fluid could result in serious engine damage.

The ether cylinder and solenoid valve assembly are mounted on the engine compartment wall and are accessible from the engine compartment R.H. side door.

The thermal cutout valve is mounted on the engine (radiator side). Its function is to prevent discharge of ether when engine is warm (over 90°F (32°C)). The atomizer is installed on top of the air intake duct (Fig. 21).

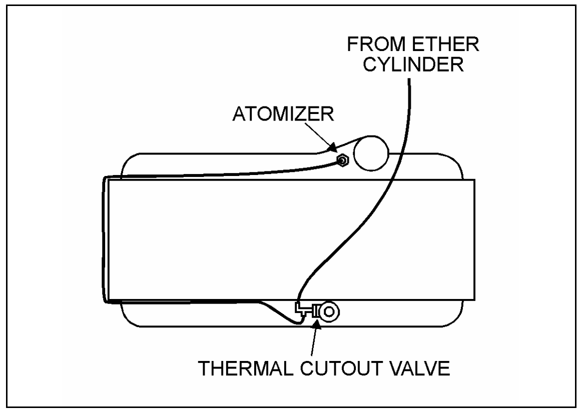


FIGURE 21: ENGINE 23032

4.1 PREVENTIVE MAINTENANCE

During the summer months, remove cylinder to avoid high temperature actuation of the cylinder safety relief device. Always screw valve cap into solenoid valve opening to prevent entrance of road dirt. When removing cylinder, be careful to prevent dirt from entering the valve.

4.2 TROUBLESHOOTING (IF SYSTEM IS NON-FUNCTIONING)

⚠ WARNING ⚠

During the following test, direct free end of tube away from personnel and all sources of ignition as this fuel is extremely flammable. Avoid breathing vapors and contacting fuel with skin. Never smoke during test.

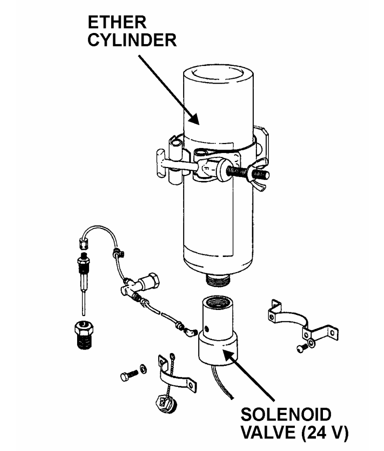


FIGURE 22: COLD STARTING AID 23048

1. Check cylinder for hand tightness and fuel supply (Fig. 22). Empty cylinder weight is approximately 17 oz (480 g); full cylinder weight is approximately 35 oz (990 g). If cylinder is empty, replace it. Before replacing cylinder, install new valve gasket in solenoid valve.
2. If still not functioning, disconnect tubing at solenoid valve fitting. Actuate solenoid valve. (Ask an assistant to actuate solenoid valve using the rocker switch on the dash-board).
   - If solenoid valve is non-functioning, check electric circuit, (refer to wiring diagrams). If sound, remove and replace the solenoid valve. If not, repair electric circuit.
   - If valve is functioning, reassemble valve fitting and connect tube. Disconnect tube at thermal cutout valve from port "Tube from valve".
3. Actuate the solenoid valve.
   - If fuel is not discharged from tube, remove tube and blow out or replace.
   - If fuel is discharged, connect tube to thermal cutout valve, and disconnect other tube.
4. Actuate the solenoid valve.
   - If fuel is not discharged, replace the cut-out valve.

NOTE
If engine coolant temperature is 90°F (32°C) or over, it is normal that fuel is not discharged as the valve is in closed position.

   - If fuel is discharged, connect tube to thermal cutout valve, and disconnect tube from atomizer.
5. Actuate the solenoid valve.
   - If fuel is not discharged from tube, fuel line is clogged. Remove tube and blow out or replace.
   - If fuel is discharged, replace the atomizer.

4.3 THERMAL CUTOUT VALVE QUICK TEST

1. Engine coolant temperature must be below 90°F (32°C).
2. Temporarily disconnect tube at thermal cutout valve from port *"Tube to atomizer"*.
3. Actuate solenoid valve (Ask an assistant to actuate solenoid valve by means of the rocker switch on the dashboard). Fuel should be discharged through the thermal cutout valve.

WARNING
Avoid breathing vapors and contacting fuel with skin. Never smoke during test.

4. Reconnect tube to thermal cutout valve.
5. Start engine, using cold starting aid if necessary. Stop engine when it reaches operating temperature.
6. Disconnect tube at thermal cutout valve as in step 2, and repeat step 3. No fuel should be discharged.

5. DESTINATION SIGN

5.1 ELECTRONIC DESTINATION SIGN (OPTIONAL)

The destination sign is located at upper front of the vehicle. To change the destination, depress the selecting switches until the desired destina-tion appears in the LCD display.

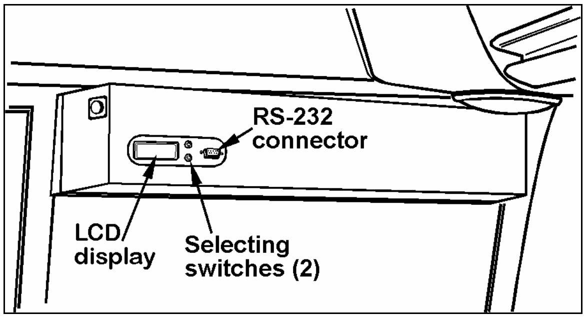


FIGURE 23; DESTINATION SIGN – ELECTRONIC 23123

NOTE
The destination sign must be programmed with a computer connected to the RS-232 connector prior to first use. Follow the instructions on the computer disk to install and run the software.

NOTE
The destination sign is equipped with lights (bulb light or fluorescent) which illuminates automatically when the headlight or fog light switch is activated.

6. LAVATORY

6.1 DESCRIPTION

The lavatory is located in the rear R.H. corner of the coach. It is equipped with a chemical flush toilet, bathroom tissue dispenser, washbasin, towel dispenser, waste container, mirror, ashtray, and a cleaning cabinet. A liquid soap dispenser and moist towel dispenser are optional.

Locking the lavatory door from the inside will illuminate a fluorescent light in the lavatory and two outside signs to indicate occupation. One sign is located on the outer wall of the lavatory and another sign is located over the windshield. An indicator light on the dashboard will illuminate to inform the driver when the lavatory is occupied. A night-light is permanently lit in the lavatory when the ignition switch is in the ON position.

If emergency assistance is required, the lavatory occupant can actuate a buzzer that will sound in driver's area. The buzzer's push-button (c/w instruction label) is located on the inner curbside wall of lavatory.

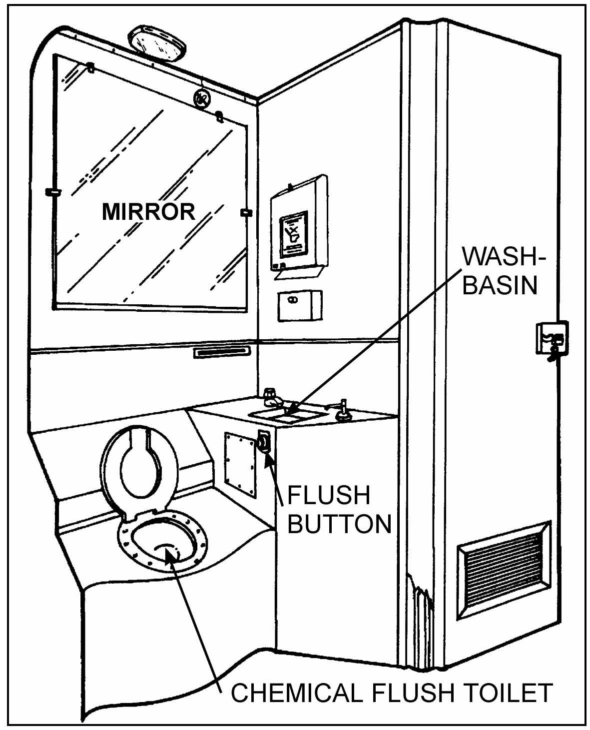


FIGURE 24: LAVATORY 23235

The lavatory has its own ventilation system that operates only when ignition switch is in the "ON" position. An auxiliary sump tank (Fig. 28) (optional) allows main tank to be drained by manually opening an interconnecting tank valve (5, Fig. 27). Lavatory can then be operated for longer periods until coach can be serviced at a facility equipped for disposal.

The fresh water tank, located behind compartment mirror (Fig. 28), is equipped with a thermal drain valve that will drain the tank when water temperature approaches the freezing point preventing damage to the tank (Fig. 28). The fresh water supplies water to the washbasin by gravity. Two tubes are connected on top of the tank. One serves as overflow as well as a vent tube and runs along the curbside wall to the engine compartment R.H. side (6, Fig. 27) while the other tube is connected to the fresh water fill connection which is also located in engine compartment R.H. side (1, Fig. 27). A third tube connected in the bottom of the fresh water tank allows fresh water to flow to the washbasin faucet. Water from washbasin drain tube flows to the main sump tank.

Also, a drain hole located on lavatory floor drain water splashed on the floor to the engine compartment R.H. side.

6.2 MAINTENANCE

The servicing procedure for the lavatory is described in the *"Operator's Manual"* included in the technical publications box delivered with the vehicle.

6.3 VENTILATION FAN

6.3.1 Description

The lavatory ventilation fan, mounted in engine compartment behind the oil reserve tank (Fig. 25), serves two purposes. It exhausts objectionable odors and provides a constant air circulation in the lavatory compartment by heating or cooling the lavatory with the vehicle ambient air. Air flows in the lavatory compartment through a vent grill located on the lavatory door and exhausts through a grill located next to the toilet.

NOTE
This fan runs constantly when the ignition switch located on the dashboard is in the "ON" position.

6.3.2 Maintenance

The frequency of preventive maintenance should be determined according to vehicle mileage and operating conditions. However, it is recommended to check this item every 50,000 miles (80 000 km) or once a year, whichever comes first.

Remove fan and motor assembly. Check for fan housing wheel and motor free operation. When defective motor occurs, new motor must be installed.

6.3.3 Removal and Installation

1. With the engine compartment rear doors opened, remove hose clamp securing duct to ventilation fan inlet, and disconnect duct.
2. Disconnect the ventilation motor wiring connector.
3. Remove the support bracket screw. Remove the three bolts fixing the ventilation fan housing support. Remove the ventilation fan assembly from its location.
4. The unit can now be disassembled and motor replaced.
5. Reverse previous steps to reinstall ventilation fan assembly on vehicle.

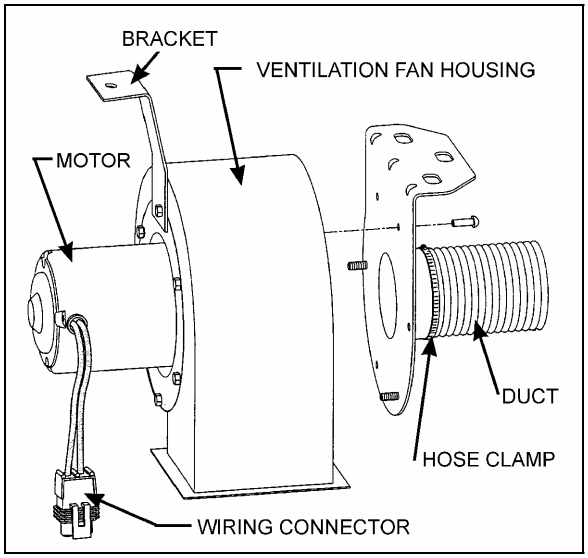


FIGURE 25: VENTILATION FAN INSTALLATION 23222

6.4 DOOR LOCK

Lavatory door lock has inside and outside handles, as well as an inside latch to lock door from inside the compartment. If the lock fails to release, the door can be opened from the outside using a special key which is supplied to the driver. Lock assembly can be removed from the door, then readily disassembled and parts replaced, if necessary (Fig. 26). A thin coat of lubricant on all moving parts will ensure trouble-free operation.

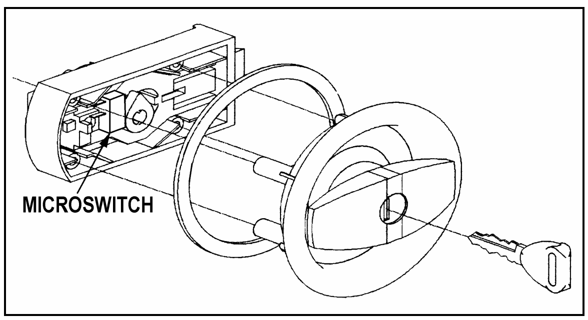


FIGURE 26: DOOR LOCK 23320

6.5 LAVATORY LIGHT

The lavatory light is installed on ceiling. A microswitch, which is mounted inside the latch housing, is activated by the door lock mechanism upon locking to energize the circuit. This switch is readily serviced by removing the four Phillips-head screws securing the housing to the door interior frame.

Proceed as Section 06, Electrical System, *Dome, Rear Roof and Lavatory Lights*" for lights replacement.

6.6 LAVATORY NIGHT-LIGHT

The lavatory night-light is illuminated as soon as the ignition switch is set to the *"ON"* position. See Section 06, Electrical System, "*Parcel Rack / Lavatory Night Light - "Bulb Removal and Replacement*" for lights replacement.

6.7 EMERGENCY BUZZER

The lavatory emergency buzzer is mounted on the inner curb side wall of lavatory and sounds when the emergency call push-button switch in the lavatory compartment is activated. For specific wiring information, refer to wiring diagrams. To remove the emergency call push-button switch, proceed as follows:

1. Remove both phillips-head screws retaining pushbutton switch plate to wall.
2. Remove steel plate located on L.H. side of pushbutton switch.
3. Remove switch through this opening, taking care to disconnect electric wires.

6.8 FRESH WATER TANK

One panel allows access to the fresh water tank. It is located behind the toilet mirror. Remove the tank as follows:

1. Remove the mirror.
2. Remove the fresh water tank tubing, bolts, and different connectors.
3. Remove the tank from the wall.
4. Reverse previous steps to reinstall fresh water tank assembly on vehicle.

6.8.1 Fresh Water Tank Draining

The fresh water tank can be drained by simply opening the fresh water drain cock (Fig. 27). Don't forget to close cock when draining is done.

NOTE
The fresh water reservoir is equipped with a thermal valve which is set to open at about 35°F, thereby automatically draining the reservoir in near-freezing temperatures.

Routine draining and filling of lavatory tanks should be performed by maintenance personnel only. If engine or heating failure occurs in extreme weather conditions, emergency draining of water tanks should be performed under the most suitable conditions and should at all times be supervised by driver.

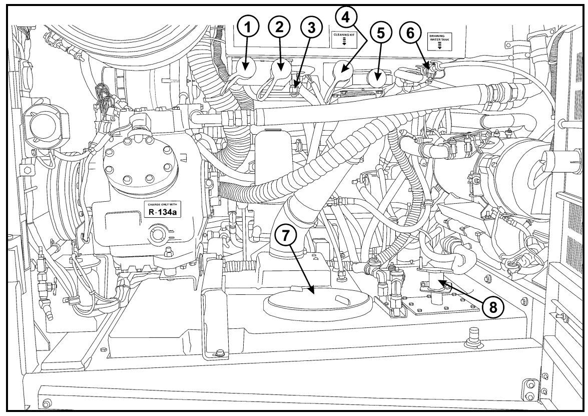


FIGURE 27: F/W TANK SERVICE VALVES 23378

1............................ Fresh water tank fill connection

2..............................Main sump tank fill connection

3..............................Main sump tank overflow cock

4................................Cleaning kit hose connector

5.................................. Main sump tank drain valve

6..................................Fresh water tank drain cock

7...........................Auxiliary sump tank access cap

8............................ Auxiliary sump tank drain valve

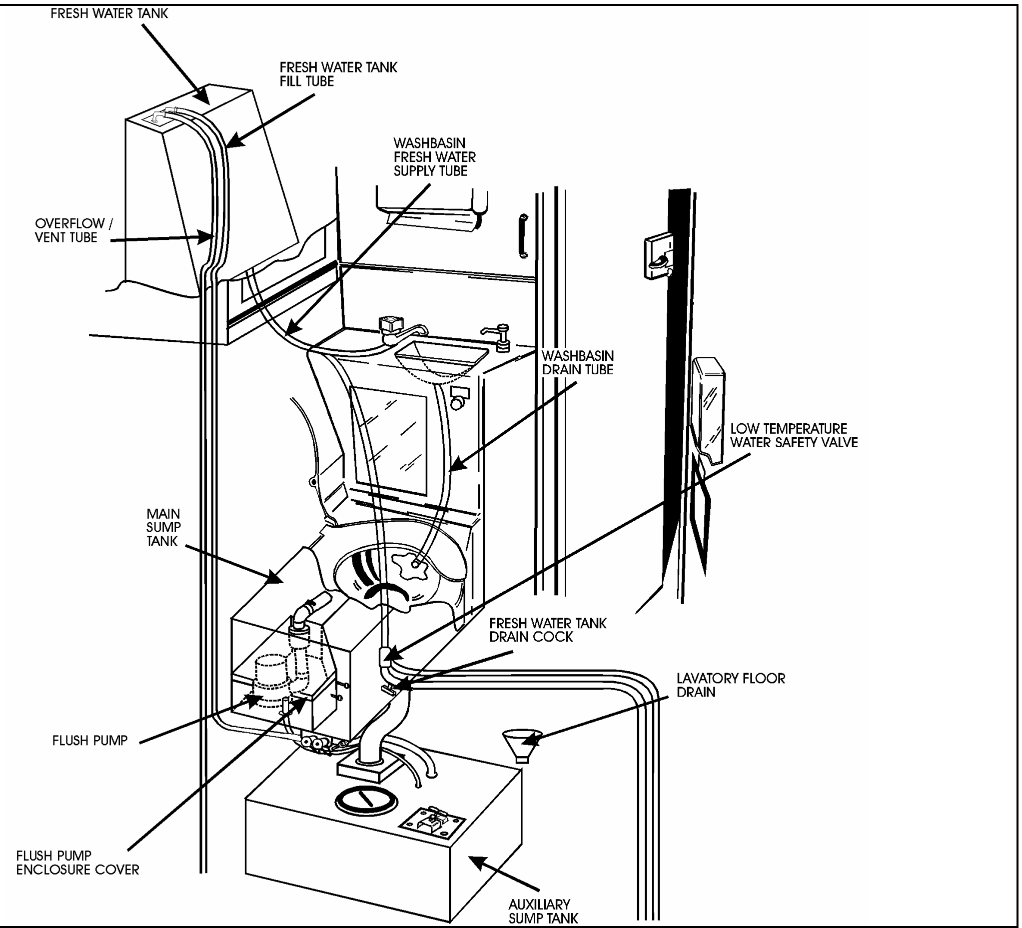


FIGURE 28: FUNCTIONING OF LAVATORY 23051

6.8.2 Fresh Water Tank Filling

Connect the fresh water supply hose to the fresh water reservoir fill connection (Fig. 27) located in the curb-side section of engine compartment. Fill the reservoir until the overflow tube leaks, signaling that the reservoir is full.

⚠ WARNING ⚠
Never put antifreeze in fresh water tank; antifreeze is toxic.

⚠ WARNING ⚠
If tank has not been drained for an extended period of time, draining and filling operations must be repeated three (3) times in order to clean tank and eliminate contaminated water.

6.9 LIQUID SOAP DISPENSER

A liquid soap dispenser may have been installed as optional equipment. To refill dispenser, proceed as follows:

1. Turn cover slightly clockwise until it stops.
2. Lift out piston and spout, cover and supply tube.

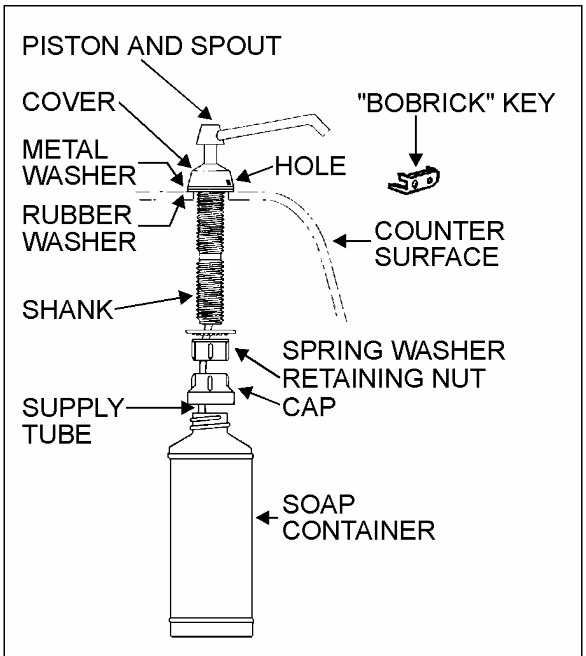


FIGURE 29: LIQUID SOAP DISPENSER 23039

3. Fill dispenser with soap. This model can dispense vegetable oil soaps, synthetic detergents, and lotion soaps.

⚠ CAUTION ⚠
Never use abrasive cleaners.

4. Replace supply tube, piston, and spout mechanism reversing the steps above.
5. Secure the cover by turning clockwise until lock snaps into position.

NOTE
The dispenser requires priming when extremely viscous lotion soaps are used. Remove piston and spout, cover and supply tube assembly. Pump water into assembly, then replace into dispenser.

6.10 FLUSH PUSH-BUTTON

The green flush push-button is located near the toilet. Press on push-button to actuate a pneumatic timer located on the other side of wall. This timer allows an electric current flow during a preset time to a pump into the sump tank.

6.10.1 Pneumatic Timer Removal and Installation

1. Unscrew and remove the flush push-button locking ring.
2. Remove steel plate located on L.H. side of pushbutton switch.
3. Remove pneumatic timer through this opening, taking care to disconnect electric wires.

NOTE
Care must be taken to avoid losing the spacers installed on the mounting sleeve.

4. Reverse the above procedure to reinstall timer. The recommended torque for the lock nut is 15 Lbf-ft· (21 Nm).

6.10.2 Timer Adjustment

Timer can be adjusted from 0.2 second to 3 minutes by turning the time adjustment screw clockwise to increase time, and counterclockwise to decrease time. To gain access to the time adjustment screw, repeat steps 1, 2 and 3 in the previous paragraph "*6.10.1 Pneumatic Timer Removal and Installation*".

6.11 FLUSH PUMP

The submersible-type flush pump is mounted inside an enclosure in the sump tank (Fig. 28). The enclosure is provided with a screened side which, serves as a strainer to prevent solid matters from entering the pump.

The pump requires no periodic maintenance other than cleaning of the strainer side using a water jet introduced through the circular cap opening, once the sump tank is completely drained. The pump can run dry periodically without damage. However, for maximum seal life, the run dry periods should be kept to a minimum.

⚠ **CAUTION** ⚠

If vehicle is stored for an extended period of time, make sure to clean the strainer as solid matter will tend to pack, and will necessitate replacement of strainer.

6.11.1 Flush Pump Removal

1. Remove the toilet to gain access to the pump enclosure.
2. Remove the flush pump enclosure cover
3. Unsnap the flush pump.

6.12 SUMP TANKS

6.12.1 Main Sump Tank Draining

When recirculating water in the toilet is soiled, drain main sump tank. If equipped with the optional auxiliary sump tank, drain the main sump tank contents into the auxiliary tank and perform the filling procedure of the main tank.

6.12.2 Main Sump Tank Filling

Open the main sump tank overflow cock and connect a water supply hose to the toilet sump tank fill connection. The main tank is full when water starts flowing through the clear overflow tube. Close main sump tank overflow cock when the tank is full.

⚠ **CAUTION** ⚠

In cold weather, add 2 gallons (9 liters) of antifreeze (e.g.: ethylene glycol) in the toilet before filling main tank.

6.12.3 Auxiliary sump Tank Draining

Remove drain cap located under auxiliary sump tank then turn the auxiliary sump tank drain valve lever counterclockwise eight or nine times. Remove the access cap and flush tank with clean water. To close, turn the valve lever several times clockwise until the rubber bladder seals the drain hole. Reinstall access and drain caps.

⚠ **CAUTION** ⚠

Lavatory tanks should be serviced only at suitably equipped stations.

NOTE

It is unlawful to dump sump tank contents in any location other than those designated as such.

When a full draining is required, clean main tank by repeating the draining and filling operations while leaving the auxiliary sump tank drain cock opened. Close cocks and pour a pack of commercial toilet deodorant (Prévost part #900329) in toilet before adding the antifreeze and starting final filling of main tank.

⚠ **WARNING** ⚠

The toilet deodorant contains products that can be very irritating to skin. Use rubber gloves when handling and then clean toilet seat.

⚠ **WARNING** ⚠

Antifreeze must comply with the effective environmental act.

⚠ **CAUTION** ⚠

When cold weather is expected and there is no antifreeze in the tank, both sump tanks must be drained.

NOTE

If there is no antifreeze solution in the tank, there is less risk of freezing if engine is operating due to the heat it produces.

NOTE

New coaches are delivered with the sump and fresh water tanks empty. Fill with water before putting the coach in service.

7. AIR HORN VALVE

The air horn valve is located in the front service compartment and the air horn valve button is on the steering wheel center.

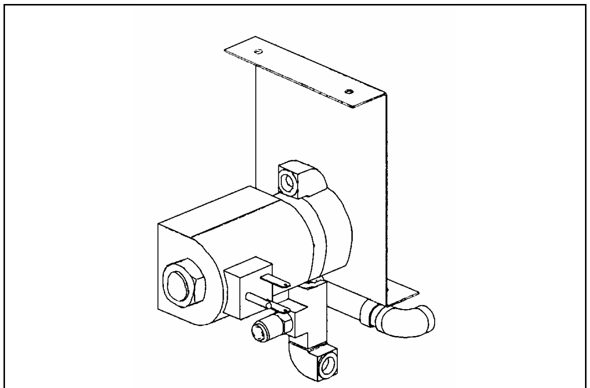


FIGURE 30: AIR HORN VALVE 23230

7.1 AIR HORN VALVE MAINTENANCE

When needed, the air horn valve can be serviced or replaced using the following procedure:

1. Unplug the cable connector;
2. Disconnect the air tubes;
3. Loosen the retaining bolts;
4. Service or replace the air horn valve;
5. Reinstall by reversing procedure.

8. HEADLIGHTS CLEANING SYSTEM

8.1 GENERAL DESCRIPTION

> **NOTE**
>
> *When inspecting the headlights cleaning system, check the washer fluid hoses, fittings and connectors to be sure they are properly connected and seal with no restriction to the flow of washer fluid. Check that the washer nozzles are properly aimed.*

The headlights cleaning system is independent from the windshield washer system and has its own washer fluid reservoir located in the front electrical and service compartment. However, this system shares the same telltale light than the windshield washer low level sensor (refer to Operator or Owner's manual for operation). Each pressing of this switch produces 2 successive 0.7 seconds jets.

> ⚠ **CAUTION** ⚠
>
> **Do not operate the headlights washer while the washer fluid reservoir is empty. This may damage the washer fluid pump.**

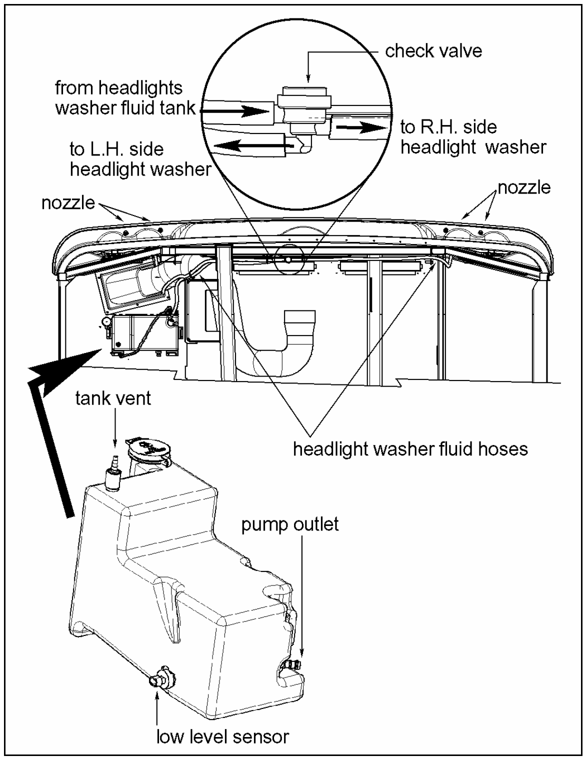


FIGURE 31: HEADLIGHTS CLEANING SYSTEM 23380

8.2 WASHER FLUID REFILLING

Open the filler neck cap and had regular windshield washer fluid as required. The tank has a capacity of 10 liters (2.6 US gallons). You may use water or windshield washer fluid as well but, during cold weather days, use windshield washer fluid suitable for freezing temperature only.

8.3 WASHER NOZZLES ADJUSTMENT

To avoid waste of washer fluid, assure the fluid jets are properly aimed. Adjust nozzles so they aim as described in figure 33. Align the jet adjustment tool #800377 with the reference line shown on the front view detail. As seen on the side view, position the end of the adjustment tool to a distance of ½" (high beam) and 1" (low beam) from the top of the headlight for proper aiming.

⚠ **CAUTION** ⚠

Because they are made of plastic, firmly tighten nozzle and bulkhead fittings by hand only.

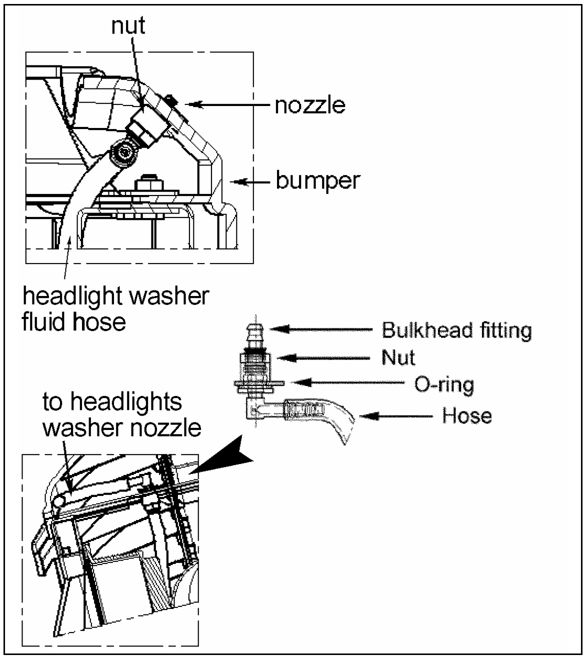


FIGURE 32: TUBING AND FITTINGS 23381

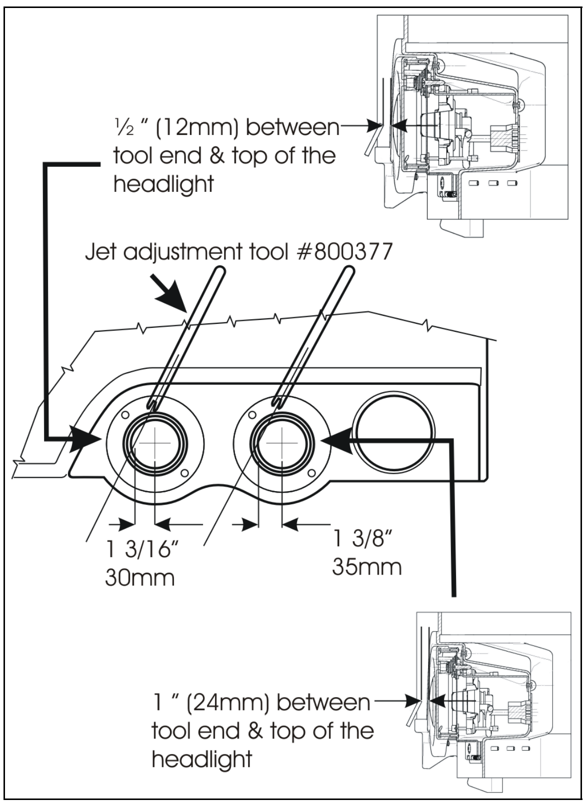


FIGURE 33: WASHER NOZZLES ADJUSTMENT 23382

9. WINDSHIELD WIPERS AND WASHERS

9.1 GENERAL DESCRIPTION

NOTE

When installing a wiper motor, arm or blade, follow recommended procedures to prevent misalignment, binding or malfunction. Check the windshield washer liquid hoses, fittings and connectors to be sure they are properly connected and seal with no restriction to the flow of washer liquid. Check that wiper arms have the proper sweep position and the washer nozzles are aimed so that spray is within the proper wiper pattern.

The windshield wipers are controlled by one electric wiper motor that is accessible for maintenance after removing the appropriate access panel beside the footwell (refer to figure 36).
Turn the multifunction lever forward to activate windshield wipers (item 2, fig. 34). The first position operates the wipers at low speed and the second position operates the wipers at high speed. Turning the lever backwards will operate the wipers in the intermittent mode.

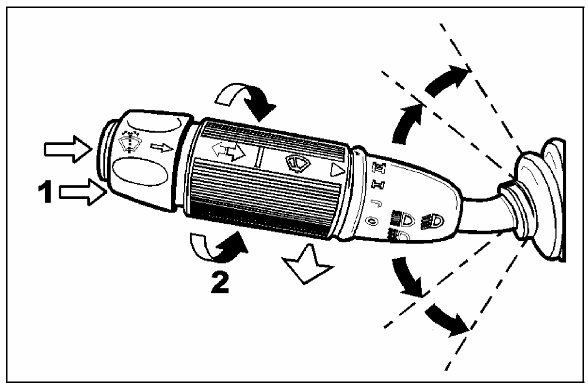


FIGURE 34: MULTIFUNCTION LEVER 23133

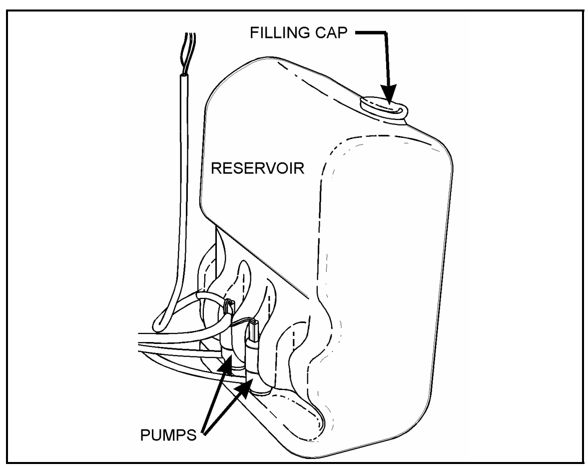


FIGURE 35: WINSHIELD WASHER RESERVOIR 23220

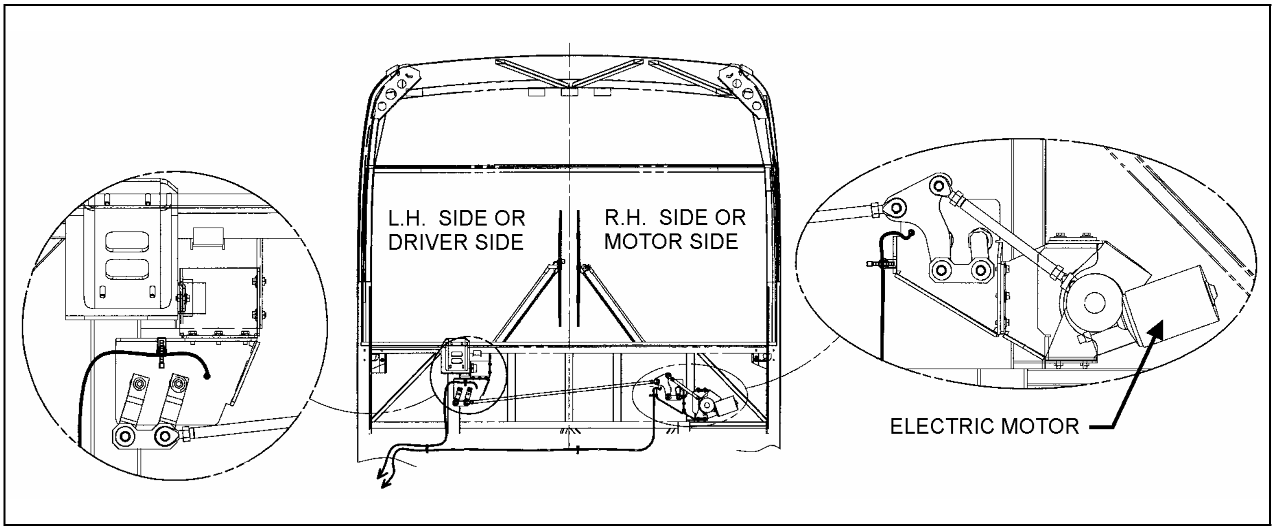


FIGURE 36: WINDSHIELD WIPER INSTALLATION 23287

The windshield washer pumps are electrically operated and are controlled by a washer control ring on the multifunction lever (item 1, fig. 34).

The windshield washer reservoir is located in the front service compartment (Fig. 35). This unit pumps the washer liquid to the spray nozzles where it is dispersed across the windshield.

9.2 WIPER ARM

Check operation of the wipers for proper blade sweep and angle.

⚠ CAUTION ⚠
Do not attempt to manually move the wiper arms to make wiper blade sweep adjustments as damage to the wiper linkage or motor may occur. If it is necessary to adjust the sweep of blades, remove the arms and make adjustment by positioning the arms using serration on the wiper arm pivot shafts.

9.2.1 Wiper Arms Positioning

1. Reinstall the wiper arms and position as shown in figure 41. Before positioning the wipers at their final position, tighten the nuts to 9 Ft-lbs (12 Nm) at first.
2. To find the final position of the wiper arms, lift then release the wiper arm so if falls back on the windshield

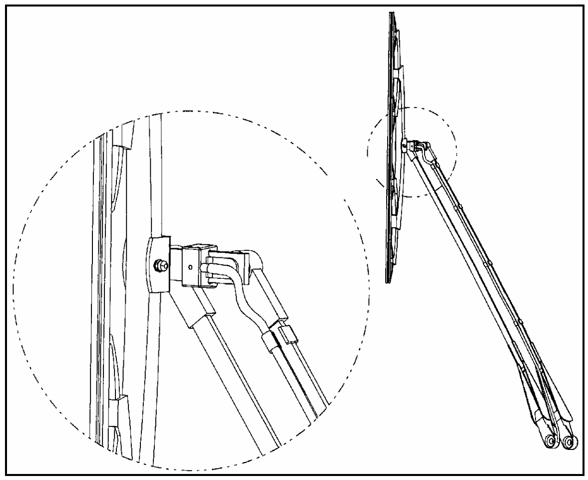


FIGURE 37: WINDSHIELD WIPER (MOTOR SIDE) 23329

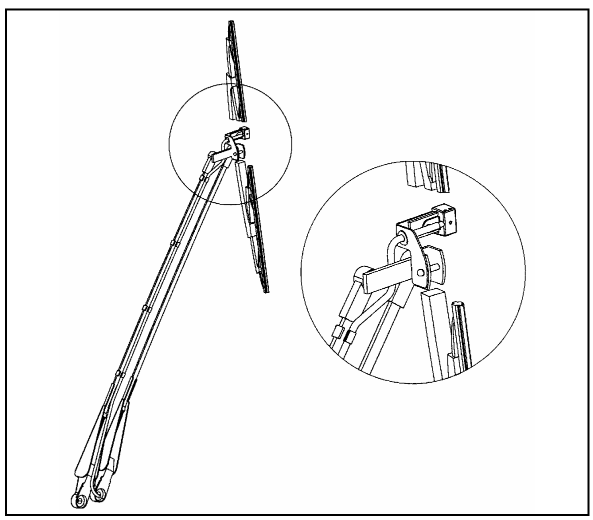


FIGURE 38: WINDSHIELD WIPER (DRIVER SIDE) 23328

3. When the final position is found, tighten the wiper arm nuts to 22 Ft-lbs (30 Nm). Wait 30 minutes and tighten again to 22 Ft-lbs.

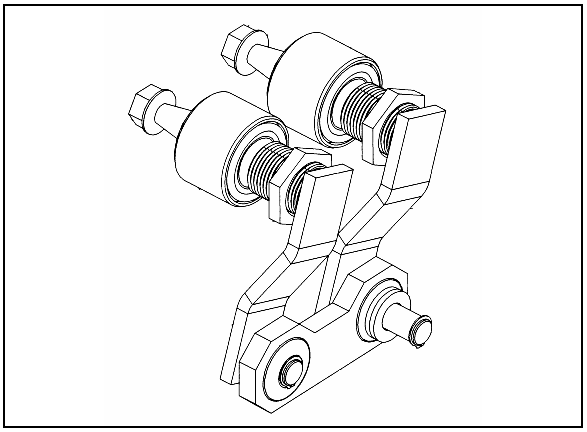


FIGURE 39: DRIVING MECHANISM (DRIVER SIDE) 23284

4. Lower the protective cover.
5. Connect the windshield washer tubing at the base of the wiper arm.
6. Check the adjustment on a wet windshield.

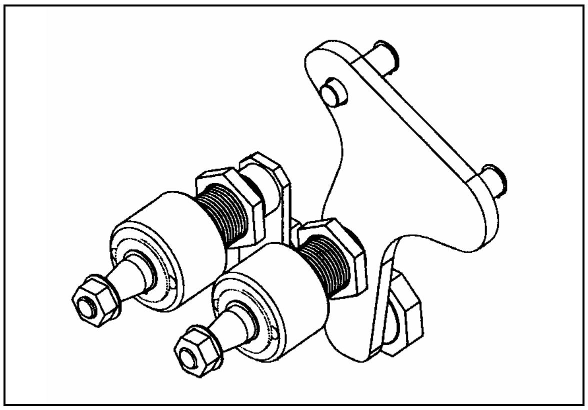


FIGURE 40: DRIVING MECHANISM (MOTOR SIDE) 23285

9.3 WINDSHIELD WIPER MOTOR

9.3.1 Windshield Wiper Motor Replacement

The windshield wiper motor is located at lower front of the vehicle, behind the defroster panel. Refer to figure 34 for motor location.

⚠ WARNING ⚠

Park vehicle safely, apply parking brake, stop engine and set battery master switch to the ''OFF'' position prior to working on the vehicle.

1. Remove the Phillips-head screws retaining the defroster panels, and remove panels.
2. Disconnect wiring connector from the windshield wiper motor.
3. Loosen clamping screw retaining the lever at the end of the motor driving shaft.
4. Remove the three bolts holding the motor to the steel plate.
5. Remove the windshield wiper motor (Prévost #800328), reverse removal procedure to reinstall.

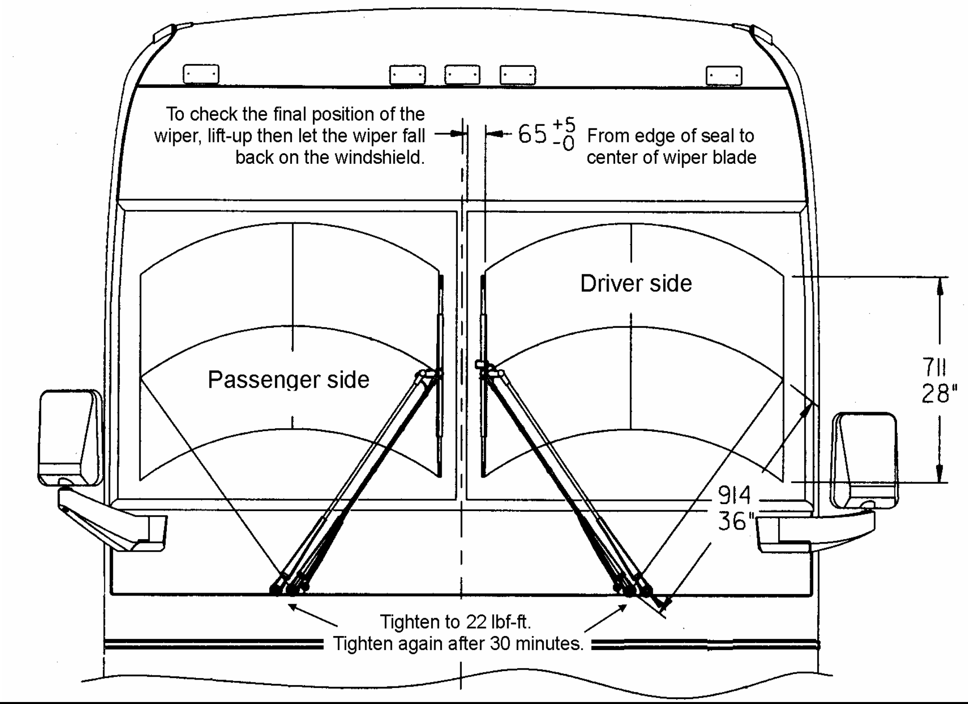


FIGURE 41: WIPER ARMS POSITIONING 23253

9.4 TROUBLESHOOTING

SYMPTOM	PROBABLE CAUSE	REMEDY
FAIL TO SPRAY WASHER FLUID	A. Reservoir empty. B. If below 32°F (0°C), improper washer fluid frozen. C. Contamination in tubing or nozzles. D. Tubing damage. E. Tubing bent (kinked) or off one or more connections.	A. Add proper fluid. B. Store coach or parts in heated area, then purge system with low-temperature solution. C. Remove with compressed air, if severely clogged, replace items. D. Replace section. E. Realign tubing and/or refit. Trim end to ensure proper fit or replace.
INADEQUATE SPRAYING	A. Tubing failure.	A. Replace tubing.
SLOW OPERATION	A. Improper solution. B. Jet stream improperly directed. C. Check if valve is stuck in the open position.	A. Replace with proper type solution. B. Reposition nozzles. C. Remove, clean or replace.

10. SPECIFICATIONS

AMPLIFIER
Model...VA400-8
Output.. 400 watts, 6 channel RMS at 4 ohm @ 0.5 T.H.D.
Prevost number..901191

SOUND SELECTOR
Model..VSS-04
Power source ....12 volts
Prevost number..901192

AM/FM/CD PLAYER RADIO (standard)
Model...VR300
Power source ....12 volts
Prevost number..901190

AM/FM/CD SATELLITE RADIO (optional)
Model...VR300
Power source ....12 volts
Prevost number..901190

6 DISC CD CHANGER
Prevost number..901196

MOBILE DVD PLAYER
Power source ....12 volts
Prevost number..901198

SPEAKER (standard)
Model...Dual Cone
Impedance .... 4 ohms
Prevost number..901194

SPEAKER (optional)
Model...Coaxial
Impedance .... 4 ohms
Prevost number..901195

SUBWOOFERS (optional)
Model..J Drive VB170
Impedance .... 4 ohms
Prevost number..901193

VIDEO CASSETTE PLAYER (VCP)
Model.. V-3000
Prevost number..901030

VIDEO SWITCHER
Model.. V-3000
Prevost number..901030

BOOM-TYPE MICROPHONE
Prevost number.. 900763

HANDHELD PRIORITY MICROPHONE
Prevost number.. 900808

RUBBER COATED MICROPHONE
Prevost number.. 900745

16 CHANNEL WIRELESS MICROPHONE
Make.. R.E.I.
Supplier number.. 700598
Prevost number.. 900954

16 CHANNEL WIRELESS MICROPHONE CHARGING STATION
Make.. R.E.I.
Supplier number.. 700532
Prevost number.. 900953

16 CHANNEL WIRELESS MICROPHONE RECEIVER
Make.. R.E.I.
Supplier number.. 700599
Prevost number.. 900952

KARAOKE
Make.. Panasonic
Model.. MOBILE DVD PLAYER DV1500
Supplier number.. 700761
Prevost number.. 901033

TV RECEIVER
Power source.. 24V
Prevost number.. 901054

VIDEO DISTRIBUTION AMPLIFIER
Power source.. 24V
Prevost number.. 901117

TV MONITOR
Type.. 10.4” LCD
Power source.. 24V
Prevost number.. 901130

HUBODOMETER (US model: miles)
Make.. Stemco
Supplier number.. 650-0593
Prevost number.. 650002

HUBODOMETER (Canada model: km)
Make...Stemco
Supplier number...650-0025
Prevost number...650117

ELECTRIC DESTINATION SIGN (FLUORESCENT TUBE)
Make...General Electric
Length...30" (76 cm)
Outside diameter...1" (25 mm)
Wattage...20
Color...Cool white
Quantity...1
Supplier number...F30T8 CW4
Prevost number...830120

ELECTRONIC DESTINATION SIGN
Make...Pocatec
Supplier number...9000230
Prevost number...940050

LAVATORY VENTILATION FAN MOTOR
Make...Aurora
Type...RG500EF
Voltage...24 volts DC
Rotation...R.H.
Supplier number...131.40.50
Prevost number...870844

LAVATORY FLUORESCENT TUBES
Make...General Electric
Model...F15T8CW
Length...18" (45 cm)
Wattage...15
Quantity...2
Prevost number...830102

EMERGENCY BUZZER SWITCH (PUSH BUTTON)
Make...Cole Hersee Co.
Voltage...24 V
Supplier number...40224
Prevost number...562117

FRESH WATER TANK
Make...Prévost
Capacity...18 US gal (68 liters)
Prevost number...401591

FLUSH PUSH BUTTON PNEUMATIC TIMER
Make...Furnas
Type...Resettable
Time...0,2 to 180 seconds
Supplier number...55-AA
Prévost number...900348

FLUSH PUMP
Make..RULE 2000
Model number..12 - 24 V
Power source..24 volts DC
Capacity..1450 GPH
Prévost number..900960

AIR HORN
Make..Allied Signal Inc.
Supplier number..101493
Prévost number..640093

AIR HORN VALVE
Make..Allied Signal Inc.
Supplier number..228672
Prévost number..640128

WINDSHIELD WIPER MOTOR
Make..BOSCH
Supplier number..0390442401
Prévost number..800328

WIPER (BLADE)
Make..BOSCH
Supplier number..3398110095
Prévost number..800329

WIPER ARM
Make..BOSCH
Supplier number..6002UWA060
Prévost number..800331

SECTION 24: LUBRICATION

CONTENTS

ILLUSTRATIONS

1. LUBRICATION

The efficiency and life expectancy of mechanical equipment is largely dependent upon proper lubrication and servicing. All mechanical components rely on a lubricating film between moving parts to reduce friction, prevent wear and oxidation. Proper lubrication also helps cool the parts and keep dirt particles away from mating surfaces. Efficient lubrication depends upon using the right type of lubricant, at specified intervals and by filling to correct capacities. Past experience shows that many service problems can be traced to an improper lubricant or to incorrect lubrication procedures.

A comprehensive maintenance and lubrication program is important to ensure the long service life this vehicle was designed for and to avoid costly repairs and associated downtime caused by premature part failure.

A lubrication schedule is included in this section to give the location of key service points on the vehicle as well as the lubricant specifications for each component to be serviced. Specific instructions on how to check and service different components are covered in their respective sections in this maintenance manual.

The recommended lubrication intervals are based on normal operating conditions and mileage accumulation.

Shorten the intervals if your vehicle operates in more severe conditions. Severe conditions include heavy towing, high vehicle weight or operation in mountainous areas. Some parts and equipment referred to in this section may not be installed on your vehicle. Check your vehicle's "Coach Final Record" for equipment list.

Dispose of used lubricants and filters in an environmentally safe manner, according to federal and/or local recommendations.

1.1 FIRST SERVICE ON NEW VEHICLE

Perform the following maintenance procedures after the first 3,000 miles (5 000 km) of operation (unless otherwise specified). Once initial maintenance is performed, refer to recommended intervals in the lubrication schedule.

Repeat a component's initial maintenance procedure when it has undergone a major repair.

1.1.1 Differential

Factory-filled oil in differential on new vehicle should be replaced after 3,000 miles (5 000 km) of initial operation or after major servicing.

1.1.2 Coolant Strainer

The coolant strainer is designed to recover the soldering residues trapped inside the coolant lines during their initial assembly; perform initial cleaning once vehicle has run approximately 3,000 miles (5 000 km), then according to the lubrication and servicing schedule.

NOTE
If additional soldering has been performed on any point of coolant piping, clean coolant system strainer as outlined for a new vehicle at 3,000 miles (5 000 km).

1.1.3 Allison World Automatic Transmission

Change oil and filter cartridges after first 5,000 miles (8,000 km) of initial operation, then according to the lubrication and servicing schedule.

1.1.4 ZF-ASTRONICTransmission

No initial oil or filter change necessary. Refer to regular lubrication and servicing schedule.

1.1.5 Engine

Since engine break-in has been done in factory, there is no special break-in, so oil should be changed according to the lubrication and servicing schedule intervals. Since some oil consumption by engine is normal, check oil level daily with engine stopped and add to FULL mark on dipstick if necessary. Furthermore, the engine oil filter should be replaced each time the engine oil is changed.

2. LUBRICATION AND SERVICE SCHEDULE

Following this service schedule is the most economical and easiest way to ensure your vehicle performs at its best, safest and longest. Also, unscheduled maintenance will be minimized since inspection should expose potential problems before they become major ones.

2.1 ENGINE OIL CHANGE INTERVALS

The engine oil change intervals are related to the operating conditions, such as vehicle load, speed, etc., and may vary. It is recommended however, that the oil change be performed after every 12,500 miles (20 000 km).

The drain intervals may then be gradually increased or decreased with experience on a specific lubricant, considering the recommendations of the oil supplier (analysis of drained oil can be helpful), until the most practical service condition has been established.

Solvents should not be used as flushing oils. Dilution of the fresh refill oil supply can occur, which may be detrimental for the engine.

Engine oil temperature should be checked every 25,000 miles (40 000 km) to determine oil cooler efficiency. This check should be made by inserting a steel jacketed thermometer in the dipstick opening, immediately after stopping a hot, loaded engine. If the oil temperature exceeds the coolant temperature by more than 60 °F (33 °C), the oil cooler may be clogged.

For detailed oil specifications, refer to *"Detroit Diesel Series 60 Service Manual"* under heading *"Lubricating Oil for Detroit Diesel Engines"*.

2.1.1 Engine Oil Reserve Tank

An oil reserve tank with a capacity of 8.4 US quarts (8,0 liters) (optional) is connected to the crankcase by a hose with a shutoff valve, allowing oil to be added to crankcase by opening valve. Comparison of oil levels in sight gauge, before and after adding oil to crankcase, shows approximately how much oil has been added.

Filling of this tank can be made by opening the rear engine doors. The tank is mounted on R.H. side of engine compartment, over the A/C compressor.

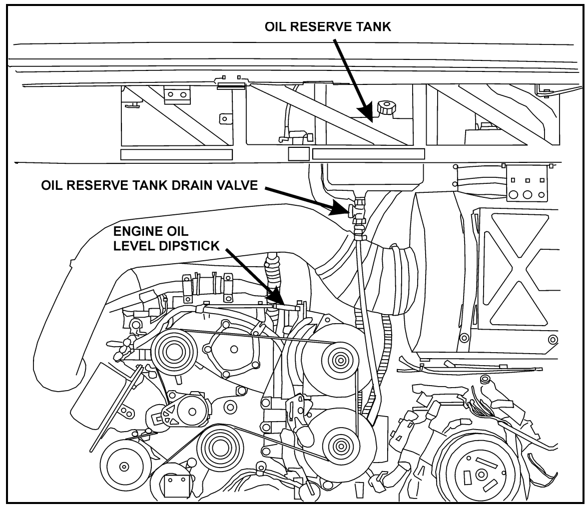


FIGURE 1: ENGINE OIL RESERVE TANK 01067

2.2 COLD WEATHER OPERATION

The proper selection of the engine oil grade will ease cold weather starting (refer to the lubrication and servicing schedule for the engine oil grade recommendation). Other practical considerations, such as the use of batteries, cables and connectors of adequate size, proper setting of voltage regulator, ether starting aid, oil and coolant heater systems, and proper fuel selection will ease cold weather starting.

2.3 FLEXIBLE HOSE MAINTENANCE

The performance of engine and equipment are greatly related to the ability of flexible hoses to supply lubricating oil, air, coolant, and fuel oil. Maintenance of hoses is an important step to ensure efficient, economical, and safe operation of the engine and related equipment.

2.3.1 Pre-Starting Inspection

Check hoses daily as part of the pre-starting inspection. Examine hose for leaks, and check all fittings, clamps, and ties carefully. Ensure that hoses are not resting on or touching shafts, couplings, heated surfaces including exhaust manifolds, any sharp edges, or other obviously damaging areas. Since all machinery vibrates and moves to a certain extent, clamps and ties can fatigue with time. To ensure proper support, inspect fasteners frequently and tighten or replace them as necessary.

2.3.2 Leaks

Investigate leaks immediately to determine if fittings have loosened or cracked, and also if hoses have ruptured or worn through. Take corrective action immediately. Leaks are not only potentially detrimental to machine operation, but can also result in added expenses caused by the need to replace lost fluids.

⚠ **CAUTION** ⚠

Personal injury and/or property damage may result from fire due to the leakage of flammable fluids, such as fuel or lube oil.

2.3.3 Service life

The limited service life of a hose is determined by the temperature and pressure of the gas or fluid within it, the time in service, its installation, the ambient temperatures, amount of flexing, and the vibration it is subjected to. With this in mind, it is recommended that all hoses be thoroughly inspected at least every 500 operating hours or after 15,000 miles (24 000 km). Look for surface damage or indications of damaged, twisted, worn, crimped, brittle, cracked, or leaking lines. Hoses having a worn outer surface or hoses with a damaged metal reinforcement should be considered unfit for further service.

It is also recommended that all hoses in this vehicle be replaced during major overhaul and/or after a maximum of five service years. Quality of replacement hose assemblies should always be equal to or superior to those supplied by the Original Equipment Manufacturer.

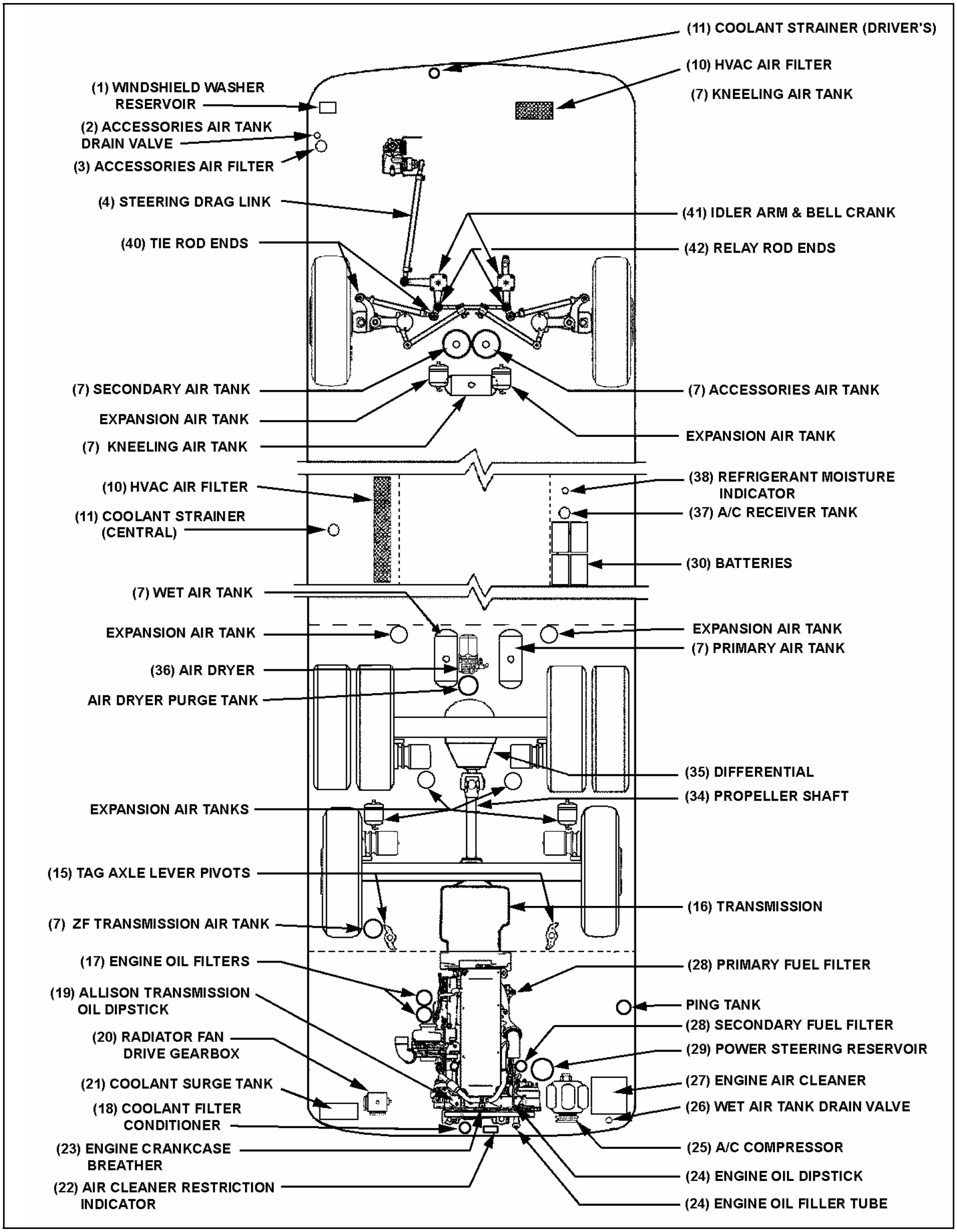


FIGURE 2: LUBRICATION AND SERVICING POINTS ON INDEPENDENT FRONT SUSPENSION VEHICLES 24031

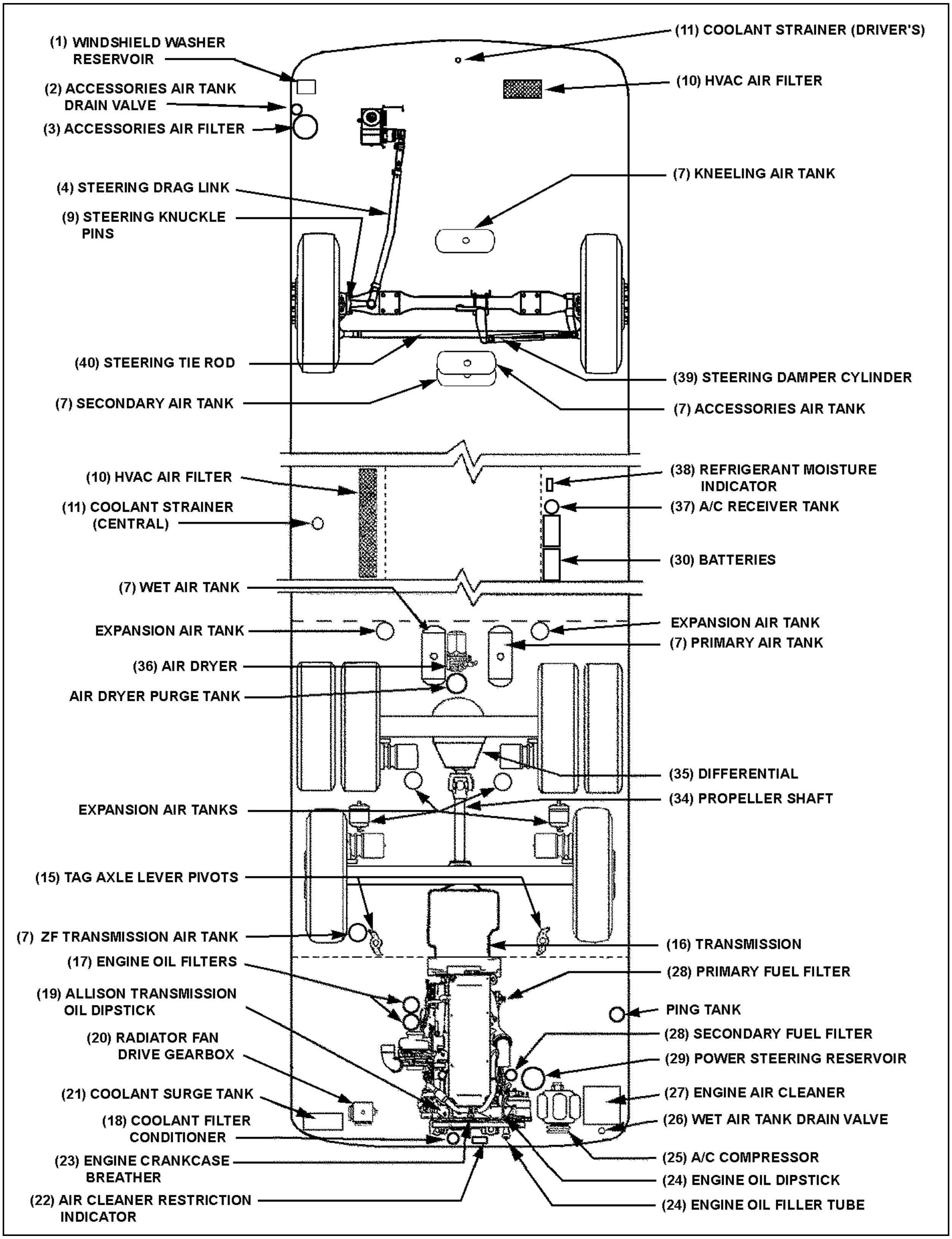


FIGURE 3: LUBRICATION AND SERVICING POINTS ON I-BEAM AXLE FRONT SUSPENSION VEHICLES 24030

2.4 WALK-AROUND INSPECTION

It is good practice to make a basic visual inspection of key areas on the vehicle every day and to correct any problem found.

OUTSIDE THE VEHICLE	
ITEM*	DESCRIPTION
---	Check for leaks under vehicle and in engine compartment.
---	Check that baggage and service compartment doors close properly.
---	Inspect tires and wheels for correct tire pressure, wear or damage and for missing wheel studs and nuts.
1	Check windshield washer fluid level and add if necessary.
---	Check condition of windshield wiper blades.
---	Verify proper operation of all road lights, signal lights, brake lights, marker lights and back-up lights; Replace light bulbs as required.
2, 26	Drain accumulated water in accessory and wet air tanks.

ENGINE COMPARTMENT	
ITEM*	DESCRIPTION
24	Check engine crankcase oil level; Add if necessary.
19	Check Allison transmission oil level (can be checked from push-button shift selector); Add if necessary.
29	Check power steering reservoir fluid level; Add if necessary.
21	Check coolant surge tank fluid level; Add if necessary.
28	Drain accumulated water in primary fuel filter/water separator (if equipped). Visually check fuel filter cartridge (Fuel-Pro 382 equipped vehicles only).
22, 27	Check air cleaner restriction indicator; Replace air cleaner when red signals locks in full view.

INSIDE THE VEHICLE	
ITEM*	DESCRIPTION
---	Check for proper operation of the entrance door.
---	Check that emergency exit windows and roof escape hatches can be opened, then close all windows and hatches securely.
---	Verify proper operation of windshield wiper/washer.
---	Adjust and clean mirrors as needed for adequate rear-view vision.
---	Start engine and check for proper operation of all gauges and indicator lights.
---	Check for proper operation of electric and air horns and back-up alarm.
---	Perform a brake test. Check both primary and secondary pressure gauges.

* Item numbers refer to figures 2 and 3.

2.5 LUBRICATION AND SERVICING SCHEDULE

2.6 LUBRICANT AND COOLANT SPECIFICATIONS

ITEM*	DESCRIPTION	SPECIFICATIONS
24	Engine Oil	SAE Viscosity Grade: 15W40 API Classification: CI-4
29	Power Steering Oil	Automatic Transmission Oil (Dexron-IIE or Dexron-III)
18, 21	Engine Coolant	Low silicate, ethylene glycol coolant 50% antifreeze/water solution is normally used Antifreeze concentration should be between 30% and 67%
25	A/C Compressor Oil	Polyolester Oil, HFC 134a compatible: Castrol SW-68 (POE) or equivalent
35	Differential Oil	Multigrade gear oil meeting MIL-L-2105-D: 85W/140. If temperature drops below 10°F (-12°C), 80W90 should be used. Below -15°F (-26°C), 75W90 should be used. (In extreme conditions or for better performance, full synthetic gear oil can be used.)
20	Fan Gearbox Oil	Synthetic oil: Mobil SHC 630
19	Allison Automatic Transmission Oil	Dexron-IIE, Dexron-III or TranSynd
19	ZF-ASTronic Transmission Oil	Castrol Syntrans Grade SAE 75W-85 (Synthetic)
---	Multi Purpose Grease	Good quality lithium-base grease: NLGI No.2 Grade is suitable for most temperatures NLGI No.1 Grade is suitable for extremely low temperatures

* Item numbers refer to figures 2 and 3.

2.7 PART NUMBER SPECIFICATIONS

ITEM*	DESCRIPTION	PRÉVOST NO
17	Engine Oil Filters	#510458
29	Power Steering Reservoir Oil Filter	#660528
27	Engine Air Cleaner Filter	#530197
38	Refrigerant Filter Dryer Unit	#950262
28	Engine Primary Fuel Filter	#510137
28	Engine Primary Fuel Filter With Water Separator (Optional)	#531407
28	Engine Secondary Fuel Filter	#510128
28	Secondary “Racor” Fuel Filter	#531390
18	Engine Coolant Precharge Unit	#550629
18	Engine Coolant Filter/Conditioner	#550630
10	A/C And Heating Driver's Air Filter	#871147--871144
10	A/C And Heating Cabin's Air Filter	#871051
16	Allison World (WT) Automatic Transmission Oil Filter Kit	#571709
11	Coolant Strainer	#871029
3	Accessories Air Filter	#641340
36	Air Dryer Cartridge	#641244
---	Alternator drive belt, 85-1/2 in. (2 alternators)	#5060055
---	Alternator drive belt, 72 in. (1 alternator, limp home)	#5060056
---	Fan gearbox drive belt	#506688
---	Compressor drive belt BX100	#506864
---	Windshield wiper blade	#800329

* Item numbers refer to figures 2 and 3.

LUBRICATION AND SERVICING SCHEDULE	Item	Months	DISTANCE TRAVELED[1] (miles/km)																																LUBRICANT &/OR PART[2]
			6 250 / 10 000	12 500 / 20 000	18 750 / 30 000	25 000 / 40 000	31 250 / 50 000	37 500 / 60 000	43 750 / 70 000	50 000 / 80 000	56 250 / 90 000	62 500 / 100 000	68 750 / 110 000	75 000 / 120 000	81 250 / 130 000	87 500 / 140 000	93 750 / 150 000	100 000 / 160 000	106 250 / 170 000	112 500 / 180 000	118 750 / 190 000	125 000 / 200 000	131 250 / 210 000	137 500 / 220 000	143 750 / 230 000	150 000 / 240 000	156250 / 250 000	162 500 / 260 000	168 750 / 270 000	175 000 / 280 000	181 250 / 290 000	187 500 / 300 000	193 750 / 310 000	200 000 / 320 000	
GENERAL																																			
Flexible hoses, thoroughly inspect all hoses	-	12								●								●								●								●	-------
Front discharge tube, qty:2, check to see if clogged[3]	-	3																																	-------
01 ENGINE																																			
Air cleaner, inspect, clean, replace element if required	27	6	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	Filter #530197
Engine, change oil and filters. Oil SAE 15W40, API CI-4	17	12		●		●		●		●		●		●		●		●		●		●		●		●		●		●		●		●	Filter #510458
Engine crankcase breather, clean breather steel mesh	23	12								●								●								●								●	-------
03 FUEL																																			
Change primary & secondary fuel filters, fill with clean fuel before installation	28	12		●		●		●		●		●		●		●		●		●		●		●		●		●		●		●		●	Primary #510137 ; prim. w/sep #531390 ; secondary #510128
05 COOLING																																			
Radiator fan drive gearbox,check oil level, add if necessary	20	6	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	Mobil SHC 630 #180217
Radiator fan drive gearbox, change oil	20	12								●								●								●								●	Mobil SHC 630 #180217
Coolant filter/Conditioner, replace element	18	12		●		●		●		●		●		●		●		●		●		●		●		●		●		●		●		●	Filter #550630
Coolant surge tank, test coolant solution	21	12		●		●		●		●		●		●		●		●		●		●		●		●		●		●		●		●	-------
Cooling system, drain, flush and refill	18/ 21	24																																●	Engine coolant
06 ELECTRICAL																																			
Battery terminals, clean and coat terminals	30	12																																	Battery terminal coating
Bosch alternators, replace brushes & voltage regulator		24																●																●	Regulator #562981 Brush set #562983
Bosch alternators, replace bearings		48																																●	Bearing, Ball #562972 Bearing, Roller #562976

[1] Proceed to maintenance operation at distance indicated on odometer or specified number of month, whichever comes first.
[2] See paragraph 2.5 & 2.6 of this section for lubricant and part number specifications.
[3] Discharge tubes are rubber tubes located under vehicle

LUBRICATION AND SERVICING SCHEDULE	Item	Months	DISTANCE TRAVELED[1] (miles/km)																																LUBRICANT &/OR PART[2]
			6 250 / 10 000	12 500 / 20 000	18 750 / 30 000	25 000 / 40 000	31 250 / 50 000	37 500 / 60 000	43 750 / 70 000	50 000 / 80 000	56 250 / 90 000	62 500 / 100 000	68 750 / 110 000	75 000 / 120 000	81 250 / 130 000	87 500 / 140 000	93 750 / 150 000	100 000 / 160 000	106 250 / 170 000	112 500 / 180 000	118 750 / 190 000	125 000 / 200 000	131 250 / 210 000	137 500 / 220 000	143 750 / 230 000	150 000 / 240 000	156250 / 250 000	162 500 / 260 000	168 750 / 270 000	175 000 / 280 000	181 250 / 290 000	187 500 / 300 000	193 750 / 310 000	200 000 / 320 000	
07 TRANSMISSION																																			
Allison World Automatic transmission, change oil (standard oil) and filters	16	12		●		●		●		●		●		●		●		●		●		●		●		●		●		●		●		●	Oil Dexron-IIE or Dexron-III Filters #571709
Allison World Automatic transmission, change oil (only if filled with TranSynd synthetic fluid) and filters[3]	16	12								●								●								●								●	TranSynd Synthetic Fluid; Filters #571709
ZF-Astronic Automatic Transmission, change oil & filter after 185 000 miles (300 000 km)	16	24																														●			Castrol Syntrans grade SAE 75W-85
Transmission oil cooler, replace unit if vehicle is equipped with transmission retarder	43	24																																	Prévost #550712
09 PROPELLER SHAFT																																			
Grease one fitting on each universal joint and slip joint	34	6	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	Multipurpose grease
11 REAR AXLE																																			
Differential, check oil level, add if necessary	35	6	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	Multigrade gear oil
Differential, change oil, clean breathers	35	24																●																●	Multigrade gear oil
Tag axle lever pivot, grease one fitting on each pivot	15	6	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	Multi purpose grease
12 BRAKE & AIR																																			
Air tanks, drain water from all tanks	7	12		●		●		●		●		●		●		●		●		●		●		●		●		●		●		●		●	-------
Accessories air filter, change filter element	3	24																●																●	Filter element #641340
Air dryer, change cartridge	36	24																●																●	Cartridge #641244 or 641278

[1] Proceed to maintenance operation at distance indicated on odometer or specified number of month, whichever comes first.
[2] See paragraph 2.5 & 2.6 of this section for lubricant and part number specifications.

[3] When the transmission contains a mixture of fluids (defined as the quantity of non-TranSynd fluid remaining in the transmission after a fluid change combined with the quantity of TranSynd required to fill the transmission to the proper level), perform the fluid and filter change at 25 000 miles (40 200km) or 1 year, whichever comes first.

LUBRICATION AND SERVICING SCHEDULE	Item	Months	DISTANCE TRAVELED[1] (miles/km)																																LUBRICANT &/OR PART[2]
			6 250 / 10 000	12 500 / 20 000	18 750 / 30 000	25 000 / 40 000	31 250 / 50 000	37 500 / 60 000	43 750 / 70 000	50 000 / 80 000	56 250 / 90 000	62 500 / 100 000	68 750 / 110 000	75 000 / 120 000	81 250 / 130 000	87 500 / 140 000	93 750 / 150 000	100 000 / 160 000	106 250 / 170 000	112 500 / 180 000	118 750 / 190 000	125 000 / 200 000	131 250 / 210 000	137 500 / 220 000	143 750 / 230 000	150 000 / 240 000	156250 / 250 000	162 500 / 260 000	168 750 / 270 000	175 000 / 280 000	181 250 / 290 000	187 500 / 300 000	193 750 / 310 000	200 000 / 320 000	
14 STEERING																																			
Drag link ends, grease one fitting at each end	4	6	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	Multi purpose grease
Relay rod ends, grease one fitting at each end	42	6	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	Multi purpose grease
Tie rod ends, grease one fitting at each end	40	6	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	Multi purpose grease
Idler arm, grease fitting	41	6	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	Multi purpose grease
Bell crank, grease fitting	41	6	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	Multi purpose grease
Power steering reservoir, replace oil and filter cartridges	29	12								●								●								●								●	Cartridge #660987
16 SUSPENSION																																			
Upper A-Arm Ball Joint, grease fitting	-	6	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	Molykote longterm 2/78 grease (preferably) or lithium NLGI no2 or no1
22 HEATING & AIR CONDITIONING																																			
A/C compressor, check oil level, add if necessary	25	6	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	Polyolester oil
A/C receiver tank, check refrigerant level, add if necessary	37	6	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	HFC 134A
Refrigerant moisture indicator, replace filter dryer unit according to moisture indicator (as needed)	38	6	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	Filter #950262
A/C and Heating air filters, clean or replace all elements	10	6		●		●		●		●		●		●		●		●		●		●		●		●		●		●		●		●	Driver #871147 , passenger #871051
Coolant strainer, check, clean, change cartridge if required	11	12								●								●								●								●	Cartridge #871029
Condenser discharge tube, qty:2, check to see if clogged [3]	-	3																																	-------
Evaporator discharge tube, qty:6, check to see if clogged [3]	-	3																																	-------
Evaporator motor, condenser motor, recirculating pump drive motor, inspect brush, replace if necessary	-	12								●								●								●								●	Refer to parts manual

[1] Proceed to maintenance operation at distance indicated on odometer or specified number of month, whichever comes first.
[2] See paragraph 2.5 & 2.6 of this section for lubricant and part number specifications.
[3] Discharge tubes are rubber tubes located under vehicle