

PREVOST®

COACH MANUFACTURER

MAINTENANCE MANUAL

H3-41, H3-45, VIP



PA1602

Revision 1

PA1602

First issue: June 2013

Production begins with vehicle: D-2364

Featuring:

- PRIME (Power Recovery by Intelligent Management of Energy) and Bitzer A/C compressor

REVISION	DESCRIPTION	FROM	DATE
1	On coaches: new front suspension, new rear suspension, new drag link	E-2505	September 3, 2013

SECTION 00: GENERAL INFORMATION

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Section 00 : GENERAL INFORMATION

1. FOREWORD

This manual includes procedures for diagnosis, service, maintenance and repair for components of the H3 series coaches or VIP model 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.*

Prevost 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 and 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 **major and costly damage** caused to the vehicle electronic components.

NOTE

Execute procedure no: SAV060034 "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 **chassis** 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, disconnect electronic modules and battery terminals.

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

Warning: 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 1/2"	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, disconnect electronic modules and battery terminals.

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

Warning: 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% CO2

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% 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 (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.

Section 00 : GENERAL INFORMATION

4. SAFETY NOTICE

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

This manual covers only the procedures as of manufacturing date.

Safety features may be impaired if other than genuine PREVOST 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:

Warning: Identifies an instruction which, if not followed, could cause personal injuries.

Caution: Outlined an instruction which, if not followed, could severely damage vehicle components.

Note: Indicates supplementary information needed to fully complete an instruction. 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

Volvo D13 Engine

Volvo D13 engine serial and model numbers are stamped on the cylinder head (Fig. 1).

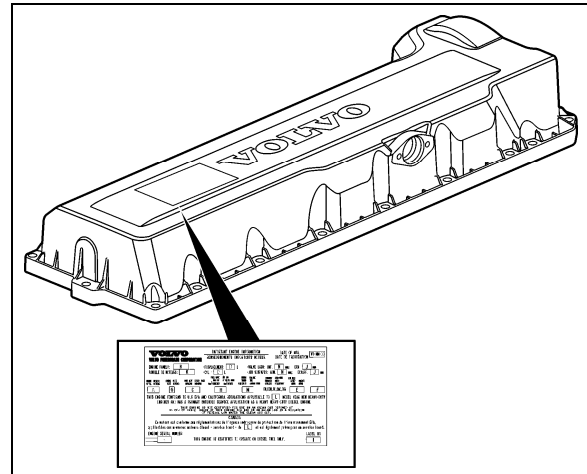


FIGURE 1: VOLVO D13 ENGINE DATA PLATE 00052

4.1.2 Transmission

The transmission identification plate is located:

Allison - on the oil level dipstick side.

I-Shift - on the transmission housing, on the vehicle R.H. side.

The identification plate shows the transmission serial number, part number (assembly number), and model number. Use all three numbers when ordering parts.

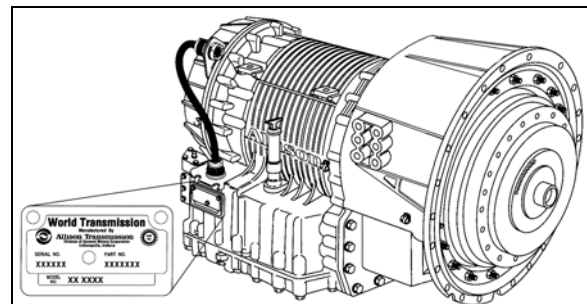


FIGURE 2: WORLD TRANSMISSION 07076

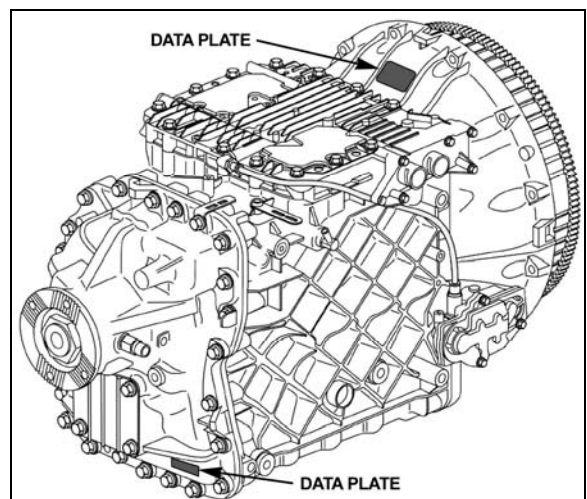


FIGURE 3: I-SHIFT TRANSMISSION

4.1.3 Drive Axle

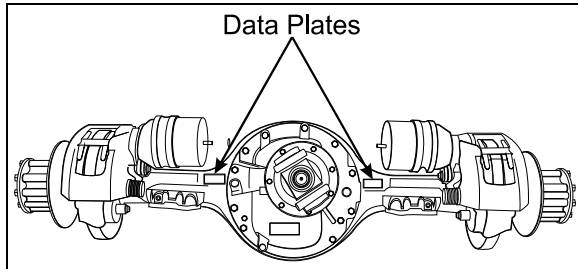


FIGURE 4: TYPICAL SERIAL & MODEL NUMBERS 11019

4.1.4 Front Axle

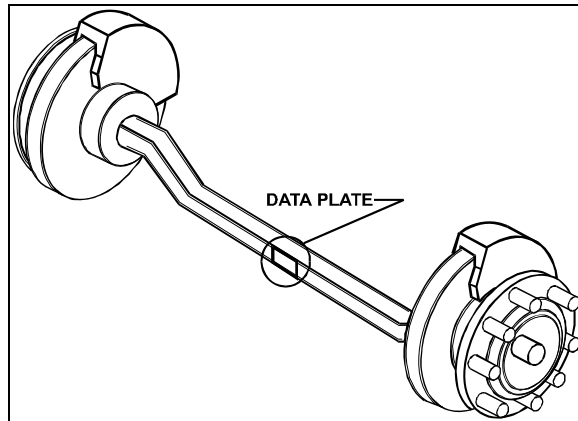


FIGURE 5 : I-BEAM AXLE TYPICAL SERIAL AND MODEL NUMBERS 10024

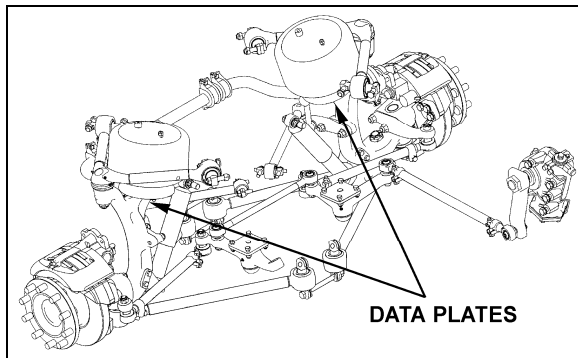


FIGURE 6: ISS TYPICAL SERIAL & MODEL NUMBERS 0025

4.1.5 Power Steering Pump

- Volvo D13 Engine

Power steering pump is mounted on the engine and located underneath the air compressor (Fig.7).

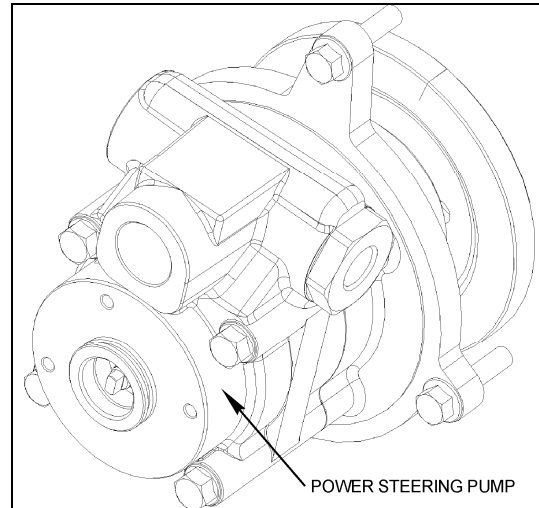


FIGURE 7: POWER STEERING PUMP

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 shipped to the new customer via a courier company. 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. The DOT Certification label is affixed on the wall, behind the driver's seat.

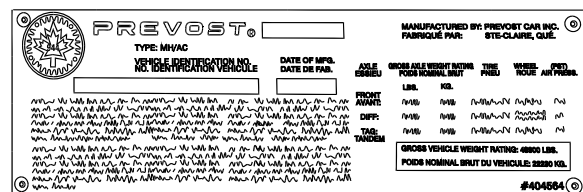


FIGURE 8: DOT CERTIFICATION PLATE 00016

Section 00 : GENERAL INFORMATION

4.1.9 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.

4.1.10 EPA Engine Label

The exhaust emission certification label affixed above the oil reserve tank certifies that the engine conforms to federal and any state exhaust emission regulations (Fig. 9). It gives the operating conditions under which certification was made.

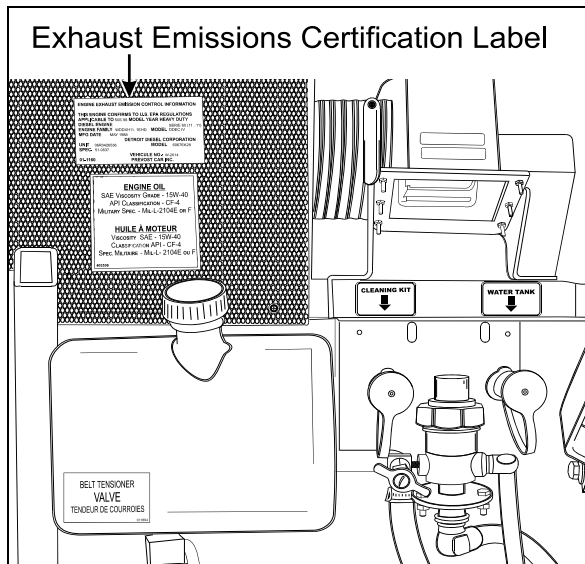


FIGURE 9: ENGINE COMPARTMENT

23229

4.1.11 Vehicle Identification Number (VIN)

The seventeen digit vehicle identification number (VIN) is located on a plate (Fig. 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.

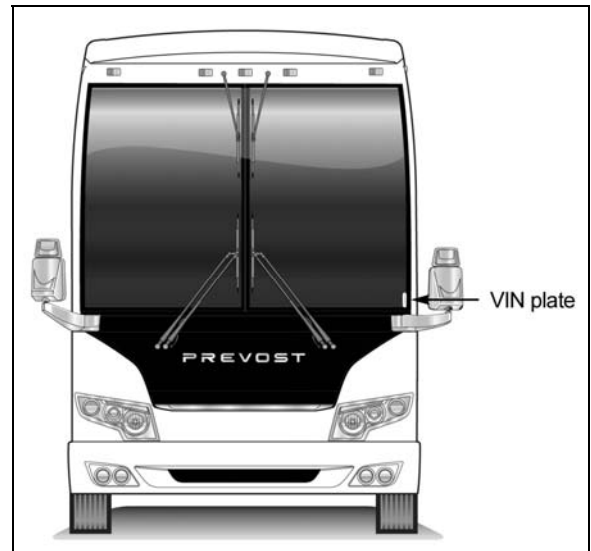


FIGURE 10 : VEHICLE I.D.

18680

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.

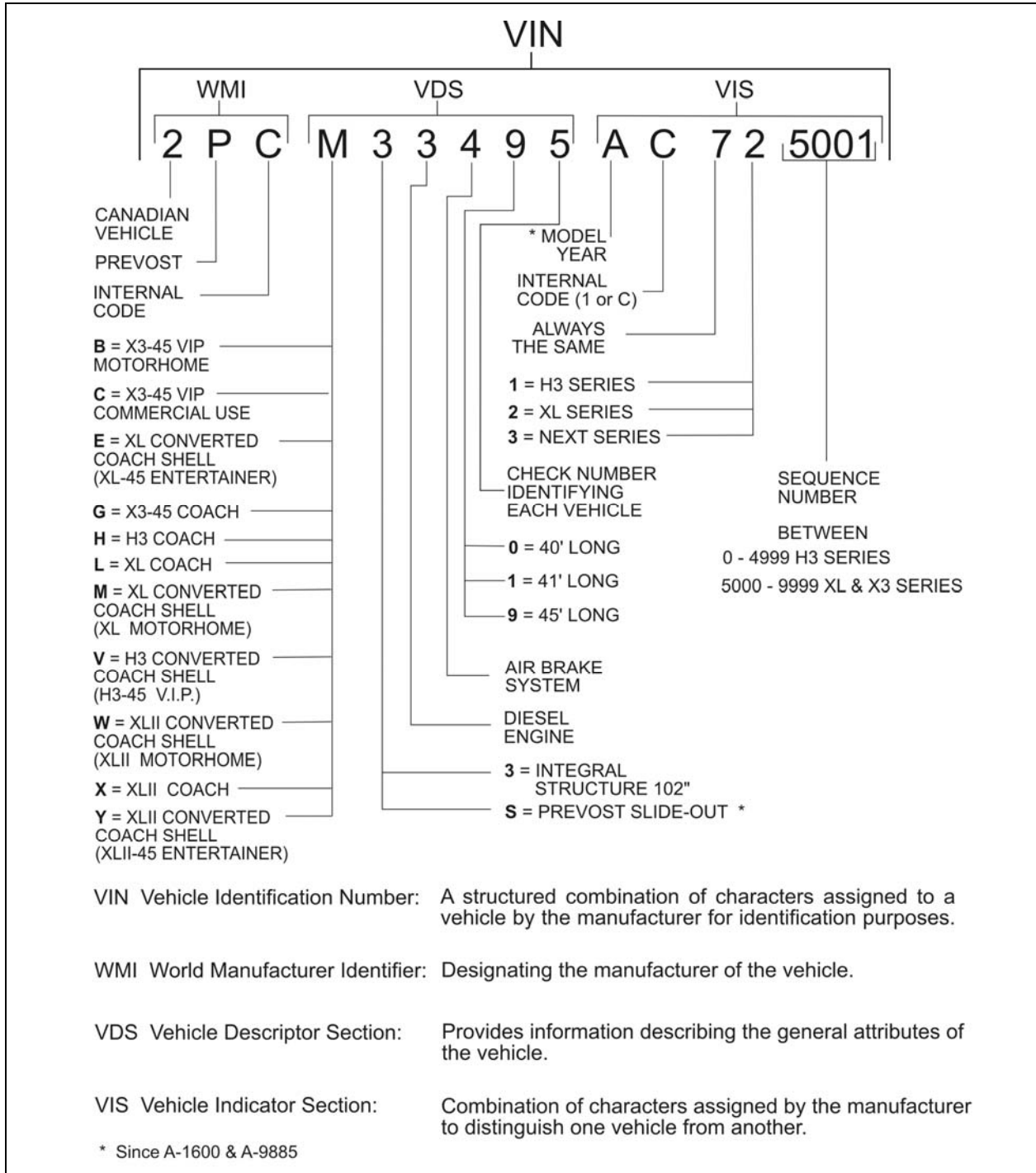


FIGURE 11 : VEHICLE IDENTIFICATION NUMBER

00050

YEAR	CODE	YEAR	CODE	YEAR	CODE
2000	Y	2006	6	2012	C
2001	1	2007	7	2013	D
2002	2	2008	8	2014	E
2003	3	2009	9	2015	F
2004	4	2010	A	2016	G
2005	5	2011	B	2017	H

Section 00 : GENERAL INFORMATION

5. FASTENERS

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. 13 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.

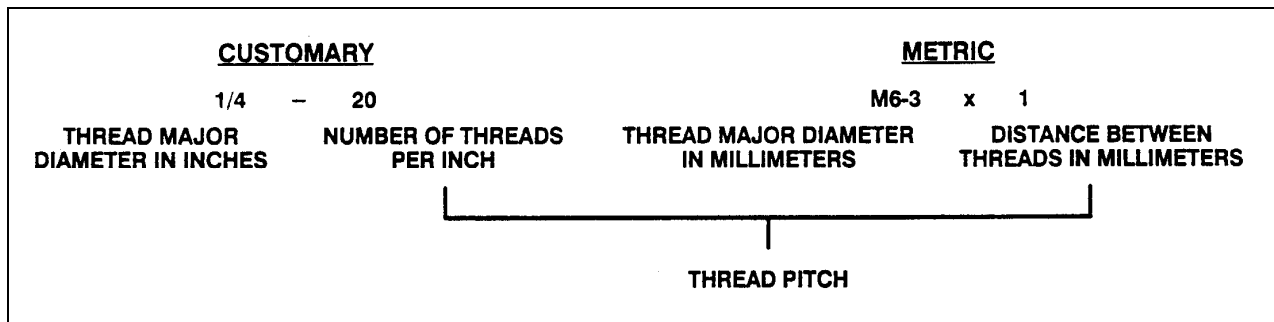


FIGURE 12 : THREAD NOTATION

00002

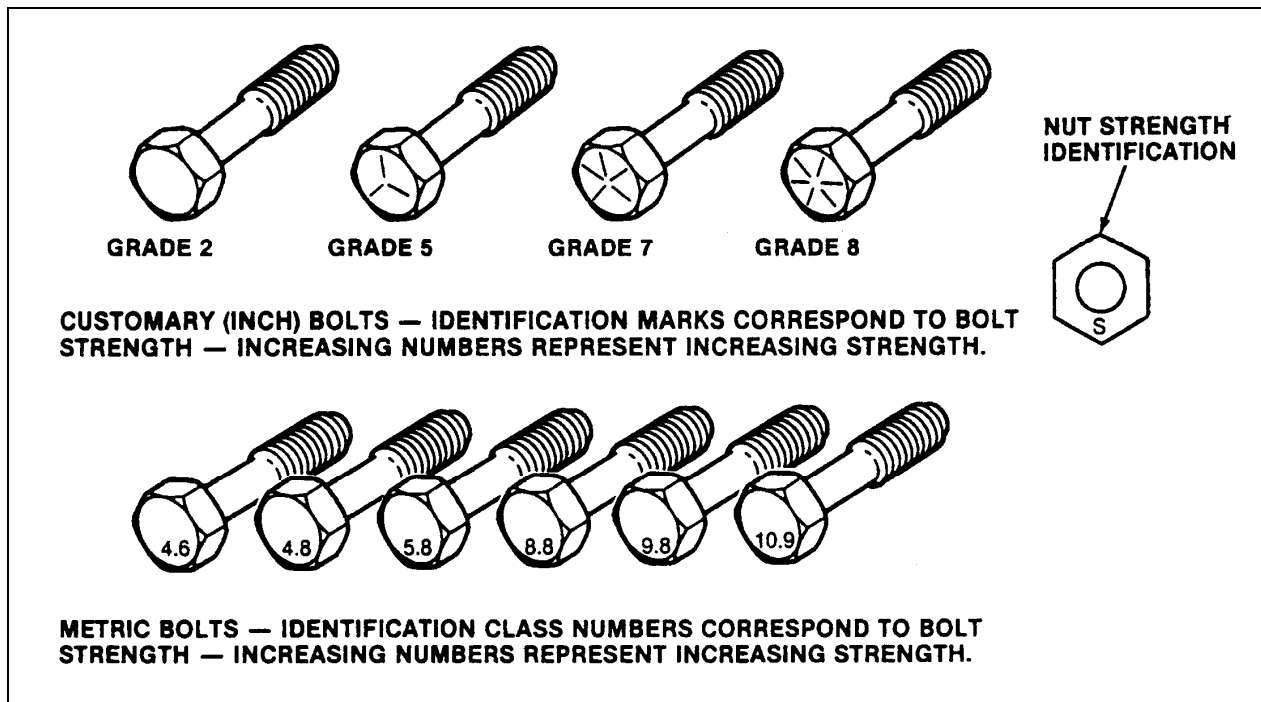


FIGURE 13: BOLT STRENGTH MARKINGS

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 STANDARD TORQUE SPECIFICATIONS

The following table lists the standard tightening torques for bolts and nuts, relating tightening torque to thread diameter. Use the following table as a general guide for tightening torques. Use this table only for the bolts and nuts which do not require a specific torque value. All of the values are for use with dry solvent-cleaned threads.

TYPE	DESCRIPTION	THREAD	GRADE	RECOMMENDED TORQUE	
				lbf-ft (dry) otherwise specified	
				Tolerance: $\pm 10\%$	
SAE	1/4-20	unc	5	100	lbf-in (dry)
SAE	1/4-20	unc	8	143	lbf-in (dry)
SAE	1/4-28	unf	5	115	lbf-in (dry)
SAE	1/4-28	unf	8	163	lbf-in (dry)
SAE	5/16-18	unc	5	210	lbf-in (dry)
SAE	5/16-18	unc	8	305	lbf-in (dry)
SAE	5/16-24	unf	2	120	lbf-in (dry)
SAE	5/16-24	unf	5	230	lbf-in (dry)
SAE	5/16-24	unf	8	325	lbf-in (dry)
SAE	3/8-16	unc	5	31	
SAE	3/8-16	unc	8	44	
SAE	3/8-24	unf	5	35	
SAE	3/8-24	unf	8	50	
SAE	7/16-14	unc	5	50	
SAE	7/16-14	unc	8	70	
SAE	7/16-20	unf	5	55	
SAE	7/16-20	unf	8	78	
SAE	1/2-13	unc	5	75	
SAE	1/2-13	unc	8	107	
SAE	1/2-20	unf	5	85	
SAE	1/2-20	unf	8	120	
SAE	9/16-12	unc	5	109	
SAE	9/16-12	unc	8	154	
SAE	9/16-18	unf	5	122	
SAE	9/16-18	unf	8	172	
SAE	5/8-11	unc	5	151	
SAE	5/8-11	unc	8	211	
SAE	5/8-18	unf	5	170	
SAE	5/8-18	unf	8	240	

Section 00 : GENERAL INFORMATION

TYPE	DESCRIPTION	THREAD	GRADE	RECOMMENDED TORQUE lbf-ft (dry) otherwise specified Tolerance: ±10%
SAE	3/4-10	unc	5	266
SAE	3/4-10	unc	8	376
SAE	3/4-16	unf	5	298
SAE	3/4-16	unf	8	420
SAE	7/8-9	unc	5	430
SAE	7/8-9	unc	8	607
SAE	7/8-14	unf	5	470
SAE	7/8-14	unf	8	670
METRIC	M6 X 1		nut 9 / screw 8.8	7
METRIC	M6 X 1		nut 10 / screw 10.9	9
METRIC	M8 X 1.25		nut 9 / screw 8.8	16
METRIC	M8 X 1.25		nut 10 / screw 10.9	22
METRIC	M10 X 1.5		nut 9 / screw 8.8	32
METRIC	M10 X 1.5		nut 10 / screw 10.9	43
METRIC	M12 X 1.75		nut 9 / screw 8.8	60
METRIC	M12 X 1.75		nut 10 / screw 10.9	74
METRIC	M14 X 2		nut 9 / screw 8.8	90
METRIC	M14 X 2		nut 10 / screw 10.9	120
METRIC	M16 X 2		nut 9 / screw 8.8	140
METRIC	M16 X 2		nut 10 / screw 10.9	190
METRIC	M16 X 1.5		nut 10 / screw 10.9	230
METRIC	M20 X 2.5		nut 9 / screw 8.8	275
METRIC	M20 X 2.5		nut 10 / screw 10.9	450
METRIC	M20 X 1.5		nut 10 / screw 10.9	465
METRIC	M22 X 2.5		nut 9 / screw 8.8	345
METRIC	M22 X 2.5		nut 10 / screw 10.9	493
METRIC	M24 X 3		nut 9 / screw 8.8	475
METRIC	M24 X 3		nut 10 / screw 10.9	640

5.2 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. 14).

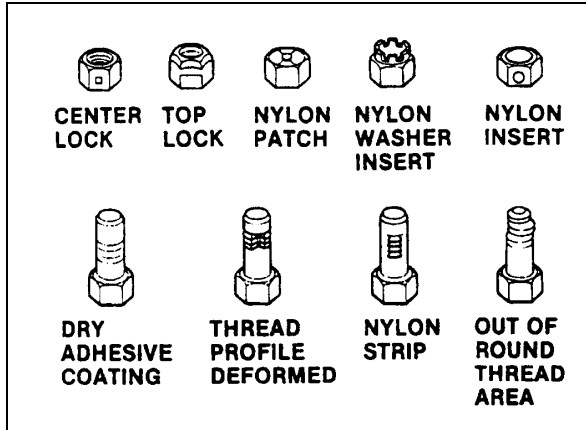


FIGURE 14 : SELF-LOCKING FASTENERS 00004

5.3 RECOMMENDATIONS FOR REUSE

Clean, rust-free 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		.250	.312	.375	.437	.500	.562	.625	.750
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

5.4 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.

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 16: CONVERSION CHART

00006

PREVOST

MULTIPLEX MODULES DISCONNECTION PROCEDURE PRIOR TO WELDING

PROCEDURE NO: PR060041

**REVISION 02
2013-04-08**

Material: N/A

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

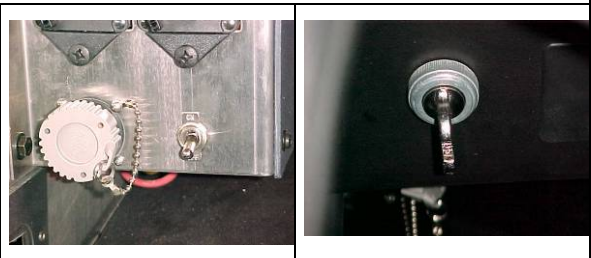
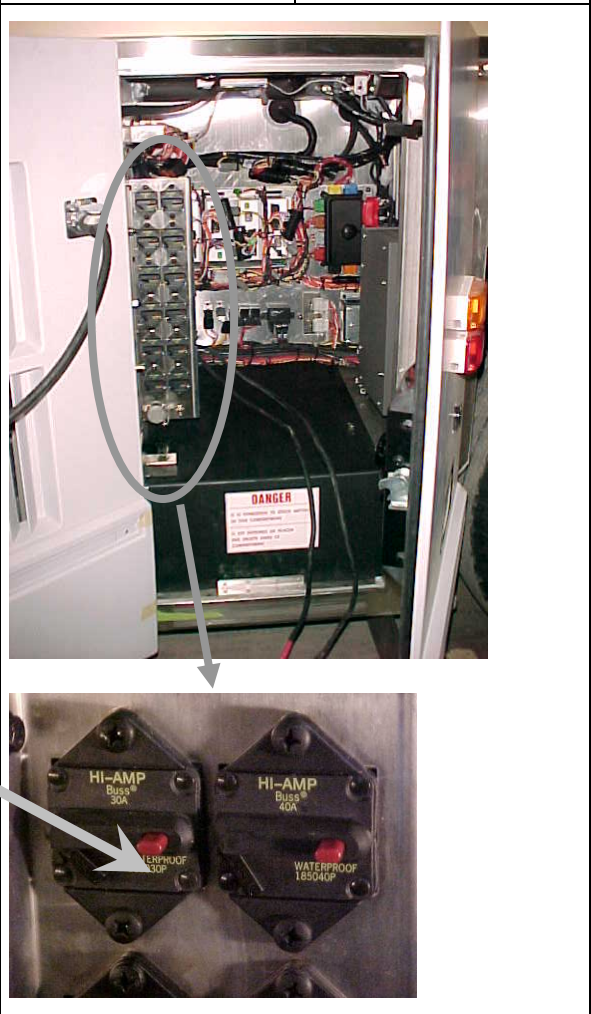
Reference schematics: N/A

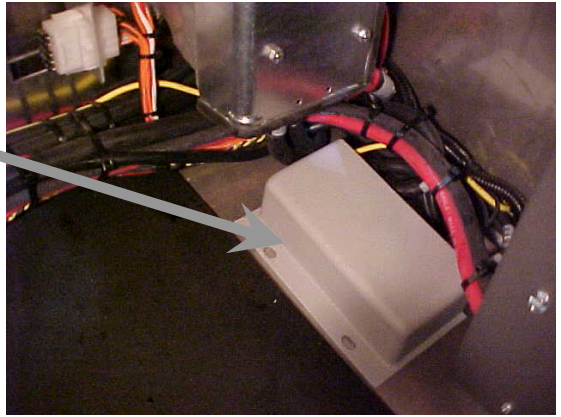
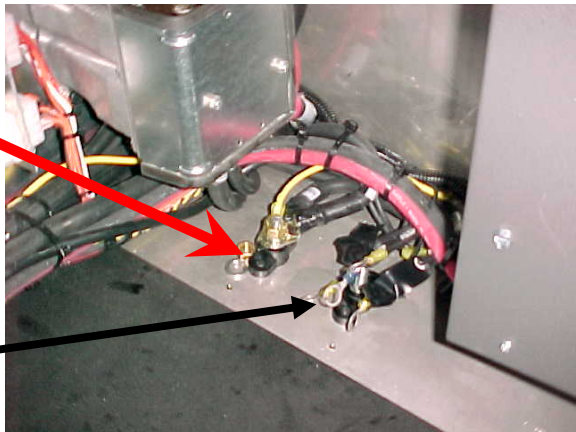
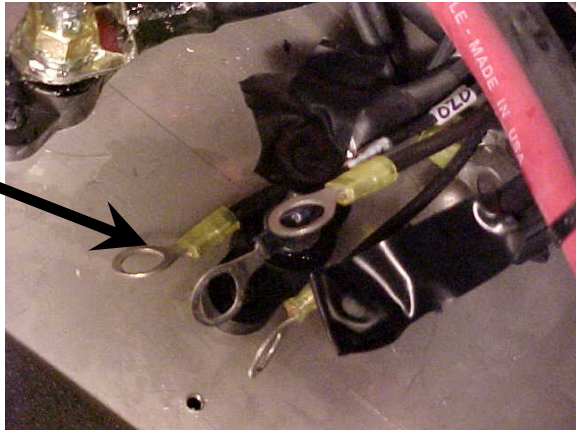
Safety rules: - Wear safety goggles
- Set the battery master switch to the OFF position first

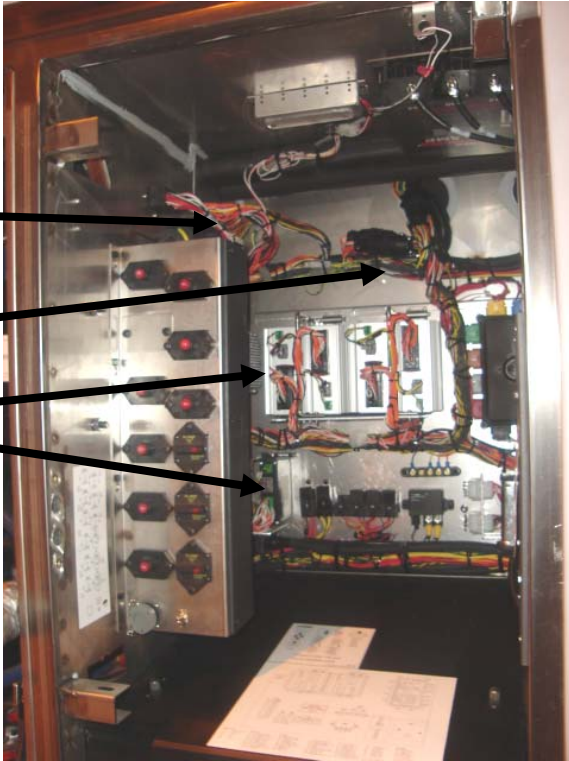

Recommendations: This procedure should be performed by qualified personnel only.

	Effective
Revision 00 : New procedure for cooling 2007	
Revision 01 : Modified for EPA 2010	
Revision 02 : Added: battery equalizer data connection (PRIME).	

SECTION 1 H3 Coaches & VIP

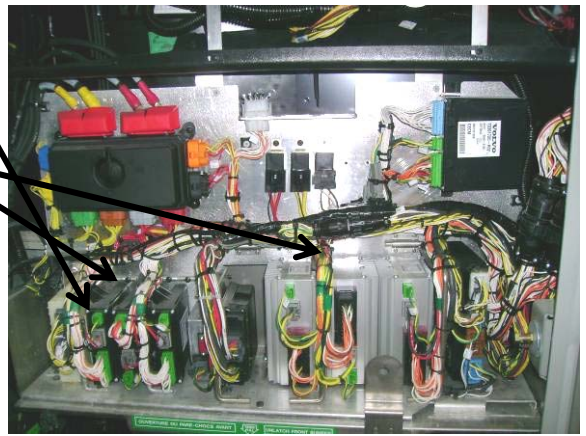
<p>1.00</p>	<p>Location: Main power compartment and dashboard.</p> <p>Set the battery master switch to the OFF position.</p> <p>Place the ignition switch to the OFF position.</p>	
<p>1.05</p>	<p>Location: Main power compartment</p> <p>Trip rear junction box circuit breakers CB2, CB4, CB6</p> <p>Push the red button to open the circuit</p>	

<p>1.10</p>	<p>Location: Main power compartment</p> <p>Remove the protective cover</p>	
	<div style="border: 2px solid red; padding: 5px; text-align: center;"> <p>⚠ WARNING ⚠</p> <p>LIVE WIRE</p> <p>This 12-volt terminal remains energized</p> </div> <p>Disconnect the electronic ground terminals from the stud.</p>	
	<p>Using electric tape, insulate the 2 largest gage wires. Make sure the ring terminals do not touch each others and the vehicle body.</p> <p>Note :</p> <p><i>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.</i></p>	

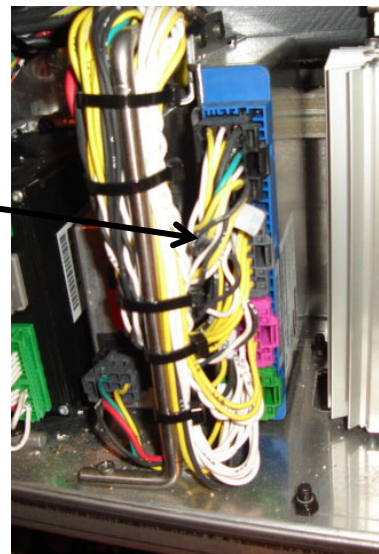
<p>1.15</p>	<p>Location: Main power compartment</p> <p>Disconnect the electronic modules :</p> <p>Disconnect I/O A, I/O B modules</p> <p>Disconnect C397</p> <p>Disconnect connector C717</p> <p>Disconnect 3 connectors from I/O B and I/O A modules.</p> <p>Disconnect data connector on equalizer</p>	 
<p>1.20 *</p>	<p>Location: Front electrical compartment</p> <p>VIP + COACH: Disconnect the I/O A, I/O B, ABS, master ID, VECU, CECM, BERU, Volvo Link, Gsecu modules.</p>	

VIP: Disconnect all keyless module connectors.

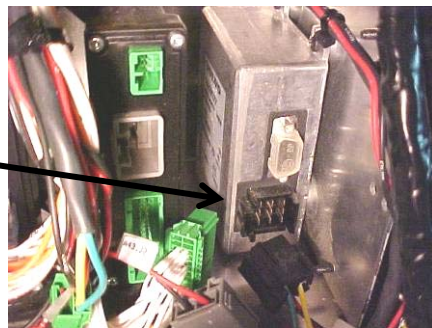
Disconnect 3 connectors from I/O B and I/O A modules



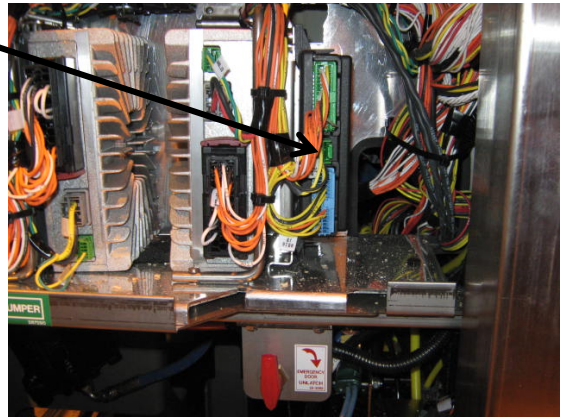
Disconnect 4 connectors from the ABS module



Disconnect connector from master ID



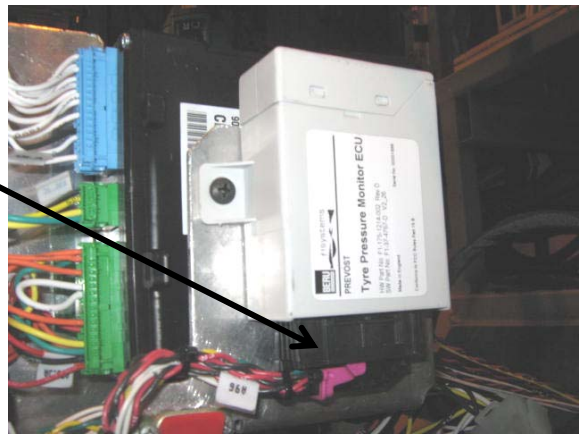
Disconnect 3 connectors from VECU



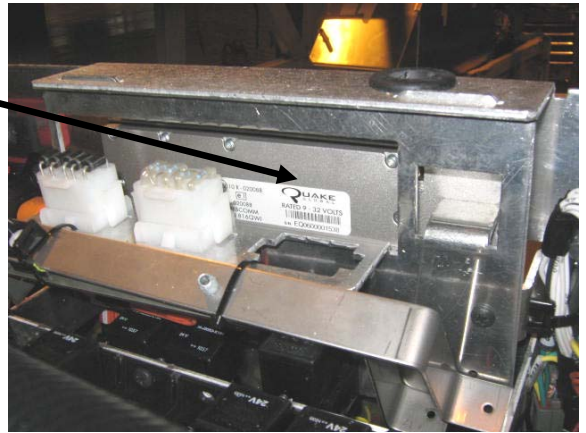
Disconnect 3 connectors from CECM



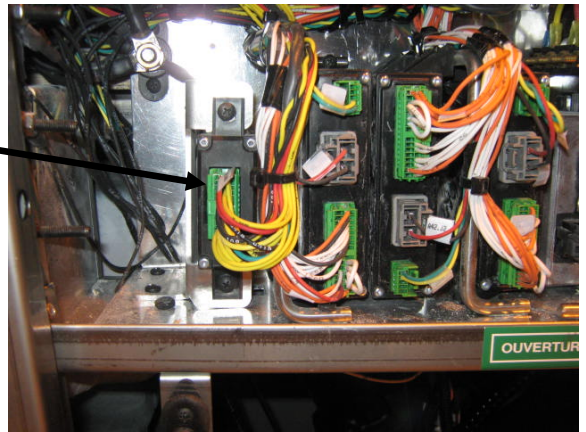
Disconnect connector A 96 from BERU
(OPTION)

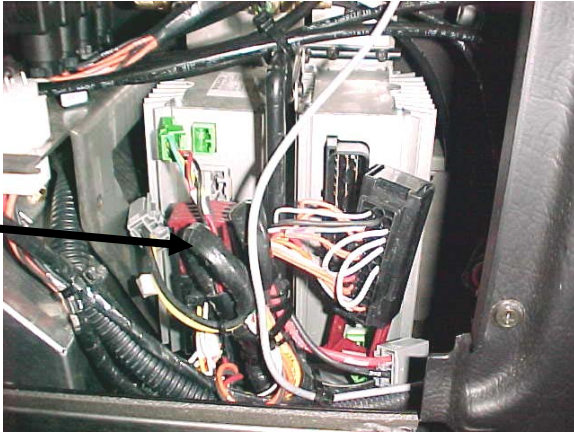




Disconnect connector A 83 under Volvo Link
module


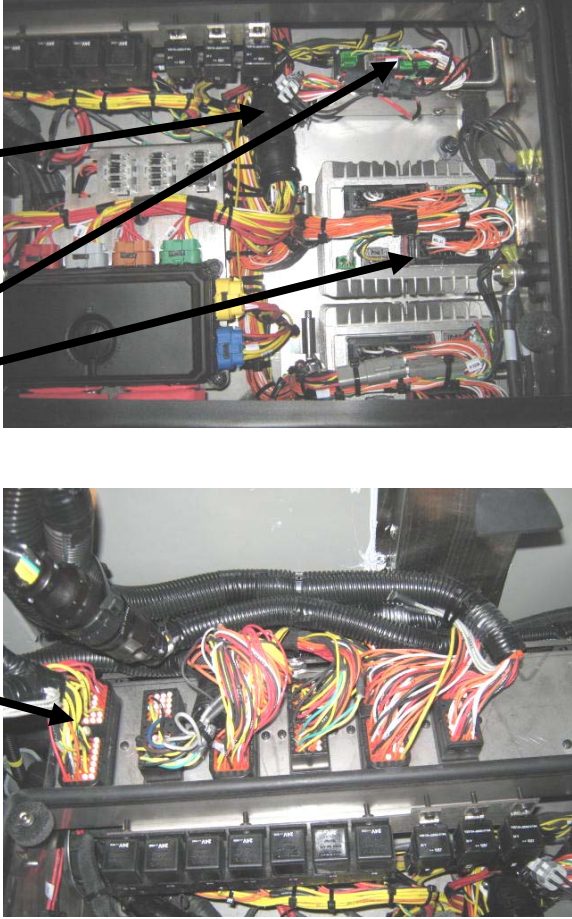


I shift Disconnect connector A 108 from
Gsecu module
(OPTION)



<p>1.25</p>	<p>Location: Pneumatic accessory panel inside right console</p> <p>Remove the access panel on the right console (R.H. side of dashboard)</p> <p>Disconnect both I/O B modules</p>	 <p>A photograph showing the interior of a vehicle's right console. It features a complex arrangement of wires, hoses, and electronic components. Two specific I/O B modules are highlighted with black arrows pointing from the text in the adjacent column.</p>
<p>1.30 *</p>	<p>Location: Condenser Compartment</p> <p>Disconnect connector A 137</p>	 <p>A photograph of a condenser compartment. It shows various blue hoses, black pipes, and electrical connectors. A specific connector, labeled 'A 137', is pointed to by a black arrow from the text in the adjacent column. A 'VOLVO 21876187' label is visible on a component in the foreground.</p>
<p>1.35</p>	<p>Location: Evaporator compartment</p> <p>Remove the protective cover and disconnect I/O B module</p>	 <p>A photograph of an evaporator compartment. It shows a metal enclosure with a protective cover partially removed. Inside, there are several I/O B modules and associated wiring. A black arrow points from the text in the adjacent column to one of the modules.</p>

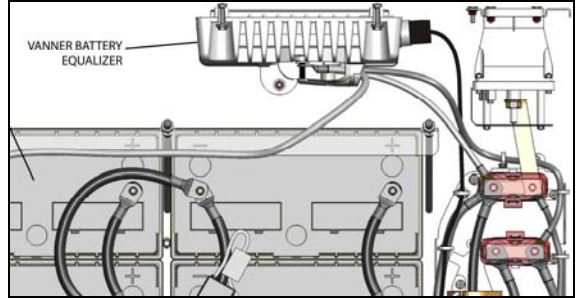
1.40	<p>Kidde Automatic Fire Detection and Suppression System (optional)</p> <p>Disconnect C466</p> <p>Kidde AFSS module is located on the lateral control panel.</p>	
1.45	<p>When all the previous steps are done, you can do welding on the vehicle.</p>	<p>ENSURE THAT THE WELDING GROUND RETURN CLAMP IS 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.</p>
1.50	<p>When welding is completed, reconnect all the modules.</p> <p>Make sure that the connectors locking tab are well engaged!</p>	<p>BE CAREFUL TO MAKE THE PROPER CONNECTIONS, IF NOT, SOME SYSTEMS OR COMPONENTS MAY NOT BE USABLE.</p>


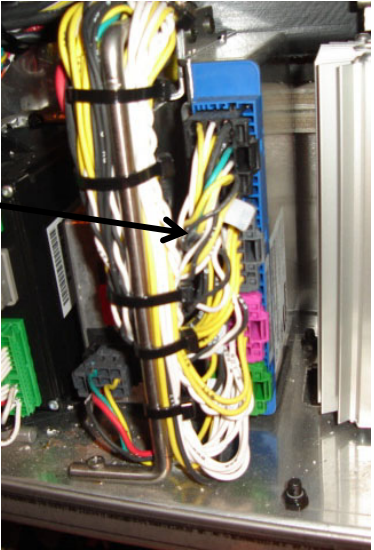
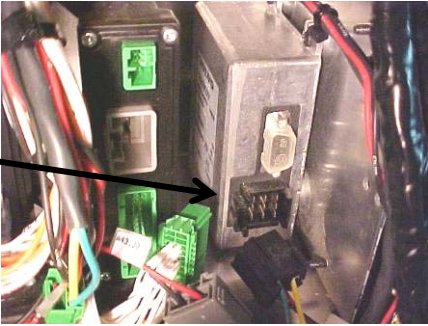
<p>2.10*</p>	<p>Location: Rear Electrical Panel</p> <p>Disconnect the electronic ground terminals from this stud.</p> <p>Use electric tape; make sure that cables do not touch each others and the vehicle body.</p> <p>Note :</p> <p><i>With disconnection of the electronic ground terminals, disconnecting the engine ECM, transmission TCM and the dashboard electronic components (telltale module, HVAC module, radio, control head ...) is not required.</i></p>	
<p>2.15*</p>	<p>Location: Rear Electrical Panel</p> <p>Disconnect the electronic modules:</p> <p>Disconnect all I/O A, I/O B modules.</p> <p style="text-align: center;">Disconnect C717</p> <p>Disconnect 3 connectors from each I/O A module</p> <p>Disconnect 3 connectors from each I/O B module</p> <p style="text-align: center;">Disconnect C397</p>	

2.15.2

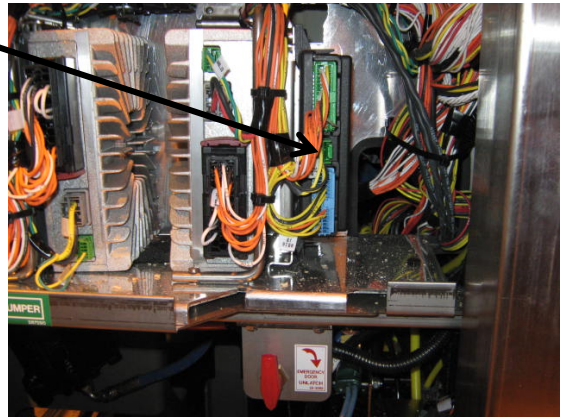
Location: battery compartment:

Disconnect data connector on equalizer



<p>2.20 *</p>	<p>Location: Front Electrical Compartment</p> <p>VIP + BUS: Disconnect the I/O A, I/O B, ABS, master ID, VECU, CECM, BERU, Volvo Link, Gsecu modules.</p> <p>VIP : Disconnect all keyless module connectors</p> <p>Disconnect 3 connectors from I/O B and I/O A modules</p>	
	<p>Disconnect 4 connectors from the ABS module</p>	
	<p>Disconnect connector from master ID</p>	

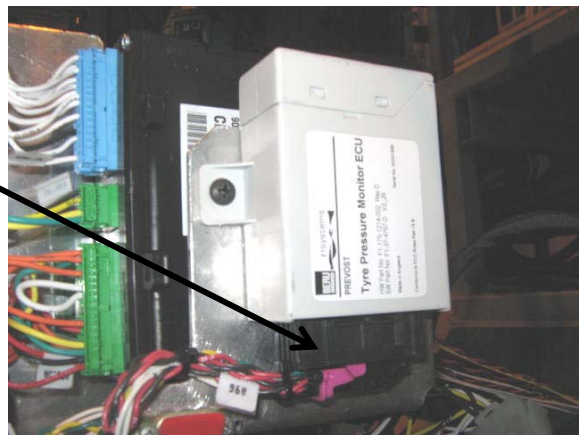
Disconnect 3 connectors from VECU



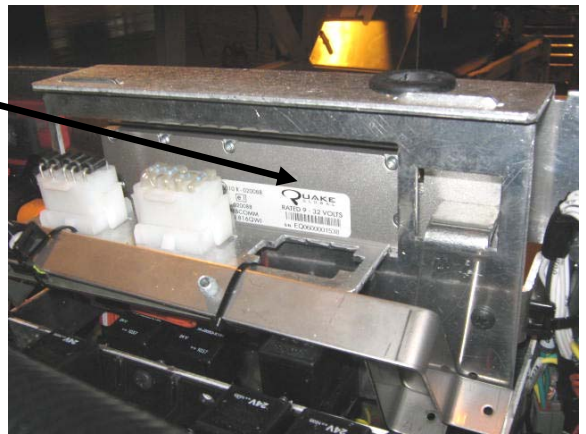
Disconnect 3 connectors from CECM

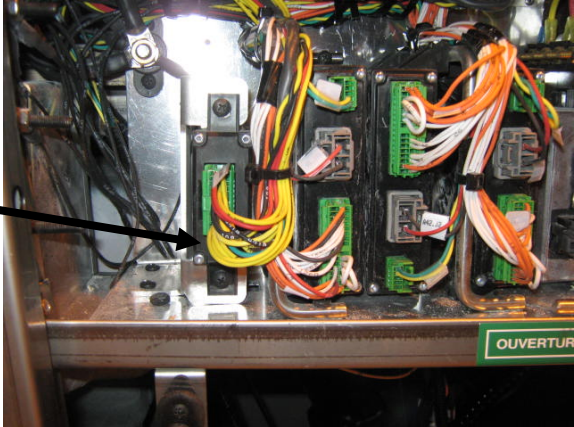
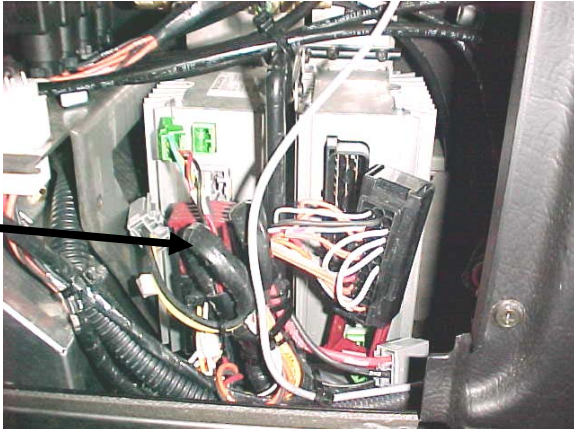
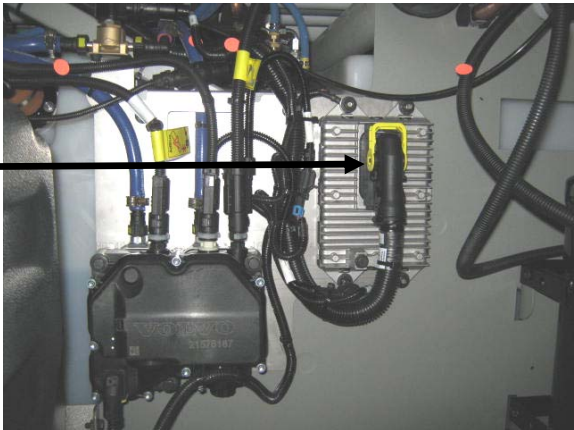


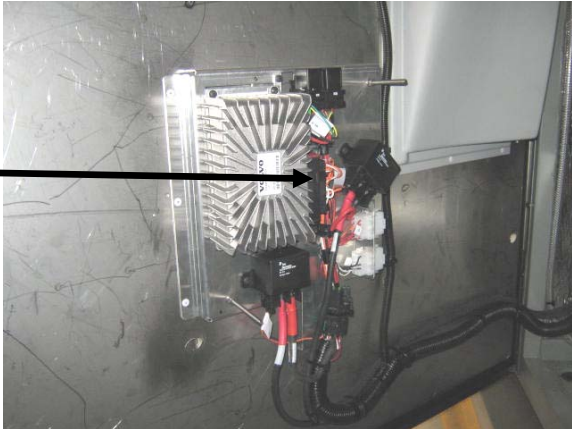
Disconnect connector A 96 from BERU
(option)



Disconnect connector A 83 under Volvo Link module



	<p>Location: Front Electrical Compartment</p> <p>I shift Disconnect connector A 108 from Gsecu module (OPTION)</p>	
2.30	<p>Location: Pneumatic accessory panel inside right console</p> <p>Remove the access panel on the right console (R.H. side of dashboard)</p> <p>Disconnect both I/O B modules</p>	
2.40	<p>Location: Condenser Compartment</p> <p>Disconnect connector A 137</p>	

<p>2.50</p>	<p>Location: Evaporator Compartment</p> <p>Disconnect A 54 module located inside the evaporator compartment, on the door.</p>	
<p>2.60</p>	<p>When all the previous steps are done, you can do welding on the vehicle.</p>	<p>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.</p>
<p>2.70</p>	<p>When welding is completed, reconnect all the modules.</p> <p>Make sure that the connectors locking tab are well engaged!</p>	<p>BE CAREFUL TO MAKE THE PROPER CONNECTIONS, IF NOT, SOME SYSTEMS OR COMPONENTS MAY NOT BE USABLE.</p>

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1. VOLVO D13 ENGINE

1.1 SYSTEM OVERVIEW

NOTE

The "Premium Tech Tool" (PTT) is the preferred tool for performing diagnostic work. Contact your local dealer for more information.

The Engine Management System (EMS) controls many engine functions such as: fuel timing and delivery, engine protection functions, engine brake operation, EGR valve function and the turbocharger nozzle function. The Engine Electronic Control Unit (EECU) along with other supporting control units and sensors are responsible for monitoring and controlling these functions. These control units communicate through the J1939 high speed serial data line to share data.

In addition to their control functions, the modules have on-board diagnostic capabilities. The on-board diagnostics are designed to detect faults or abnormal conditions that are not within their operating parameters. When the system detects a fault or abnormal condition, the fault will be logged in one or both of the modules' memory. The vehicle operator will be advised that a fault has occurred by the illumination of a malfunction indicator lamp and a message in the driver information display, if equipped. The module may initiate the engine shutdown procedure if the system determines that the abnormal condition could damage the engine. In some situations, the system will enter the "limp home" mode. Limp home mode allows continued vehicle operation but, the system may substitute a sensor or signal value that may result in reduced engine performance.

Fault codes logged in the system memory, can later be read to aid in diagnosing the fault. These faults can be read via a diagnostic computer or through the instrument cluster display, if equipped. The "Premium Tech Tool" (PTT) is the preferred tool for performing diagnostic work. Using a diagnostic computer (or PTT) connected to the Serial Communication Port, expands the technicians diagnostic capabilities with additional data and tests.

For diagnostic software, contact your local dealer.

The following is a list of engine sensors that provide input to the EMS:

- Ambient Air Temperature Sensor
- Ambient Pressure sensor
- Boost Air Pressure (BAP) Sensor
- Camshaft Position (Engine Position) Sensor
- Crankshaft Position (Engine Speed) Sensor
- Differential Pressure DPF Sensor
- EGR Differential Pressure Sensor
- EGR Temperature Sensor
- Engine Coolant Level (ECL) Sensor
- Engine Coolant Temperature (ECT) Sensor
- Engine Oil Pressure (EOP) Sensor
- Engine Oil Level (EOL) Sensor
- Engine Oil Temperature (EOT) Sensor
- Exhaust Temperature Sensor (DPF Sensors)
- Fuel Pressure Sensor
- Intake Air Temperature And Humidity (IATH) Sensor
- Intake Manifold (Boost) Temperature Sensor
- Throttle Position (TP) Sensor
- Turbo Speed Sensor
- Variable Geometry Turbocharger (VGT) Position Sensor

Sensors

Ambient Air Temperature Sensor

The Ambient Air Temperature Sensor is used to detect the outside air temperature. The sensor modifies a voltage signal from the ECM. The modified signal returns to the ECM as the ambient air temperature. The sensor uses a thermistor that is sensitive to the change in temperature. The electrical resistance of the thermistor decreases as temperature increases.

The Ambient Air Temperature Sensor is located in the front of the vehicle.

Ambient (Atmospheric) Pressure Sensor

The Ambient (Atmospheric) Pressure Sensor contains a pressure sensitive diaphragm and an electrical amplifier. Mechanical pressure applied to the diaphragm causes the diaphragm to deflect and the amplifier to produce an electrical signal proportional to the deflection.

The Ambient (Atmospheric) Pressure Sensor is built into the Engine Management System (EMS) Module.

Camshaft Position Sensor

The Camshaft Position (Engine Position) Sensor is located in the rear face of the timing gear cover at the rear of the engine, near the bottom of the valve cover. It uses magnetic induction to generate a pulsed electrical signal. It senses the passage of seven (7) timing bumps on the edge of the camshaft dampener. Six of the holes correspond to the phasing of the electronic unit injectors, while the seventh hole indicates the top dead center position.

Crankshaft Position (Engine Speed) Sensor

The Crankshaft Position (Engine Speed) Sensor uses magnetic induction to generate a pulsed electrical signal. Notches are machined into the edge of the flywheel. When one of the notches passes close to the sensor, electric pulses result.

The Crankshaft Position (Engine Speed) Sensor also indicates when the crankshaft is at the top dead center position.

Differential Pressure DP Sensor

The differential pressure sensor is used for flow measurement of the Diesel Particulate Filter (DPF). This sensor has two pressure ports and senses the difference in pressure between the two ports. Measurement of the pressure before and after the DPF is used to calculate diesel filter regeneration.

The Differential Pressure DPF Sensor is located on the side of the Diesel Particulate Filter (DPF).

EGR Differential Pressure Sensor

The EGR differential pressure sensor is used for flow measurement of the Exhaust Gas Recirculation (EGR) valve. This sensor has two pressure ports and senses the difference in pressure between the two ports. Measurement of the pressure before and after the EGR valve is used to calculate EGR flow.

The EGR Differential Pressure Sensor is located on the left or right side of the engine.

EGR Temperature Sensor

The EGR temperature sensor detects exhaust gas temperature for EGR system. The sensor

modifies a voltage signal from the control unit. The modified signal returns to the control unit as the exhaust temperature of the EGR system to confirm EGR operation. The sensor uses a thermistor that is sensitive to the change in temperature.

The EGR Temperature Sensor is located near the EGR valve.

Engine Coolant Level (ECL) Sensor

The Engine Coolant Level (ECL) Sensor is a switch. If engine coolant level falls below a calibrated point the contacts open and the driver will be notified of the low coolant level.

The Engine Coolant Level (ECL) Sensor is located in the cooling system reservoir tank.

Engine Coolant Temperature (ECT) Sensor

The Engine Coolant Temperature Sensor is located at the front of the engine. The sensor will indicate a high coolant temperature caused by problems like radiator blockage, thermostat failure, heavy load, or high ambient temperatures. This sensor is also used for cold start enhancement and for fan clutch engagement.

Engine Oil Pressure (EOP) Sensor

The Engine Oil Pressure Sensor contains a pressure sensitive diaphragm and a electrical amplifier. Mechanical pressure applied to the diaphragm causes the diaphragm to deflect and the amplifier to produce an electrical signal proportional to the deflection.

The Engine Oil Pressure Sensor is located on the oil filter assembly. The sensor monitors engine oil pressure to warn of lubrication system failure.

Engine Oil Level (EOL) Sensor

The Engine Oil Level Sensor is located in the oil pan.

Engine Oil Temperature (EOT) Sensor

The Engine Oil Temperature Sensor is a thermistor whose resistance varies inversely to temperature. The sensor has a negative temperature coefficient, which means the sensor resistance will decrease as the engine oil temperature increases.

The Engine Oil Temperature Sensor is located in the oil pan.

Exhaust Temperature Sensor (DPF Sensors)

The exhaust gas temperature sensor detects exhaust gas temperature for DPF protection as well as DPF regeneration control. The sensor modifies a voltage signal from the control unit. The modified signal returns to the control unit as the exhaust temperature at that specific location of the exhaust. The sensor uses a thermistor that is sensitive to the change in temperature.

The Exhaust Temperature Sensors are located in the DPF assembly.

Fuel Pressure Sensor

The fuel pressure sensor contains a diaphragm that senses fuel pressure. A pressure change causes the diaphragm to flex, inducing a stress or strain in the diaphragm. The resistor values in the sensor change in proportion to the stress applied to the diaphragm and produces an electrical output.

The Fuel Pressure Sensor is located on top of the fuel filter housing.

Intake Air Temperature and Humidity (IATH) Sensor

The Intake Air Temperature and Humidity (IATH) Sensor contains a thermistor and a capacitive sensor. The resistance of the thermistor varies inversely to temperature. The output of the capacitive sensor increases as the humidity of the surrounding air increases. By monitoring the signals from both portions of the sensor, the Engine Management System (EMS) Module calculates the temperature and humidity of the air passing through the air filter housing.

The Intake Air Temperature and Humidity (IATH) Sensor is located in the air intake tube just downstream from the air filter canister.

Intake Manifold (Boost) Temperature Sensor

The Intake Manifold (Boost) Temperature Sensor is a thermistor whose resistance varies inversely to temperature. The sensor has a negative temperature coefficient, which means the sensor resistance will decrease as the inlet air temperature increases.

The Intake Manifold (Boost) Temperature Sensor is located in the intake manifold.

Intake Manifold Pressure Sensor

The Intake Manifold Pressure Sensor contains a pressure sensitive diaphragm and an electrical amplifier. Mechanical pressure applied to the diaphragm causes the diaphragm to deflect and the amplifier to produce an electrical signal proportional to the deflection.

The Intake Manifold Pressure Sensor is located on the air inlet pipe before the intake manifold.

Throttle Position (TP) Sensor

The Throttle Position Sensor is a potentiometer that is mechanically linked to the accelerator pedal. A potentiometer is a variable resistor whose resistance will change as the pedal is pressed. As the resistance changes, the signal voltage of the sensor changes indicating the accelerator pedal position.

The Throttle Position Sensor is located above the accelerator pedal. The sensor is designed to improve the driver's control by reducing sensitivity to chassis motion. This sensor provides the driver's fuel request input to the VECU.

Turbo Speed Sensor

The Turbo Speed Sensor informs the EMS of the turbo shaft speed. The sensor does not read from the vanes, but reads from the shaft. The Engine Management System (EMS) Module uses this signal in conjunction with the VGT position sensor signal to control the speed of the turbocharger and therefore optimize the intake manifold pressure.

The Turbo Speed Sensor is mounted in the center of the turbocharger.

Variable Geometry Turbocharger Smart Remote Actuator (VGT SRA)

The Variable Geometry Turbocharger Smart Remote Actuator (VGT SRA) takes the position commands from the EMS, moves the nozzle of the turbocharger to the desired position, and performs all of the diagnostics and self checks on the actuator.

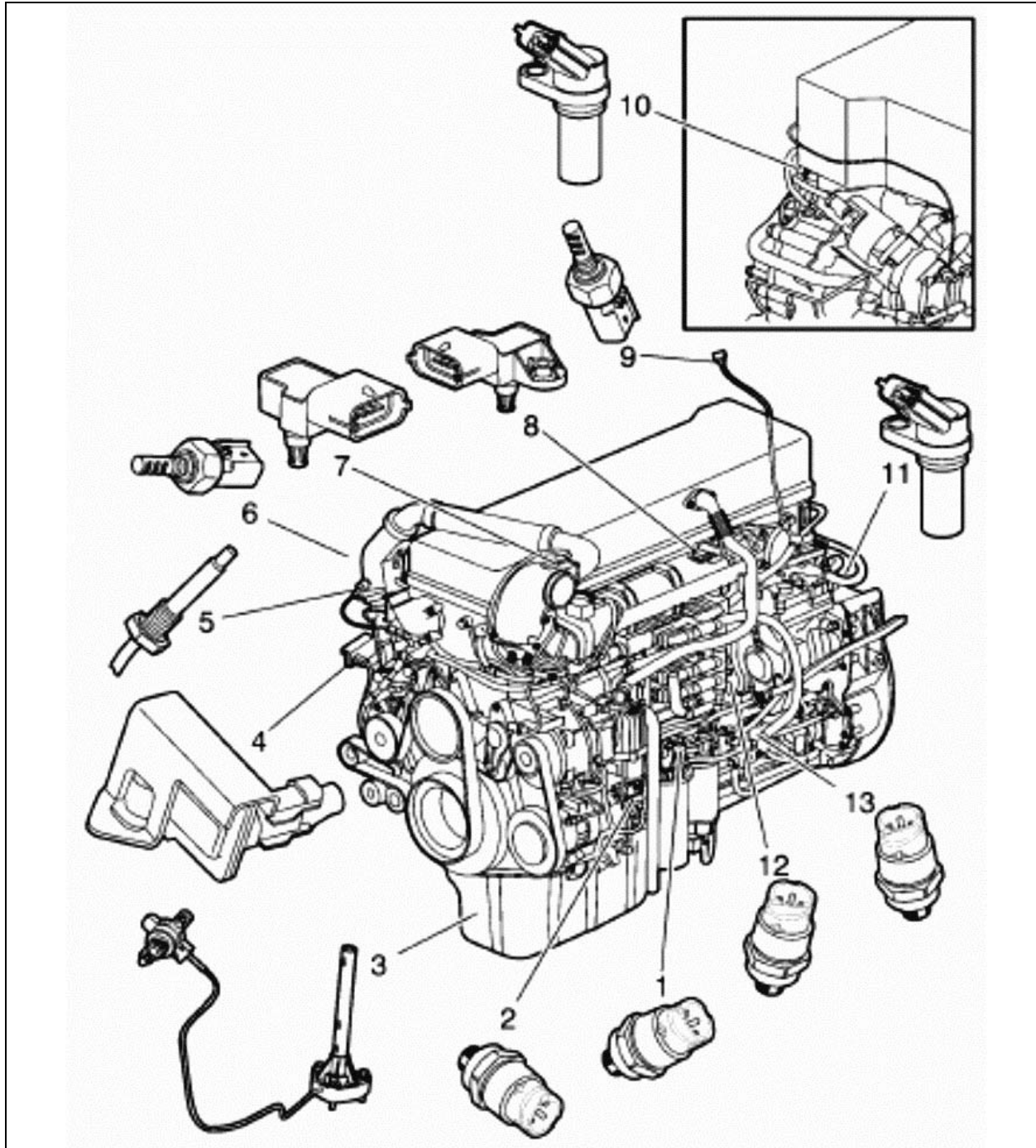


FIGURE 1: ENGINE SENSORS LOCATION

1	Fuel Pressure	8	Air Temperature
2	Crankcase Pressure	9	Humidity/Ambient Air Temperature
3	Oil Level/Temperature	10	Camshaft Speed
4	EGR Differential Pressure	11	Crankshaft Speed
5	EGR Temperature	12	Oil Pressure
6	Coolant Temperature	13	AFI Fuel Pressure
7	Boost Pressure		

Section 01: ENGINE

1.2 ENGINE OVERVIEW

NOTE

For additional information concerning Volvo D13 engine components or engine-related components, consult Volvo Trucks Canada or Volvo Trucks North America Web Site under: Parts & Service. On Volvo web site, you will find detailed service procedures for parts replacement, repair and maintenance.

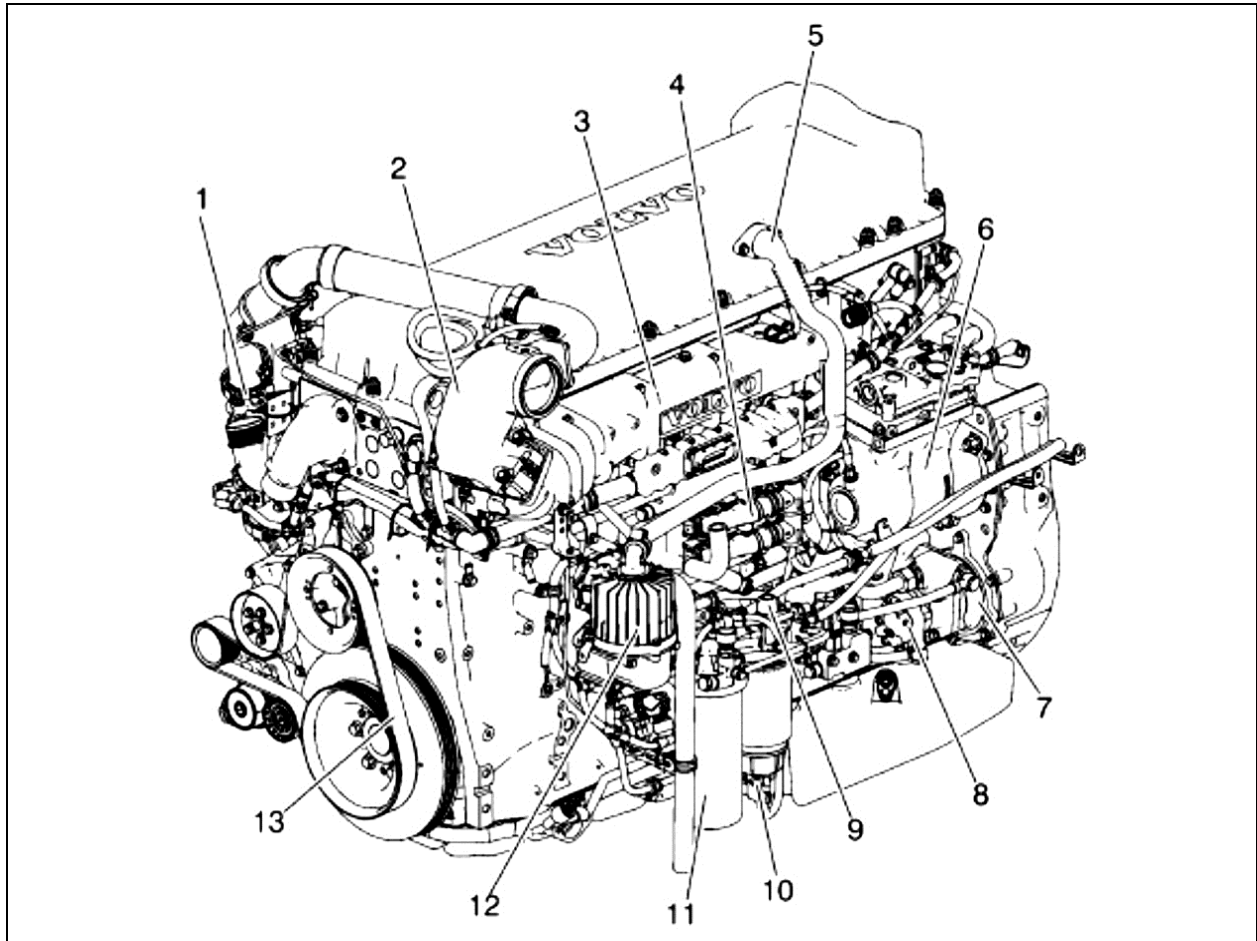


FIGURE 2: D13F ENGINE, ALTERNATOR SIDE (TYPICAL)

1. Venturi Pipe	8. Fuel Pump
2. EGR Mixing Chamber	9. Hand Primer
3. Intake Manifold	10. Fuel/Water Separator
4. Engine Electronic Control Unit (EECU)	11. Fuel Filter
5. Breather Tube	12. Crankcase Ventilator
6. Air Compressor	13. Fan/Coolant Pump Belt
7. Power Steering Pump	

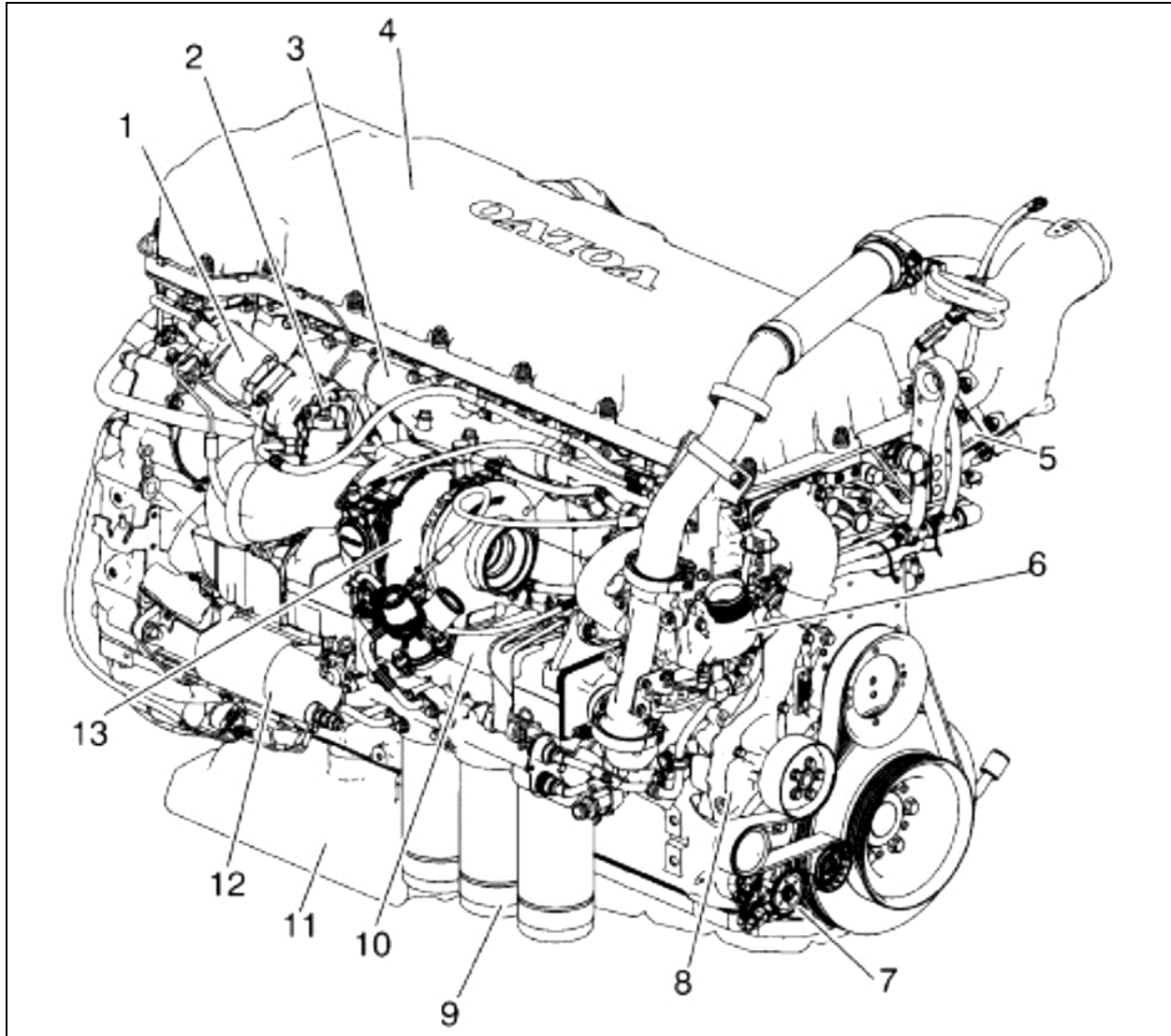


FIGURE 3: D13F ENGINE, TURBO SIDE (TYPICAL)

1. EGR Valve	8. Coolant Pump
2. Aftertreatment Fuel Injector	9. Oil Filters
3. Exhaust Manifold	10. EGR Cooler
4. Valve Cover	11. Oil Pan
5. Engine Preheater Element	12. Starter Motor
6. Thermostat Cover	13. Turbocharger
7. Belt Tensioner	

1.3 ENGINE OIL

1.3.1 General

Keep the engine oil at the proper level and change it at the recommended intervals. Always replace the oil filters at the same time as when the oil is changed.

Section 01: ENGINE

1.3.2 Oil Quality

Volvo North America recognizes engine oils that meet or exceed the standards given by American Petroleum Institute (API) for the oil classifications listed in this manual. Only oils licensed to carry the API symbol should be used. Lubricants meeting API standards have provided maximum engine life when used together with the recommended oil and oil filter change intervals.

VDS-4 diesel engine oil is mandatory for use in all 2010 emission compliant Volvo engines. These engines, which can be identified by the presence of an exhaust aftertreatment system using Selective Catalytic Reduction (SCR), also require the use of Ultra Low Sulfur Diesel (ULSD) fuel. VDS-4 oils exceed the new API service category CJ-4.



CAUTION

DO NOT add extra oil additives. Additives such as break-in oils, top oils, graphitizers, and friction-reducing liquids are not necessary and can harm the engine.

1.3.3 Oil Change Intervals

The length of time an engine can operate before an oil change depends on the quality oil used, the type of fuel used, fuel consumption, engine oil consumption, vehicle application, level of dust in the air, and fuel consumption. The change intervals given in this manual are maximum intervals. If the vehicle is operating in heavy-duty operation, dusty or off-road conditions, etc., reduce the intervals for more frequent oil changes.

NOTE

Use the information in the table below to determine the operating condition and usage applicable to your vehicle.

Engine Operating Condition	Medium	Heavy	Severe
Total Fuel Consumption (mpg)	More than 6	More than 4.7	More than 3.7
Total Fuel Consumption (L/100 KM)	Less than 39	Less than 50	Less than 64
Engine Oil and Filter Change Interval, miles (km) – 41 U.S. quarts (39L) Oil capacity	35,000 (55 000)	25,000 (40 000)	15,000 (24 000)

NOTE: If idle time is greater than 25%, use the next lower drain interval.

NOTE

Oil filters should always be changed when changing the oil.

1.3.4 Oil Filters

There are three filters on the engine, one of which is a bypass filter. This should be changed at the same time as the full-flow filter(s).

**CAUTION**

Volvo branded oil filters are designed to provide the proper level of filtration and protection for Volvo engines. Filters that do not meet the same stringent requirements may void engine warranty.

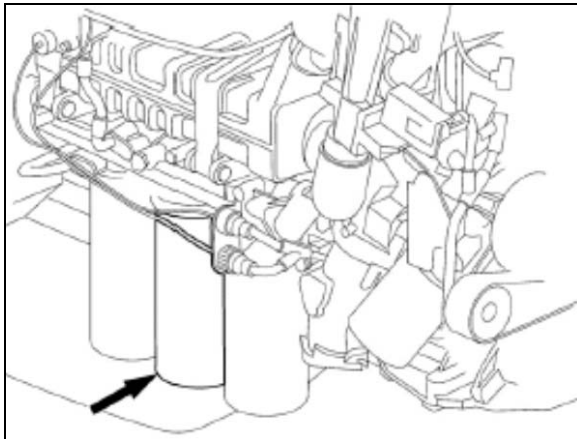


FIGURE 4: D13F OIL FILTERS

1.3.5 Synthetic Lubrication

Synthetic oils are offered by some oil suppliers as an alternative to the traditional, petroleum based oils for engines. These oils may be used in Volvo engines, provided they meet the quality level VDS-4.

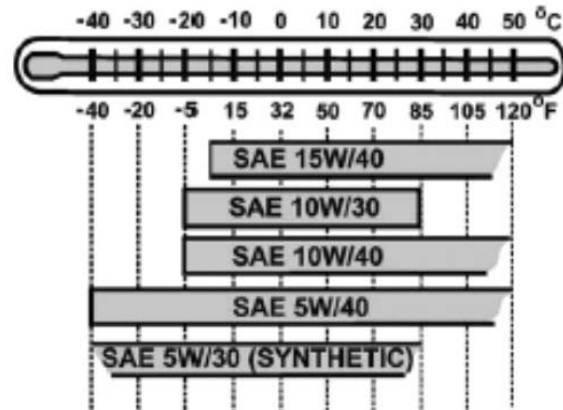
The use of synthetic oils does not permit the extension of the recommended oil change intervals.

1.3.6 Oil Viscosity

The viscosity grade defines the thickness of the oil. The oil must be thin enough at low temperatures for easy cold starts and thick enough to protect at high temperatures. An oil is not fully defined until both the API quality classification and the viscosity grade are specified.

Choose the viscosity grade for the typical ambient temperature for the application. Multigrade oils have a broad range that suit operation in changing temperature.

Volvo North America recommends the viscosities shown in the viscosity/temperature table for Volvo engines.



1.3.7 Oil Additives

**CAUTION**

Extra oil additives must never be added to any engine oil used. Additives such as break-in oils, top oils, graphitizers, and friction reducing liquids are not necessary and may even harm the engine.

Using oils to the quality standards recommended in this manual makes the use of extra oil additives unnecessary, as these oils already contain a balanced treatment of additives.

1.3.8 Oil Consumption

Once the engine is stopped, check the oil level daily. If the engine has just been stopped and it is warm, wait approximately five minutes to allow the oil to drain back to the oil pan before checking. Add oil as necessary.


**CAUTION**

DO NOT overfill engine with oil.


All diesel engines are designed to consume some oil, so it is normal to add oil periodically. An engine used in heavy-duty operation will consume more oil than one in normal operation.

Section 01: ENGINE


1.3.9 Oil Change

 **WARNING**


A hot engine or engine oil can be dangerous. Serious burns can result from contact with a hot engine or oil. Take precautions when draining the oil. Wear gloves or let the engine cool down before draining.

 **WARNING**

When draining the oil, use the proper tools and keep away as far as possible. Raise the elbow so the forearm is parallel to the ground to prevent oil running down the arm, causing burns.

 **CAUTION**

Always dispose of all lubricants (motor oil, coolant, gear box oils, etc) and filters according to Federal or local regulations. Used oil disposed of in nature or waterways contaminates our drinking water and kills wildlife.

 **WARNING**

Prolonged contact with used engine oil may be harmful. Use rubber gloves when handling used oil. Wash skin thoroughly if it comes in contact with used oil.


It is important to drain as much oil as possible. Try to change oil immediately after driving, when the oil is warm. Always replace the oil filters when changing the oil.

Component	Capacity (L)
Oil pan	24 min - 32 max
Engine block (remaining oil)	1
Filters (3)	6
Total oil fill (empty)	39


NOTE

Since about 1 liter of oil remains in the engine after draining, approximately 38 liters will be needed for a complete oil change.

1.3.10 Oil Filters Change

 **WARNING**

Hot oil can cause severe burns. DO NOT allow hot oil to contact the skin. When changing oil, wear protective gloves.

 **CAUTION**

Volvo-branded oil filters are designed to provide the proper level of filtration and protection for Volvo engines. Filters that do not meet the same stringent requirements may cause unsatisfactory results.

- Clean around the oil filter housing and remove the filters using the oil filter wrench or the oil filter socket.

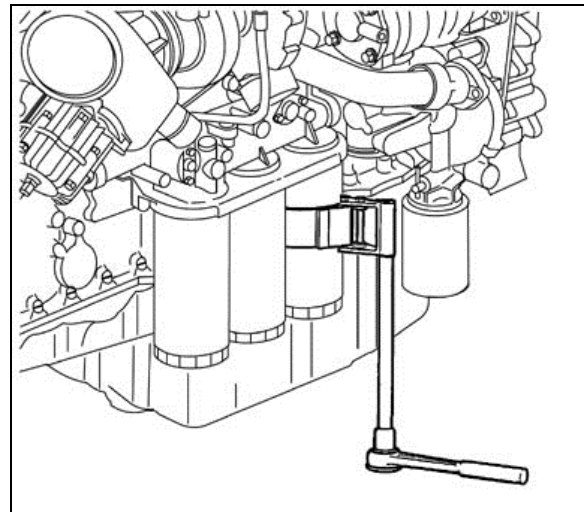
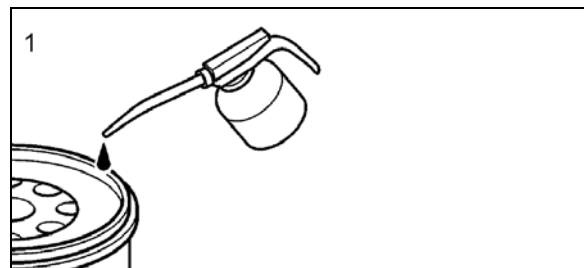


FIGURE 5: OIL FILTER WRENCH

- Prefill the new oil filters with approved engine oil. Also, lubricate the filter gaskets with engine oil (1). Hand tighten the oil filters until they contact the sealing surface of the oil filter housing (2). Manually tighten the oil filters an additional $\frac{3}{4}$ to 1 full turn (3).



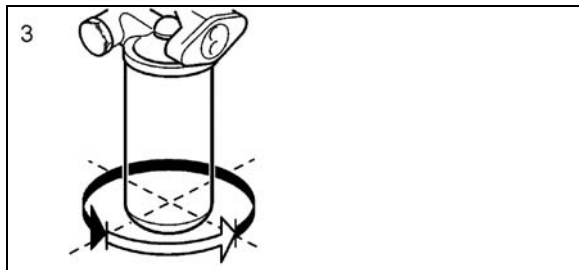
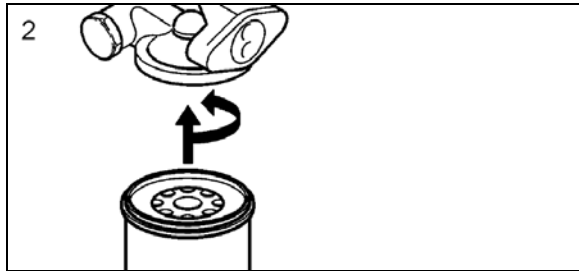


FIGURE 6: OIL FILTER REPLACEMENT

- Start the engine and check for leaks around the oil filter housing and filters.
- Check the oil level. Add approved engine oil to the recommended level, if necessary. Do not overfill.

1.3.11 Checking the Oil Level

Ensure that the vehicle is parked on level ground before checking the oil level. Wait five minutes after shutting off the engine and then proceed with checking the oil.



CAUTION

DO NOT let the oil level fall below the marking on the dipstick. **DO NOT** overfill so the level is above the upper marking on the dipstick. This could lead to excessive oil temperature and/or poor crankcase breather performance. Add oil through the oil filler pipe as required in order to maintain level within the safe range.

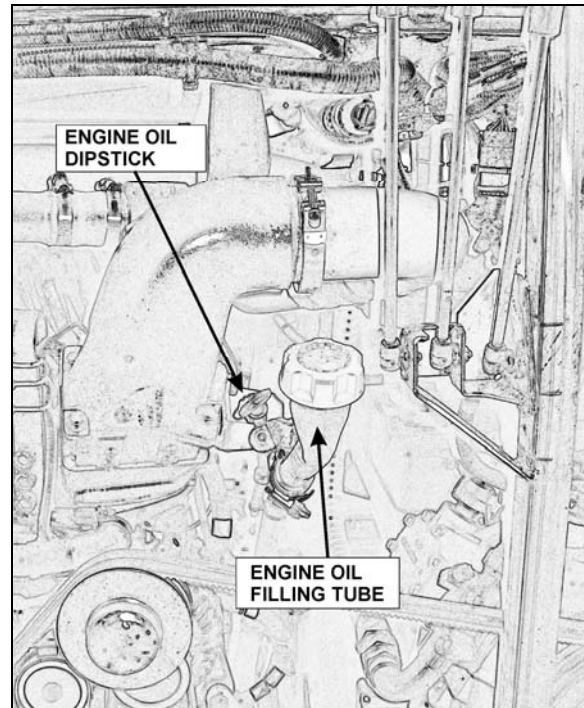


FIGURE 7: ENGINE OIL FILLING TUBE

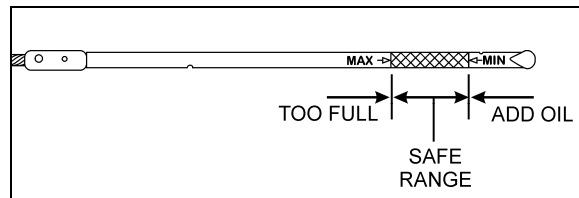


FIGURE 8: ENGINE OIL LEVEL DIPSTICK

1.4 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 EECU are serviceable. If found defective, replace the EECU as a unit.

Section 01: ENGINE

• Preparation

1. Close the heater lines shut-off valves.
2. 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.



WARNING

Due to the heavy load of the rear bumper assembly, it must be adequately supported before attempting to remove it.

3. Remove the rear bumper assembly from the vehicle. Refer to Section 18 BODY, under "Rear Bumper Removal".
4. If applicable, disconnect the block heater connector located near the EGR mixing chamber.

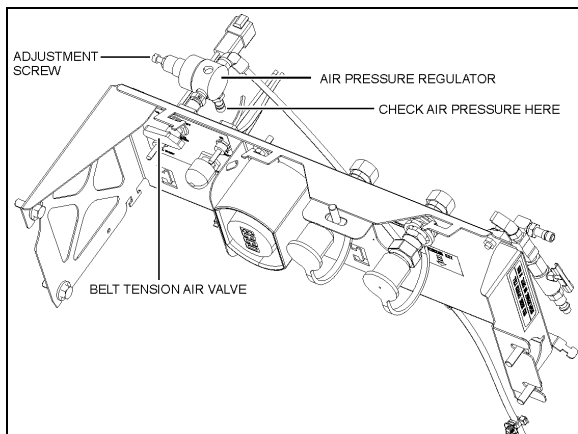


FIGURE 9: BELT TENSIONER VALVE

12200

5. Locate the A/C compressor belt tensioner pressure releasing valve (Fig. 9). Turn pressure releasing valve handle counterclockwise in order to release pressure in belt-tensioner air bellows and loosen belt. Remove the A/C compressor belt.
6. To release all pressure from the air system. Refer to Section 12, BRAKES & AIR SYSTEM for instructions.
7. Disconnect and remove the engine-air intake duct mounted between air cleaner housing and turbocharger inlet.



CAUTION

To avoid damage to turbocharger, cover the turbocharger inlet opening to prevent foreign material from entering.

8. Disconnect and remove the air intake duct mounted between the air cooler outlet and the engine intake.
9. Disconnect and remove the air intake duct mounted between the turbocharger outlet and the air cooler inlet.
10. Disconnect and remove section of coolant pipe assembly mounted between the radiator outlet and the water pump inlet.
11. Disconnect and remove a section of coolant pipe assembly mounted between the thermostat housing and the radiator inlet, if applicable.
12. Disconnect the electric fan-clutch connector located near the cooling fan right angle gearbox.
13. Disconnect the cooling fan drive shaft.



CAUTION

To avoid damage to cooling fan right angle gearbox, make sure the power plant cradle clears the gearbox when pulling the engine out.

14. Disconnect surge tank hoses connected to the thermostat housing, the pump inlet and to the transmission oil cooler.
15. Disconnect and remove the exhaust pipe mounted between the flexible coupling and the pipe going to the Aftertreatment Device (ATD). If necessary, refer to Section 04 EXHAUST SYSTEM under "Muffler Removal and Installation".



CAUTION

To avoid damage to turbocharger, cover the turbocharger outlet opening to prevent foreign material from entering.

16. Remove the power steering pump.

17. Close engine fuel supply shutoff valve on primary fuel filter or Fuel Pro. Disconnect the fuel line located above fuel filters and connected to inlet port. On vehicles equipped with the optional fuel filter/water separator, disconnect the connector and remove cable ties from cradle.

• **With Vehicle Raised**

- 18. Using the quick-connect drain hose, drain the engine cooling system. Refer to Section 05 COOLING under "Draining Cooling System".
- 19. From under the vehicle, disconnect the propeller shaft as detailed in Section 09, under heading "Propeller Shaft Removal".
- 20. 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.
- 21. Remove the retaining bolts, washers and nuts securing the power plant cradle to the vehicle rear subframe.
- 22. Disconnect transmission harness from transmission housing.

• **With Vehicle Lowered**

- 23. Disconnect the air compressor discharge, governor steel-braided airlines and manual filling airlines from compressor. Remove retaining clips.
- 24. Disconnect the hose connecting the compressor head to the sump tank, if applicable.
- 25. Disconnect ground cables from rear subframe ground-stud located close to the starter motor.

26. Inside main power compartment, disconnect starter, alternators and heater cables. Also disconnect AFSS cable if applicable.

- 27. Disconnect Aftertreatment Device (ATD) control cable.
- 28. Disconnect VIH (vehicle interface harness) connector.
- 29. Disconnect fuel return line from bulkhead fixed on engine cylinder head end.
- 30. Unfasten and put aside engine compartment lighting fixture and turbocharger fire suppression nozzle if applicable.
- 31. Disconnect turbo boost pressure gauge airline from engine air intake, if applicable.
- 32. Disconnect the engine coolant hose near the starter.
- 33. On partition wall, disconnect connector C397 located between engine compartment and main power compartment.
- 34. 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.

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.

- 35. Using a forklift, with a minimum capacity of 4,000 lbs (1 800 kg), slightly raise the power plant cradle.
- 36. Pull engine out slowly from the engine compartment. Make sure all lines, wiring and accessories are disconnected and are not tangled.

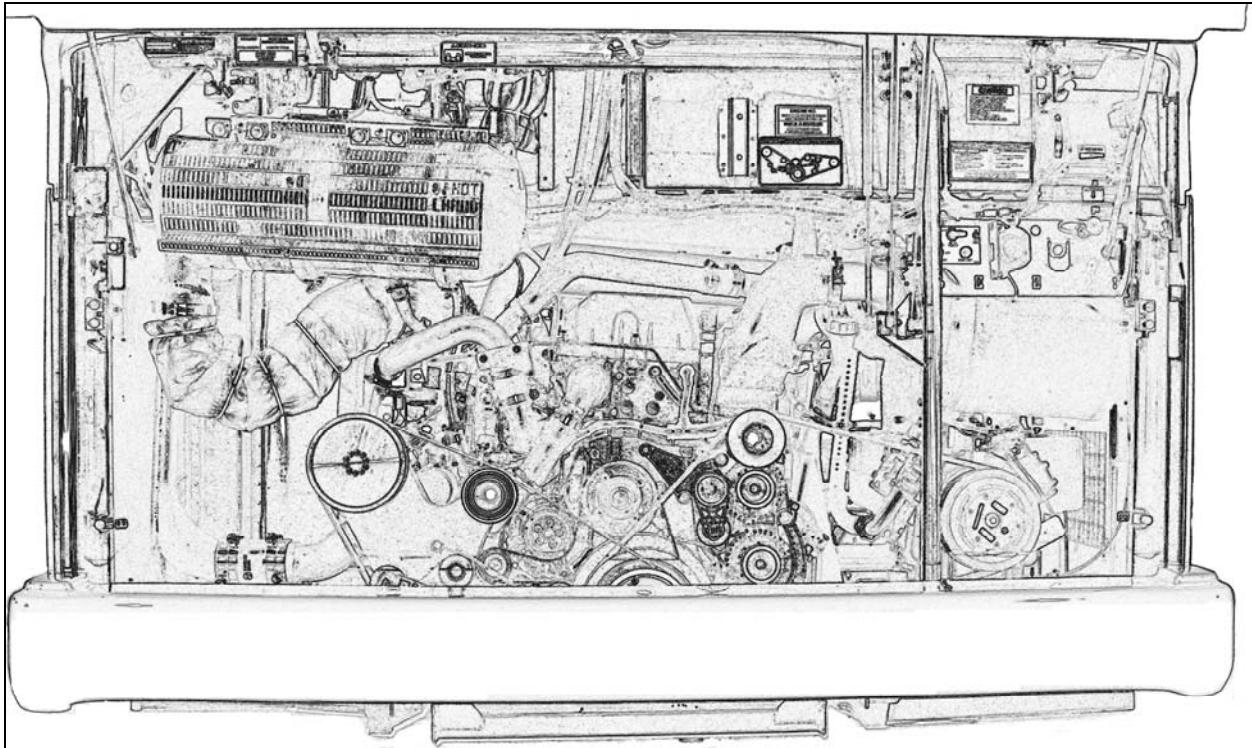


FIGURE 10: ENGINE COMPARTMENT H3 COACHES (TYPICAL)

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1.5 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. Refill cooling system with saved fluid (refer to Section 05 COOLANT SYSTEM).
3. 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).
4. Start engine for a visual check. Check fuel, oil, cooling, pneumatic and hydraulic system connections for leakage. Test operation of engine controls and accessories.

1.6 ENGINE MOUNTS

The power plant assembly is mounted to the cradle by means of rubber mounts and supports.

Two engine support brackets are used at the front of the engine while two rubber mounts are mounted underneath the engine & radiator fan drive mechanism support and the engine & alternator support (Fig. 11).

It is recommended that new rubber mounts be installed at each major overhaul.

NOTE

Refer to the table on the following page for engine cradle tightening torques.

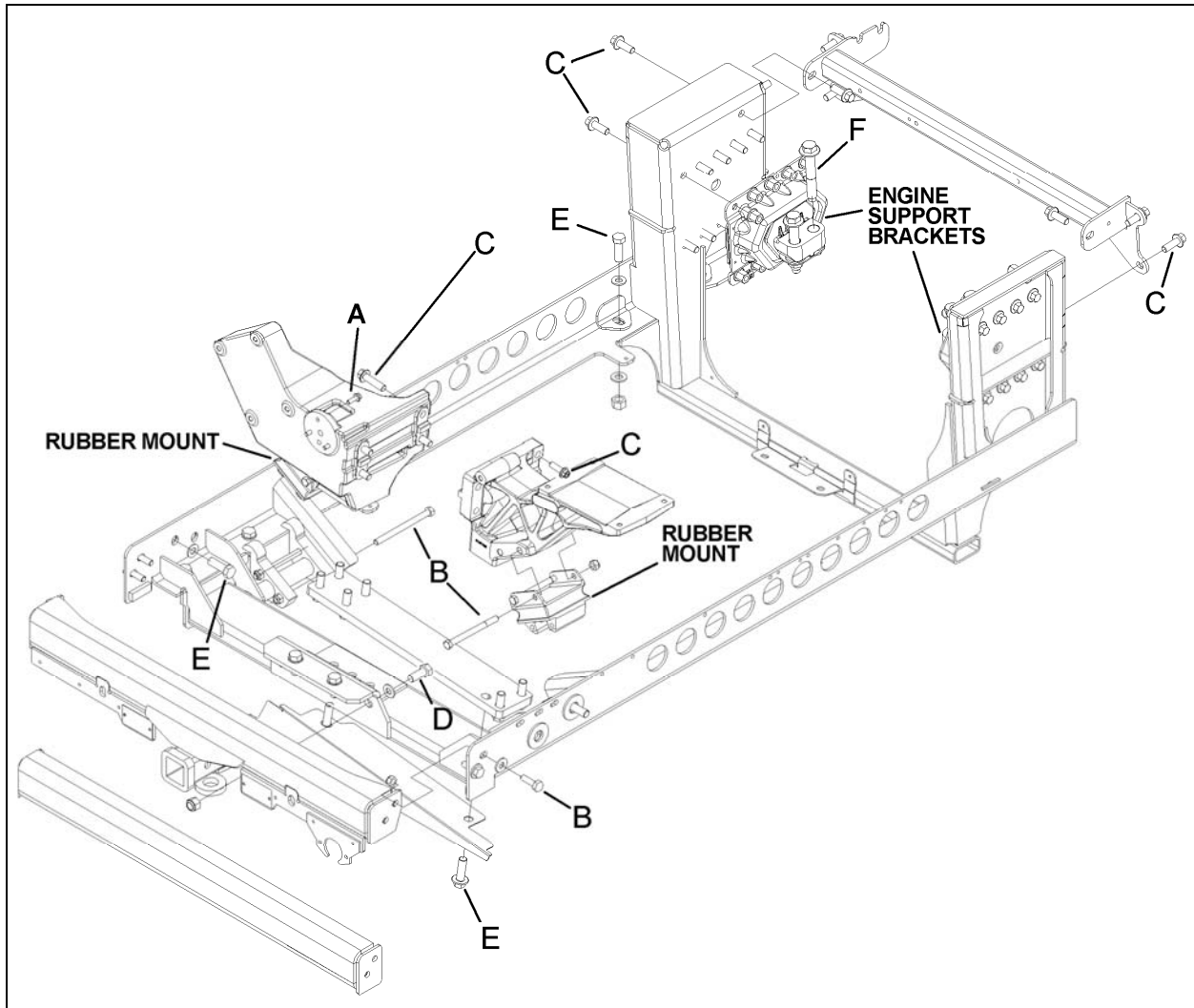


FIGURE 11: VOLVO ENGINE POWER PLANT CRADLE INSTALLATION

DRY TORQUES			
REFERENCE	DESCRIPTION	Lbf-ft	Nm
A	SCREW, CAP HEXAGONAL HEAD M8 – 1.25 G8.8	16	22
B	SCREW, CAP HEXAGONAL HEAD M12 – 1.75 G8.8	60	81
C	SCREW, CAP HEXAGONAL HEAD M14 – 2.0 G8.8	90	122
D	SCREW, CAP HEXAGONAL HEAD M16 – 2.0 G8.8	140	190
E	SCREW, CAP HEXAGONAL HEAD M16 – 2.0 G10.9	190	258
F	SCREW, CAP HEXAGONAL HEAD M20 – 2.5 G10.9	450	610

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 Motor Control Module (MCM). The TPS 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. 24). The (TPS) converts the operator's foot pedal input into a signal for the MCM.

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.

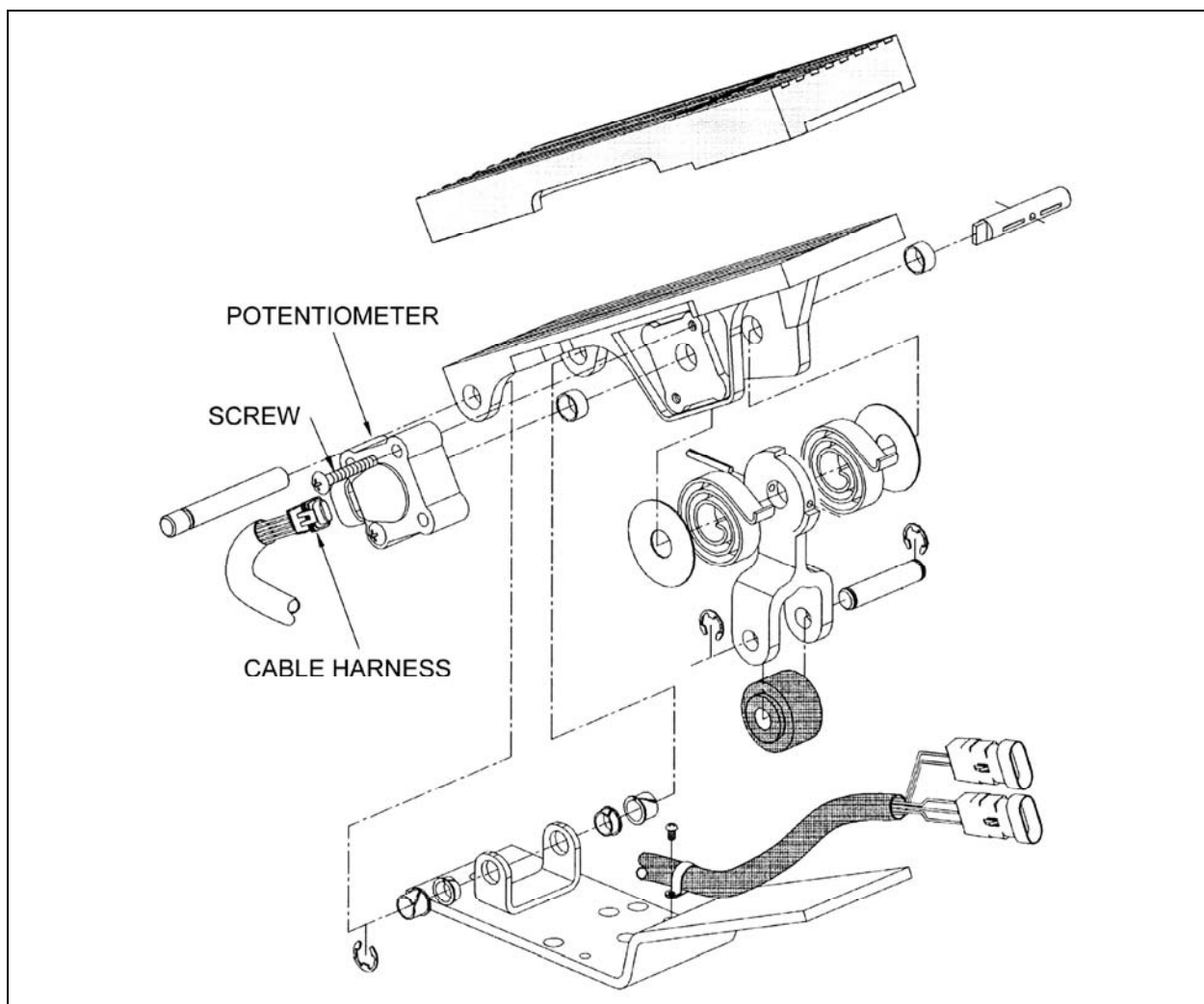


FIGURE 12: ELECTRONIC FOOT PEDAL ASSEMBLY

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 CPC will signal diagnostic codes of 21-12 for idle error and 21-23 for wide-open throttle error.

3. SPECIFICATIONS

Make Volvo Powertrain
 Type Diesel four cycle/in-line direct injection engine
 Description Turbo/Air to air charge cooled
 No. of cylinders 12.8 L in-line 6
 Operating range 1400-1800 RPM
 Peak Power Rating 435 HP (324 kW)
 Peak Torque Rating 1650 Ft-lb (2237 Nm)
 Low Idle 600 rpm
 Fast Idle 2150 rpm
 Maximum full load revolutions 1900 rpm

Engine oil level quantity

Oil Pan Capacity; Low Limit 25 quarts/24 liters
 Oil Pan Capacity; High Limit 34 quarts/32 liters
 Total Engine Oil Capacity with Filters 41 quarts/39 liters

Lubricating oil filter elements

Prevost number 478736 (Full Flow)
 Prevost number 510938 (By-pass)

Torque specification

Engine oil filter Tighten 3/4 to 1 turn after gasket contact

Filters**Engine Air Cleaner Filter**

Prevost number 530197

Engine Coolant Filter

Make Volvo
 Number 20458771

SECTION 03: FUEL SYSTEM

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1. FUEL SYSTEM WITH VOLVO D13 ENGINE

1.1 DESCRIPTION

NOTE

For additional information concerning Volvo D13 engine components or engine-related components, consult Volvo Trucks Canada or Volvo Trucks North America Web Site under: Parts & Service. On Volvo web site, you will find detailed service procedures for parts replacement, repair and maintenance.

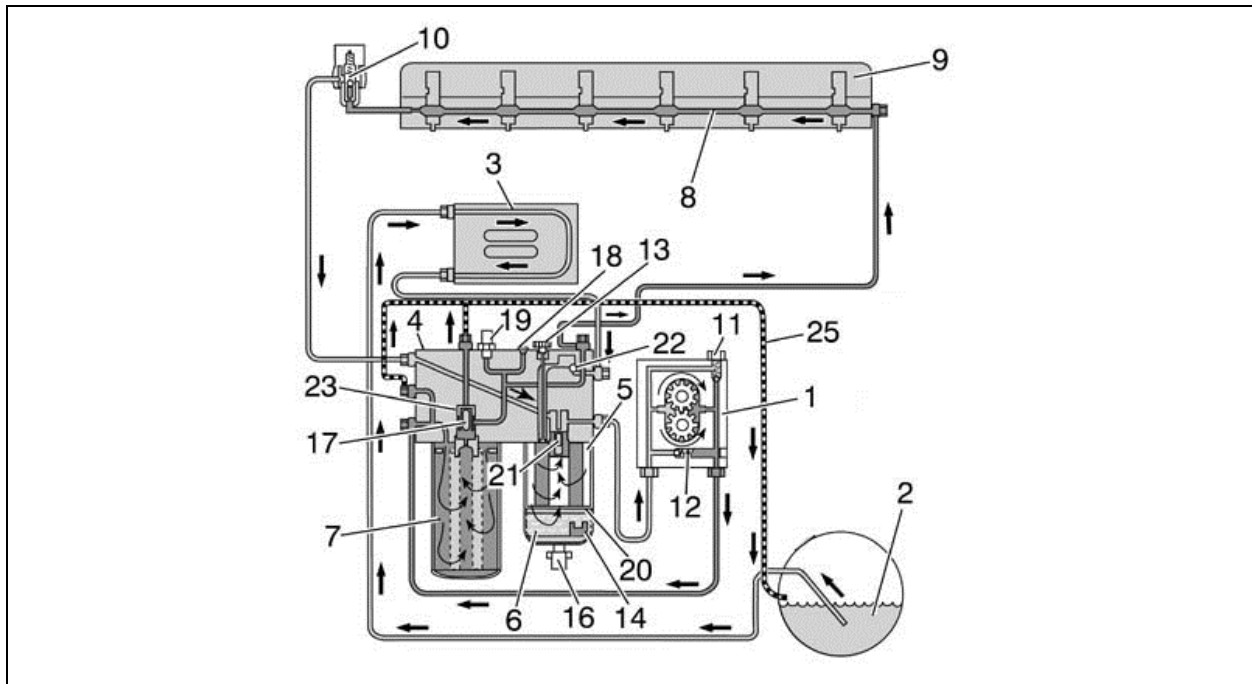


FIGURE 1: FUEL SYSTEM SCHEMATIC (VOLVO D13 ENGINE) 03086

Fuel is drawn up the fuel lines by the supply pump (1) through the pickup tube in the tank (2) and through the Engine Electronic Control Unit (EECU) cooling coil (3) and into the fuel filter housing (4). The fuel housing is equipped with a primary fuel filter (fuel/water separator) consisting of a filter cartridge and a water separation bowl.

The supply pump (1) forces the fuel into the fuel filter housing through the secondary filter (main) to a cylinder head longitudinal gallery (8). This channel supplies each unit injector (9) with pressurized fuel by a circular groove around each unit injector in the cylinder head. The overflow valve (10) controls the fuel supply pressure to the unit injectors.

The return fuel from the overflow valve (10) is returned back to the fuel filter housing and is mixed with the fuel from the fuel tank in a channel within the fuel filter housing (4).

Supply Pump Valves

Two valves are located in the supply pump (1). The safety valve (11) allows fuel to flow back to the suction side when the pressure becomes too high, e.g., if the fuel filter is blocked or is too restricted. The non-return valve (12) opens when the hand-priming pump is used.

Automatic Bleeding

If air gets into the system, it is bled when the engine starts. During bleeding, air is pressed out through the fuel filter housing over to the fuel tank through the return line (25). Bleeding for the filter replacement is controlled by valves (17) and (23).

Section 03: FUEL SYSTEM

Other

The fuel filter housing eliminates the need to drain the fuel when replacing the filter. The valve pegs (17) and (21) close when the fuel filter is removed. It is not necessary to bleed the fuel system after replacing the filter, since this is performed automatically when the engine is started and runs for more than 2 minutes.

The plugged outlet (18) is fitted on the fuel filter housing. This outlet is used when measuring supply pressure after the fuel filter with an external pressure gauge. The pressure sensor (19) on the fuel filter housing monitors the supply pressure after the fuel filter. A fault code is displayed on the instrument cluster if the fuel supply pressure is less than the specified value.

Hand Priming Pump

The hand priming pump (13) is located on the fuel filter housing and is used to pump fuel (when engine is not running) after the fuel system has been drained for repair, etc. The non-return valve (22) for the hand priming pump is also located in the fuel filter housing.

1.2 FUEL VALVES

The manual shut-off valve on engine fuel-supply line is located on the R.H. side of engine compartment. A manual shut-off valve is located at the inlet side of the primary fuel filter or at the inlet side of Davco Fuel Pro 382 fuel filter.

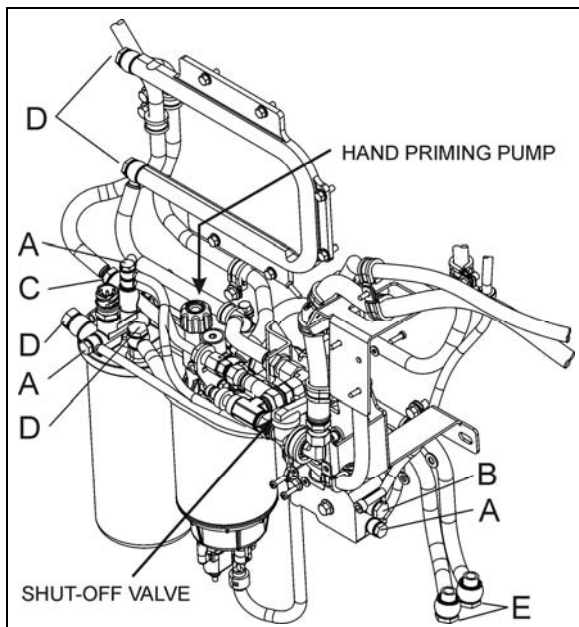


FIGURE 2: MANUAL SHUT-OFF VALVE (VOLVO D13 ENGINE) 03088

Shut-off valve is designed to prevent loss of fuel prime. 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.

FUEL LINE FITTINGS – VOLVO D13 ENGINE	
A	13 ± 2 ft-lb (18 ± 3 Nm)
B	20.5 ± 3 ft-lb (28 ± 4 Nm)
C	22 ± 3 ft-lb (30 ± 4 Nm)
D	26 ± 4 ft-lb (35 ± 5 Nm)
E	29.5 ± 4 ft-lb (40 ± 5 Nm)
F	35 ± 4 ft-lb (48 ± 5 Nm)

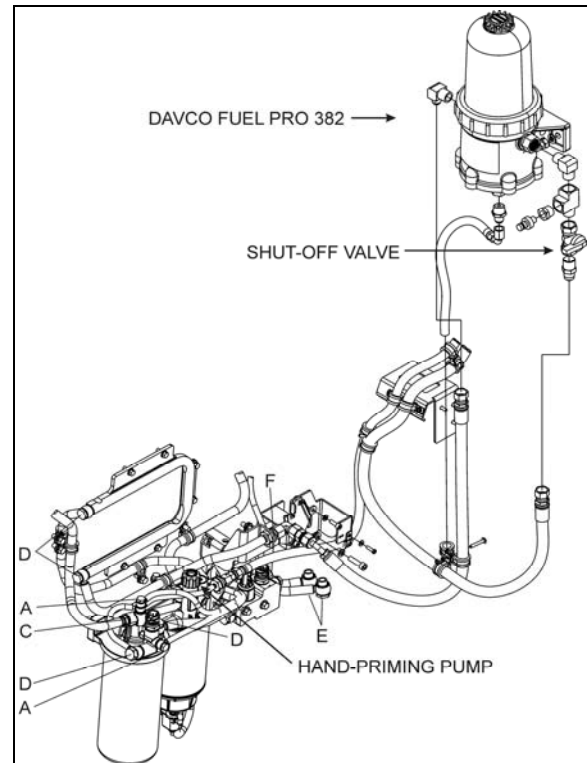


FIGURE 3: MANUAL SHUT-OFF VALVE LOCATION WITH DAVCO FUEL PRO 382 (VOLVO D13 ENGINE) 03087

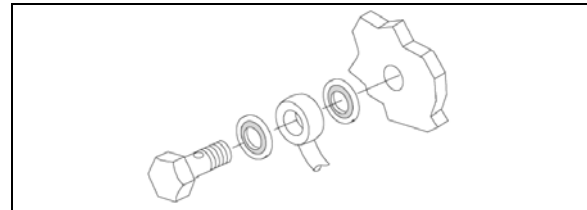


FIGURE 4: FUEL LINE COMPRESSION FITTING –



CAUTION

ALWAYS replace the fuel line compression sealing washers when troubleshooting for fuel aeration or performing any service procedure that requires the removal of engine fuel lines.

1.3 FUEL FILTERS

A primary fuel filter (aka pre-filter) is installed on the engine. This filter consists of a filter cartridge, a water separation bowl with a drain valve. It is used to prevent water from entering the fuel system.

MAINTENANCE

The primary (aka pre-filter) and secondary (aka main) fuel filters are of a spin-on type and must be replaced at **every engine oil change**.

The primary fuel filter should be drained periodically or when the telltale light on the dashboard illuminates if equipped with this system. To drain water, loosen the drain valve below the separator. Place an appropriate container under the filter. Close the drain valve when finished.

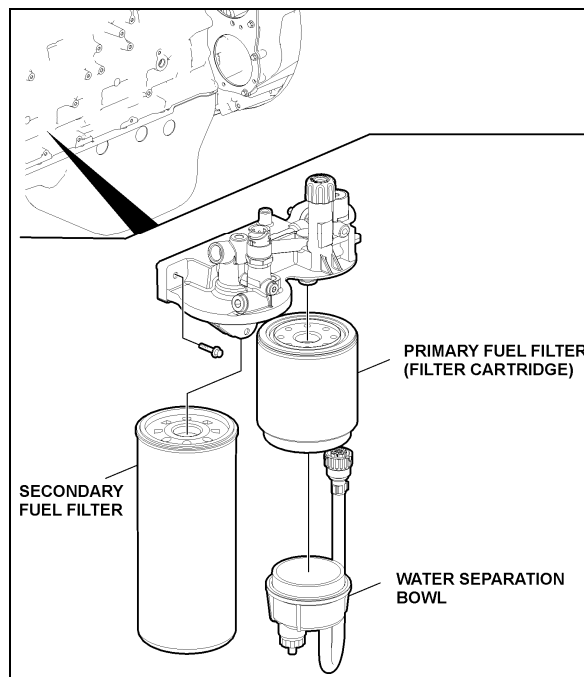
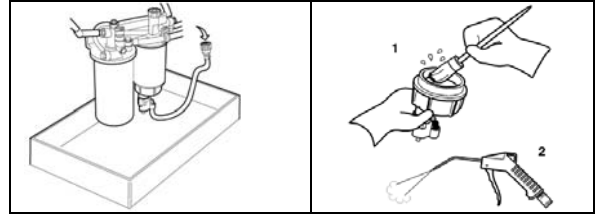


FIGURE 5: FUEL FILTERS WITH VOLVO D13 ENGINE
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1.3.1 Primary Fuel Filter Replacement

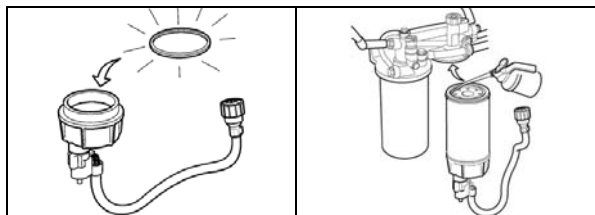
1. Stop engine, close the fuel supply line shut-off valve.
2. Place an appropriate container under the fuel filter housing, then drain the water from the water separation bowl.
3. Disconnect the fuel/water separator indicator electrical connector.



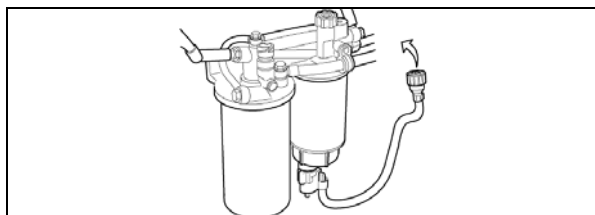
4. Unscrew and remove the primary fuel filter from the fuel filter housing. Drain filter.
5. Unscrew and remove the separation bowl from the filter cartridge.
6. Remove and discard the old gasket from the water separation bowl. Clean the bowl thoroughly and then blow dry with filtered compressed air.



7. Check that the drainage hole in the water separator bowl is not blocked.
8. Apply a thin coating of clean engine oil to the surface of the water separation bowl.



9. Install a new gasket to the water separation bowl and then reinstall the separation bowl to the new primary fuel filter cartridge.
10. Apply a thin coating of clean engine oil to the surface of the primary fuel filter, install the primary fuel filter to the fuel filter housing, then tighten the primary fuel filter 1/2-3/4 turn.



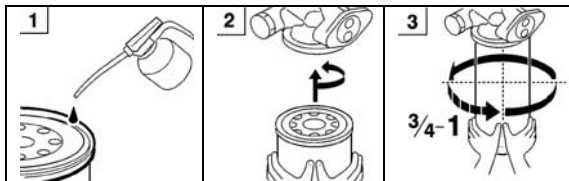
11. Connect the electrical connector for the water/fuel separation bowl indicator.
12. Open the fuel supply line shut-off valve.

Section 03: FUEL SYSTEM

13. Purge air from the filter by operating the priming pump to draw fuel and fill the filter. When using the hand priming pump, approximately 100 strokes will be required.
14. Start the engine and carry out a fuel-tightness check. Let the engine run for about 5 minutes to remove air pockets from the fuel system.

1.3.2 Secondary Fuel Filter Replacement

1. Stop engine, close the fuel supply line shut-off valve. Place an appropriate container under the fuel filter housing.
2. Clean around sealing area on fuel filter and housing.
3. Unscrew and remove the secondary fuel filter from the fuel filter housing.
4. Apply a thin coating of clean engine oil to the gasket of the secondary fuel filter. Screw the fuel filter into position. Tighten the filter $\frac{3}{4}$ to 1 turn after the gasket makes contact with the fuel filter housing.



CAUTION

Fuel in the old filter **must absolutely not** be poured into the new filter. This kind of contaminated fuel can damage the unit injectors.

5. Prime the fuel system by pumping the hand priming pump on the fuel filter housing until resistance is felt indicating that the system is full of fuel.
6. Start the engine and carry out a fuel-tightness check. Let the engine run for about 5 minutes to remove air pockets from the fuel system.

1.4 PRIMING THE FUEL SYSTEM

The fuel system will need to be bled if:

- The vehicle has run out of fuel.
- The engine has not been running for an extended period of time.

- Service work has been done on the fuel system, (tank, fuel lines, filters, valves, etc.) for example cleaning or replacing fuel filter cartridges.
- The engine is new or rebuilt.



CAUTION

When priming the system, movement of the primer pump should be as up and down as possible. Avoid putting any side load on the pump or causing a binding condition. Failure to follow these instructions could prematurely damage the primer pump.

NOTE

When the fuel system is empty, 200 or more pump strokes may be needed to properly prime system. There are no bleed nipples to be opened to prime the fuel system.

1. Stop engine;
2. Unlock the hand pump by turning the handle counterclockwise.
3. Prime the system by moving the primer pump in an up and down pumping motion. Avoid putting any side load on the pump or causing a binding condition.

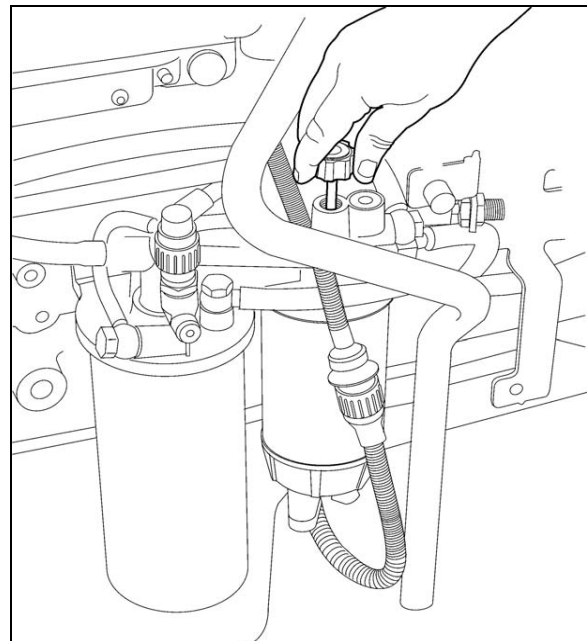


FIGURE 6: HAND PRIMING PUMP

4. Lock the hand primer pump by retracting it into the housing and turning it clockwise.

5. Start the engine and run it at an increased idle speed for approximately 5 minutes to remove any remaining air in the system. Check the fuel system for leaks.

1.5 FUEL PUMP REMOVAL AND INSTALLATION

The pump is located underneath the air compressor and is accessible through the engine compartment R.H. access door.

To remove the pump, proceed as follows:

- Clean around the fuel pump and fuel lines. Position a container to catch any fuel that might drain from the pump or lines.
- Remove the fuel pump.

NOTE

Only unfasten the bolts marked with arrows.

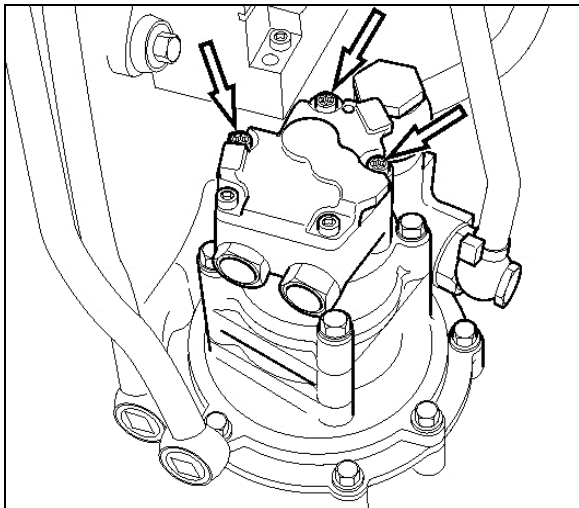


FIGURE 7: FUEL PUMP REMOVAL



CAUTION

Ensure to clean around the head of the bolts. Debris will prevent the tool from fitting properly and cause damage to the fasteners..

- Check that the adapter and fuel pump drive axle are not damaged.
- Install the fuel pump. Torque-tighten bolts to specification.

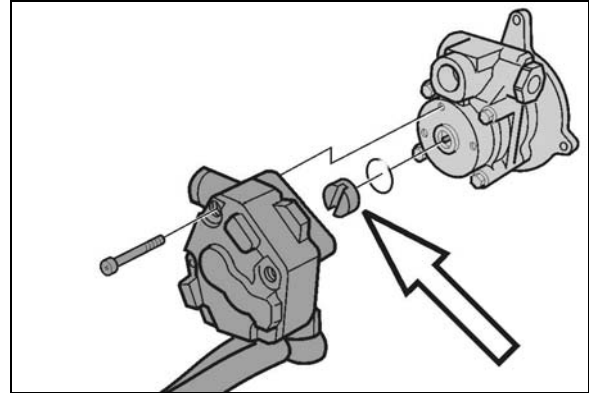


FIGURE 8: FUEL PUMP DRIVE AXLE

NOTE

Use a new sealing ring. Check that the fuel pump drive axle sits correctly in the power steering pump.

- Using the hand primer on the fuel filter housing, prime the fuel system.
- Start the engine and let run for 5 minutes. Make sure that there are no leaks.

2. 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. The filter serves as a water separator as well as a fuel filter (Fig. 9).

The filter fibers used in the Davco Fuel Pro 382 element may cause the fuel level to read artificially high when the filter is first installed. Over the first few days, the filter fibers eventually become fully saturated and the fuel level will drop to normal levels. Do not be concerned about an abnormally high fuel level when a new Davco element is installed.

Fuel level rises as dirt collects on the filter from the bottom up. Restriction remains consistently low because fuel always flows through clean, new media.



MAINTENANCE

Replace Fuel Pro 382 filter element when the fuel level in the see-thru filter cover reaches the top of the filter element or after one year of service, whichever comes first.

Section 03: FUEL SYSTEM

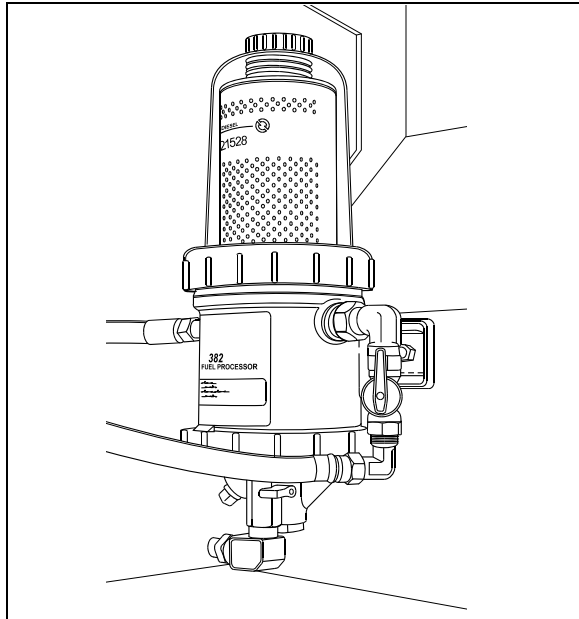


FIGURE 9: DAVCO FUEL PRO 382 INSTALLATION 03032

Filter replacement:

1. Stop engine;
2. Place a suitable container under the fuel processor;
3. Close the shut-off valve on the discharge side of the fuel filter;
4. Open the drain valve at the base of the fuel processor and drain the fuel until it is below the level of the filter;
5. Untighten upper collar, remove cover, filter spring, filter element and cover seal;
6. Dispose of used filter element;
7. Ensure the filter grommet is included in the base of the new filter element and then install the element onto the center stud;
8. Ensure the filter spring is installed at the top of the cover. If missing, the spring must be replaced to insure proper filter operation.
9. Wipe the cover lid and seal clean. After ensuring the seal is properly positioned at the base of the cover, install the cover and collar onto the fuel processor. Tighten the collar by hand until secure;
10. Fill the cover full of clean fuel through spin off cap located on top of cover. Install vent cap seal and then reinstall the cap and tighten by hand only;
11. Open the shut-off valve;
12. Start engine, raise rpm for 2-3 minutes, hand tighten collar again.

13. After the air is purged and with the engine still running, slowly loosen the vent cap on the filter cover. The fuel level in the cover will start falling. When the fuel level falls to the top of the collar, tighten the vent cap quickly by hand.

14. Shut down the engine and hand-tighten the collar again.

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.

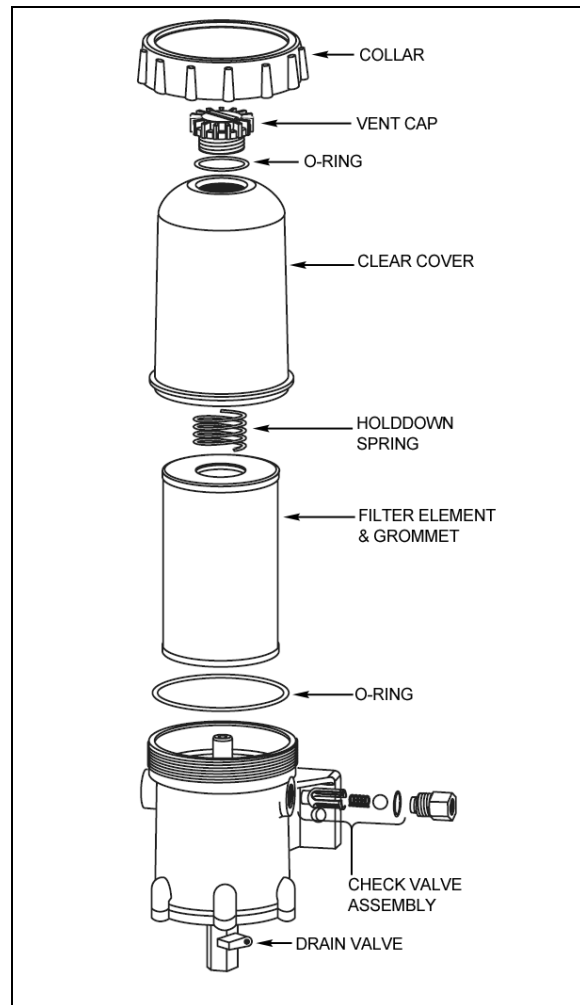



FIGURE 10: DAVCO FUEL PRO 382 EXPLODED VIEW


03076

3. 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.


 <h2 style="margin: 0;">MAINTENANCE</h2>
<p>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.</p>

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).

 <h2 style="margin: 0;">CAUTION</h2>
<p>Oil level above the dipstick full mark or a decrease in lube oil consumption may indicate internal fuel leaks. Check oil level frequently.</p>

4. PREHEATER FUEL FILTER

The preheater fuel filter is located beside the preheater in the dedicated compartment above the rear wheelhousing, on the L.H. side of vehicle.

 <h2 style="margin: 0;">MAINTENANCE</h2>
<p>Replace preheater fuel filter every 50,000 miles (80 000 km) or once a year, whichever comes first.</p>

5. FUEL TANK


All H3 series vehicles are equipped with a high-density cross-link polyethylene fuel tank with a

capacity of 235 US gallons (890 liters). The tank is located just forward of the last baggage compartment, between the A/C condenser and evaporator.

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.

5.1 TANK REMOVAL

 <h2 style="margin: 0;">WARNING</h2>
<p>Park vehicle safely, apply parking brake, stop engine and set battery master switch(es) to the OFF position before working on the vehicle.</p> <p>Before working under an air-suspended vehicle, it is strongly recommended to support the body at the recommended jacking points.</p>

<h3 style="margin: 0;">NOTE</h3>
<p><i>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.</i></p>

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. 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.

Section 03: FUEL SYSTEM

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.

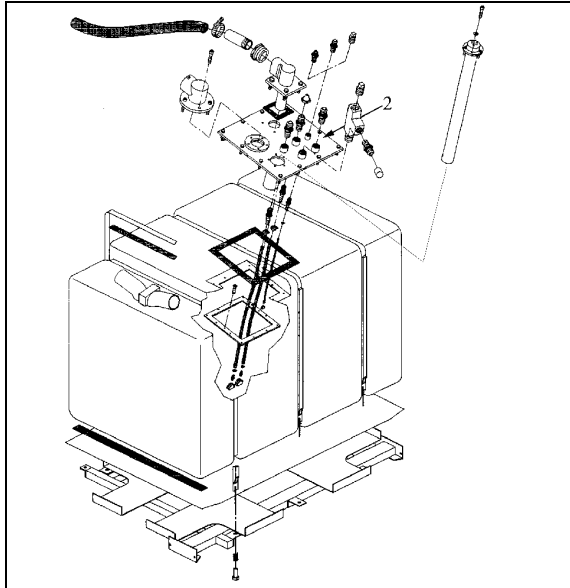


FIGURE 11: FUEL TANK ARRANGEMENT

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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

Tank installation is the reverse of removal.

NOTE

Fastening of rubber flap must always be on top, in line with clamp screw.

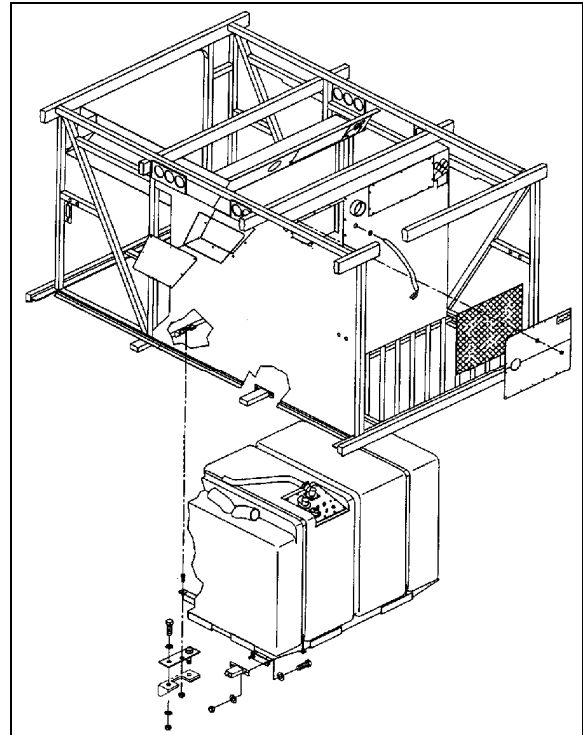


FIGURE 12: FUEL TANK INSTALLATION

03049

NOTE

Insert check valve assembly in right-side filler hose, use hose clamp to fix it. Repeat with left side filler hose.

NOTE

When reinstalling lines, use Loctite 567 type thread sealant on line fittings.



WARNING

For proper assembly, check connections and fasteners for tightness.

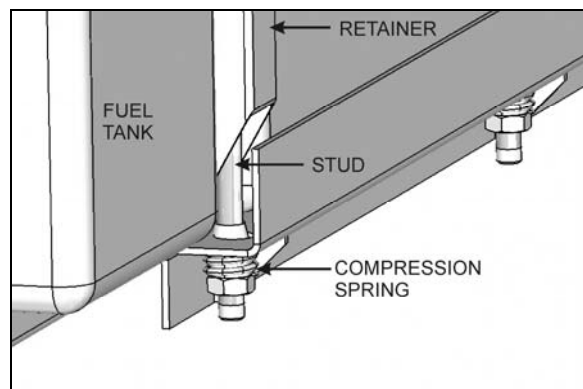


FIGURE 13: FUEL TANK RETENTION

03019

For each fuel tank retainers (Fig. 13):

1. Clean nuts and stud threads.
2. Apply a Loctite 242 type thread adhesive on stud threads.

Fix the retainers to the tank platform. Tighten the nuts to compress the spring completely and then loosen 3 turns.

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 before 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 switches to the OFF position before 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 (Prevost #5001244) into anchor nut (Prevost #500331).
5. Place assembly in drill hole. Tighten screw by 10 complete turns. Refer to Fig. 14.
6. Apply sealant on head plug (Prevost #507300) and seal hole with the head plug.

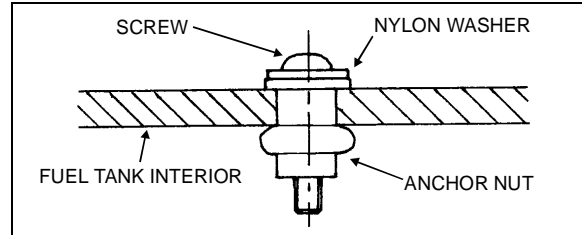


FIGURE 14: FUEL TANK REPAIR

03014

6. FUEL SPECIFICATIONS

The quality of fuel 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 U.S. Environmental Protection Agency (EPA) has issued new standards to improve air quality by significantly reducing emissions through a combination of cleaner-burning diesel engines and vehicles.

To meet EPA standards, the petroleum industry produces **Ultra Low Sulfur Diesel** (ULSD) fuel, also referred to as S15, containing a maximum 15ppm (parts-per-million) sulfur.

On-highway diesel engines meeting 2010 emission regulations are designed to operate **ONLY** with ULSD fuel. ULSD fuel will enable the use of cleaner technology diesel engines and vehicles with advanced emissions control devices, resulting in significantly improved air quality.

6.1 FUEL TYPE

EPA-10 engines like the Volvo D13 are designed to run on **Ultra Low Sulfur Diesel** (ULSD) fuel, which can contain no more than 15 ppm sulfur.

Fuel used must meet engine manufacturer's specification. Refer to Volvo engine specifications.



CAUTION

ULSD fuel is necessary to avoid fouling the engine's Exhaust Aftertreatment System. Improper fuel use will reduce the efficiency of the engine's Aftertreatment System and may permanently damage the system.

Section 03: FUEL SYSTEM



CAUTION

Owners of 2010 and later model year on-highway diesel engine must refuel only with ULSD fuel.

NOTE

Burning Low Sulfur Diesel fuel (instead of ULSD fuel) in 2010 and later model year diesel engines is illegal and punishable with civil penalties.

NOTE

Engine and vehicle manufacturers expect ULSD fuel to be fully compatible with the existing fleet, including 2006 and earlier model year vehicles. In some instances, the introduction of ULSD fuel to older vehicles may affect fuel system components or loosen deposits in fuel tanks. As part of a good maintenance program, owners and operators of existing cars, trucks and buses are encouraged to monitor their diesel-powered vehicles closely for potential fuel system leaks or premature fuel filter plugging during the change-over to ULSD fuel.

NOTE

Like Low Sulfur Diesel fuel, ULSD fuel requires good lubricity and corrosion inhibitors to prevent unacceptable engine wear. As necessary, additives to increase lubricity and to inhibit corrosion will be added to ULSD fuel prior to its retail sale.

6.2 BLENDING

Only ultra low sulfur kerosene – No.1 diesel with no more than 15ppm sulfur may be blended with ULSD fuel to improve cold weather performance. With so many kerosene formulations on the market, care must be taken to select kerosene with a maximum of 15ppm sulfur.

Blend rates remain the same as with Low Sulfur Diesel fuel.

6.3 BIODIESEL FUELS

ULSD-B5 biodiesel may be used. B5 tells you the percentage of biodiesel mixed in with ULSD. B5 is 5% biodiesel and 95% ULSD.

Fuel used must meet engine manufacturer's specification for biodiesel fuel. Refer to Volvo engine specifications.

Biodiesel fuels are alkyl esters of long chain fatty acids derived from renewable resources. Volvo highly recommends biodiesel fuels made from soybean or rapeseed oil through the proper transesterification reaction process. Other feedstock source of biodiesel fuels such as animal fat and used cooking oils are not recommended by Volvo. Failures attributed to the use of biodiesel fuel will not be covered by Volvo or Prevost product warranty. Also, any engine performance problem related to the use of biodiesel fuel would not be recognized nor considered as Volvo or Prevost's responsibility.

6.3.1 Biodiesel fuels and auxiliary heaters

For operation of the auxiliary heater with biodiesel, a retrofit is mandatory. Refer to the guidelines outlined in the Spheros Workshop Manual for Thermo 230, 300, 350 (doc P/N 9003656D), available on the publications DVD and in the technical manuals section of the Prevost technical publications website.

6.3.2 Biodiesel fuels and the engine

Use an oil sampling method to establish the appropriate oil drain interval for your application.

Fuel filter change intervals should be analyzed and adjusted accordingly.

7. 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 an intake duct on the R.H. side of the rear cap, next to the last window. 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).

7.1 PRE-CLEANER SERVICING



MAINTENANCE

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.

7.2 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.

7.3 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.

7.4 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.

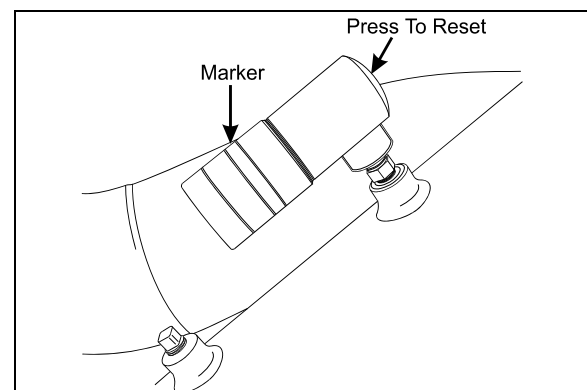


FIGURE 15: RESTRICTION INDICATOR

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8. FUEL PEDAL

The EFPA (Electronic Foot Pedal Assembly) connects the accelerator pedal to a potentiometer (a device that sends an electrical signal to the CPC, 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.

8.1 FUEL PEDAL ADJUSTMENT

The EFPA contains a throttle position sensor that varies the electrical signal sent to the CPC. 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.

Section 03: FUEL SYSTEM

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.

8.2 POTENTIOMETER REPLACEMENT

1. Disconnect cable harness connector.
2. Loosen the two screws and remove potentiometer. Retain for re-assembly.
3. Discard potentiometer (Fig. 16).



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. 16) and tighten just enough to secure potentiometer lightly. Tighten screws to 10 - 20 lbf-in (1.5 - .2 Nm).
5. Reconnect electronic foot pedal assembly's cable harness to the CPC 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.

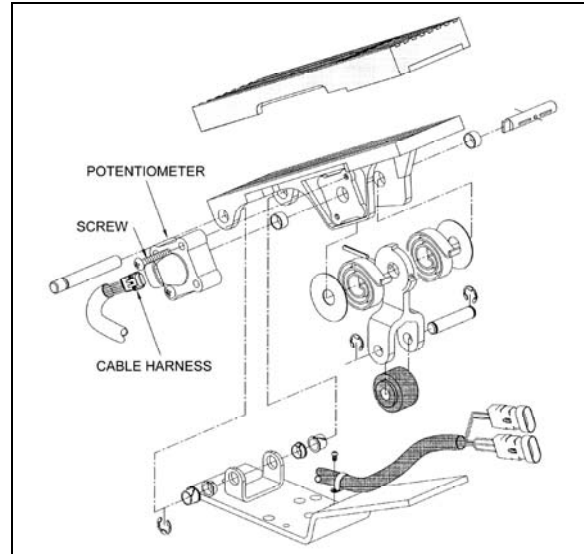


FIGURE 16: ELECTRONIC FOOT PEDAL ASSEMBLY 03035

9. SPECIFICATIONS

Davco Fuel Pro 382 Fuel Filter / Water Separator Element

Prevost number Refer to the Parts Manual

Primary Fuel Filter (Fuel/Water Separator)

Part number Refer to the Parts Manual

Filter torque 1/2-3/4 turn after gasket contact

Secondary Fuel Filter (Main)

Part number Refer to the Parts Manual

Filter torque 3/4- 1 turn after gasket contact

Fuel tank

Capacity 235 US gal (890 liters)

Air Cleaner

Prevost Number Refer to the Parts Manual

Prevost number (element cartridge) Refer to the Parts Manual

Air Cleaner Restriction Indicator

Prevost number530161

Preheater Fuel Filter

Prevost number871037

SECTION 04: EXHAUST AND AFTERTREATMENT SYSTEM

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Section 04: EXHAUST AND AFTERTREATMENT SYSTEM

1. EXHAUST AFTERTREATMENT SYSTEM OVERVIEW

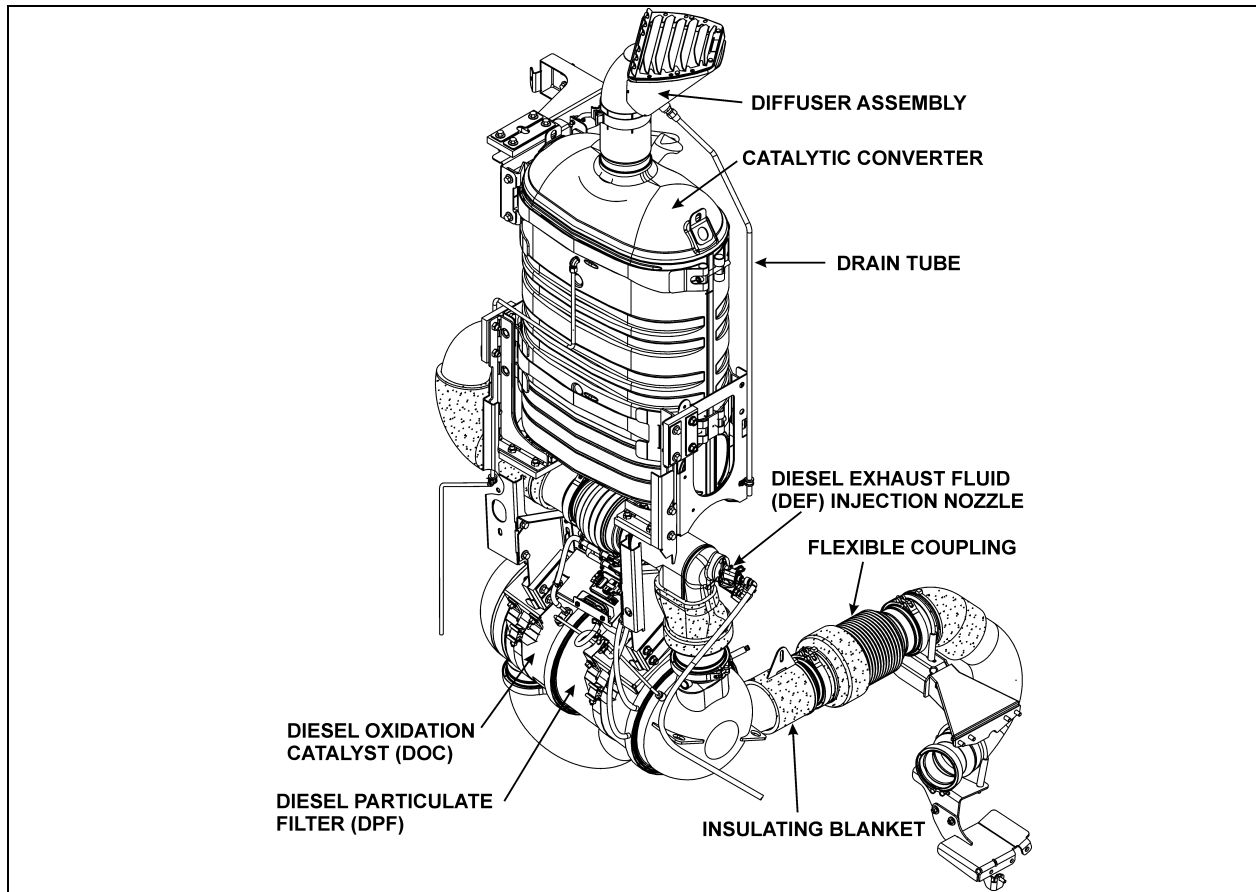


FIGURE 1: EXHAUST SYSTEM

The technology behind clean emissions is through the immediate aftertreatment of engine exhaust. The process for reducing NO_x via aftertreatment is called Selective Catalytic Reduction (SCR). It requires a catalytic converter into which is injected Diesel Exhaust Fluid (DEF). The primary component of DEF is water; the active component is urea. Urea is a nitrogen compound that turns to ammonia when heated. When a urea-and-water solution is injected into the exhaust stream and passed over a catalyst, the urea reacts with the NO_x to form nitrogen and water vapor – two clean and harmless components of the air we breathe. The aftertreatment system primary function is to capture and oxidize (regenerate) the particulate matter (soot) in the engine exhaust gases and to reduce NO_x. To achieve this goal, the exhaust aftertreatment system is split into two main sections: the exhaust gases first enter the **Diesel Oxidation Catalyst (DOC)** and **Diesel Particulate Filter (DPF)** assembly to capture

and regenerate the soot on a regular or passive basis, then the exhaust gases flow through the **catalytic converter** to reduce NO_x to minimum level. Through constant monitoring of the exhaust gas temperature and the system back pressure, the Engine Monitoring System (EMS) is able to manage regeneration.

The exhaust aftertreatment system is rubber mounted to the vehicle structure. This feature reduces the transmission of vibrations to the exhaust aftertreatment system thus resulting in extended life of the system, brackets and also noise reduction.

1.1 MAINTENANCE

Inspect the exhaust system periodically for restrictions and leaks. Figure 1 presents the major components of the exhaust system. Exhaust leaks are commonly the result of loose clamp bolts, corroded or punctured pipes. In


In addition to excessive noise, a leaking exhaust system could allow toxic gases to enter the vehicle. Damage to surrounding components from hot gases could result as well. Replace damaged or corroded exhaust components immediately.

Inspect the exhaust system as follows:


- At vehicle inspection intervals ;
- Whenever a change is noticed in the sound of the exhaust system ;
- When components close to the exhaust system get unnaturally dirty ;
- 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.


DANGER

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.


WARNING

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


NOTE

The key to successful regeneration is high exhaust temperature for an extended period of time. For this reason, insulating blankets must remain permanently on the exhaust system.

If insulating blankets are removed from the system, the exhaust gases temperature may not be high enough to permit efficient particulate oxidation during passive regeneration, resulting in increased fuel consumption due to overuse of active or stationary regeneration.

1.2 FLEXIBLE COUPLING INSTALLATION

The flexible coupling contains a rigid interior pipe (Fig. 2). To allow appropriate flexibility once installed, be sure interior pipe is concentric to flexible part and that the flexible coupling is straight when installed. This piece of equipment handles vibration and thermal expansion.


CAUTION

Adequately support the exhaust system line. The load of the exhaust line **must not** be transferred to the turbocharger.

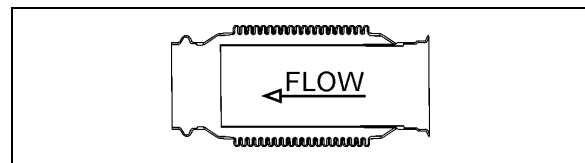



FIGURE 2: FLEXIBLE COUPLING

04022

2. DIESEL PARTICULATE FILTER (DPF)

Besides trapping soot, the **DPF (Diesel Particulate Filter)** also traps the ash that has been generated when additives in engine oil are burned. However, unlike soot, ash cannot be oxidized. The ash that accumulates in the filter will eventually cause an increase in exhaust back pressure. EMS will constantly monitor the ash accumulation and forecast the approximate time until DPF ash cleaning is required. This allows you the opportunity to plan for the DPF ash cleaning interval. If ash cleaning is not performed proactively, and the back pressure increases beyond the system limit, EMS will flag the amber warning light on the telltale panel, notifying the operator that an ash cleaning is required. Clean remanufactured DPF cartridge will be available through Prevest on an exchange basis. For most vehicle applications and duty cycle, this will occur after approximately 200,000-400,000 miles (320,000-640,000 km) of operation.


WARNING

HOT SURFACES

Keep yourself clear of hot Aftertreatment System surfaces, particularly during and after active or stationary regeneration. Hot surfaces can cause serious burns.

Make sure Aftertreatment System components are cold before handling.

Section 04: EXHAUST AND AFTERTREATMENT SYSTEM

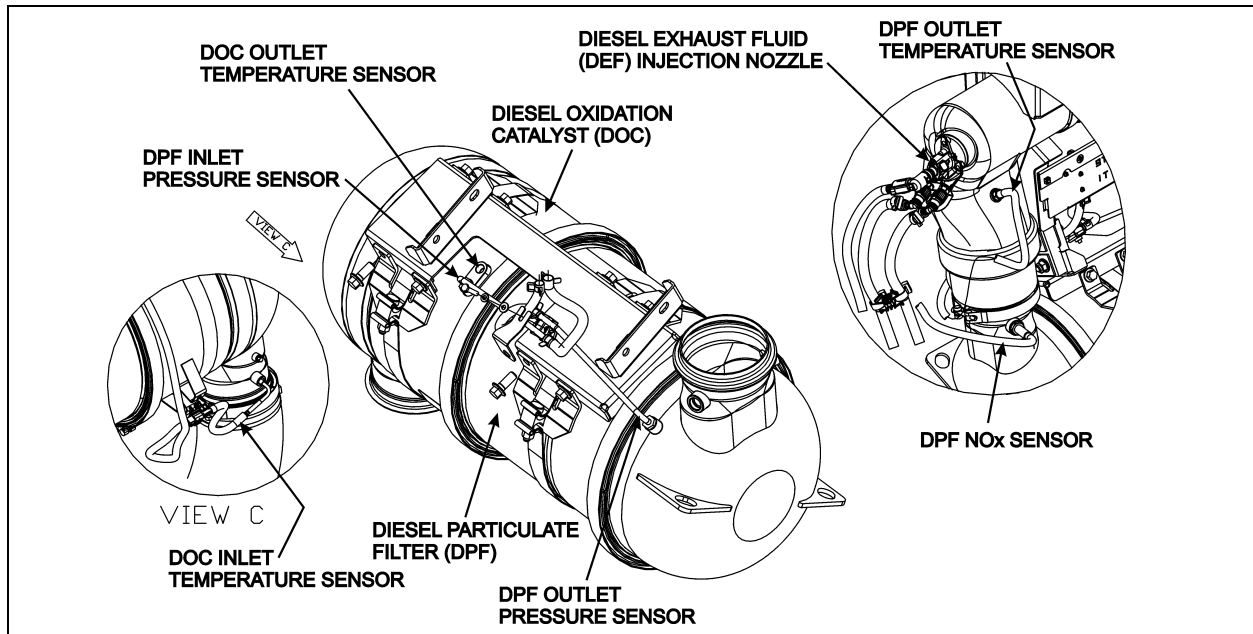


FIGURE 3: DIESEL OXIDATION CATALYST (DOC) & DIESEL PARTICULATE FILTER (DPF) ASSEMBLY 04016

WARNING

HOT EXHAUST

During stationary regeneration, exhaust gases temperature may get very hot at the diffuser outlet. Do not direct diffuser at combustible materials. Before initiating stationary regeneration, make sure that the diffuser outlet is clear of objects and that no one is working near the diffuser outlet. Stationary regenerations must be undertaken outdoors only.

Never initiate regeneration when exhaust gas collection system is in place.

WARNING

TOXICITY

Do not initiate a stationary regeneration in a closed area like a garage. **Stationary regeneration must be undertaken outdoors only.**

2.1 DIESEL PARTICULATE FILTER ASSEMBLY REMOVAL

To remove the DPF, proceed as follows:

CAUTION

External and internal temperatures remain hot long after engine has been shutdown. Allow the Exhaust Aftertreatment System to cool before handling. Wear protective clothing and glove while servicing.

1. First, open the engine compartment door;
2. Put insulating blanket aside;
3. Disconnect pressure, NOx and temperature sensors;
4. Support Diesel Oxidation Catalyst (DOC) and Diesel Particulate Filter (DPF) assembly;

CAUTION

HEAVY DEVICE

A suitable lifting or holding device is required. Properly support and attach lifting equipment to prevent the DOC and DPF assembly from falling when servicing.

5. Unfasten clamps holding DOC and DPF assembly;

6. Carefully lower DOC and DPF assembly;
7. To make sure components are reinstalled in the same position, mark position of DOC, DPF and clamps in relation with one another before taking apart;



CAUTION

FRAGILE - HANDLE WITH CARE

Use extreme care when handling DPF cartridge as it could be damaged or destroyed by dropping or sudden impact.

Clean remanufactured DPF filtration cartridge will be available on an exchange basis. For this reason, it is very important to maintain the cartridge in perfect condition. Damaged cartridge may not be refunded.

8. Also replace V-band clamps and gaskets when replacing DPF filtration cartridge;

NOTE

When replacing the DPF cartridge, refer to the specifications on the DPF attached tag for proper replacement DPF selection.

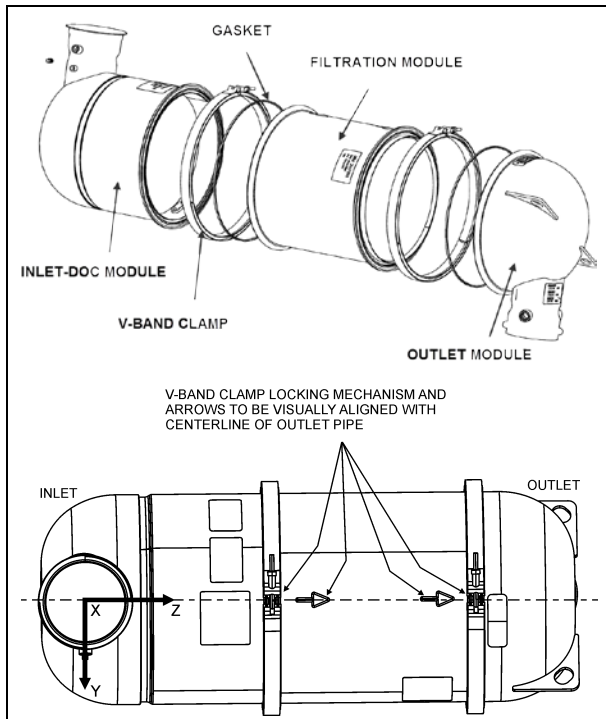
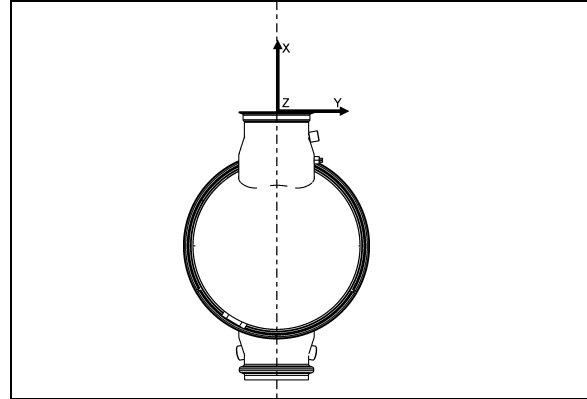


FIGURE 4: TAKING DOC AND DPF APART

9. Always put DOC and DPF filtration cartridge back together again in a vertical position to facilitate gaskets positioning;



10. Torque V-band clamps to 20 lbf-ft (27 Nm) by hand;



CAUTION

Always torque clamps by hand.

11. With a rubber mallet, hit clamps forcefully around circumference to make sure gasket is fully seated;
12. Support Diesel Oxidation Catalyst (DOC) and Diesel Particulate Filter (DPF) assembly during reinstallation;
13. Reconnect pressure, NOx and temperature sensors;
14. Fasten straps holding DOC and DPF assembly;
15. Put insulating blanket back.

3. CATALYTIC CONVERTER

In the first instance, the catalytic converter of the Selective Catalytic Reduction (SCR) does not need any maintenance. Unless an accident or damage occurs in the vicinity of the engine compartment; the catalytic converter will not have to be replaced.

However if the catalytic converter must be replaced, use one of the two following procedures:

3.1 REMOVAL

Procedure # 1

Radiator must be removed in order to lower the catalytic converter for replacement.

- Set the starter selector switch to the *OFF* position.

Section 04: EXHAUST AND AFTERTREATMENT SYSTEM

- Shut off the heater line shut-off valves.
- Using the quick-connect drain hose, drain the engine cooling system. Refer to Section 05, COOLING under "DRAINING COOLING SYSTEM".



CAUTION

Tag hoses and cables for identification before disconnecting in order to facilitate re-installation. Plug all openings to prevent dirt from entering the system.

- Disconnect and remove section of coolant pipe assembly mounted between the radiator outlet and the water pump inlet.

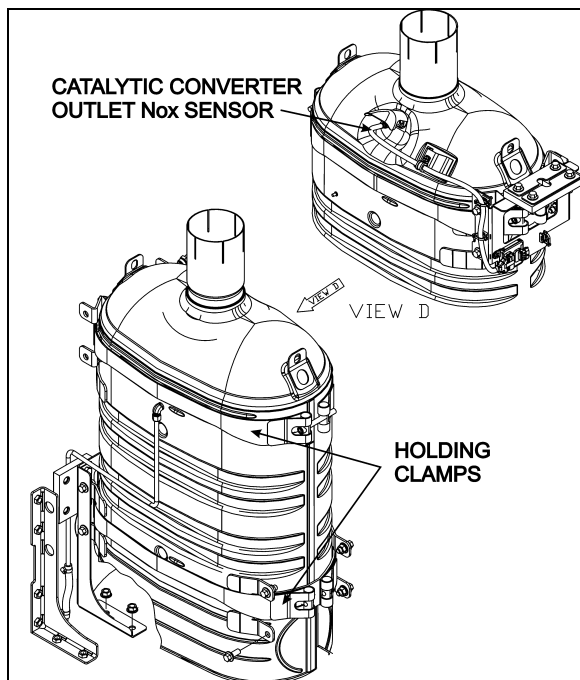


FIGURE 5: CATALYTIC CONVERTER

- Disconnect and remove a section of coolant pipe assembly mounted between the thermostat housing and the radiator inlet.
- Disconnect the electric fan-clutch connector located near the cooling fan right angle gearbox.
- Disconnect and remove the air intake duct mounted between the turbocharger outlet and the air cooler inlet.
- Open radiator door. Unfasten bolts and screws fixing radiator sealing frame.
- Remove radiator and air cooler assembly.



WARNING

Due to the heavy load of the radiator assembly, it must be adequately supported before attempting to remove it.

- Safely support catalytic converter from the top.
- Disconnect catalytic converter outlet NOx sensor.
- Remove clamps holding catalytic converter then lower.
- Remove or disconnect any piece of equipment or component that might be in the way or that might prevent removing the catalytic converter.

Procedure # 2

- Set the starter selector switch to the *OFF* position.
- Shut off the heater line shut-off valves.
- Remove DOC and DPF assembly (Refer to paragraph 2.1 in this Section).
- Remove pipe connecting DOC & DPF assembly to catalytic converter.
- Using the quick-connect drain hose, drain the engine cooling system. Refer to Section 05, COOLING under "DRAINING COOLING SYSTEM".



CAUTION

Tag hoses and cables for identification before disconnecting in order to facilitate re-installation. Plug all openings to prevent dirt from entering the system.

- Disconnect and remove section of coolant pipe assembly mounted between the radiator outlet and the water pump inlet.
- Disconnect and remove a section of coolant pipe assembly mounted between the thermostat housing and the radiator inlet.
- Disconnect and remove the air intake duct mounted between the turbocharger outlet and the air cooler inlet.
- Remove coolant surge tank.

SECTION 04: EXHAUST AND AFTERTREATMENTS SYSTEM

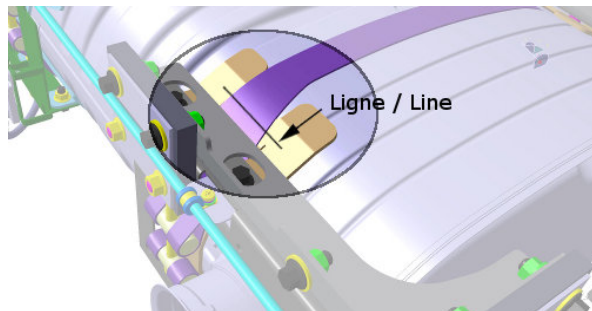
- Release tension from drive belt (Refer to paragraph 12.1 and 15.1 in Section 05: Cooling System).
- Cut cable ties and disconnect electrical connector from fan clutch. Remove fan drive shaft fasteners at the gear box.
- Remove radiator fan drive mechanism support.
- Safely support catalytic converter from the top.
- Disconnect catalytic converter outlet NOx sensor.
- Remove clamps holding catalytic converter then lower.
- Remove or disconnect any piece of equipment or component that might be in the way or that might prevent removing the catalytic converter.

3.2 ASSEMBLING CATALYTIC CONVERTER

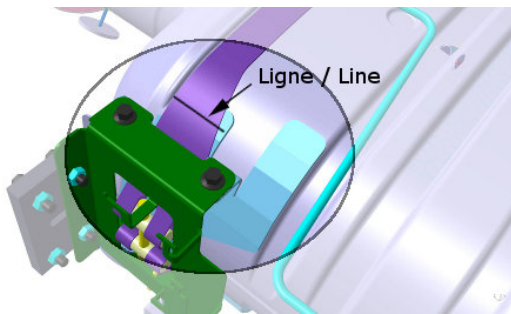
Before removing

- Mark, with a vertical line the angular position of the lower (both sides) and upper clamps with regard to the clamps support located on the catalytic converter.

Lower



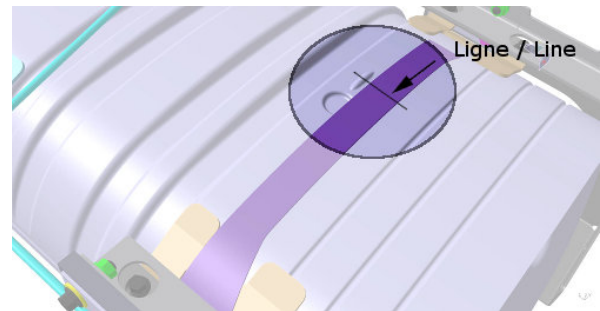
Upper



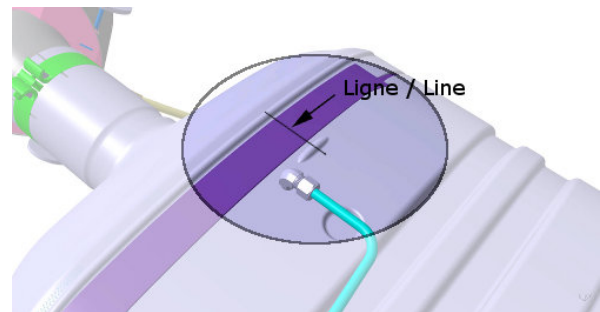
- Mark, with a vertical line the central position of the lower and upper clamps with regard to

the emboss located at the bottom and at the top of the catalytic converter.

Lower



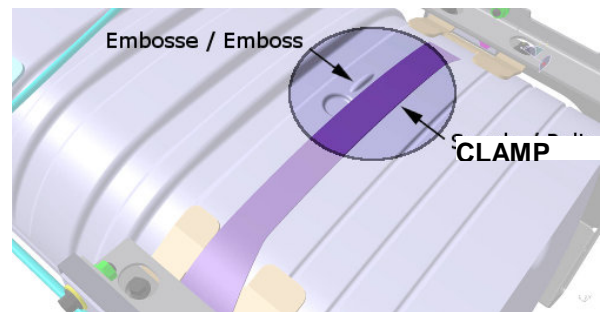
Upper



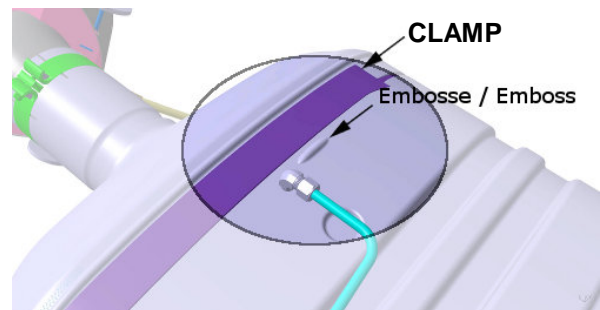
Assembling

- Position the upper clamps above the upper emboss and the lower clamps below the lower emboss of the catalytic converter.

Lower



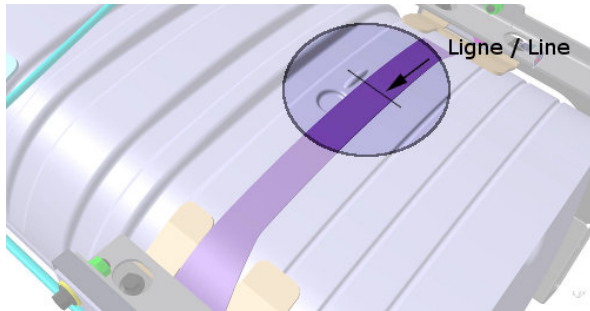
Upper



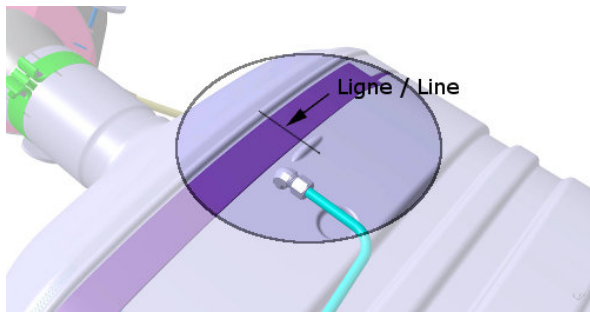
Section 04: EXHAUST AND AFTERTREATMENT SYSTEM

- Using the lines made earlier, line up the lower and upper clamps with regard to the emboss of the converter and afterward, line up the lines made earlier on the clamps with regard to the clamp supports on the catalytic converter.

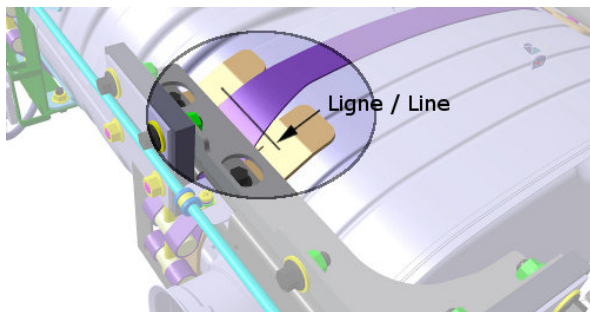
Lower



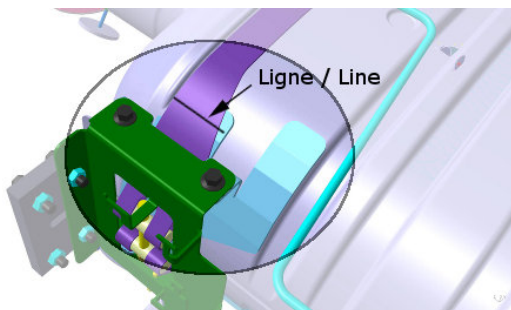
Upper



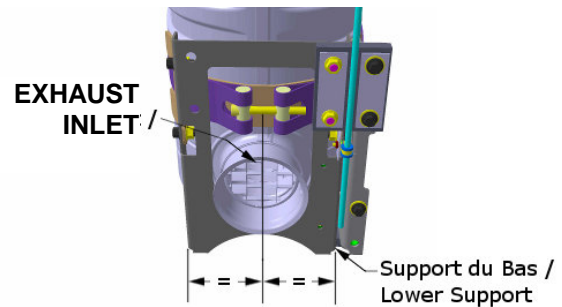
Lower



Upper



- Before tightening the parts, make sure that the catalytic converter lower support is well centered with the exhaust inlet of the catalytic converter.



- While tightening the bolts, keep in mind to respect the alignment of the parts and keep the lower support as centered as possible with the catalytic converter exhaust inlet.

4. DIFFUSER ASSEMBLY

During stationary regeneration, exhaust gases temperature may get very hot at the SCR outlet. The diffuser decreases the exhaust gasses temperature by about half approximately, at 6 inches above the diffuser. The diffuser is an important component of the exhaust system and must remain on the vehicle at all times. Operating the vehicle without the diffuser may seriously damage the vehicle.

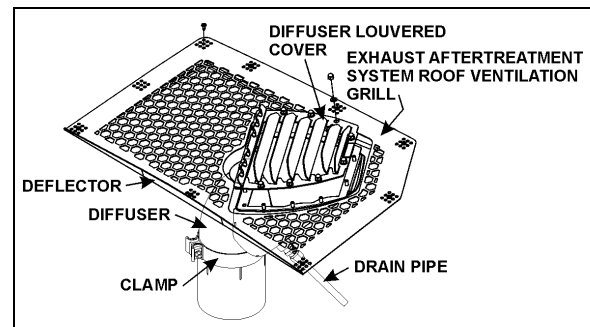


FIGURE 6: DIFFUSER ASSEMBLY

04014

4.1 DIFFUSER ADJUSTMENT

Should an adjustment of the diffuser position be necessary, first remove the exhaust aftertreatment roof ventilation grill.



CAUTION

To prevent paint damage and fiberglass overheating caused by hot exhaust gases, the diffuser louvered cover must be flush with the roof surface or may not exceed the roof

SECTION 04: EXHAUST AND AFTERTREATMENT SYSTEM

surface more than 3/32 inch (2 mm).



CAUTION

Tighten clamps properly in order to prevent any movement of the diffuser assembly. An impact wrench is necessary.

1. Loosen the clamp securing the diffuser assembly to the catalytic converter.

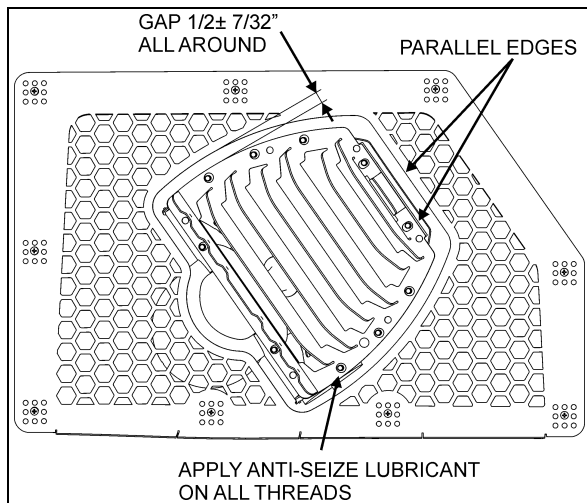


FIGURE 7: DIFFUSER POSITION ADJUSTMENT 04015_1

2. For proper angular position, make sure that the two edges shown on figure 7 are parallel with each other.
3. Using a straightedge, adjust the diffuser assembly level. The top surface of the warning plate fixed on the diffuser louvered cover must be flush with the roof surface or may exceed about 3/32in (2mm).
4. Tighten the clamp securing the diffuser assembly to the catalytic converter.
5. Reinstall the exhaust aftertreatment system roof ventilation grill and deflector.

4.2 MAINTENANCE

At vehicle inspection intervals, inspect the diffuser assembly as follows:

- Inspect diffuser grille for stress cracking;
- Check for presence of foreign matter and debris inside the diffuser housing, remove and clean if applicable;

- Check for proper functioning of the rain cap inside the diffuser housing, make sure that it moves freely;
- Make sure that the water drain tube is not clogged. Pour a cup of water into the diffuser housing and assure that all the water is drained at once at the other end of the drain tube. If tube is clogged, remove tube and blow compressed air inside, in reverse flow;
- Check that the warning plate "THIS DIFFUSER SURFACE MUST BE FLUSH WITH THE ROOF SURFACE" is still in place.

4.3 DIFFUSER EXTENSION – VIP

A diffuser extension is available for converters. To install:

1. Remove the existing diffuser louvered cover;
2. Mount the extension on the diffuser housing. Secure with the 10 existing cap nuts;
3. Slide the heat shield over the extension;
4. Place the diffuser louvered cover over the assembly and secure with a second set of 10 identical cap nuts.

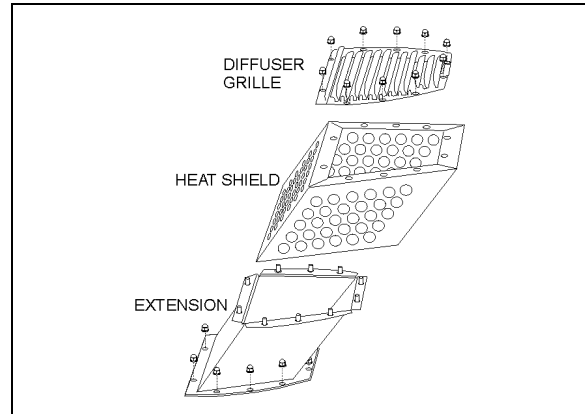


FIGURE 8: DIFFUSER EXTENSION

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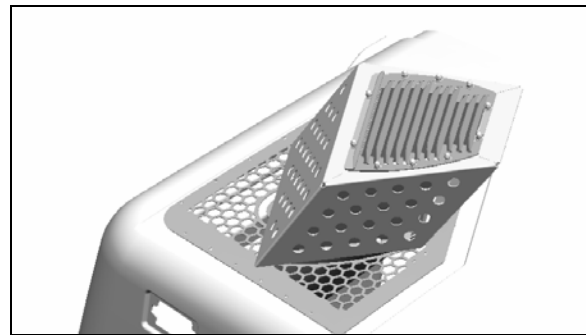


FIGURE 9: DIFFUSER EXTENSION FOR MOTORHOMES

Section 04: EXHAUST AND AFTERTREATMENT SYSTEM

5. DIESEL EXHAUST FLUID (DEF) TANK AND INJECTION SYSTEM

The DEF tank and injection system control unit continuously vary the amount of DEF injected in response to the engine's current load conditions.

Diesel Exhaust Fluid (DEF) is stored in a 16 gallons (60 liters) plastic tank located in the condenser compartment, behind the condenser – ventilation fan assembly.

A pump located beside the DEF tank is used to pressurize the system and deliver the fluid.

A heating coil located inside the tank use engine coolant to keep the DEF in a liquid state or to melt DEF at engine start up during cold season.

DEF is injected into the exhaust gases through an injection nozzle located between the DPF and the catalytic converter (refer to figure 1).

In the catalytic converter, nitrogen oxides are transformed into harmless nitrogen gas and water.

The system notifies the driver when it is time to top up with DEF.

5.1 DIESEL EXHAUST FLUID

When handling DEF solution, it is important that electrical connectors to be connected or well encapsulated, otherwise there is a risk that the DEF will cause oxidation that cannot be removed. Water or compressed air will not help, since DEF quickly oxidizes certain metals. If a disconnected connector comes into contact with the DEF solution, it must be replaced immediately to prevent the DEF solution from creeping further into the copper wiring, which takes place at a speed of about 2.4 in (60 mm) per hour.



CAUTION

Diesel Exhaust Fluid (DEF) is a nontoxic aqueous solution of urea (32.5%) and ultra-pure water (67.5%). Urea is a compound of nitrogen that turns to ammonia when heated. The fluid is non-flammable, and is not dangerous when handled as recommended. However, it is highly corrosive to certain metals, especially copper and brass.

When detaching hoses and components, do not spill DEF on disconnected or unsealed connectors. If DEF is spilled on a

disconnected or unsealed connector, the connector must be removed immediately and replaced.

Things to know about spilt diesel exhaust fluid (DEF):

- If urea solution comes into contact with the skin, rinse with plenty of water and remove contaminated clothing.
- If urea solution comes into contact with the eyes rinse for several minutes and call for medical help if necessary.
- If inhaled breathe fresh air and call for medical help if necessary.
- Do not allow the DEF solution to come into contact with other chemicals.
- The DEF solution is not flammable. If the DEF solution is exposed to high temperatures, it breaks down into ammonia and carbon dioxide.
- The DEF solution is highly corrosive to certain metals, including copper and aluminum.
- If the DEF solution is spilled onto the vehicle, wipe off the excess and rinse with water. Spilled DEF solution can form concentrated white crystals on the vehicle. Rinse off these crystals with water.



WARNING

DEF spilt onto hot components will quickly vaporize. Turn your face away!

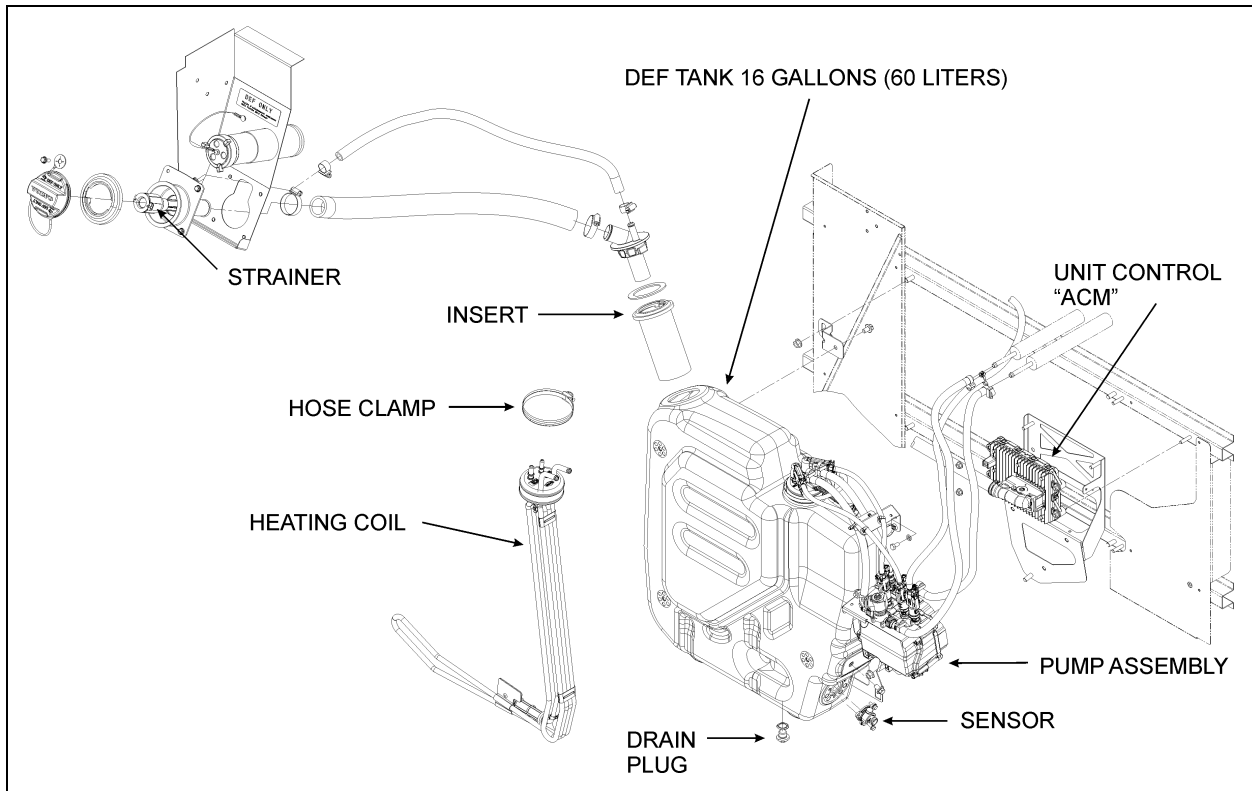
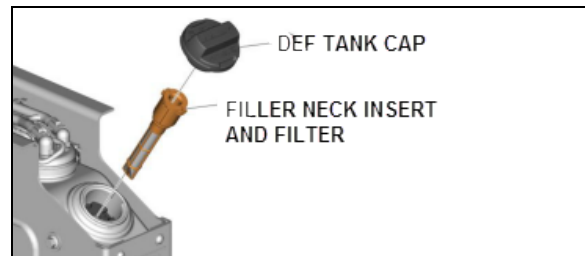


FIGURE 10: DEF TANK AND PUMP LOCATION (INSIDE CONDENSER COMPARTMENT)

5.2 DEF TANK CLEANING

Removing the DEF tank for cleaning is not necessary.

1. Put a suitable container under the DEF tank.
2. Remove the DEF tank drain plug through the DEF tank support pan access hole.
3. Let all of the DEF drain from the tank. Discard the used DEF according to local regulations.
4. Remove the DEF tank filler neck insert. To do so, release the retaining tab and remove filler neck insert. Replace old seal if damaged.



5. Flush the tank with hot water. Let all of the water drain from the tank.
6. Clean the filler neck insert screen with hot water.
7. Reinstall the filler neck insert until the retaining tabs snap into filler neck. Reinstall DEF tank drain plug.



MAINTENANCE

Drain and clean DEF tank and filler neck insert filter with hot water every 175,000 miles or once a year, whichever comes first.

Section 04: EXHAUST AND AFTERTREATMENT SYSTEM

5.3 PUMP ASSEMBLY FILTER ELEMENT REPLACEMENT

1. Clean the area around filter cover.
2. Before you loosen the filter cover, place a suitable container under the cover to catch fluid that may drain from the pump;
3. Remove filter cover.



CAUTION

Contamination or damage of the sealing surface on the housing is not acceptable.

4. Use needle nose pliers to carefully remove the equalizer and filter element. Do not damage the sealing surface on the housing.

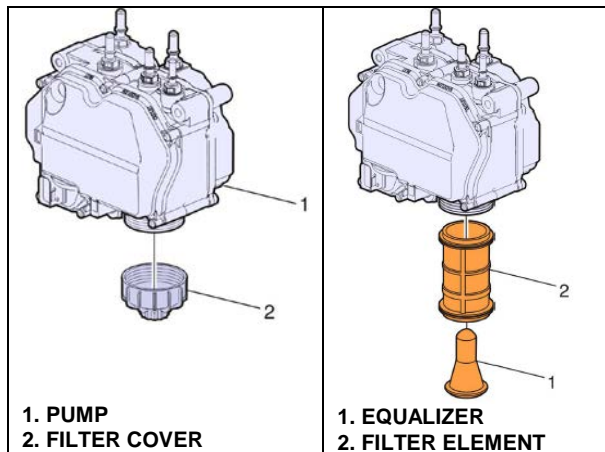


FIGURE 11 : PUMP ASSEMBLY FILTER ELEMENT

5. Install new filter element and equalizer. Checks filter element cover and housing for damage. If either the filter or housing is damaged, the damaged part must be changed.
6. Install filter cover. Torque to 22.5 ± 2.5 Nm.



CAUTION

Check if there are cracks around the area of the filter cover. No cracks in the material are allowed.



MAINTENANCE

Replace DEF pump filter element and equalizer every 150,000 miles (240 000 km) or 36 months, whichever comes first.



MAINTENANCE

Drain and clean DEF tank with water once a year. Clean DEF tank filler neck strainer once a year.

5.4 FILLER NECK STRAINER

If the DEF tank filler neck strainer (figure 10) becomes obstructed with foreign matter and debris, remove and clean strainer as follows;

1. Remove filler neck cap.
2. Release the retaining tabs and remove filler neck strainer from the filler neck. Discard the old seal.
3. Clean and reinstall strainer into DEF tank filler neck with new seal.
4. Insert until the retaining tabs snap into the filler neck.

6. AFTERTREATMENT FUEL INJECTOR

Proper functioning of the aftertreatment fuel injector a.k.a. aftertreatment hydrocarbon injector (AHI) is required in order to obtain efficient regeneration process of the DPF. Clogged aftertreatment fuel injector will result in clogged DPF.

SECTION 04: EXHAUST AND AFTERTREATMENT SYSTEM

In addition to the activation of the CHECK telltale, emission of diagnostic troubleshooting codes (DTC) by the engine ECM (MID128) will indicate malfunction of the aftertreatment system and/or aftertreatment fuel injector. DTC may be accessed through the Driver Information Display. Select DIAGNOSTICS menu then FAULT DIAGNOSTICS and ENGINE ECU submenus.

Check status of the aftertreatment system through the Driver Information Display. Select AFTERTREATMENT menu then ATS STATUS. Then check the DPF soot level with SOOT LEVEL GAUGE.

6.1 REPLACEMENT

1. Remove fastener and p-clamp securing the line to the mounting bracket on the diffuser pipe.



WARNING

Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire and result in component damage and serious personal injury.

2. Disconnect the line from the aftertreatment hydrocarbon injector fitting. Collect any residual fuel that might be in the line in a suitable container.



CAUTION

Do not kink the line. Kinking the line may result in leakage.

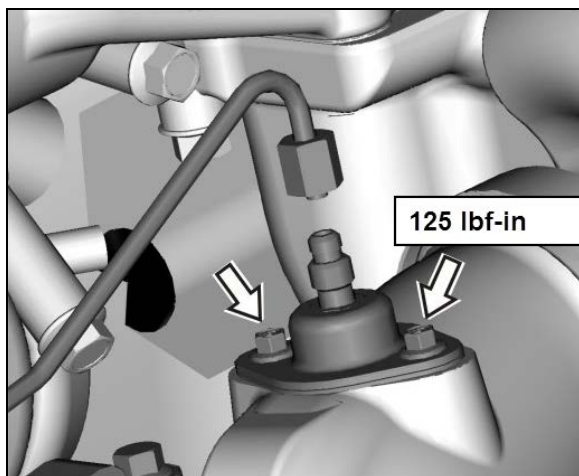


FIGURE 12: AFTERTREATMENT FUEL INJECTOR

3. Remove the aftertreatment hydrocarbon injector mounting fasteners. Remove the aftertreatment hydrocarbon injector from the diffuser pipe (which attaches to the turbocharger outlet).
4. Clean the sealing surface on the diffuser pipe before mounting the aftertreatment hydrocarbon injector.
5. Install the aftertreatment hydrocarbon injector onto the diffuser pipe (which attaches to the turbocharger outlet). Tighten the fasteners to **125 lbf-in**.

NOTE

The fasteners already include pre-applied high-temperature anti-seize compound.

6. Connect the line to the aftertreatment hydrocarbon injector. Tighten the line fitting to **135 lbf-in**.

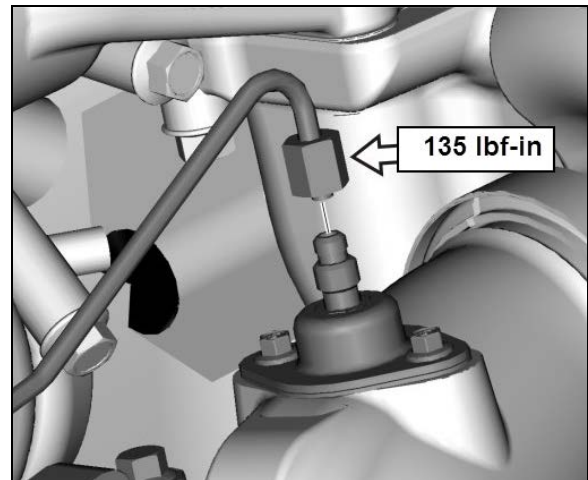


FIGURE 13: FUEL LINE FITTING

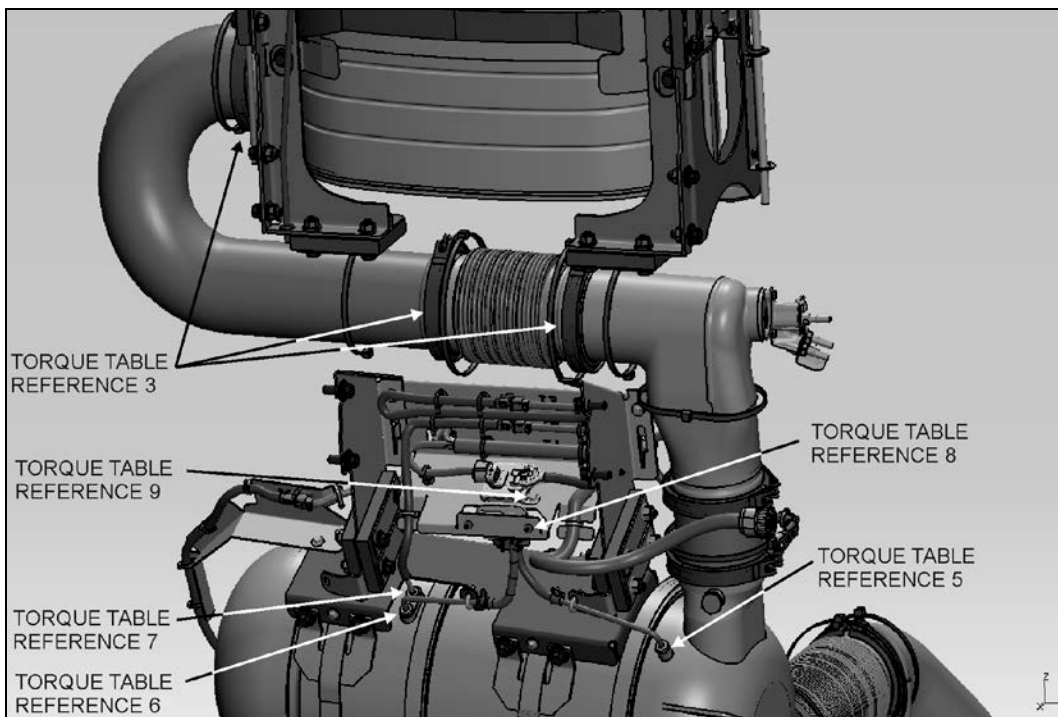
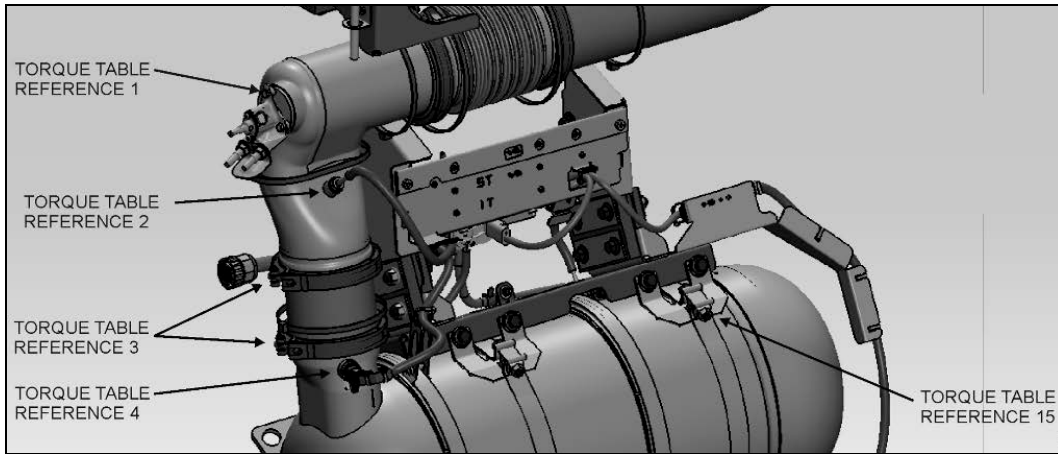
7. Install the P-clamp and fastener to secure the line to the mounting bracket on the diffuser pipe.
8. Start the service regeneration process. When fuel dosing starts, check for leaks starting on the hot side of the engine. Clear any diagnostic trouble codes, if needed.

NOTE

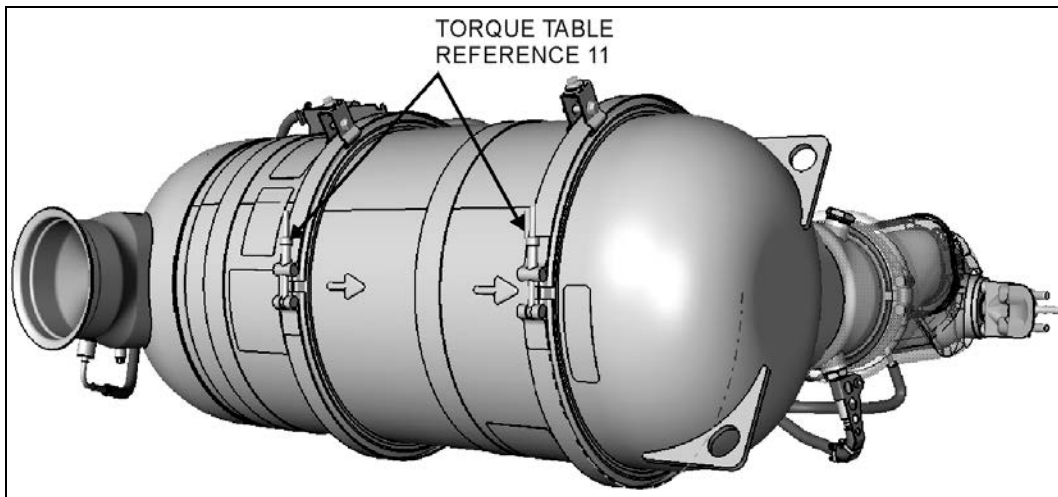
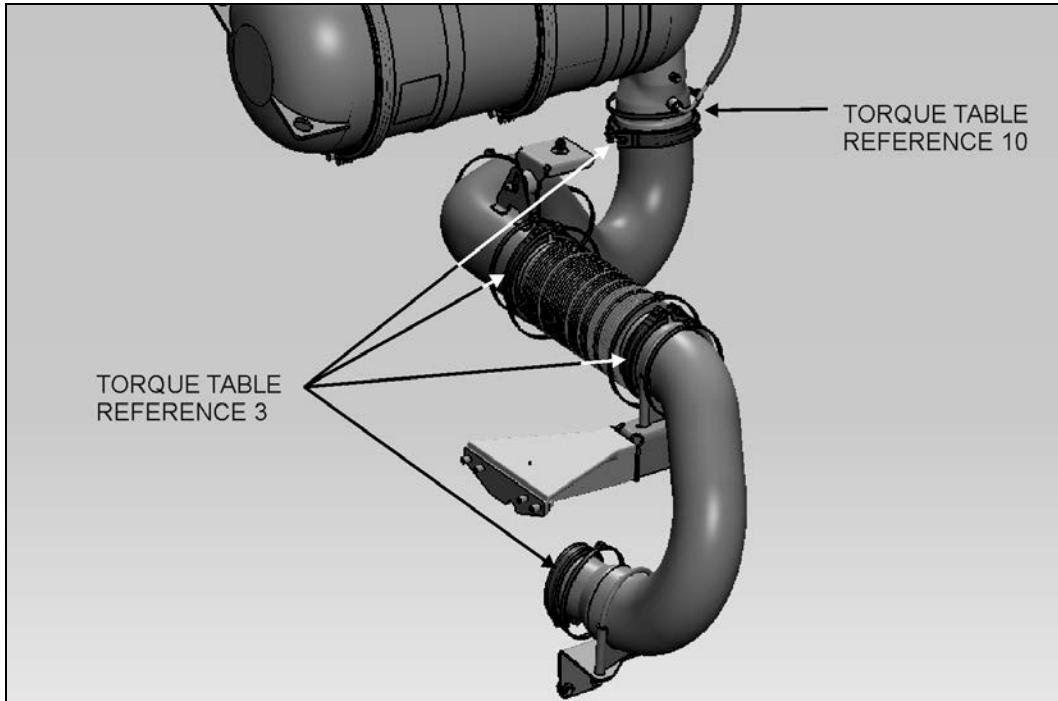
If fault tracing was performed using Guided Diagnostics, return to Guided Diagnostics for repair verification.

Section 04: EXHAUST AND AFTERTREATMENT SYSTEM

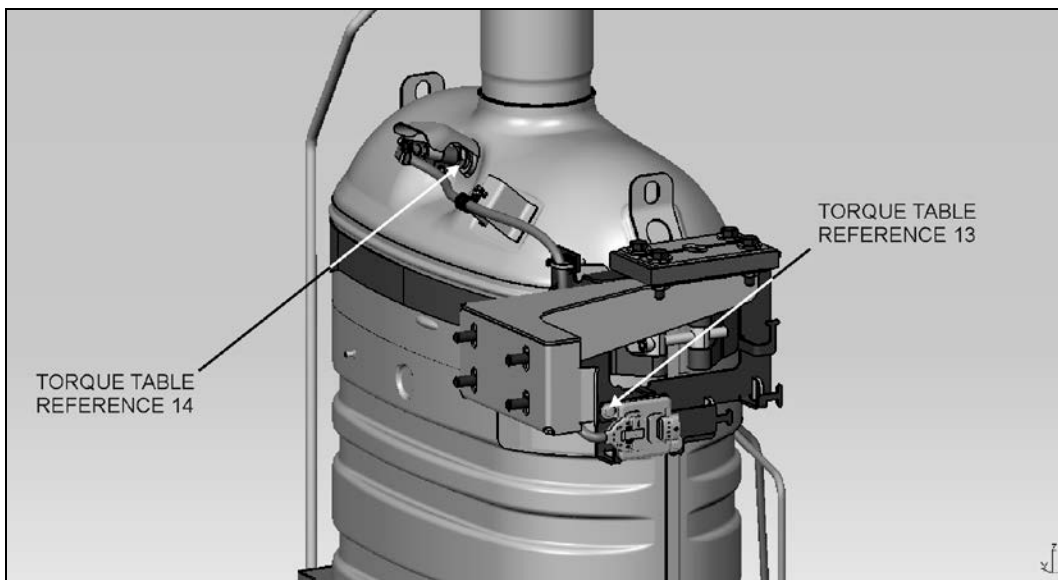
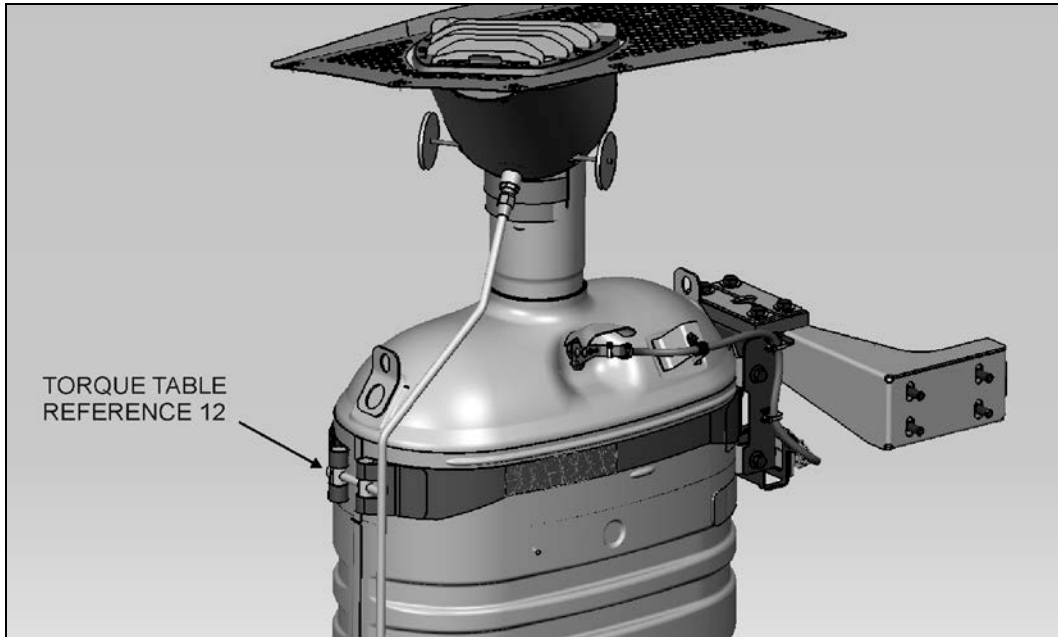
7. TORQUE SPECIFICATIONS



SECTION 04: EXHAUST AND AFTERTREATMENTSYSTEM



Section 04: EXHAUST AND AFTERTREATMENT SYSTEM



SECTION 04: EXHAUST AND AFTERTREATMENT SYSTEM

The following table lists the tightening torques for the bolts, nuts, etc. on the DPF assembly which do require a specific torque value. When no torque specifications are indicated, use the Standard Torque Specifications table found in Section 00: General Information of the Maintenance Manual.

SPECIFIC TORQUE TABLE			
<i>DESCRIPTION</i>	<i>QTY</i>	<i>REFERENCE</i>	<i>TORQUE DRY (lbf-ft)</i> <i>Tolerance: ±10%</i>
<i>DEF injection nozzle mounting bolt</i>	3	1	7.5
<i>DPF outlet temperature sensor *</i>	1	2	33
<i>V-band clamp 4-inch & 5-inch</i>	9	3	8
<i>NOx sensor *</i>	1	4	37
<i>DPF outlet pressure sensor *</i>	1	5	4
<i>DPF inlet pressure sensor *</i>	1	6	4
<i>Diesel Oxidation Catalyst (DOC) temperature sensor *</i>	1	7	33
<i>Cap screw</i>	2	8	4.5
<i>Cap screw</i>	-	9	7.5
<i>DPF inlet temperature sensor *</i>	1	10	33
<i>V-band clamp</i>	2	11	20
<i>Strap – SCR tank</i>	4	12	33
<i>NOx sensor – SCR tank</i>	1	13	37
<i>Bolts – SCR tank</i>	2	14	7.5
<i>Strap – DPF tank</i>	2	15	20

* Use Permatex 454G anti-seize lubricant or Loctite 76764 silver grade anti-seize

SECTION 05: COOLING SYSTEM

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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).

One full blocking-type thermostat is 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 the cylinder block.

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.

The cooling system is filled through a pressure & filler cap on the surge tank (Fig. 1) the cap is also 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. 1). The thermostat is located in the housing bolted to the engine on the L.H. side.

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.

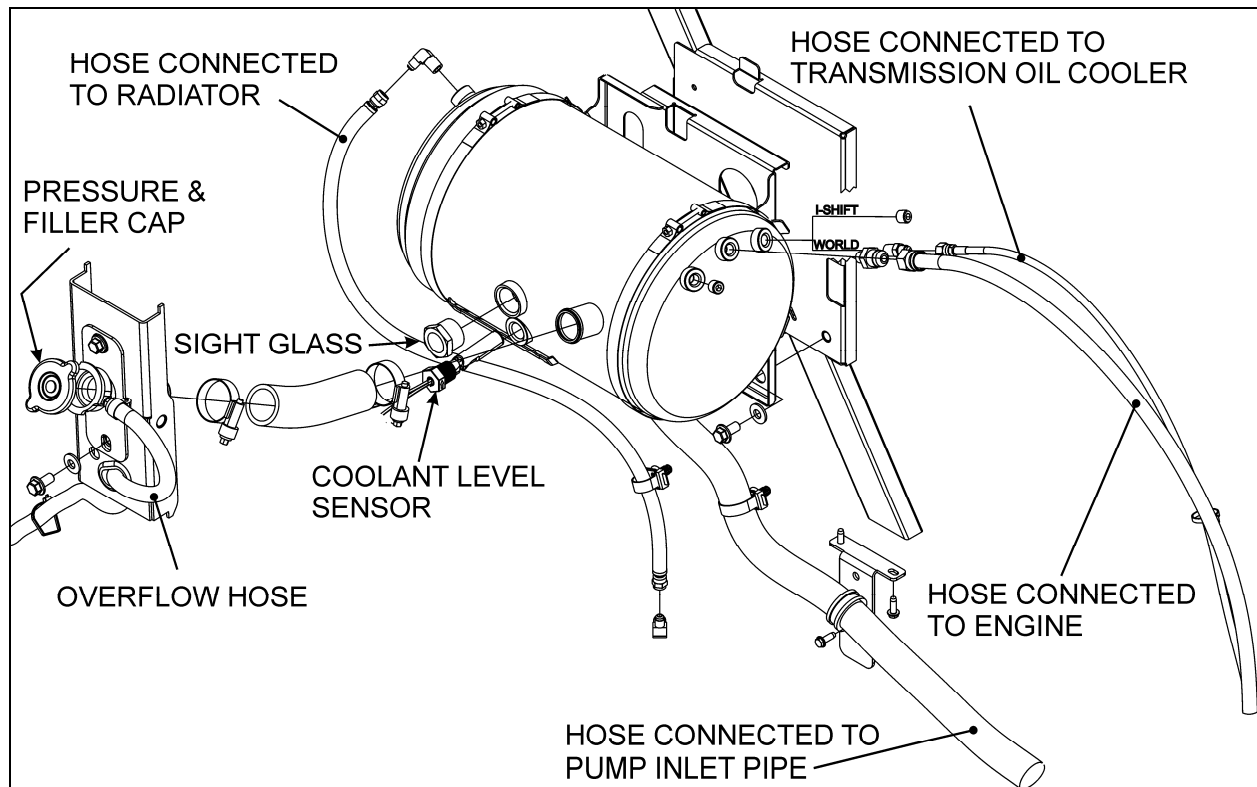


FIGURE 1: COOLANT SURGE TANK

Section 05: COOLING SYSTEM

2. MAINTENANCE

2.1 GENERAL RECOMMENDATIONS

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.
- 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.

2.2 VEHICLES EQUIPPED WITH VOLVO D13 ENGINE

NOTE

For additional information concerning Volvo D13 engine components or engine-related components, consult Volvo Trucks Canada or Volvo Trucks North America Web Site under: Parts & Service. On Volvo web site, you will find detailed service procedures for parts replacement, repair and maintenance.



MAINTENANCE

Drain, flush, thoroughly clean and refill the system with Extended Life Coolant (ELC) every four years or every 600,000 miles (1 000 000 km), whichever comes first. Change the coolant filter once a year or every 150,000 miles (240 000 km), whichever comes first. When using ELC, **do not** use a filter that contains Supplemental Coolant Additives (SCA).

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 ON COOLANT LINES - VOLVO D13

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, supplied with a spring or 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.

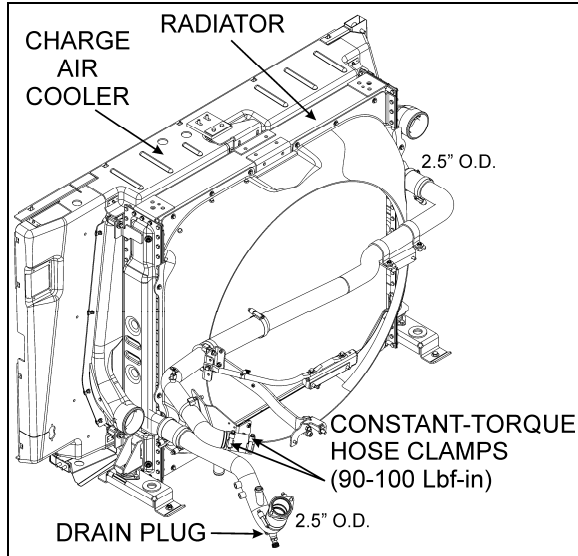


FIGURE 2: COOLANT FLOW TO RADIATOR 05119

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 1/4" (6 mm) beyond the housing (Fig. 4).

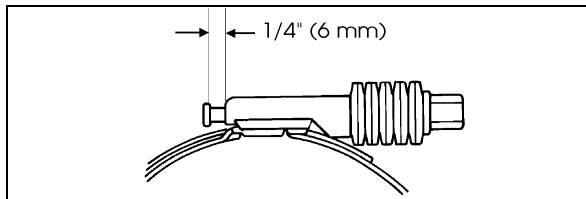



FIGURE 3: CONSTANT-TORQUE CLAMP 05037

 <p>CAUTION</p>
<p>The hose clamps will break if over-tighten. Do not over-tighten, especially during cold weather when hose has contracted.</p>

Maintenance

The constant-torque clamps contain a visual torque check feature. When the tip of the screw is extending 1/4" (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.

3.2 CONSTANT-TORQUE HOSE CLAMPS ON CHARGE AIR COOLER (CAC) SYSTEM

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) (Fig. 5).

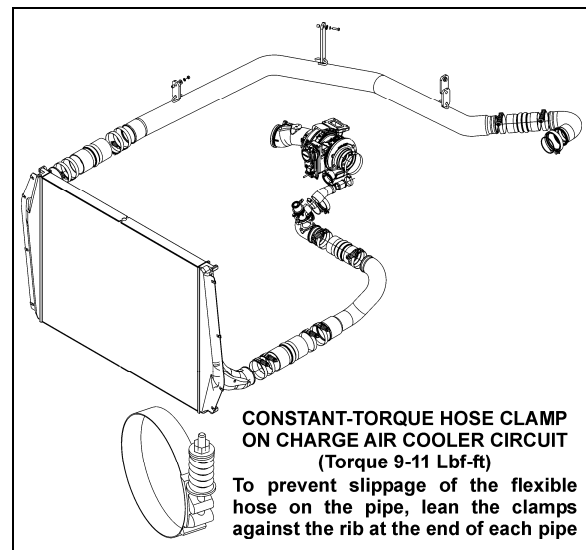



FIGURE 4: CHARGE AIR COOLER HOSE CLAMPS

 <p>CAUTION</p>
<p>The hose clamps will break if over-tighten. Do not over-tighten, especially during cold weather when hose has contracted.</p>

Maintenance

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. THERMOSTAT OPERATION

4.1 THERMOSTAT REPLACEMENT

1. Drain the cooling system.
2. Remove the bolts, the thermostat housing and the thermostat. Carefully clean the thermostat seat and all cylinder head-to-thermostat housing mating surfaces.

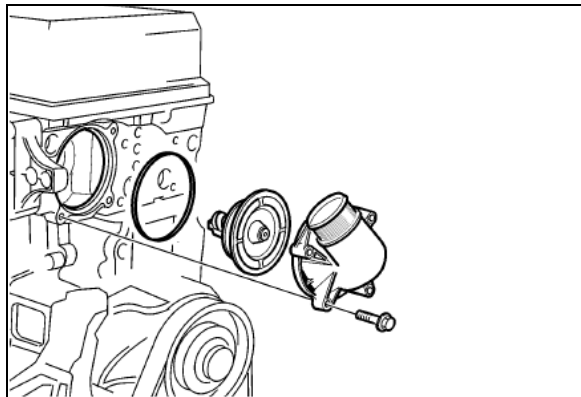


FIGURE 5: VOLVO D13 THERMOSTAT HOUSING

3. Install the new thermostat. Make sure that the rubber seal remains properly seated.
4. Position the thermostat housing to the cylinder head, install the bolts and torque-tighten to 24 ± 4 Nm (18 ± 3 ft-lb).
5. Install the rubber radiator hose to the thermostat housing. Position the clamp and tighten to secure.
6. Fill the system with the recommended coolant.
7. Start the engine, check for leaks and proper operation. After shutdown, replenish fluids as necessary.

4.2 CHECKING THERMOSTAT

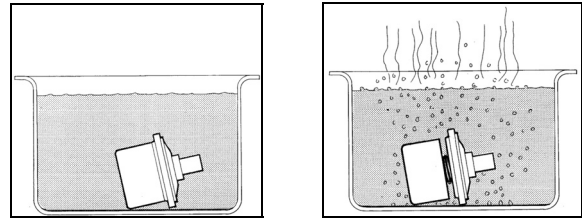
A function check must be carried out before installing a new thermostat.

NOTE

Check to be sure that the thermostat closes fully. This can be done by holding it up to the light to check that there is no visible gap at the opening point. If the thermostat does not close properly, replace it.

1. Warm up water in a receptacle to 75°C (167°F) and immerse the thermostat in the water. Use a piece of wire attached to the thermostat.

2. After at least 30 seconds, check that the thermostat is still closed.



3. Now warm the water to 100°C (212°F). After at least 30 seconds at the boiling point, check that the thermostat has opened at least 7mm ($9/32$ in). If the thermostat has not opened, it must be replaced. A good thermostat starts to close at 95°C (203°F) and is fully closed at approximately 85°C (185°F).

5. COOLANT

5.1 COOLANT LEVEL VERIFICATION

Coolant level is correct when cold coolant is visible through the surge tank sight glass (Fig. 1). If coolant level is low, fill cooling system.

5.2 COOLANT LEVEL SENSOR

This warning device consists of a fluid level probe mounted on the surge tank. The probe sends a signal to the engine control module 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 front of the surge tank.

5.3 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.

5.4 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.

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.

When freeze protection is required, a mixture of suitable water and antifreeze containing adequate inhibitors will provide a satisfactory coolant fluid.

Freeze protection down to:	percentage of antifreeze in mixture
-13°F (-25°C)	40%
-22°F (-30°C)	46%
-36°F (-38.5°C)	54%
-51°F (-46°C)	60%

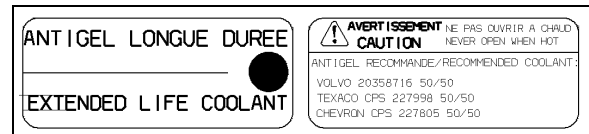
5.5 COOLANT RECOMMENDATIONS FOR VOLVO D13 ENGINE

Coolant mixture consisting of 50/50 antifreeze and deionized water solution should be used year-round to provide freeze and boil-over protection as well as providing a stable environment for seals and hoses.

When topping up coolant, use the same coolant mixture type as the mixture already in the cooling system. Do not mix two different types of coolant.

Do not use antifreeze formulated for automobile gasoline engines, these have a very high silicate content that will clog the radiator and leave unwanted deposits in the engine.

A decal (053487) located on the surge tank provides information on recommended coolants.



Recommended coolants for Volvo D13 engine:

- Prevost #685241 (pre-diluted 50/50 mixture);
- Texaco CPS#227998 (pre-diluted 50/50 mixture);
- Chevron CPS#2227805 (pre-diluted 50/50 mixture);
- Volvo 20358716 (pre-diluted 50/50 mixture);

CAUTION

On Volvo D13 engine, use **only** Extended Life Coolant (ELC). **Do not** add supplemental coolant additives (SCA) to extended life coolant. **Do not** use a coolant filter containing Supplemental Coolant Additives (SCA).

CAUTION

Extended Life Coolant (ELC) will test as out of additives (SCA), but SCA should not be added. Shortened engine life may be the result of adding SCA.

Section 05: COOLING SYSTEM

6. 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 shut-off valves.

One valve is located in the engine compartment near the water pump (Fig. 6). Another valve is located behind rear fender, above the L.H. rear wheelhousing near the optional coolant heater.

NOTE

Refer to section 22 under "Preheating System" for information about preheater access and heater line shutoff valve.

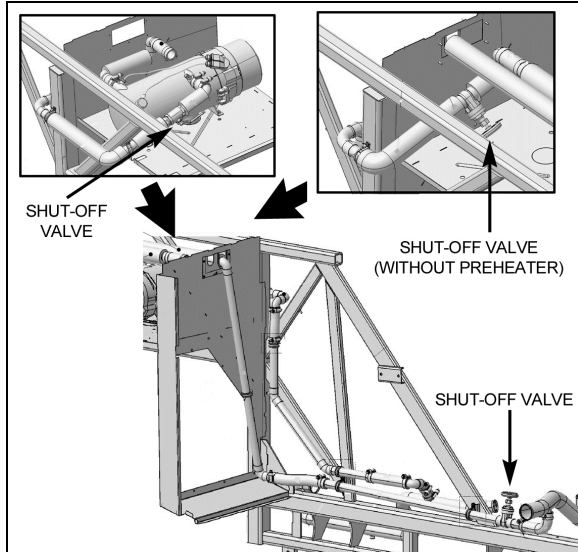


FIGURE 6: HEATER LINE SHUTOFF VALVES 05144



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. Close the shut-off valve on the coolant filter mounting head and remove filter (perform only if filter as to be replaced).
3. Open the shut-off valve on the coolant filter mounting head and drain the coolant into a suitable container. Close the shut-off valve.

4. Unscrew the surge tank pressure cap counterclockwise, $\frac{1}{4}$ turn to let air enter the system and permit the coolant to drain completely from system.
5. Connect coolant extractor (Fig. 7). Use coolant extractor to drain the coolant from the engine. An alternate method is to drain the coolant into a suitable container using the drain hose.



WARNING

Coolant is toxic; risk of poisoning. Do not drink coolant. Use proper hand protection when handling. Keep coolant out of reach of children and animals. Failure to follow these precautions can cause serious illness or death.

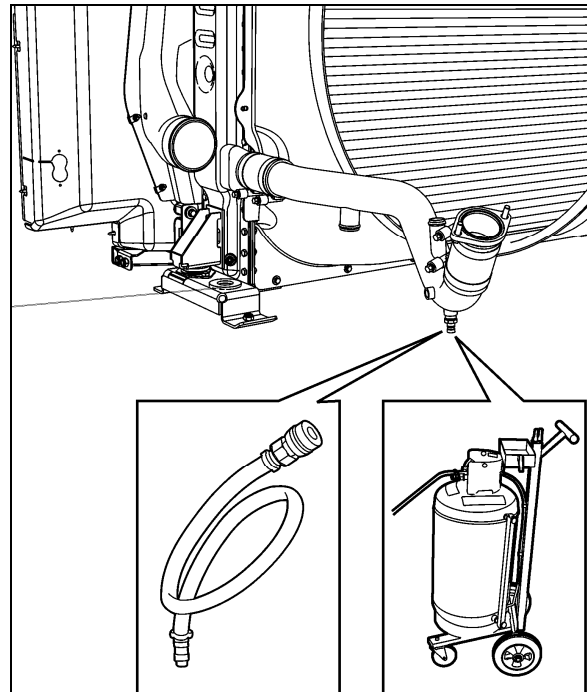


FIGURE 7: EXTRACTING COOLANT 05093

6. Open the radiator drain cock.
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 "Draining Heating System" in Section 22.

7. 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 radiator drain cock.
2. Open the shut-off valve on the coolant filter mounting head.
3. Refill cooling system from the surge tank filler cap inlet with the recommended ethylene glycol-based antifreeze and water solution of the required concentration using the coolant extractor.

NOTE

Make sure the purge lines are properly connected and not obstructed. The purge lines (thermostat housing dome, radiator top tank, transmission oil cooler or delivery line) are required to ensure complete engine fill and proper purging of air in the system.

NOTE

The coolant level should remain within two inches of the surge tank filler neck.

4. Install the filler and pressure cap, 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 warning light will illuminate.

5. Stop engine and allow cooling.
6. 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. If the vehicle is equipped with a windshield upper section defroster, momentarily pinch the hose located between the recirculating pump suction and the defroster outlet connector to ensure windshield upper section defroster complete filling. Complete the procedure by bleeding the heater cores as explained in Section 22, under "9.4 Bleeding Heating System".

8. 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:

Section 05: COOLING SYSTEM

Fill with a 50/50-antifreeze/water solution and add required inhibitors.

Vehicles with coolant filters:

Fill with a 50/50-antifreeze/water solution. Replace coolant filter as per the Lubrication and Servicing Schedule in section 24 if required.

Dispose of spent fluids in an environmentally responsible manner according to regulations in effect in your area.

COOLING SYSTEM CAPACITY (approximation)

Includes heating system: 24 US gal (91 liters)
--

8.1 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.

8.2 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

<i>Apply air gradually. Do not exert more than 138 kPa (20 psi) air pressure. Too great a pressure may rupture a radiator tube.</i>

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.

9. 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 mounted onto the cooling fan drive mechanism aluminum casting (Fig. 8).

To replace a filter:

1. Close the filter shut-off valve 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. Recover the coolant remaining in the filter with a suitable container.
3. Clean the filter adapter with a clean, lint-free cloth.
4. Coat surface of gasket with clean antifreeze, tighten 2/3 to 1 turn after gasket makes contact with head.
5. Open the filter shut-off valve.
6. Start engine and check for leaks. After shutdown, replenish fluid as necessary.



CAUTION

Do not exceed recommended service intervals.

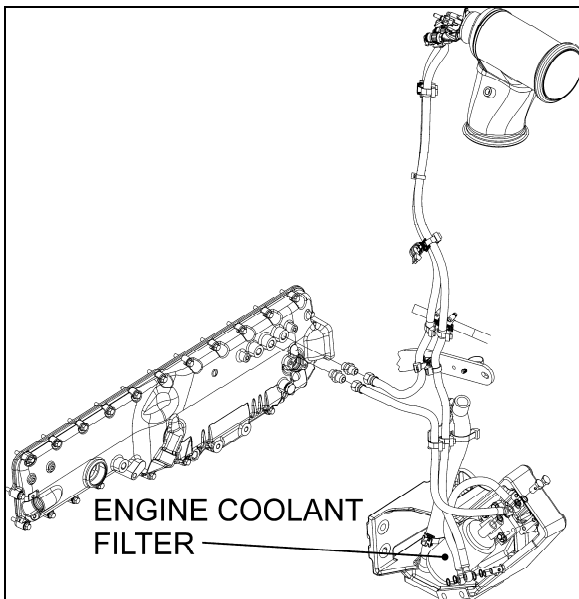


FIGURE 8: COOLANT FILTER (VOLVO D13) 05145



MAINTENANCE

VOLVO D13 ENGINE

Replace the coolant filter cartridge after 150,000 miles (240 000 km) or one year to prevent external rust damage to the filter walls. **Do not** use a coolant filter containing Supplemental Coolant Additives (SCA).

Coolant filter cartridge (Volvo D13): #20458771

10. RADIATOR

The radiator is mounted at 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.

10.1 MAINTENANCE



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.

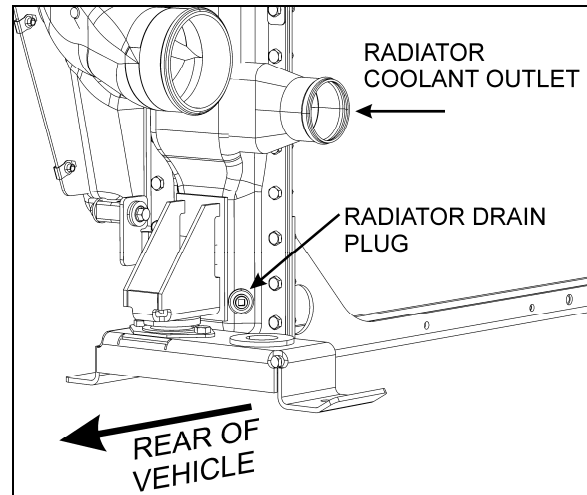


FIGURE 9: RADIATOR DRAIN PLUG 05129

10.2 RADIATOR REMOVAL & INSTALLATION

1. Apply the parking brake and shift the transmission to neutral. Shut off all electrical loads. Turn the ignition key to the OFF position.

Section 05: COOLING SYSTEM

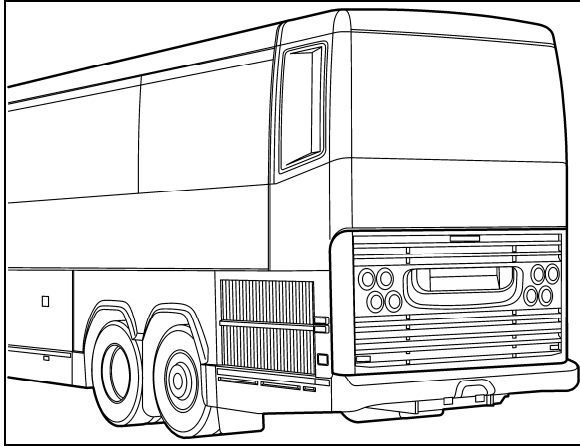


FIGURE 10: ENGINE COMPARTMENT DOOR

2. Open engine compartment door (Fig. 10).
3. Set starter selector switch to the OFF position (Fig. 11).

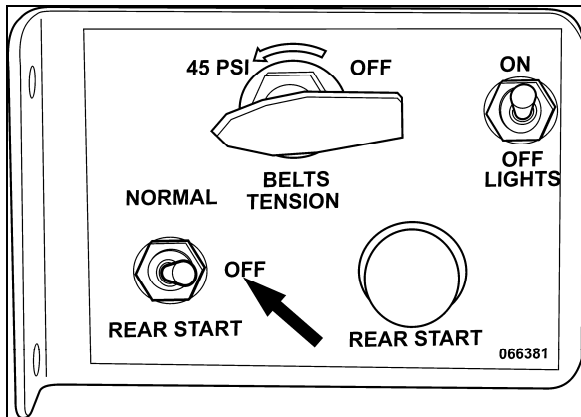


FIGURE 11: REAR START PANEL

4. Connect coolant extractor (Fig. 7). Use coolant extractor to drain the coolant from the engine. An alternate method is to drain the coolant into a suitable container using the drain hose.



DANGER

Coolant is toxic; risk of poisoning. Do not drink coolant. Use proper hand protection when handling. Keep coolant out of reach of children and animals. Failure to follow these precautions can cause serious illness or death.

5. Remove L.H. side rear fender (Fig. 12).

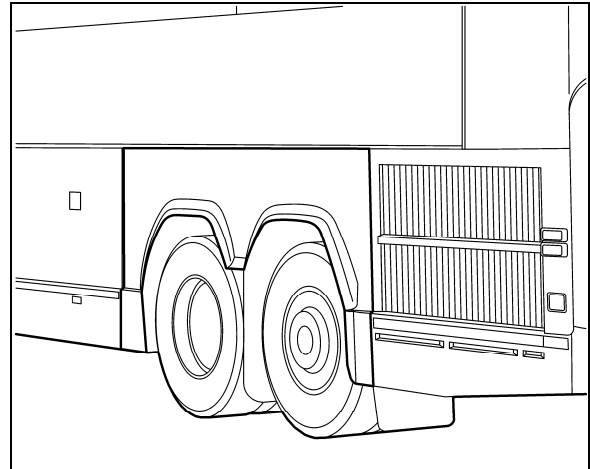


FIGURE 12: L.H. SIDE REAR FENDER

6. Remove tag axle L.H. side wheel.
7. Unfasten cap screws and remove access panel located behind tag axle L.H. side wheel (refer to figure 13).

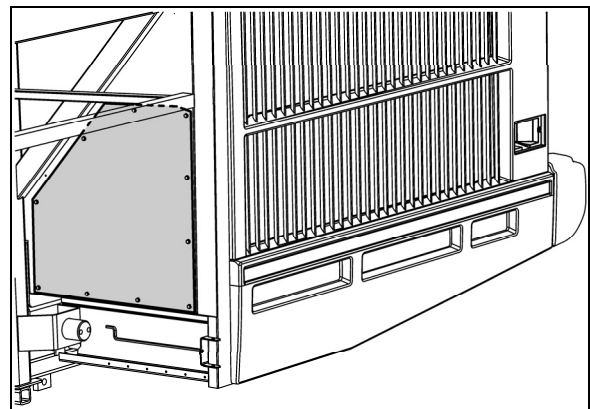


FIGURE 13: ACCESS PANEL BEHIND TAG AXLE WHEEL

8. Open radiator door to access radiator assembly. Unfasten upper arm assembly (Fig. 14).

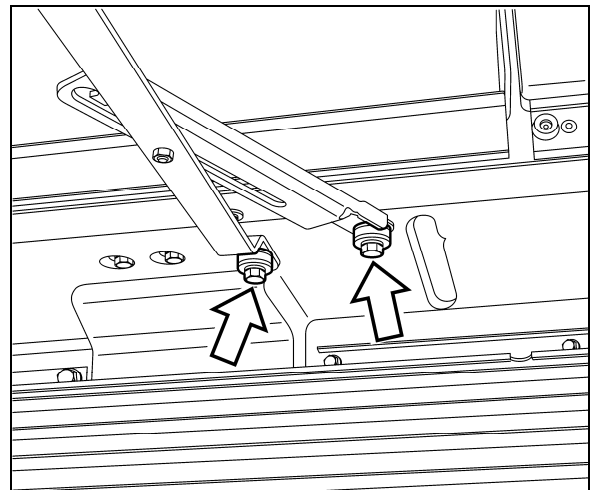


FIGURE 14: UPPER ARM ASSEMBLY

9. Remove radiator sealing frame (Fig. 15).

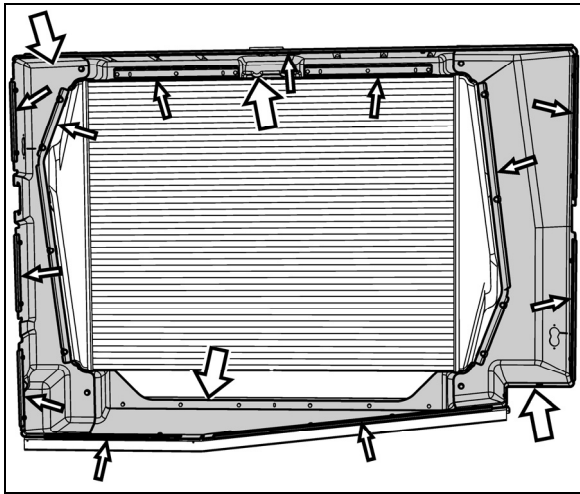


FIGURE 15: RADIATOR SEALING FRAME

10. Remove clamps and then break hoses from the front coolant and charge air pipes (Fig. 16).

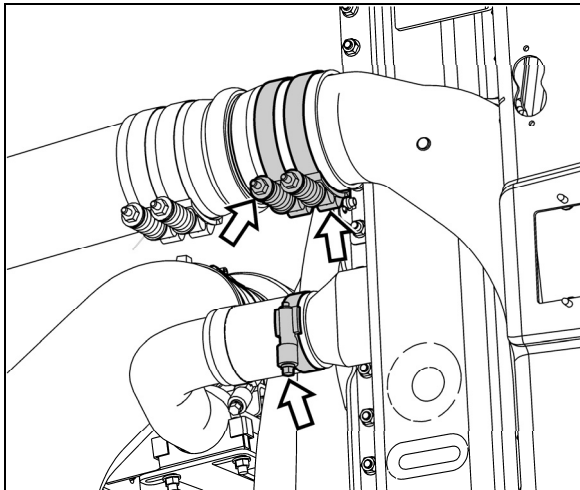


FIGURE 16: FRONT COOLANT & CHARGE AIR PIPES

11. Remove rear coolant and charge air hose clamps then break hoses loose (Fig. 17).

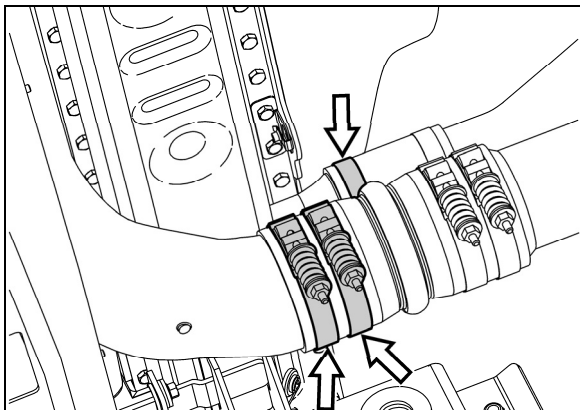


FIGURE 17: REAR COOLANT & CHARGE AIR PIPES

12. Remove the upper radiator assembly support bracket (Fig. 18).

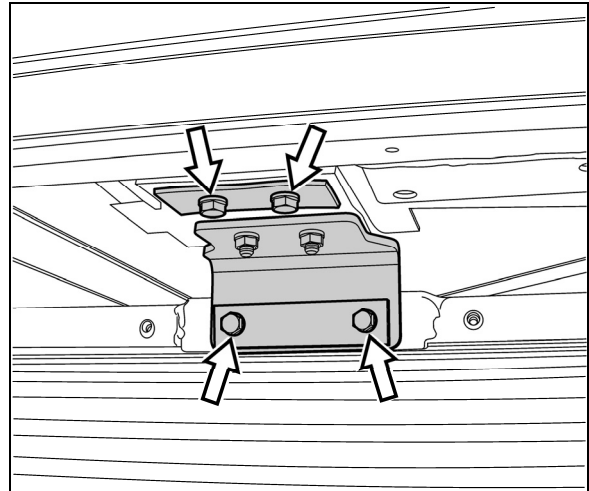


FIGURE 18: UPPER RADIATOR ASSY SUPPORT BRACKET

13. Remove the lower radiator assembly tube protector from the lower section (Fig. 19).

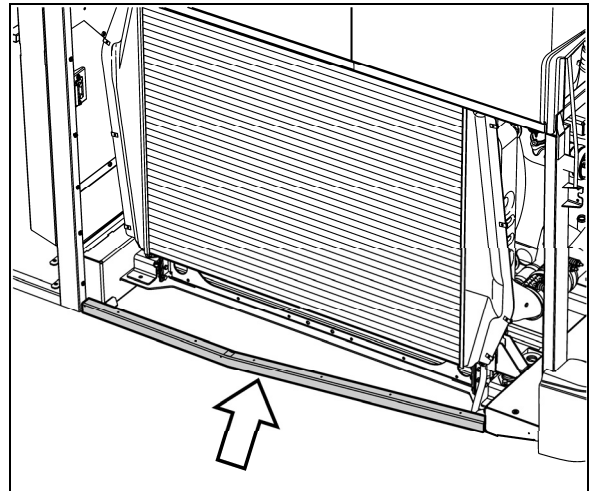


FIGURE 19: LOWER RADIATOR ASSY TUBE PROTECTOR

14. Remove all lower radiator assembly mounting fasteners.

Section 05: COOLING SYSTEM

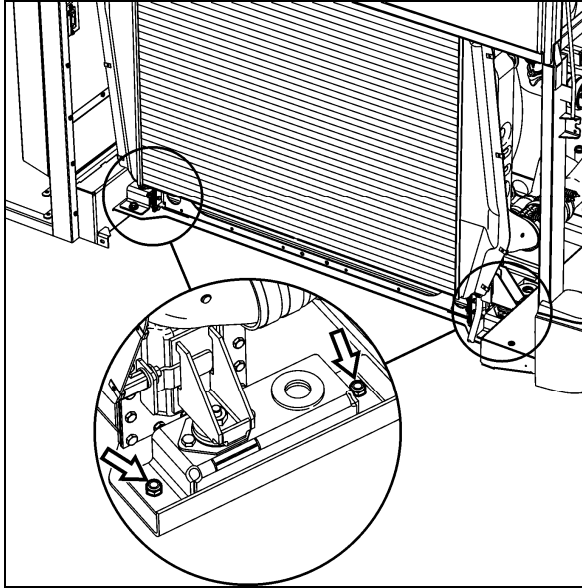


FIGURE 20: RADIATOR ASSEMBLY LOWER MOUNTING FASTENERS

15. Cut cable tie and disconnect electrical connector from fan clutch. Remove fan drive shaft fasteners at the gear box.

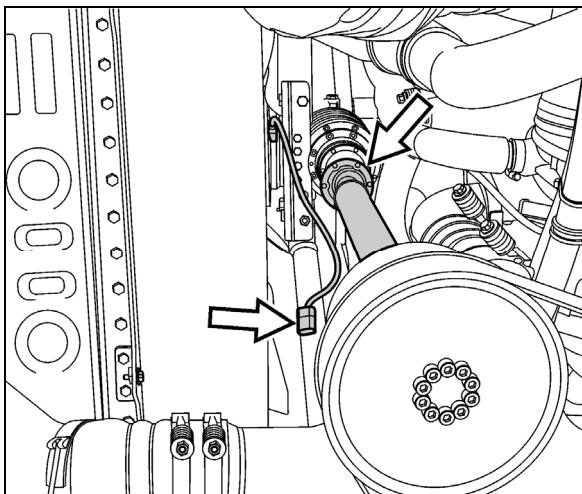


FIGURE 21: DISCONNECTING FAN DRIVE SHAFT

16. Position a forklift under the radiator assembly that is capable of safely lifting the radiator.

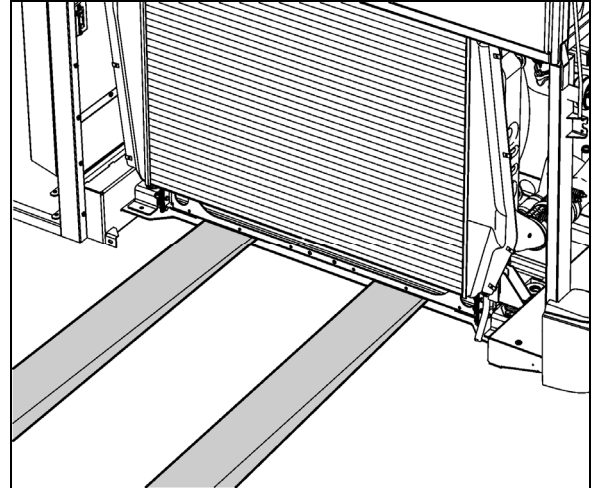


FIGURE 22: POSITIONING FORKLIFT

17. With assistance, slide radiator assembly out and onto the forklift. Transfer radiator assembly to a secure location.
18. Separate charge air cooler from radiator (Fig. 23).

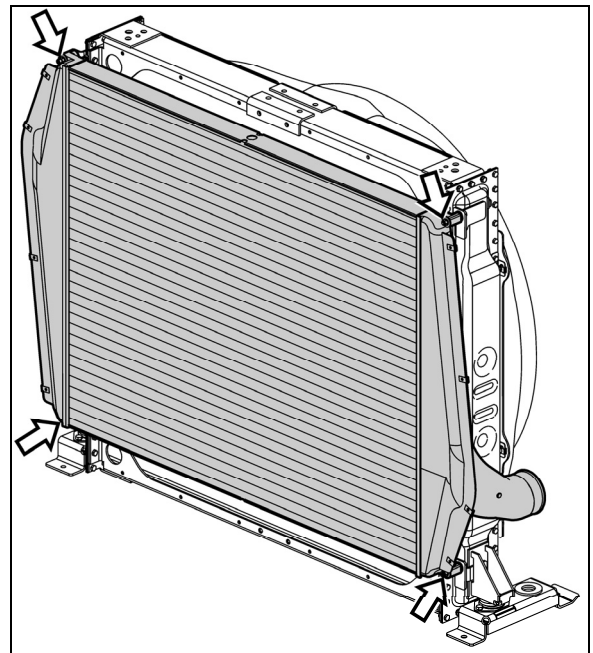


FIGURE 23: SEPARATING CHARGE AIR COOLER

19. Lay radiator face down. Remove the fasteners that connect lower radiator mounts to radiator.

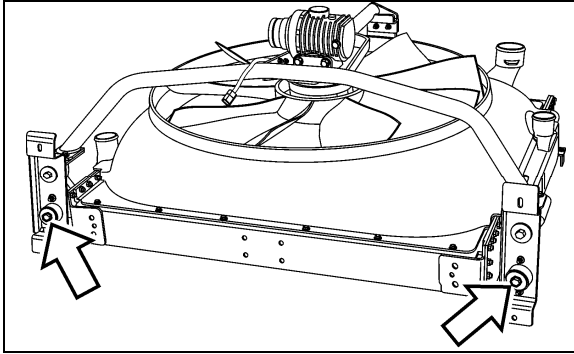


FIGURE 24: REMOVING FASTENERS

20. Remove upper fan drive support bracket from the upper section of the radiator.

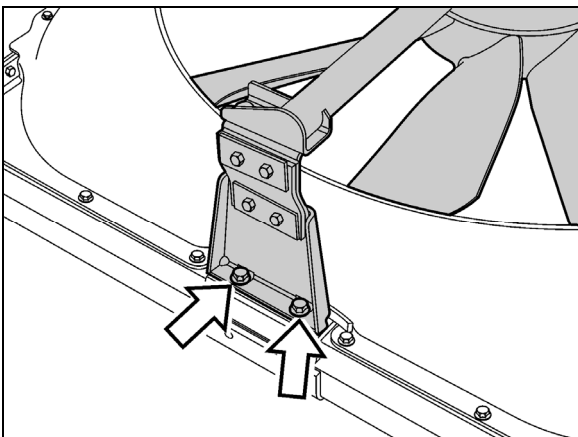


FIGURE 25: REMOVING UPPER FAN DRIVE SUPPORT BRACKET

21. With assistance, remove fan drive and drive frame from radiator.

22. Remove fan shroud from radiator.

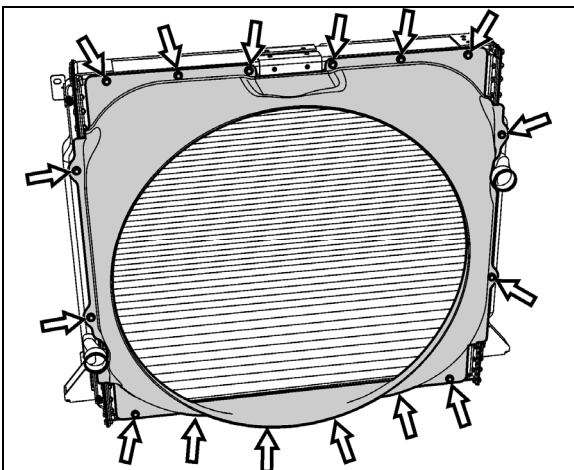


FIGURE 26: REMOVING FAN SHROUD FROM RADIATOR

Reverse removal procedure to reinstall radiator assembly.

11. CHARGE AIR COOLER (CAC) LEAKAGE

Spec for CAC acceptable leakage: The CAC is considered acceptable if it can hold 30 psi (206 kPa) gauge pressure with not more than 5 psi (34 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.

12. COOLING FAN DRIVE MECHANISM

12.1 DRIVE PULLEY AND UNIVERSAL JOINT SHAFT

To disconnect the universal shaft, proceed as follow:



WARNING

Set the ignition to the OFF position and remove the key from the contact switch to prevent accidental starting of the engine.

1. Unwrap the drive belt from around the pulley (see paragraph MOUNTING THE DRIVE BELT).
2. Dismount the drive pulley. Gain access to the 6 mounting bolts from behind the pulley, through the opening in the cast aluminum support (Fig. 28).
3. Unscrew and remove the universal joint shaft mounting bolts (6) at the right angle gearbox.
4. Slowly, move the shaft toward the rear of the vehicle.
5. Finally, dismount the universal joint shaft from the drive pulley (6 bolts).

Installation of the universal joint shaft is the same as removal, but in reverse order.

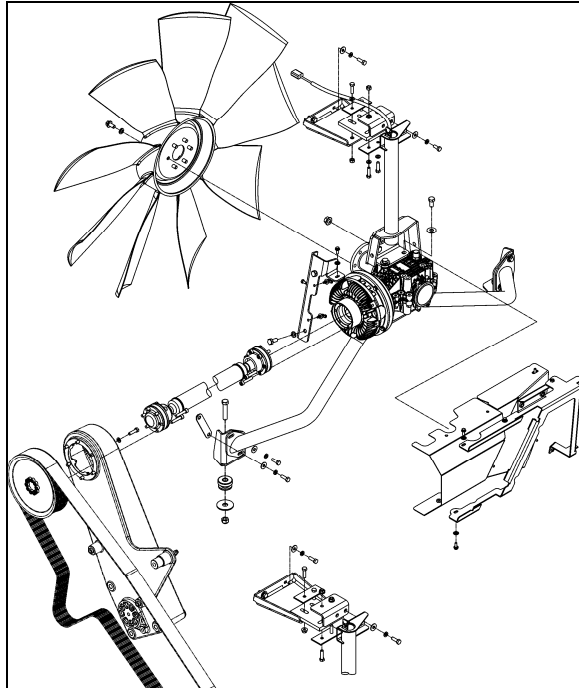


FIGURE 27: COOLING FAN DRIVE MECHANISM 05149

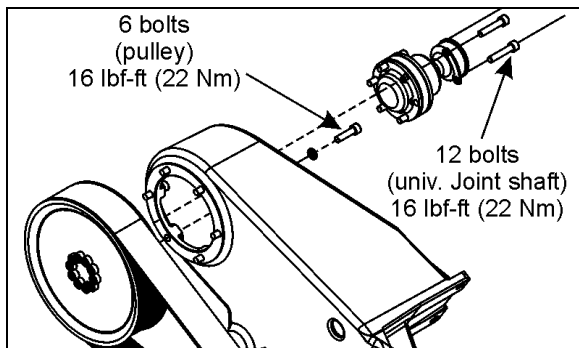


FIGURE 28: TIGHTENING SPECIFICATION 05123A

12.2 IDLER REPLACEMENT

If an idler is defective, replace as follow:



WARNING

Set the ignition to the OFF position and remove the key from the contact switch to prevent accidental starting of the engine.

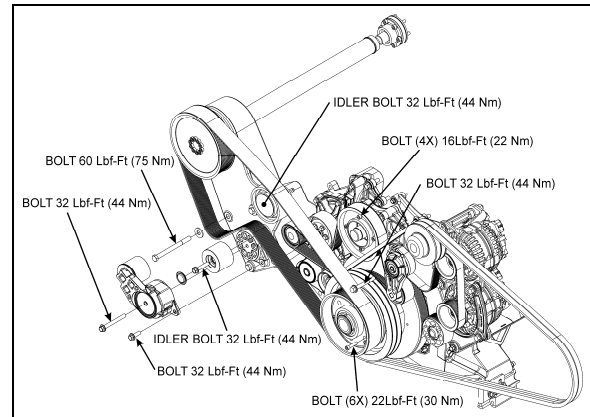


FIGURE 29: TIGHTENING SPECIFICATIONS 05146

1. Remove the protective cap (replace with a new one).
2. Unscrew the idler mounting bolt.
3. Replace idler with a new one.



CAUTION

When installing the idler, make sure it rests perfectly against the bearing surface on the cast aluminum support. If not, the drive belt may slip out of the idler. See figure below.

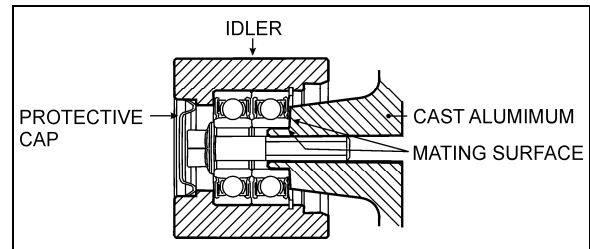




FIGURE 30: IDLER MOUNTED ON THE CAST ALUMINUM SUPPORT



4. Bolt the new idler on the cast aluminum support. Tighten to 32 lbf-ft (44 Nm).
5. Place a new protective cap.


13. VARIABLE SPEED COOLING FAN

The cooling fan clutch has two thermostatically controlled speeds, plus a neutral (clutch disengaged). The engine control module controls the speed by comparing data from engine coolant temperature, charge air temperature, Allison transmission oil temperature and small A/C high side pressure to a set of calibration data. The fan drive clutch is electromagnetic; the engine control module 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:

	Engine coolant temp.	Air intake temp.	Allison trans. oil temp.
temperature rising 	208°F: fan engages in HIGH SPEED	194°F: fan engages in HIGH SPEED	230°F: fan engages in HIGH SPEED
	203°F: fan engages in LOW SPEED	176°F: fan engages in LOW SPEED	216°F: fan engages in LOW SPEED
temperature dropping 	203°F: fan HIGH SPEED disengages	189°F: fan HIGH SPEED disengages	225°F: fan HIGH SPEED disengages
	198°F: fan LOW SPEED disengages	170°F: fan LOW SPEED disengages	210°F: fan LOW SPEED disengages

	Small A/C high side pressure
pressure rising 	170 psi: fan engages in HIGH SPEED
	120 psi: fan engages in LOW SPEED
pressure dropping 	130 psi: fan HIGH SPEED disengages
	90 psi: fan LOW SPEED disengages



WARNING


DO NOT work near the fan with the engine running or the ignition in the ON position. The engine fan can engage at any time without warning. Anyone near the fan when it turns on could be seriously injured.

13.1 LOCKING RADIATOR FAN CLUTCH FOR EMERGENCY OPERATION

13.1.1 Electrical Locking

If the radiator fan clutch does not function due to an electrical control system malfunction and the engine is overheating, execute the following procedure:

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.



WARNING

Potential Accident Risk. Always use extreme caution when working in the vicinity of hot, rotating or moving parts.

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.

4. Press the push-button one time to engage the clutch to 1st speed, press a second time to engage to 2nd speed, press a third time to stop the fan, press once again to return to 1st speed.

NOTE

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 as described in section 13.1.2.

13.1.2 Mechanical Locking In Case Of Power Failure

Once mechanically locked, the fan clutch is rigidly connected to the drive mechanism and will rotate continuously, with no considerations for the cooling needs. This is an emergency situation and the vehicle shall not be operated in that situation for an extended period.

In case of a magnetic clutch malfunction:

1. Set the ignition to the OFF position and remove the key from the contact switch to prevent accidental starting of the engine.
2. Disconnect the fan clutch electrical connector.
3. Unscrew and remove the 4 spare M6x12 hex bolts screwed to the angle on the fan gearbox mounting support (Fig. 31).
4. Screw in 4 hex bolts through the clutch anchor plate into the rotor. Using the automatic belt tensioner, release tension on the drive belt in order to be able to rotate the fan clutch drive mechanism by hand.

Tightening torque: 7.5 lbf-ft

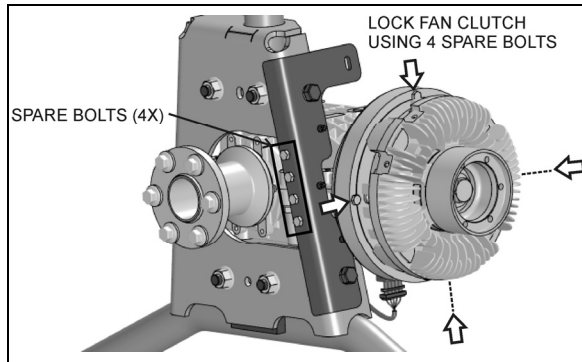


FIGURE 31: MECHANICAL LOCKING

05124

13.2 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 drive mechanism pulley. If the grooves are damaged or severely worn, replace the pulley.
4. Do not restrict fan rotation during engine operation for any reason.
5. Do not operate fan driving mechanism with a damaged fan assembly. Replace a damaged fan as soon as the fault is noted.
6. Immediately investigate and correct any operator complaint involving driving mechanism or cooling system performance.
7. When questions arise, obtain answers before proceeding. Assistance is available through the Prevost After-Sales Service support serving your area.

13.3 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 right angle 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 drive belt for fraying, cracking, and proper tension.
- Turn fan through at least 360° of rotation. It should turn smoothly with no resistance.

13.4 FAN REMOVAL / INSTALLATION

The fan is bolted to the right angle gearbox shaft flange. To remove the fan:

- Unscrew and remove the mounting bolts and washers.

To reinstall the fan:

- If the fan is still in the radiator fan shroud, place 2 of the mounting bolts on the opposite side of the flange, in reverse direction, in order to use them as guide pins to position the fan.
- Once properly positioned, screw the 4 remaining bolts back in (finger tight).
- Finally, take the 2 bolts that were used as guide pins and screw them back in on the proper side of the fan. Tighten in a star pattern to 32 lbf-ft.

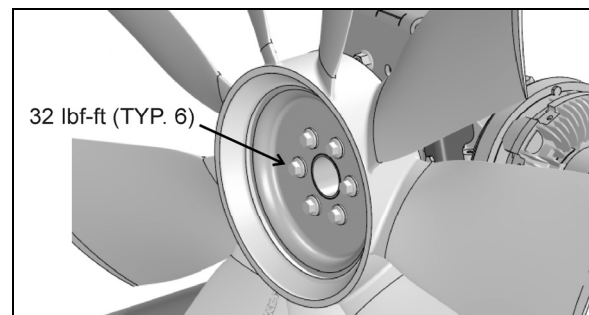


FIGURE 32: RADIATOR FAN MOUNTING BOLTS

05125

14. FAN RIGHT ANGLE GEARBOX

The radiator fan is belt driven from the engine crankshaft pulley through a drive belt, a universal joint shaft, a clutch and right angle gearbox assembly.

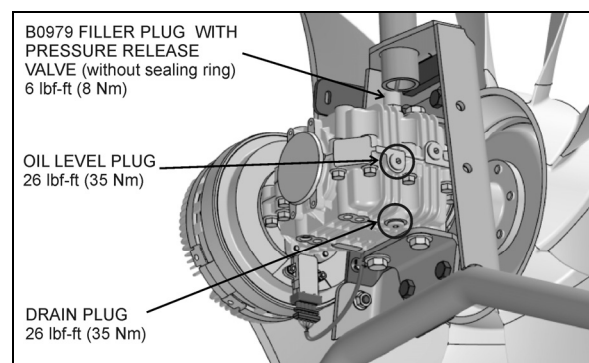



FIGURE 33: RIGHT ANGLE GEARBOX


05118

14.1 MAINTENANCE

 <h2 style="margin: 0;">MAINTENANCE</h2>
<p>Change the right angle gearbox oil only at operating temperature every 110,000 miles (177,000 km). Replace sealing rings at every oil change</p> <p>Use Shell transmission oil MA 75W90.</p>

14.2 OIL CHANGE

1. Stop engine and make sure that all engine safety precautions have been observed.
2. Set the ignition to the OFF position and remove the key from the contact switch to prevent accidental starting of the engine or set the rear start panel selector switch to the OFF position.
3. Clean gear case carefully.
4. Remove the drain plug and allow the oil to drain into a suitable container.
5. Replace the sealing ring and screw the drain plug back in.
6. Unscrew and remove the oil level plug and the top filler plug/vent.
7. Add gear lubricant. The oil level is correct once the top of the oil has reached the bottom of the oil level plug.

 <h2 style="margin: 0;">WARNING</h2>
<p>Note that warranty may be voided if proper maintenance at oil change intervals is not respected.</p>

8. Replace the sealing rings and screw oil level plug and top filler plug back in.
9. Start the engine and allow running a few minutes. Stop the engine and check for leaks.

14.3 REMOVAL / INSTALLATION

To remove the right angle gearbox, proceed as follow:

1. Set the ignition to the OFF position and remove the key from the contact switch to prevent accidental starting of the engine.
2. Disconnect the fan clutch electrical connector.

3. Dismount the fan and lean it against the radiator (refer to previous paragraph).
4. Disconnect the universal joint shaft.
5. Dismount the angle.
6. Loosen the gearbox upper support bracket top bolts.
7. Unscrew and remove 4 gearbox mounting bolts.
8. Slide the gearbox out of the support assembly.

Installation procedure is the same as removal but in reverse order. Tighten the 4 mounting bolts as specified.

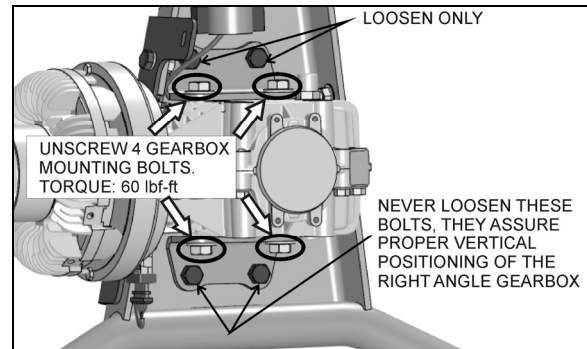


FIGURE 34: RIGHT ANGLE GEARBOX

05126

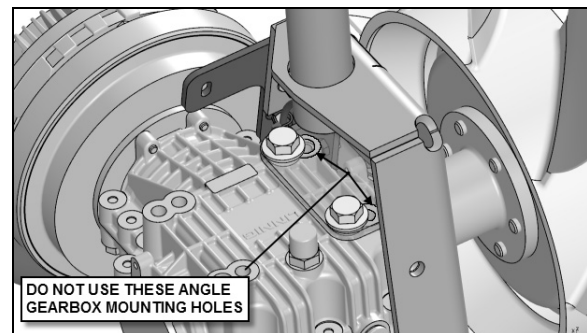



FIGURE 35: RIGHT ANGLE GEARBOX

15. COOLING FAN DRIVE BELT

15.1 MOUNTING THE DRIVE BELT

To install the cooling fan drive belt, proceed as follow:

 <h2 style="margin: 0;">WARNING</h2>
<p>Set the ignition to the OFF position and remove the key from the contact switch to prevent accidental starting of the engine.</p>



WARNING

Potential Accident Risk. Always use extreme caution when working in the vicinity of hot, rotating or moving parts.

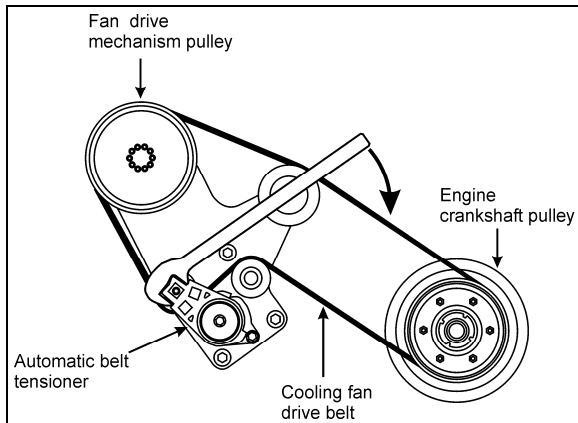


FIGURE 36: DRIVE BELT ROUTING (VOLVO D13 ENGINE)

05127

1. Wrap the new drive belt around the fan drive mechanism pulley, the idlers and the automatic tensioner idler as shown on figure 35.
2. Using the special tool included with your vehicle (see inside the Warning Reflectors box located in the first curb-side baggage bay), rotate the automatic tensioner in clockwise direction to relieve tension on the belt and hold the tensioner in that position (Fig. 36).
3. Finally, place the drive belt around the engine crankshaft pulley.
4. Release the tensioner slowly and let it return to its natural position.

16. SPECIFICATIONS

Cooling System Capacity (Approximation)

Includes heating system..... 24 US gal (91 liters)

Thermostat - Volvo D13 Engine

Number used..... 1
Start to close..... 203°F (95°C)
Fully closed..... 185°F (85°C)

Cooling Fan Drive Belt – Volvo D13 Engine

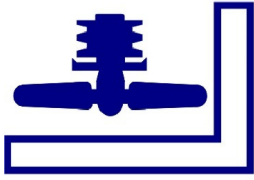
Type..... Poly-Rib 14PK2213
Qty..... 1
Prevost number..... 5060096

Coolant - Volvo D13 Engine

Prevost Number..... 685241
Texaco CPS..... 227998
Chevron CPS..... 2227805

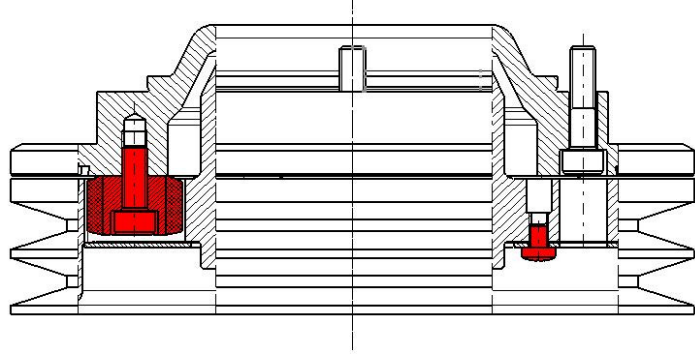
Coolant Filter Cartridge – Volvo D13 Engine

Number used..... 1
Type..... Spin-on
Prevost number..... 20458771



LINNIG®
Antriebstechnik

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D - 88672 Markdorf
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Fax: + 49 7544 / 6218
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Mail: webinfo@linnig.com



Reparaturanleitung

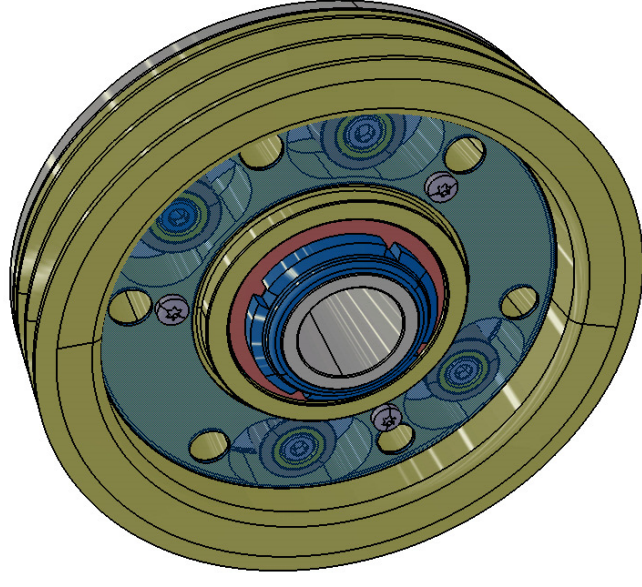
*LINNIG Drehschwingungsdämpfer LDD (außer LDD12)
Austausch Gummidämpfer 127.032 mit EB0112*

Repair instructions

*LINNIG Torsional vibration damper LDD (except LDD12)
Replacement of the rubber damper 127.032 with EB0112*

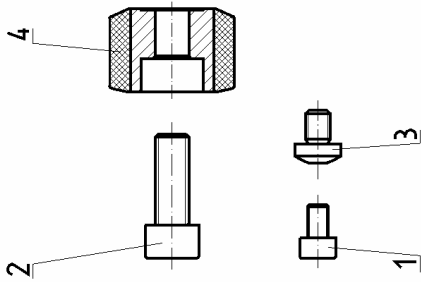
Instrucciones de servicio

*LINNIG Polea antivibratoria LDD (excepto LDD12)
Reemplazo de amortiguadores de goma 127.032 con EB0112*



Lieferumfang / Delivery / Volumen de suministro

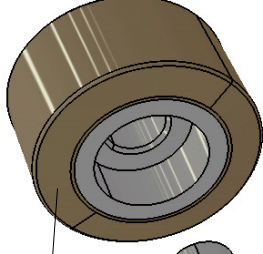
Ersatzteilbaugruppe / Assembly group / Juego de refacciones EB0112



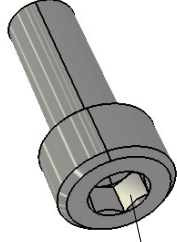
Schrauben 50.002 (Pos.1), 50.099 (Pos.2) und 65.003 (Pos.3) zusammen mit Gummidämpfer 127.032 (Pos.4) und Reparaturanleitung 14.2.219 (Pos.6) in Mini-Griffbeutel 14.1018 (Pos.5) verpacken.

Pos.5 und 6 nicht dargestellt.

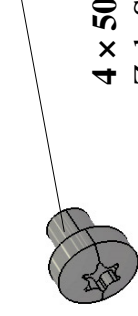
6 x 127.032
Gummidämpfer
Rubber damper
Amortiguadores de goma



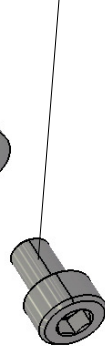
6 x 50.099
Zyl.-Schraube
Socket head cap screw
Tornillo cabeza allen



3 x 65.003
IN-STAR LIKO-Schraube
IN-STAR LIKO-screw
Tornillo IN-STAR LIKO



4 x 50.002
Zyl.-Schraube
Socket head cap screw
Tornillo cabeza allen



Achtung:
Je nach Ausführung des Drehschwingungs-dämpfers können evtl. Schrauben bzw. Gummidämpfer übrig bleiben !



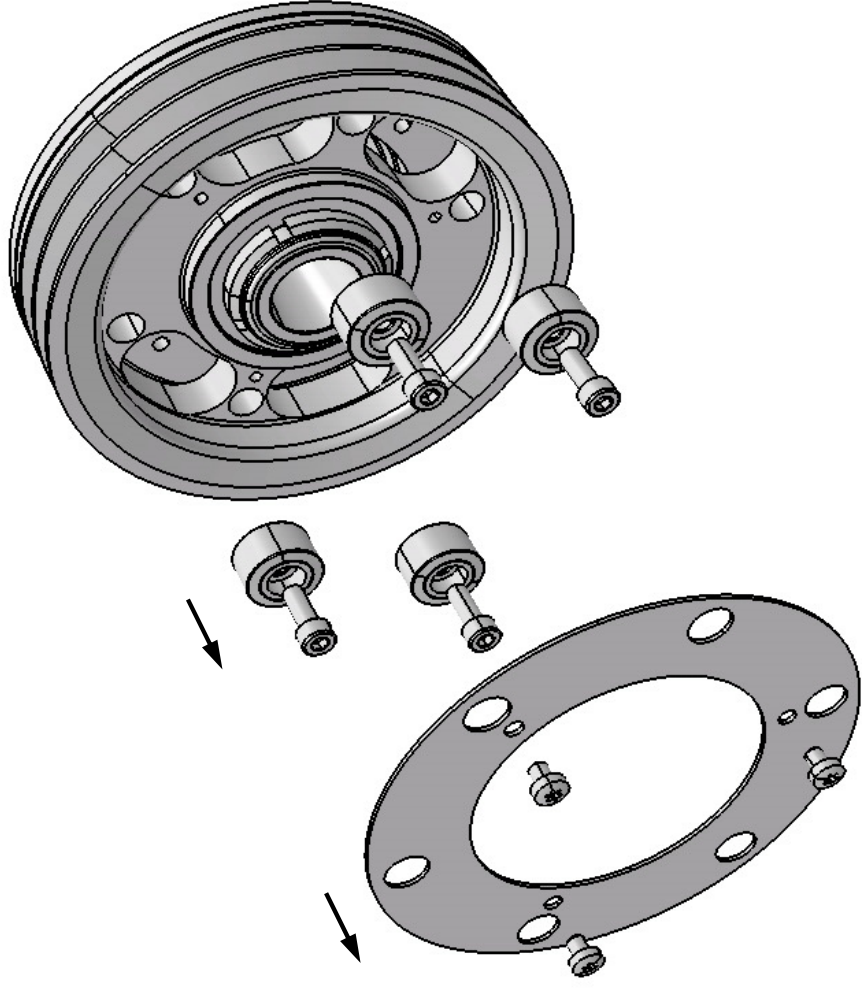
Attention:
Because of different versions of the torsional vibration damper, it is possible that some of the delivered screws and rubber damper are not be used !



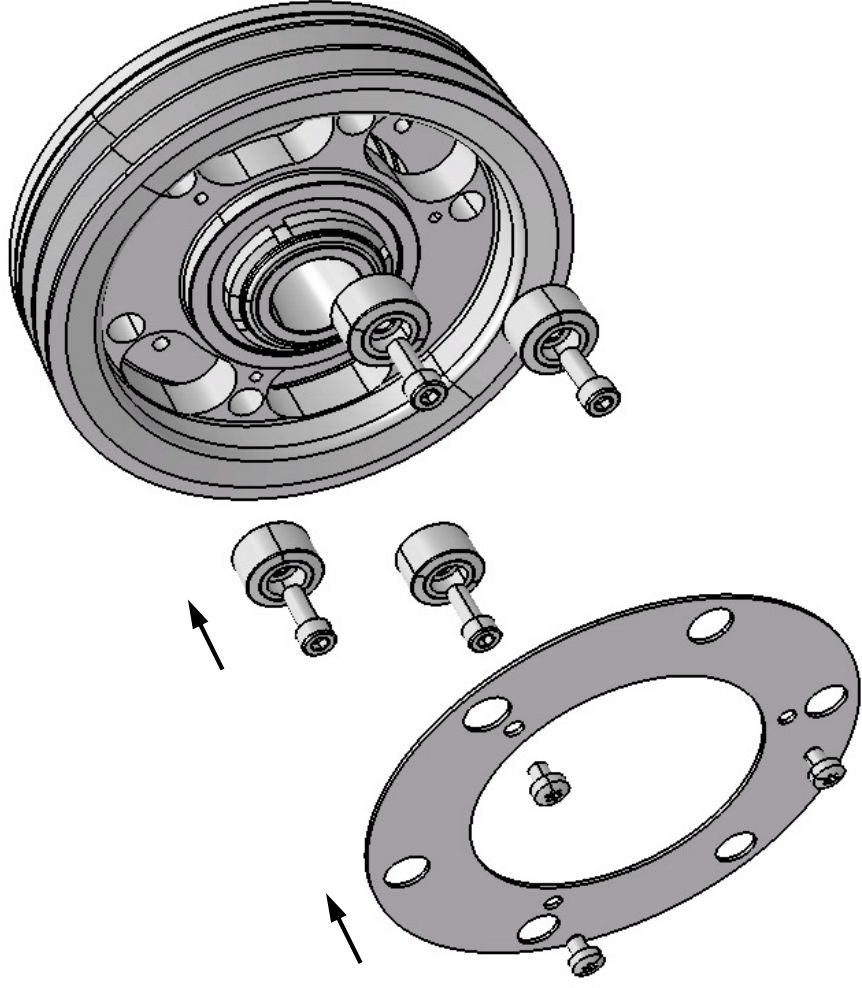
Atención:
Debido a las diferentes versiones de Poleas antivibratorias, es posible que algunos de los tornillos y amortiguadores de goma no se utilizen!

Pos.	Menge	Bezeichnung	Suchnummer/Norm-Kurzbezeichnung	6		
6	1 Stk	Reparaturanleitung LDD	Austausch Gummidämpfer 127.0	14.2.219		
5	1 Stk	Mini-Griffbeutel	220x150x0.050	14.1018		
4	6 Stk	Gummidämpfer		127.032		
3	3 Stk	IN-STAR LIKO-Schraube	M6x8-8.8-A3C-P80	65.003		
2	6 Stk	Zyl.-Schraube	DIN 912-M8x22-8.8-A3C	50.099		
1	4 Stk	Zyl.-Schraube	DIN 912-M5x8-8.8-A3C	50.002		
Pos.	1	2	3	4	5	6

LINNIG		Maßstab		Werkst.:	
2	3185	27.04.2006	1:1		
Für alle Zeichnungen gelten die Regeln nach DIN 34.100		Ersatzteilbaugruppe für LDD (außer LDD12)		Ers. aus: EB003, EB012, EB01	
1	3190	28.04.2006			
Name		Datum	Name		
Gepl.		17.06.04	Heckes		
Freig.					
27704					
Gew.: 0.360		kg		EB0112	
Blatt					
Index	Änderungsnummer	Datum	Name		
			Ers. aus: EB003		



<p>1. 4 Zyl.-Schrauben M5 bzw. 3 IN-STAR LIKO-Schrauben M6 am Deckel entfernen.</p>	<p>1. Remove 4 socket head cap screws M5 resp. 3 IN-STAR LIKO-screws M6 on the cover.</p>	<p>1. Retire los 4 tornillos M5 o 3 tornillos M6 IN-STAR LIKO de la tapa de la polea.</p>
<p>2. Deckel entfernen.</p>	<p>2. Remove cover.</p>	<p>2. Retire la tapa.</p>
<p>3. 4 bzw. 6 Zyl.-Schrauben M8 der Gummidämpfer entfernen.</p>	<p>3. Remove 4 resp. 6 socket head cap screws M8 of the 4 resp. 6 rubber damper.</p>	<p>3. Retire los 4 o 6 tornillos M8 de los amortiguadores de goma de la polea.</p>
<p>4. 4 bzw. 6 Gummidämpfer entfernen.</p>	<p>4. Remove 4 resp. 6 rubber damper.</p>	<p>4. Retire los 4 o 6 amortiguadores de goma de la polea.</p>
<p>5. Nach Entfernen der Gummidämpfer alle 4 bzw. 6 Gewinde M8 reinigen.</p>	<p>5. After removing of the rubber damper clean all of the 4 resp. 6 threads.</p>	<p>5. Después de retirar los amortiguadores de goma de la polea, limpiar las 4 o 6 roscas.</p>



<p>6. 4 bzw. 6 neue Zyl.-Schrauben 50.099 mit Loctite 270 versehen und 4 bzw. 6 neue Gummidämpfer 127.032 an Nabe anschrauben.</p> <p><u>Anzugsmoment</u> Ma = 25 Nm</p>	<p>6. Protect 4 resp. 6 new socket head cap screws 50.099 with Loctite 270 and attach the 4 resp. 6 new rubber damper on the hub.</p> <p><u>Tightening torque</u> Ma = 25 Nm (18,5 lbs.ft)</p>	<p>6. Aplicar Loctite 270 o equivalente a los 4 o 6 tornillos M8 nuevos (50.099), y sujetar los 4 o 6 nuevos amortiguadores de goma a la polea.</p> <p><u>Torque de apriete</u> Ma = 25 Nm (18,5 lbs.ft)</p>
<p>7. <u>Deckelmontage:</u> Bei LK 4x90°: 4 neue Zyl.-Schrauben 50.002 (M5) mit Loctite 270 versehen und Deckel an Riemenscheibe anschrauben.</p> <p><u>Anzugsmoment</u> Ma = 6 Nm</p> <p>Bei LK 3x120°: Mit 3 neuen IN-STAR LIKO-Schrauben 65.003 (M6) Deckel an Riemenscheibe anschrauben.</p> <p><u>Anzugsmoment</u> Ma = 10 Nm</p>	<p>7. <u>Mounting the cover:</u> Pitch circle 4x90°: Protect 4 new socket head cap screws 50.002 with Loctite 270 and attach the cover on the pulley.</p> <p><u>Tightening torque</u> Ma = 6 Nm (4,5 lbs.ft)</p> <p>Pitch circle 3x120°: Attach cover with 3 new IN-STAR LIKO-screws 65.003 (M6) on the pulley.</p> <p><u>Tightening torque</u> Ma = 10 Nm (7,5 lbs.ft)</p>	<p>7. <u>Montaja de la tapa:</u> Tapa con 4 tornillos: Aplicar Loctite 270 o equivalente a los tornillos M5 nuevos (50.002) y colocar la tapa de la polea.</p> <p><u>Torque de apriete</u> Ma = 6 Nm (4,5 lbs.ft)</p> <p>Tapa con 3 tornillos: Con los 3 tornillos M6 IN-STAR LIKO nuevos (65.003) colocar la tapa de la polea.</p> <p><u>Torque de apriete</u> Ma = 10 Nm (7,5 lbs.ft)</p>

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1 GENERAL DESCRIPTION

This vehicle uses a dual voltage system to obtain two different voltages (12-volt and 24-volt) for various electrical controls and accessories. The main power source incorporates four 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-volt and 24-volt systems are controlled through individual main battery relays. Two 28-volt self-regulated alternators are belt driven from the engine, and can be reached through the engine compartment door.

Vehicles equipped with optional PRIME energy management system are equipped slightly differently and feature AGM batteries and a Vanner Vann-Bus 80 Series battery equalizer.

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.

- a) Refer to wiring diagram index and look for "*Sound system*".
- b) 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 Driver Information Display (DID), you check on arrival if there are active errors in the vehicle electrical system. With the DIAGNOSTICS menu, highlight FAULT DIAGNOSTICS, highlight ELECTRICAL SYSTEM to request a diagnostic of the electrical system and then press the enter key. If applicable, the DID 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 button 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.

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- 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 DIAGNOSTICS menu, wait approximately 20 to 30 seconds and then return to FAULT DIAGNOSTICS to request a new diagnostic of the ELECTRICAL SYSTEM. The DID 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
Black	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.

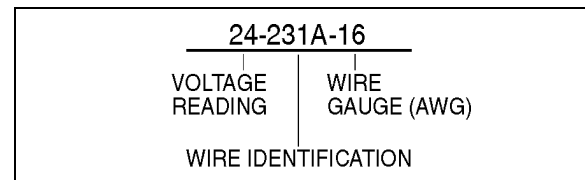


FIGURE 1: WIRE NUMBER

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 to serve as replacement wires if regular wires are damaged. Refer to page 8.1 "Spare wires" and page E "Circuit number listing" to determine the number 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 the letters "SP" and by the wire identification number.

1.4 CLEANING CONNECTORS

When connector pin and socket terminals become dirty, clean 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.

DANGER

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 manually switchable circuit breakers. The main circuit breakers, as well as those protecting the A/C system, are located in the main power compartment, on R.H. side of the vehicle (Fig. 2).

CIRCUIT BREAKERS (VIP)			
CB1	Front distribution	24 VI	90 amps
CB2	Front distribution	12 VD	90 amps
CB3	HVAC - evaporator	24 VI	90 amps
CB4	Rear distribution	12 VD	70 amps
CB5	Rear distribution	24 VI	150 amps
CB6	Rear Distribution	24 VD	70 amps
CB7	HVAC - condenser	24 VI	70 amps
CB8	Rear distribution	12 VI	40 amps
CB9	Slide-out	24VI	40 amps
CB10	Front distribution	12 VI	70 amps
CB60	Luggage door lock - VECR		20 amps
CB61	Luggage door lock - VECR		20 amps
CB62	Lower wiper - VECF		20 amps

This type of circuit breaker opens the circuit without disconnecting any wire. Push the red button on breaker to open the circuit, repair defective circuit, and afterwards lift the black tab of breaker to its original position to close the circuit.

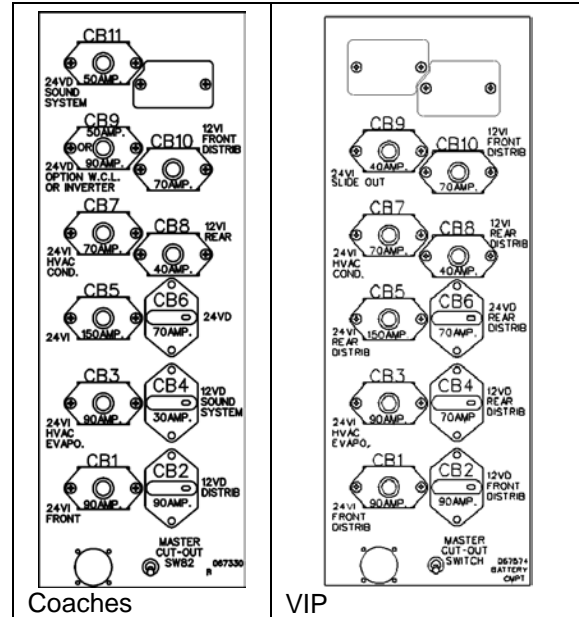


FIGURE 2: MAIN BREAKERS

CIRCUIT BREAKERS (coaches)			
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 options	24VI	50 amps
CB10	Front distribution	12 VI	70 amps
CB11	Sound system	24 VD	50 amps
CB13	Galley		50 amps
CB14	Galley		90 amps
CB82	Wipers		20 amps
CBOP1	Driver seat		40 amps
CBOP1	Driver seat		40 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 is set to ON.

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.

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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 de-energize 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 de-energize 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 "12 V" or "24 V" printed on its casing in order to identify the coil operating voltage.



CAUTION

The Multiplex vehicle uses a VF4 relay designed especially 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



DANGER

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 MCM, ECM (engine Control Module), 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 battery master switch in the main power 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 the main circuit breakers located in the main power compartment to stop the small current drawn by the radio preset station memory, the MCM 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.

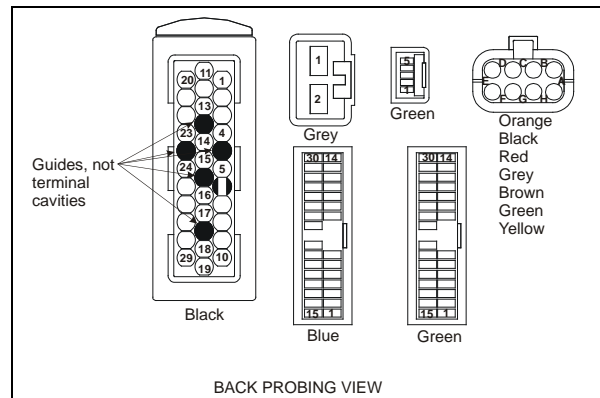
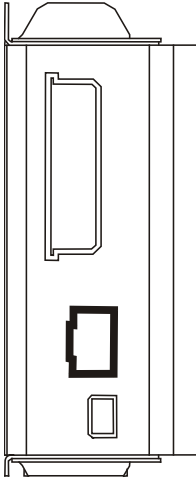
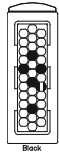
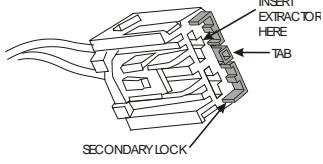
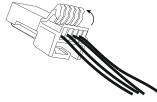
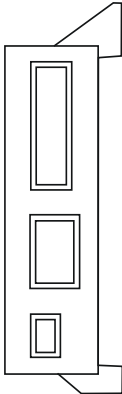
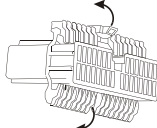
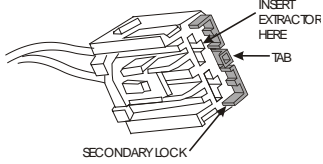
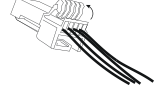
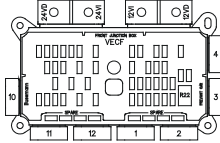
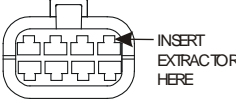


FIGURE 3: MULTIPLEX MODULE CONNECTORS PIN-OUT

Multiplex modules	Connector type	Terminal removal
 <p>IO-B 06625</p>	 <p>Black AMP 06628</p>	<p>EXTRACTOR/TOOL: Prevost #683594</p> <p>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.</p>
	 <p>grey 06629 YAZAKI</p>	<p>EXTRACTOR/TOOL: Packard #12094430</p> <p>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.</p>
	 <p>green 06630 JAE</p>	<p>EXTRACTOR/TOOL: Prevost #683766</p> <p>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.</p>
 <p>IO-A 06626</p>	 <p>green, blue JAE 06631</p>	<p>EXTRACTOR/TOOL: Prevost #683766</p> <p>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.</p>
	 <p>grey 06629 YAZAKI</p>	<p>EXTRACTOR/TOOL: Packard #12094430</p> <p>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.</p>
	 <p>green 06630 JAE</p>	<p>EXTRACTOR/TOOL: Prevost #683766</p> <p>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.</p>
 <p>VECF 06627</p>	 <p>Orange Black Red Grey Brown Green Yellow BUSSMANN 06632</p>	<p>EXTRACTOR/TOOL: Prevost #682256 (Packard 12094429)</p> <p>Remove the terminal by disengaging the flexible lock tab on the terminal. Gently remove the terminal from the connector by pulling on the wire.</p>

2 H3 SERIES VEHICLES ELECTRICAL COMPARTMENTS

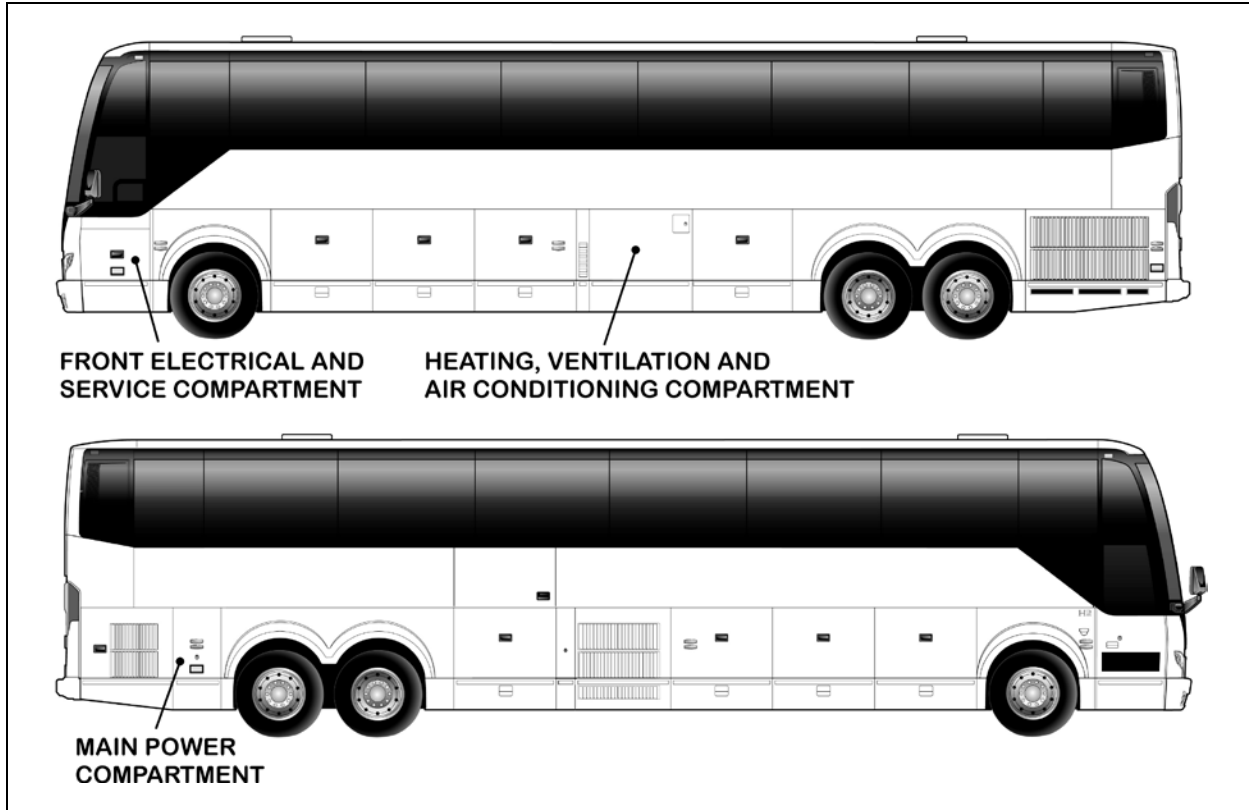



FIGURE 4: ELECTRICAL COMPARTMENTS


2.1 MAINTENANCE

A corrosion inhibitor has been sprayed on certain electrical components in order to protect them from corrosion. Refer to procedure SAV00002E at the end of this section for recommended products and where they are used.



DANGER

Use sprayed sealer in a well ventilated area. Do not smoke. Avoid prolonged contact with skin and breathing of spray mist.



CAUTION

Never put grease or other product on the multiplex modules connector terminals.

2.2 MAIN POWER COMPARTMENT

The main power compartment is located on rear R.H. side of vehicle behind the rear wheelhousing. This compartment contains the following components (fig. 5 & 6):

- Four 12-volt batteries;

- Main circuit breakers for 12-volt and 24-volt electrical system;
- Voltage regulator (if applicable);
- Battery equalizer;
- Battery Charger (optional);
- Battery master relay (R1) & battery master switch;
- TCM (Transmission Control Module);
- Secondary circuit breakers;
- Relays;
- Rear fuse box known as VECR (Vehicle Electrical Center Rear);
- Multiplex modules: I/O-A, I/O-B;
- OBD13 connector C464A (On-Board Diagnostic);
- Electronic ground stud.

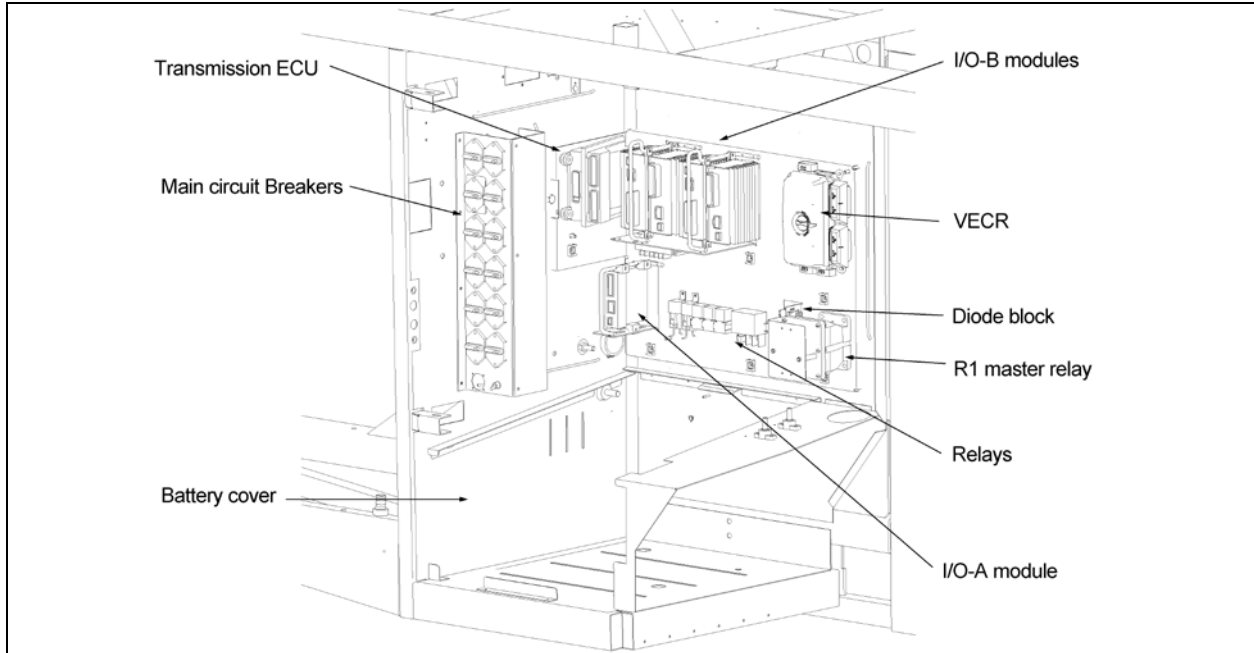


FIGURE 5: MAIN POWER COMPARTMENT (PARTIAL VIEW)

06594

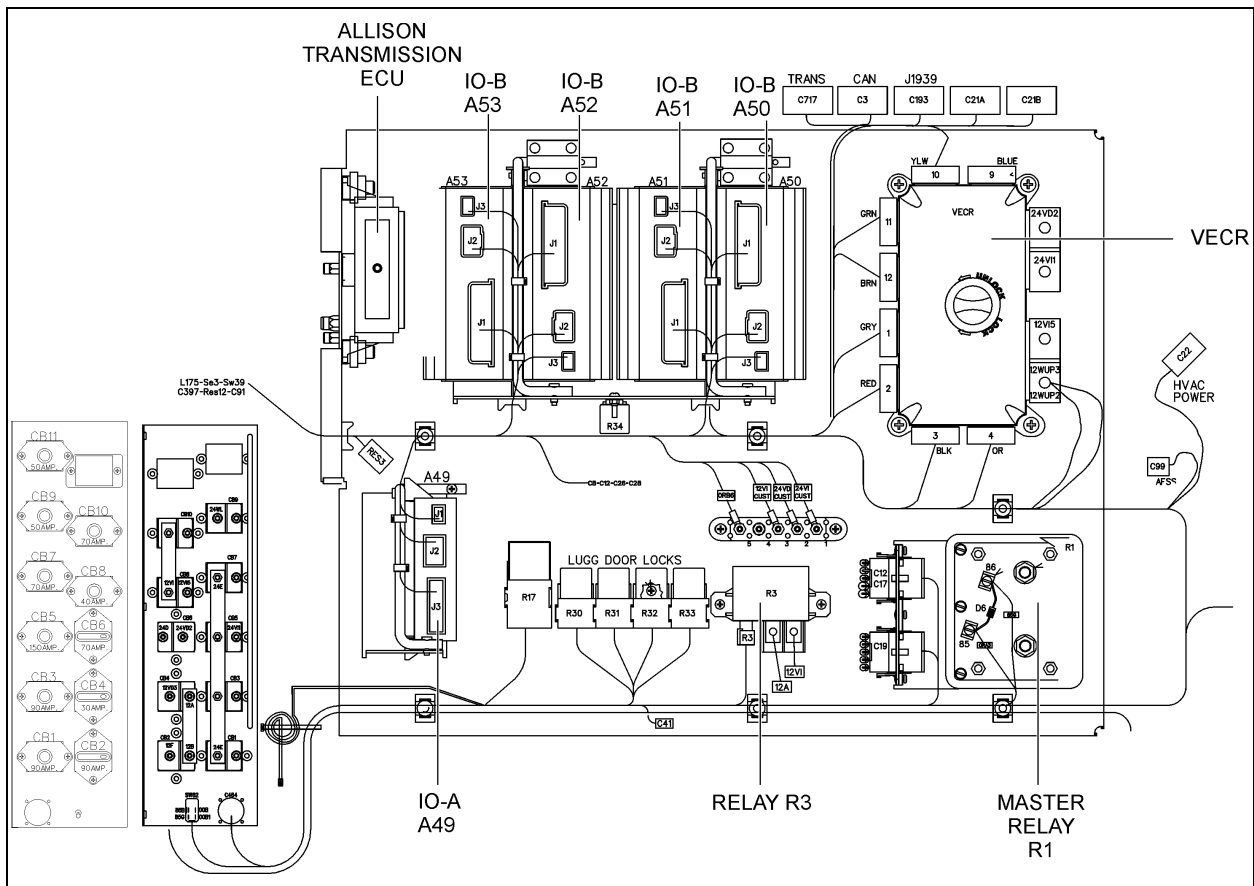


FIGURE 6 : MAIN POWER COMPARTMENT

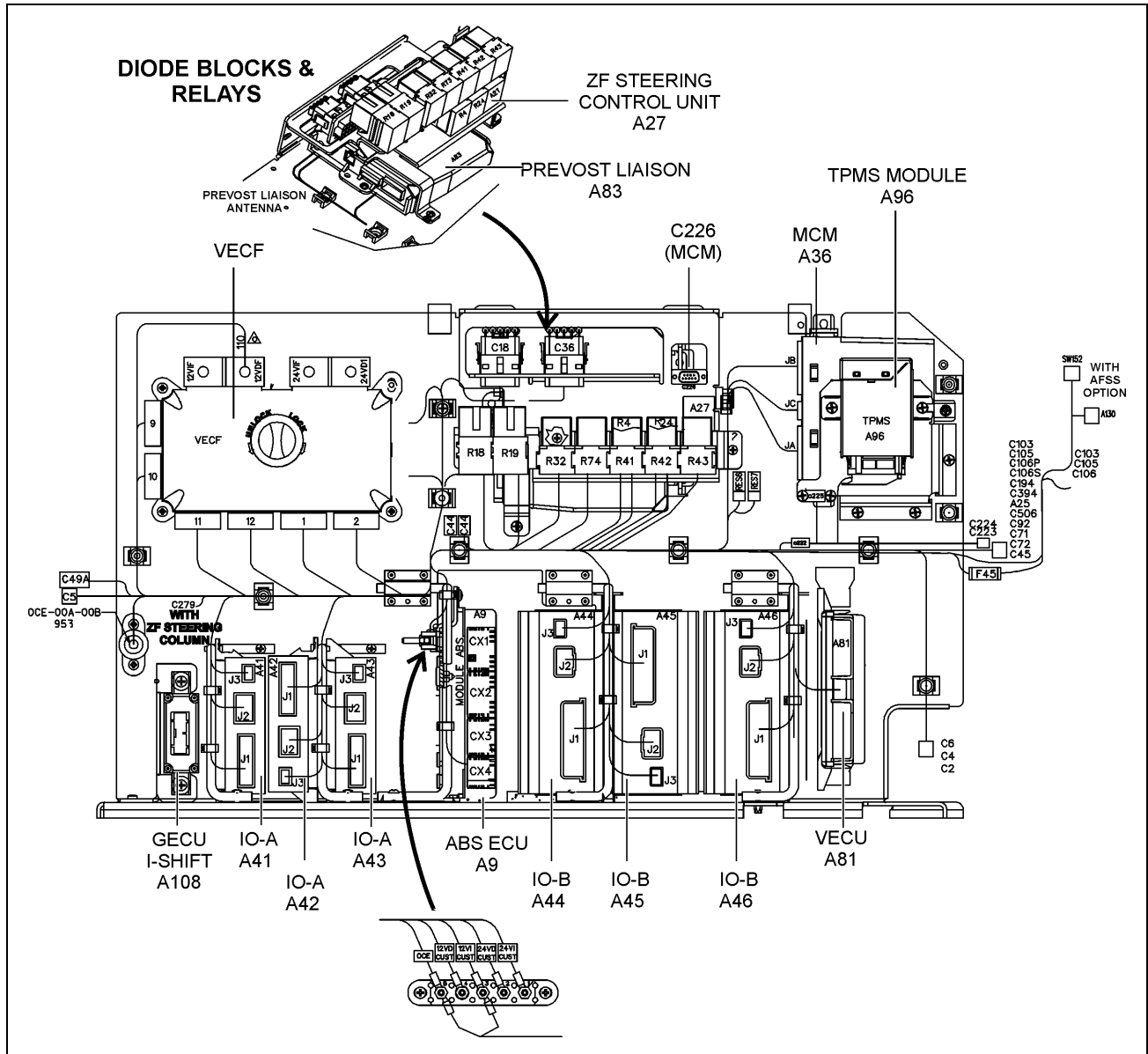


FIGURE 7: FRONT ELECTRICAL AND SERVICE COMPARTMENT

2.2.1 Battery Charger Or In-Station Lighting Connector

The vehicle may be equipped with a battery charger or in-station lighting connector. When it is connected to an external 110-120 VAC power source, the in-station lighting circuit can be energized without depleting the batteries. The receptacle is usually located on the main power compartment door or engine compartment R.H. side door.

2.3 FRONT ELECTRICAL AND SERVICE COMPARTMENT

The front electrical and service compartment is located on front L.H. side of vehicle. It contains the front junction panel with the following components (fig.7).

- Resistors;
- ABS module;
- Fuses;
- Relays;
- Kneeling audible alarm;

- Front multiplex modules;
- Front fuse box known as VECF (Vehicle Electrical Center Front);
- Emergency door opening unlock valve (coaches only);
- Windshield washer reservoir;
- Reclining bumper opening handle;
- Accessories air tank purge valve;
- Accessories system fill valve;
- Spare wheel support and rail (coaches only);
- Keyless entry system module (VIP only).

2.4 ENGINE REAR START PANEL

This control panel is located in the R.H. side of engine compartment near the engine oil reserve tank. This control panel includes the engine starter selector switch, as well as the rear start push button switch to start engine from engine compartment.

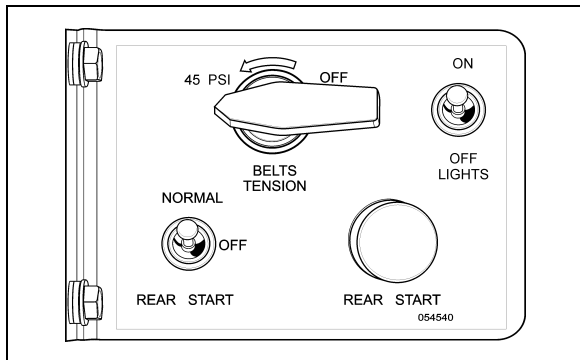


FIGURE 8: ENGINE REAR START PANEL 01044

2.5 A/C AND HEATING CONTROLS

The following components are located in the main power compartment (fig.5).

The following components are located in the front electrical and service compartment (fig.7).

The following components are located in the Evaporator Compartment (HVAC). They are mounted on a panel located on the R.H. side wall when facing the compartment (fig.9).

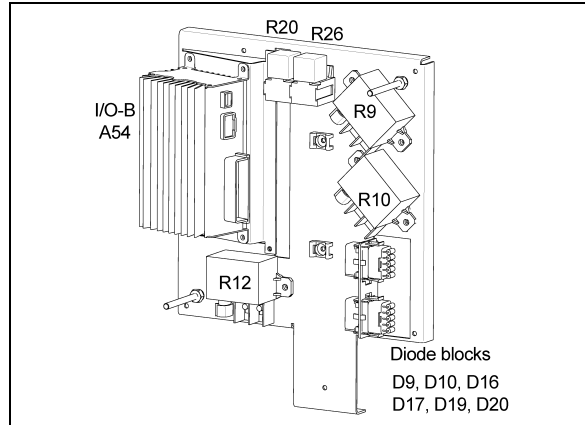


FIGURE 9: HVAC PANEL IN EVAPORATOR COMPARTMENT 06596

Each relay or resistor is identified to facilitate its location (fig.9).

NOTE

It is important when checking the A/C and heating system to keep the condenser compartment door closed in order to avoid faulty readings.

2.6 PNEUMATIC ACCESSORY PANEL

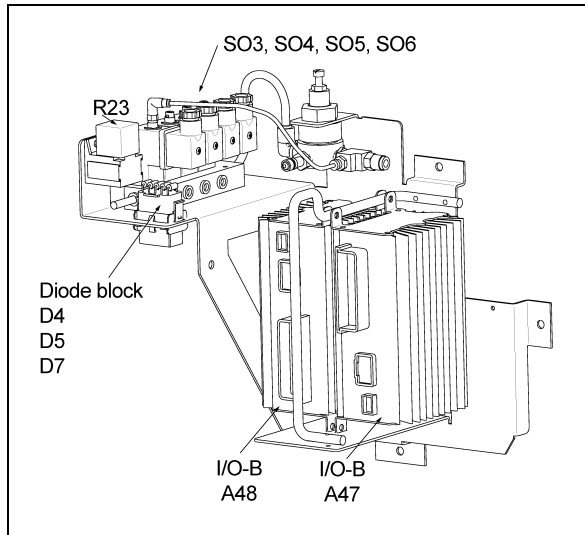


FIGURE 10 : PNEUMATIC ACCESSORY PANEL 06597

To access the pneumatic accessory panel of the right console, remove the panel under the larger utility compartment at the right of the dashboard.

3 BATTERIES

Section 06: ELECTRICAL

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.

Two types of batteries are available.

- Standard acid-lead Group 31 maintenance free batteries
- AGM Spill proof batteries provided with optional PRIME energy management system.

3.1 GROUP 31 ACID-LEAD BATTERY

The vehicle is provided with four (4) 12-volt heavy-duty batteries connected in series-parallel. 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.

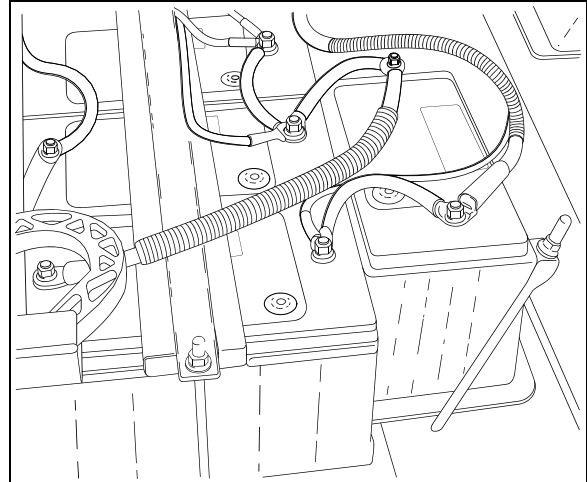


FIGURE 11: BATTERIES

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With special cables properly attached to the 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 connections.



DANGER

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.



WARNING

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

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

Wash hands after handling.

3.2 GROUP 31 AGM BATTERIES

If your vehicle is equipped with PRIME energy management system, it is provided with four (4)

Absorbed Glass Mat (AGM) 12-volt batteries connected in series-parallel.

These batteries require no maintenance for their lifetime. They can withstand deeper discharge cycles and several times the charging cycles of a standard battery.

These are sealed, valve regulated recombinant batteries which means that the oxygen created will recombine with the hydrogen in the battery, creating water and preventing water loss. Water never needs to be added to this type of battery.

The top-mounted negative and positive terminals are tightly sealed to prevent leaks.

The electrolyte in this type of battery is absorbed in micro-porous glass separators. This design prevents spills and results in greater resistance to vibration.

Always replace these batteries with identical make and model batteries as the system is balanced and optimized for this type of battery.



CAUTION

Replace only with AGM type batteries of the same specification and capacity.

PRIME system is programmed for the charging capacity of the batteries installed.

Installing a higher capacity battery will affect the battery life as the system will not fully charge the batteries, which is detrimental to battery performance.

Refer to "Specifications" at the end of this section for further details.

AGM batteries should be replaced in pairs or four at a time.



CAUTION

AGM (Absorbed Glass Mat) batteries require a voltage-limited charger, ideally fitted with a battery temperature sensor for temperature correction of charging parameters.

Charge voltage: 13.8-14.6 Volt @77°F (25°C)

Float voltage: 13.4-13.6 Volt @77°F (25°C)

Charging AGM battery on a typical constant current or taper current charger – even one time – may greatly shorten its life.

3.3 BATTERY PROTECTION

DISCHARGE

To prevent discharge of the batteries when the engine is not running, some functions are automatically switched off if the battery voltage drops below 24 volts for more than 30 seconds. The "Battery Voltage Warning" pictogram will show on the DID. 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.

3.4 MAIN BATTERY RELAYS

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

When the main battery relays 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;
- Engine Control Module;
- TCM power (Allison transmission);
- Preheater electronic timer;
- Preheater and water recirculating pump;
- Sedan entrance door;
- Radio memory;
- MCM;
- Cluster memory.

3.5 BATTERY REMOVAL AND INSTALLATION

1. Remove the two screws at the bottom of the plastic protective cover. Unscrew the two quarter turn nuts to remove the protective cover.
2. Remove supports. Unscrew terminal nuts of each defective battery.



DANGER

Section 06: ELECTRICAL

To prevent possible electric shock or sparking, the main battery relays should be in the "Off" position before disconnecting cables from the batteries.

- Remove battery cables from the batteries.

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.

- Remove batteries.
- Installation is the reverse of removal. Connect the red (24-volt) battery cables first, then the yellow (12-volt) battery cables and finish with the black (ground) cables. Tighten battery terminal nuts 10-15 lbf-ft.

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.

NOTE

When reinstalling batteries, battery connections must be tightened to 10-15 lbf-ft (13-20 Nm).



CAUTION

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



DANGER

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

NOTE

A protective coating should be applied on certain power connections that have been disconnected. Refer to Procedure PR00002E included at the end of this section to know the recommended products and where they are used.

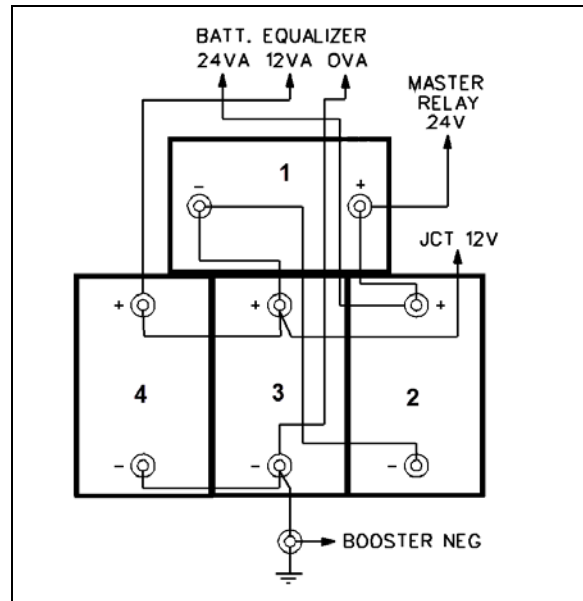


FIGURE 12 : BATTERY CONNECTIONS (STANDARD ACID-LEAD GROUP 31)

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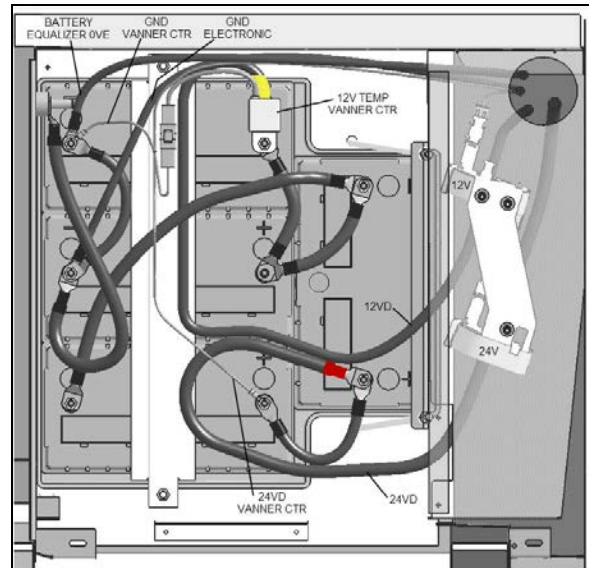


FIGURE 13: AGM BATTERY CONNECTIONS WITH PRIME

3.6 BATTERY RATING

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

Standard acid-lead battery

- 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)

AGM batteries (PRIME)

- Reserve capacity: 200 minutes

- Cold cranking (amps): 800 @ 0°F (-18°C)
- Weight (filled): 69 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-volt 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-volt battery). This rating can be used as a basis for comparing starting performance.

3.7 BATTERY TESTING

3.7.1 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. Also, check for wet areas around the terminals.
2. Check for loose terminal posts, cable connections, damaged cables, and for evidence of corrosion. Correct conditions as required before proceeding with tests.
3. Check for damaged or loose battery tie-downs.

3.7.2 Removing Surface Charge

Disconnect cables from the battery and attach alligator clamps to the contact lead pad on the battery as shown in figure 14. Connect a load equal to half the CCA across the terminal for 5 seconds to remove surface charge from the battery.

3.7.3 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 along with an ammeter and volt meter. Charging system analyzer test equipment may also be used.

1. Connect a voltmeter, ammeter, and a variable load resistance as illustrated in figure 14.

CAUTION

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

2. Apply a load equal to half the CCA rating at 0°F 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 70°F (21°C) and above. For temperatures below 70°F (21°C), refer to the following "Voltage and Temperature Chart".

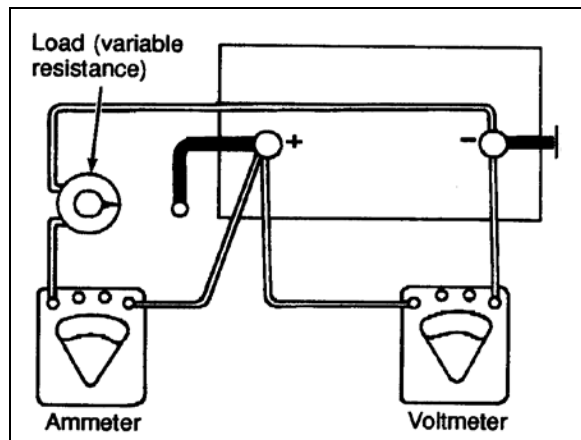


FIGURE 14: LOAD TEST

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NOTE

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

Voltage and Temperature Chart


Ambient Temperature	Minimum Voltage
70°F (21°C) and above	9.6

Section 06: ELECTRICAL

60°F (16°C)	9.5
50°F (10°C)	9.4
40°F (4°C)	9.3
30°F (-1°C)	9.1
20°F (-7°C)	8.9
10°F (-12°C)	8.7
0°F (-18°C)	8.5

3.7.4 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:



DANGER

To prevent the engine from starting, remove fuses F78 & F79 located in the VECR. Once these tests are completed, reinstall F78 & 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 70°F (21°C), 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 starter 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.




DANGER

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.

3.8 BATTERY CHARGING



DANGER

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.

Do not smoke near a battery which is being charged or which has been recently charged.

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.

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 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.**

The alligator clamps of the tester or charger must be placed between the terminal nuts and the lead pads of the terminal studs (Fig. 15) 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.

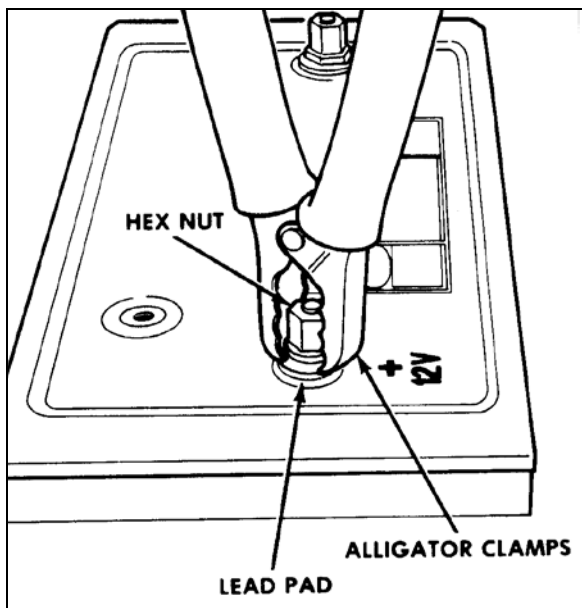


FIGURE 15: ALLIGATOR CLAMPS AND BATTERY 06065

A charge rate between 3 and 50 amperes is generally satisfactory for any maintenance-free battery as long as spewing out of electrolyte does not occur or the battery does not feel excessively hot (over 125°F (52°C)). If spewing out or violent gassing of electrolyte occurs or battery temperature exceeds 125°F (52°C), 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.

**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.

3.8.1 Battery Charging Guide**NOTE**

AGM (Absorbed Glass Mat) batteries require a voltage-limited charger, ideally fitted with a battery temperature sensor for temperature correction of charging parameters. *Do not manually charge AGM batteries. Look for the following voltage values on your voltage-limited charger.*

Charge voltage: 13.8-14.6 Volt @77°F (25°C)

Float voltage: 13.4-13.6 Volt @77°F (25°C)

Charging AGM battery on a typical constant current or taper current charger – even one time – may greatly shorten its life.

Fast Charging Rate

3-3/4 hours @ 20 amps

2-1/2 hours @ 30 amps

2 hours @ 40 amps

1-1/2 hours @ 50 amps

Slow Charging Rate

15 hours @ 5 amps

7-1/2 hours @ 10 amps

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°F (-18°C) than at 80°F (27°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.

Section 06: ELECTRICAL


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.


3.8.2 Emergency Jump Starting With Auxiliary (Booster) Battery

 **DANGER**

Off-board battery charger with a start boost facility must not be used to jump start the vehicle. This could damage the electrical system.

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.

On H3 coaches, the booster block is located in the engine compartment, on the R.H. side and is accessible through engine R.H. side door.

 **DANGER**

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.

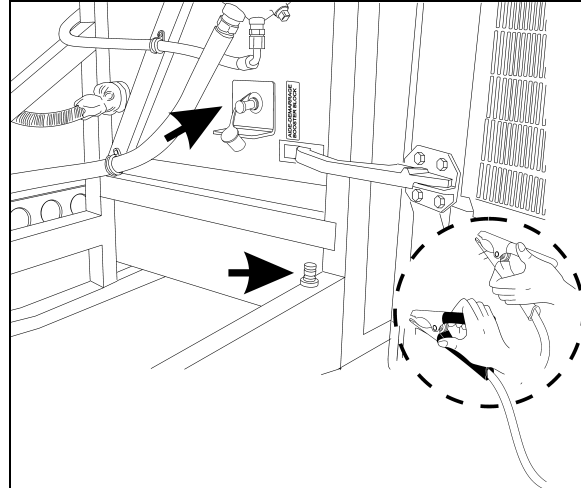



FIGURE 16: BOOSTER BLOCK

 **DANGER**

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.

The following procedure should be used only when the batteries are discharged.

Do not attempt jump starting if you suspect the batteries are charged. Inspect the engine starting system prior to using this procedure.

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 in the engine compartment R.H. side.
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.

- When removing the jumper cables, perform the above procedure exactly in reverse order, and replace protective caps on booster block terminals.



DANGER

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.

3.9 AGM BATTERY CHARGING PRECAUTIONS

AGM (Absorbed Glass Mat) batteries require a voltage-limited, temperature corrected charger.

Make sure your charger is multi-staged and minimally provides the following voltage values:

Charge stage voltage:

13.8-14.6 V @77°F (25°C)

Float stage voltage:

13.4-13.6 V @77°F (25°C)

Charging AGM battery on a typical constant current or taper current charger – even one time – may greatly shorten its life.

3.10 BATTERY EQUALIZATION AND AGM BATTERIES

Equalization is a controlled over charge. Conventional batteries may benefit from this procedure, stirring the chemistry of the entire battery it counters stratification (layers of different concentration of electrolyte), and also counters sulfating that may have accumulated on the battery plates.

AGM battery design prevents chemical unbalance of the electrolyte. Manufacturers of this type of battery generally do not recommend performing equalization.

3.11 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, and 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.

3.12 COMMON CAUSES OF BATTERY FAILURE

When a battery fails, the cause of failure may be related to something other than the battery itself. 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:

- A defect in charging system such as high resistance or a faulty alternator or regulator. The dashboard ALTERNATOR telltale illuminates if one of the alternators is defective.
- A malfunction within the 12-volt system (equalizer).
- Overloads caused by a defective starter or excessive use of accessories.
- Dirt and electrolyte on top of the batteries causing a constant drain.
- Hardened battery plates, due to battery being in a low state of charge over a long period of time.
- Shorted cells, loss of active material from plates.



ALTERNATOR telltale

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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.

3.13 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 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.

3.14 "BATTERY VOLTAGE WARNING" PICTOGRAM

If the "BATTERY VOLTAGE WARNING" (battery voltage incorrect) pictogram shows up in the DID (Driver Information Display), use the DID voltmeter gauge to determine if the battery voltage is too high or too low.



BATTERY VOLTAGE WARNING pictogram

3.14.1 Voltmeter Gauge Definitions

Voltmeter drops below 24 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 PRIME ENERGY MANAGEMENT SYSTEM

4.1 DESCRIPTION

PRIME stands for Power Recovery by Intelligent Management of Energy.

This system focuses on eliminating parasitic loads on the engine by intelligent management of the alternators and air compressor duty cycle.

Instead of constantly charging, the alternator uses engine negative torque (braking, deceleration) to generate free electricity.

Depending on the air requirement, PRIME will also trigger the production of compressed air on negative torque.

PRIME also introduces maintenance-free Absorbed Glass Mat (AGM) batteries and a new Vanner 80 series battery equalizer that monitors battery State of Charge (SOC).

Battery temperature, voltage and current are also monitored to prevent overcharging and overheating.

Maximum fuel economy is obtained on a ride when the mix of hilly and flat portions allows the

batteries to be charged when the vehicle is in free wheel. It basically means that batteries are charged with free energy and that no fuel consumption is dedicated to charge the batteries.

4.2 COMPONENTS

New components includes AGM batteries, a Vanner Battery equalizer, a temperature sensor located on the battery post and two voltage and current sensors monitoring 12V and 24 V circuits.

The compressor duty cycle control is achieved by an electric air dryer. This is covered in section 12 of this manual.

4.3 DID DISPLAY

In the DID you will find the percentage of trip made with regenerated electricity displayed along with the instantaneous fuel consumption.

This value is reset each time the engine is restarted.

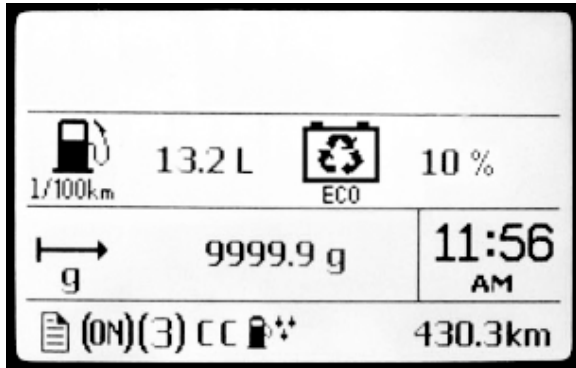


FIGURE 17: PRIME DID DISPLAY

In addition to the standard voltage gage, the DID also includes a state of charge gage for the batteries:

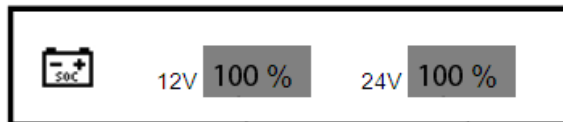


FIGURE 18: Battery state of charge

This gage displays the level of charge for the 12V and 24V battery banks in percentage.

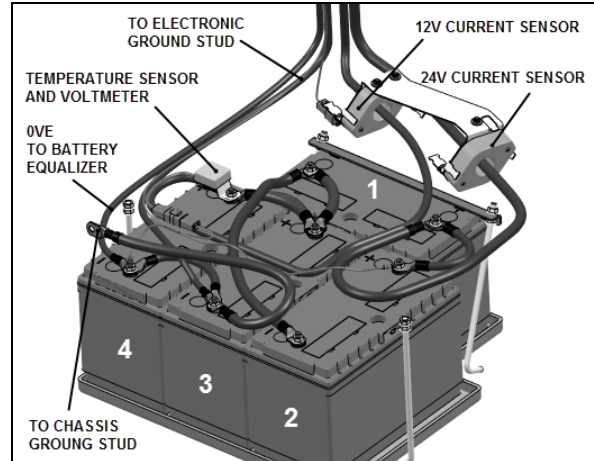


FIGURE 19: BATTERY ARRANGEMENT WITH PRIME

5 TROUBLESHOOTING AND TESTING THE MULTIPLEX VEHICLES

5.1 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

- Verify on the wiring diagram whether the voltage is 12V or 24V,
- 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.
- 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.

5.2 CAN NETWORK

The CAN link 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.

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In case of a short-circuit on the CAN link, this affects all the modules and they all show “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 right-hand console. Connector C100 disconnects the modules from the evaporator compartment. Connector C3 (main power compartment) disconnects the modules from the battery compartment.

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.

5.2.1 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 paragraph 4.6 for more information.

5.3 ELECTRICAL SYSTEM DIAGNOSTIC

Using the Driver Information Display (DID), check if there are active errors for the vehicle electrical system. With the DIAGNOSTICS menu, highlight **FAULT DIAGNOSTICS** and then highlight **ELECTRICAL SYSTEM** to request a diagnostic of the electrical system. Press the enter key. If applicable, the DID 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 DID still shows the fault as being active. You have to leave the **FAULT DIAGNOSTICS** menu, wait approximately 20 to 30 seconds and then return to **FAULT DIAGNOSTICS** to request a new diagnostic of the **ELECTRICAL SYSTEM**. The DID should display the fault as being inactive. The MCM 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 MCM memory.

NOTE

When performing an electrical system diagnostic with the DID, the message « No Response ModA41 » indicates either module A41 is not responding due to a CAN link problem or module A41 is not powered. Similar messages exist for all modules (A42, A43, A44, etc.).

NOTE

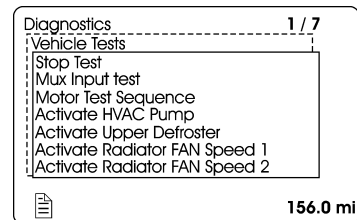
*Because it is easier to do, check first if the module is powered by probing on its gray connector. If it is, then you can conclude that there is a CAN link problem. Refer to **CAN NETWORK LAYOUT AND TROUBLESHOOTING** in this section.*

NOTE

The Driver Information Display (DID) is the most important tool to achieve troubleshooting on a multiplex vehicle.

5.4 MULTIPLEX INPUT TEST MODE

The multiplex input test provides useful information to diagnose multiplexed inputs of switches and sensors, complimentary to the electrical system diagnosis.



To initiate the test mode, use the Driver Information Display (DID) **DIAGNOSTICS** menu. Select **VEHICLE TESTS** submenu and then **MUX INPUT TEST**. Press **ENTER** button to start the test. The DID status line will show **TEST** to confirm the test mode is active. To exit test, press **ESCAPE** button, select **STOP TEST** submenu and then press **ENTER** button twice. **TEST** will disappear from the DID status line.

Instrument 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 *beep* that allows verification of the sensors at the rear of the vehicle.

Certain inputs are doubled (for example, 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
HVAC control unit driver recirculate switch
HVAC overhead compartment fan switch
HVAC control unit passenger's section ON/OFF
Radiator fan clutch switch
Engine rear start selector switch "rear start"
Engine rear start selector switch "normal"
Engine ignition front switch
Engine ignition rear switch
Entrance door inside opening /closing switch
Entrance door outside opening /closing switch
Electric horn button
Kneeling down switch
Kneeling up switch
Baggage compartment locking system switch
Baggage compartment door ajar open sensor
Steering wheel control buttons
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 lever
Wheelchair lift activation switch
Windshield lower wiper

Multi-function lever windshield wipers intermit.
Lower windshield wipers backup switch
Lower windshield washer switch
Upper windshield washer switch
Upper windshield wipers switch, 2 positions

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

- Service chime enable switch,
- Horn selector switch,
- Outside rear view mirror heat,
- Mirror control switches,
- Low-buoy switch,
- Starter sensor,
- ABS warning input,
- WCL switch,
- Driver's power window switch,
- Fog lights switch,
- Alternator sensors 1 & 2,
- Retarder active signal,
- Radiator fan speed 1 & 2 signals.

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 is required, initiate the multiplex input test mode. While in this mode, just set the passenger set point temperature to the minimum 64°F (18°C) to shut off the pump.


5.5 MOTOR TEST SEQUENCE

This test mode allows testing of the electrical 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:

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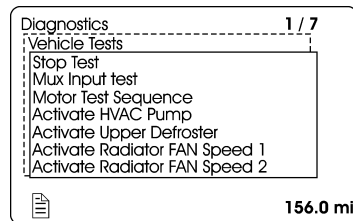
- A. The battery charger must be connected to a 110-120 volt power supply. If not, the test will be interrupted when the voltage drops below 24 volts,
- B. Engine not running,
- C. Parking brake applied,

 **DANGER**

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

NOTE

The back-up alarm will beep ten (10) times prior the test starts to warn people that may be working on the vehicle.



To enter this mode:

- Using the dashboard DID, select DIAGNOSTICS menu and press ENTER button ;
- Select VEHICLE TEST, press ENTER button then select MOTOR TEST SEQUENCE and press ENTER button to initiate the test mode for electrical motors;
- Ten (10) beeps can be heard indicating the motor test mode has started.

Using the test mode:

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

5.5.1 Test Sequence – Coaches only

Go to the condenser compartment:

- The condenser fans start at speed 1, then after a short pause, speed 2 activates.
- The passenger's unit refrigerant solenoid valve activates.

Then 5 beeps can be heard from the back-up alarm to indicate to go to the engine compartment.

In the engine compartment, the sequence is as follows:

- Toilet fan motor starts.
- A/C compressor clutch activates 3 times.
- Left compressor unloader activates 3 times.
- Right compressor unloader activates 3 times.
- Fan clutch is disengaged (fan can be turned freely by hand).
- Fan clutch engages in speed 1 (fan can be turned by hand but with a certain resistance).
- Fan clutch engages in speed 2 (cannot be turned but hand).

5 beeps from the back-up alarm indicate to go to the evaporator compartment.

In the evaporator compartment:

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

5 beeps from the back-up alarm indicate to get to the driver's area inside the vehicle.

Inside the vehicle:

- The driver's HVAC unit refrigerant solenoid valve cycles 3 times and the hot water pneumatic valve cycles 3 times also.
- Left and right overhead compartment fans start running one after the other for 5 seconds.
- The upper windshield defroster (optional) starts running.

To exit the electric motors test sequence, press ESCAPE button, select STOP TEST submenu and then press ENTER button twice.

5.5.2 Test Sequence – VIP With Central HVAC System

Driver's & passenger's unit fresh air damper open. [20 seconds delay]

Go to the condenser compartment:

- Check the fans. The condenser motors start at speed 1 for 3 seconds, then after a short pause, speed 2 activates. [3 seconds delay]
- The passenger's unit refrigerant solenoid valve activates 3 times. [10 seconds delay]

Then 5 beeps can be heard from the back-up alarm to indicate to go to the engine compartment and main power compartment.

In the engine compartment, the sequence is as follows:

- The main power compartment door fan starts running for 3 seconds (will not run if door is open). [10 seconds delay]
- A/C compressor clutch activates 3 times.
- Left compressor unloader activates 3 times.
- Right compressor unloader activates 3 times. [5 seconds delay]
- Radiator fan clutch is disengaged (fan can be turned freely by hand). [3 seconds delay]
- Fan clutch engages in speed 1 (fan can be turned by hand but with a certain resistance). [3 seconds delay]
- Fan clutch engages in speed 2 (cannot be turned but hand). [10 seconds delay]

5 beeps from the back-up alarm indicate to go to the evaporator compartment.

In the evaporator compartment:

- Evaporator fan motor runs at speed 1 for 3 seconds then runs at speed 2 for 2 seconds.
- Hot water pump starts running for 5 seconds and hot water pneumatic valve cycles 3 times. [20 seconds delay]

5 beeps from the back-up alarm indicate to go to the spare wheel compartment behind the reclining bumper.

Inside the spare wheel compartment:

- Driver's unit refrigerant solenoid valve activates 3 times.
- Driver's unit hot water pneumatic valve cycles 3 times.
- Closing of the fresh air dampers.

To exit the electric motors test sequence, press ESCAPE button, select STOP TEST submenu and then press ENTER button twice.

5.5.3 Test Sequence – VIP With Small HVAC System

Driver's unit fresh air damper opening. [20 seconds delay]

Then 5 beeps can be heard from the back-up alarm to indicate to go to the engine compartment and main power compartment.

In the engine compartment, the sequence is as follows:

- The main power compartment door fan starts running for 3 seconds (will not run if door is open). [10 seconds delay]
- A/C compressor clutch activated 3 times. [5 seconds delay]
- Radiator fan clutch is disengaged (fan can be turned freely by hand). [3 seconds delay]
- Fan clutch engages in speed 1 (fan can be turned by hand but with a certain resistance). [3 seconds delay]
- Fan clutch engages in speed 2 (cannot be turned but hand). [10 seconds delay]

5 beeps from the back-up alarm indicate to go to the spare wheel compartment behind the reclining bumper.

Inside the spare wheel compartment:

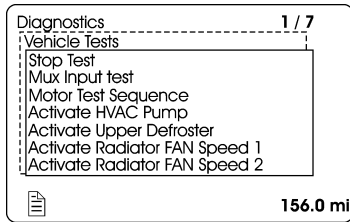
- Auxiliary unit refrigerant solenoid valve activates 3 times. [10 seconds delay]
- Hot water pump starts running for 5 seconds.
- Driver's unit refrigerant solenoid valve activates 3 times.
- Driver's unit hot water pneumatic valve cycles 3 times.
- Closing of the fresh air dampers.

To exit the electric motors test sequence, press ESCAPE button, select STOP TEST submenu and then press ENTER button twice.

5.6 FORCED ACTIVATION OF THE RADIATOR FAN CLUTCH

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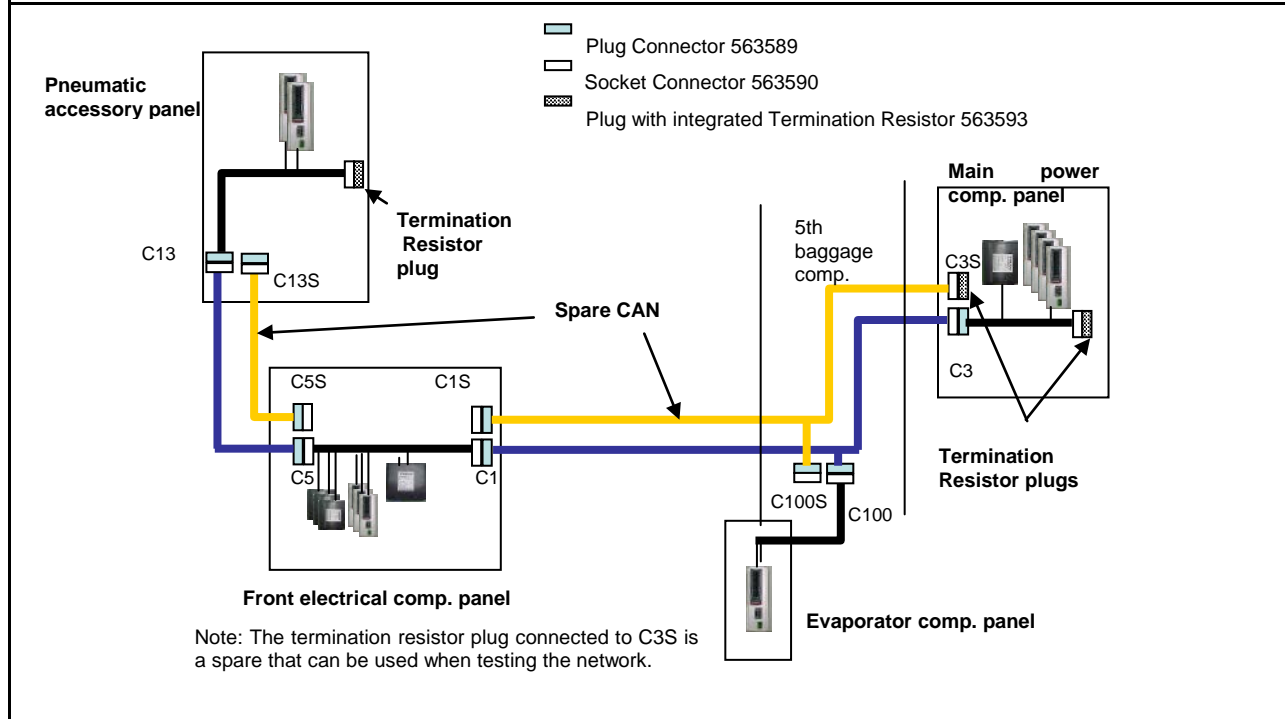
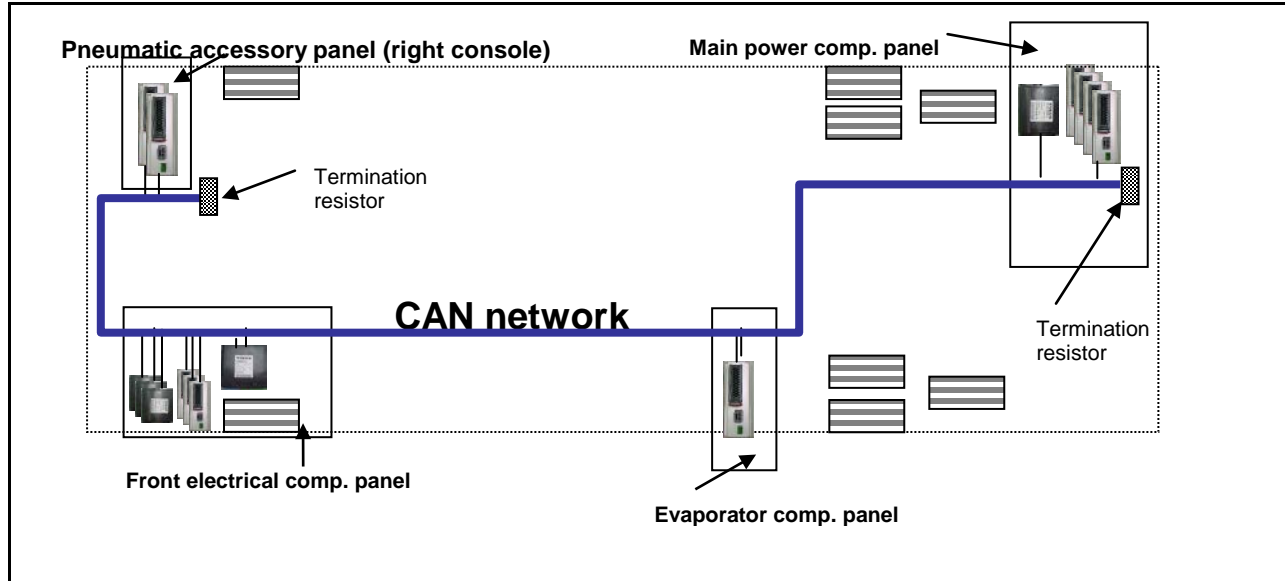
To prevent the engine from overheating in case of malfunction of the clutch activation system, it is possible to force activation of the clutch.



1. On the Driver Information Display, select DIAGNOSTICS menu. Select VEHICLE TESTS submenu and then ACTIVATE RADIATOR FAN SPEED 1 or ACTIVATE RADIATOR FAN SPEED 2 as required.
2. The DID status line will show TEST to confirm the forced activation of the radiator fan clutch. To cancel, turn the ignition switch to the OFF position or press ESCAPE button, select STOP TEST submenu and then press ENTER button twice. TEST will disappear from the DID status line.

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.

5.7 CAN NETWORK LAYOUT AND TROUBLESHOOTING

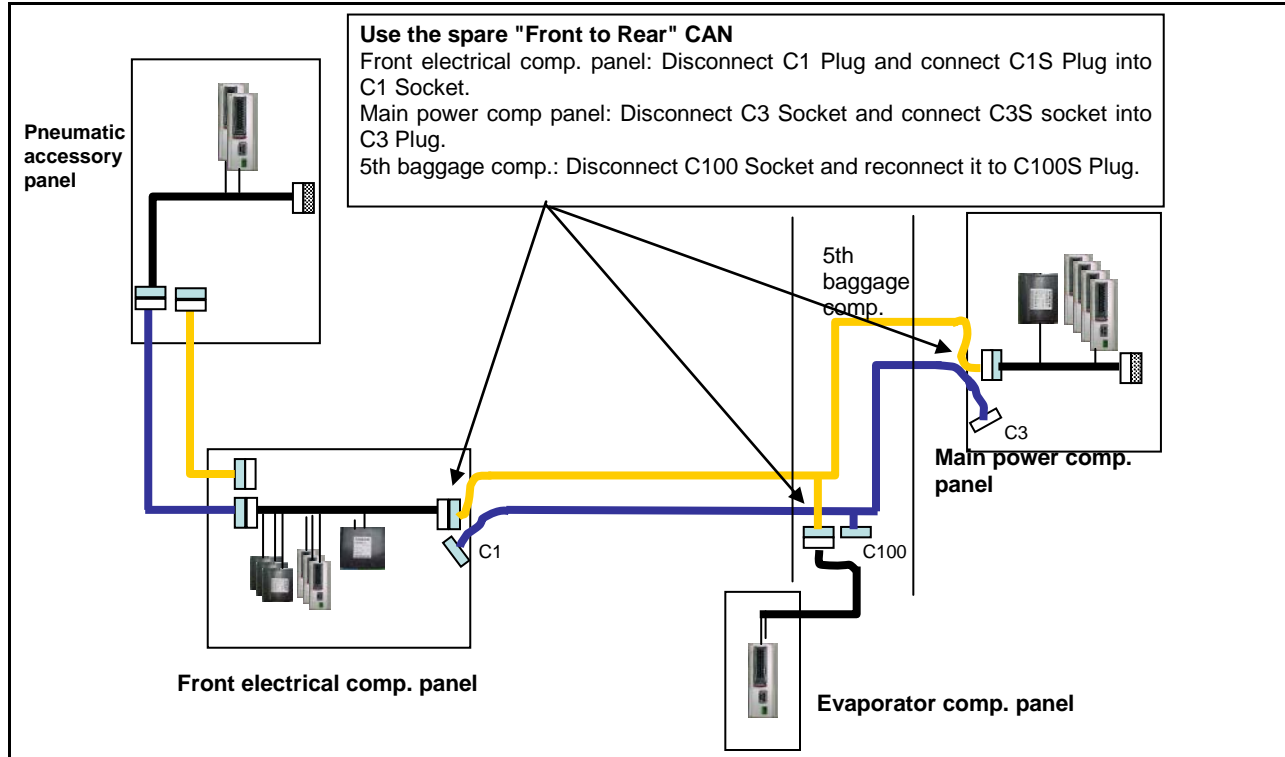


If all 14 modules (A41 to A54) are showed as Not Responding and Active Fault, the problem could be:

- A short circuit somewhere on the CAN network.
- The network is completely open circuit. That means none of the two termination resistors are connected.

Several simple tests can be done to locate the problem.

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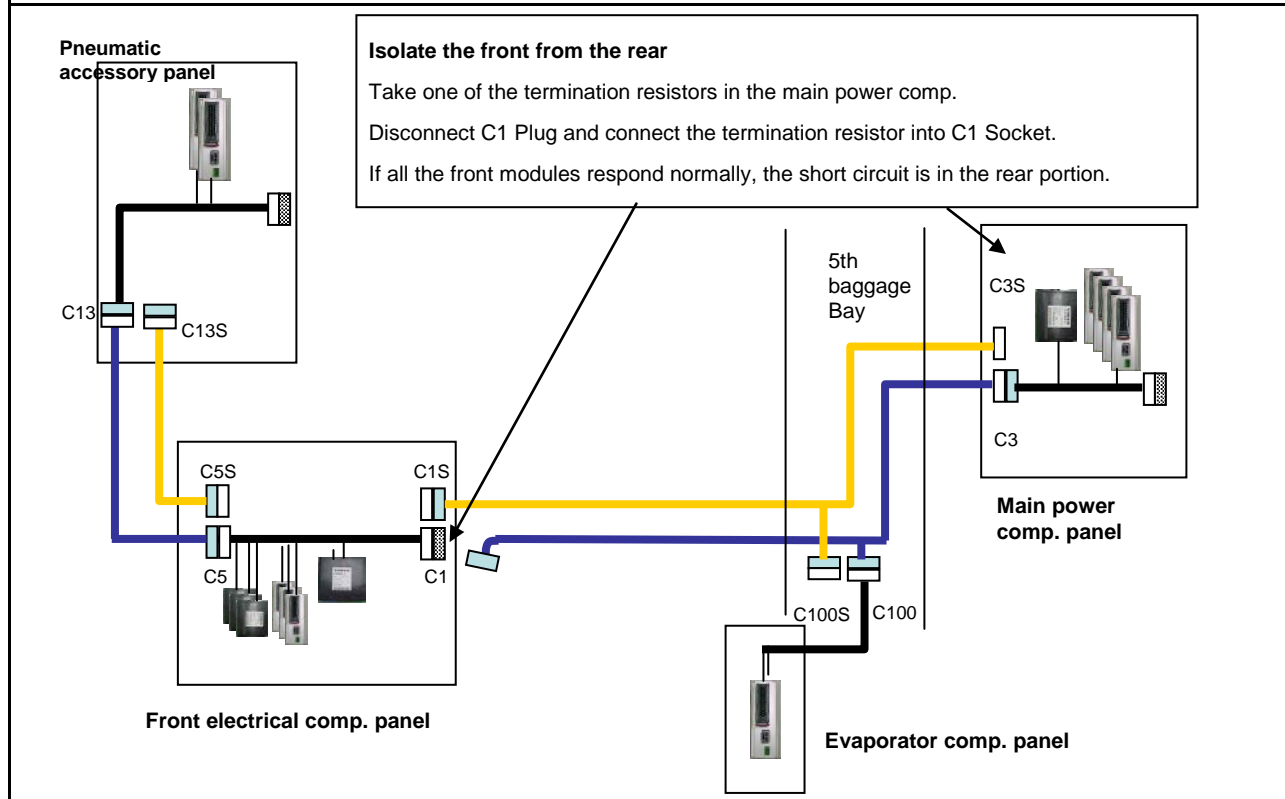
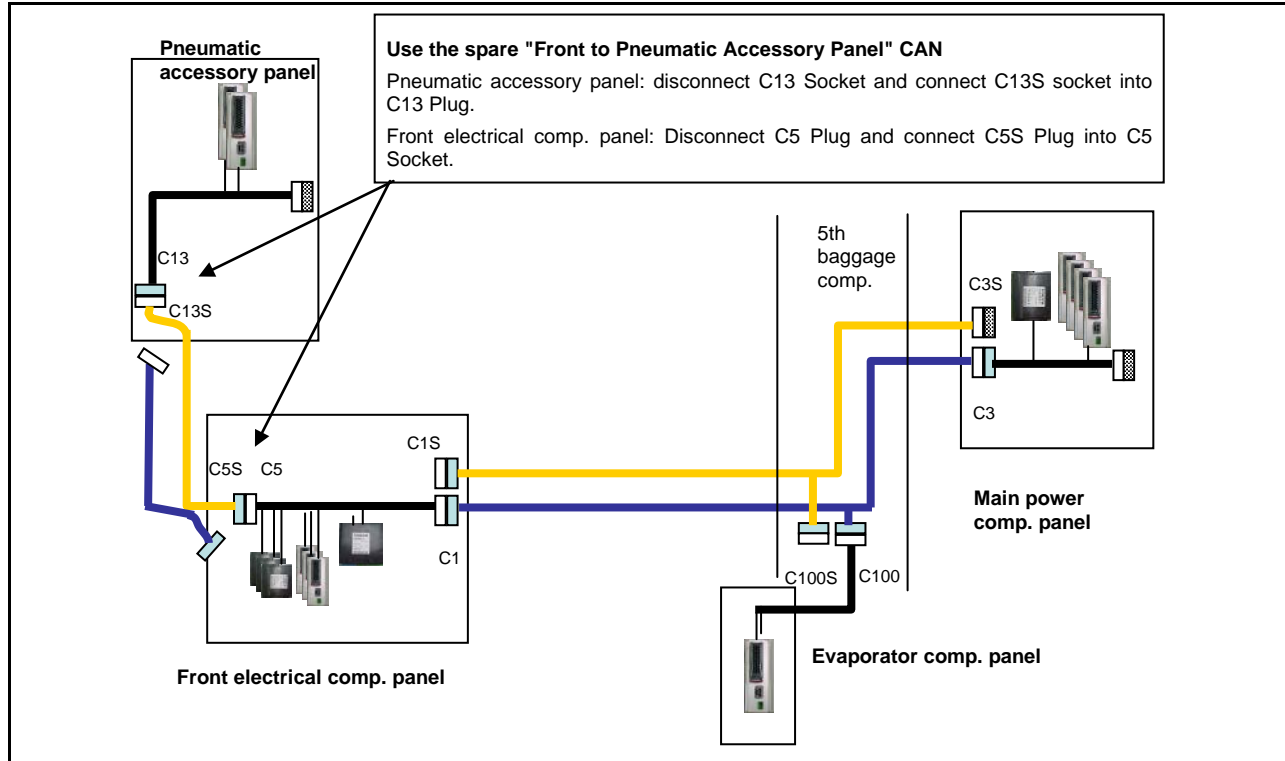


All modules including Wake-up modules and MCM have to be powered OFF prior to probe the CAN lines with an ohmmeter.

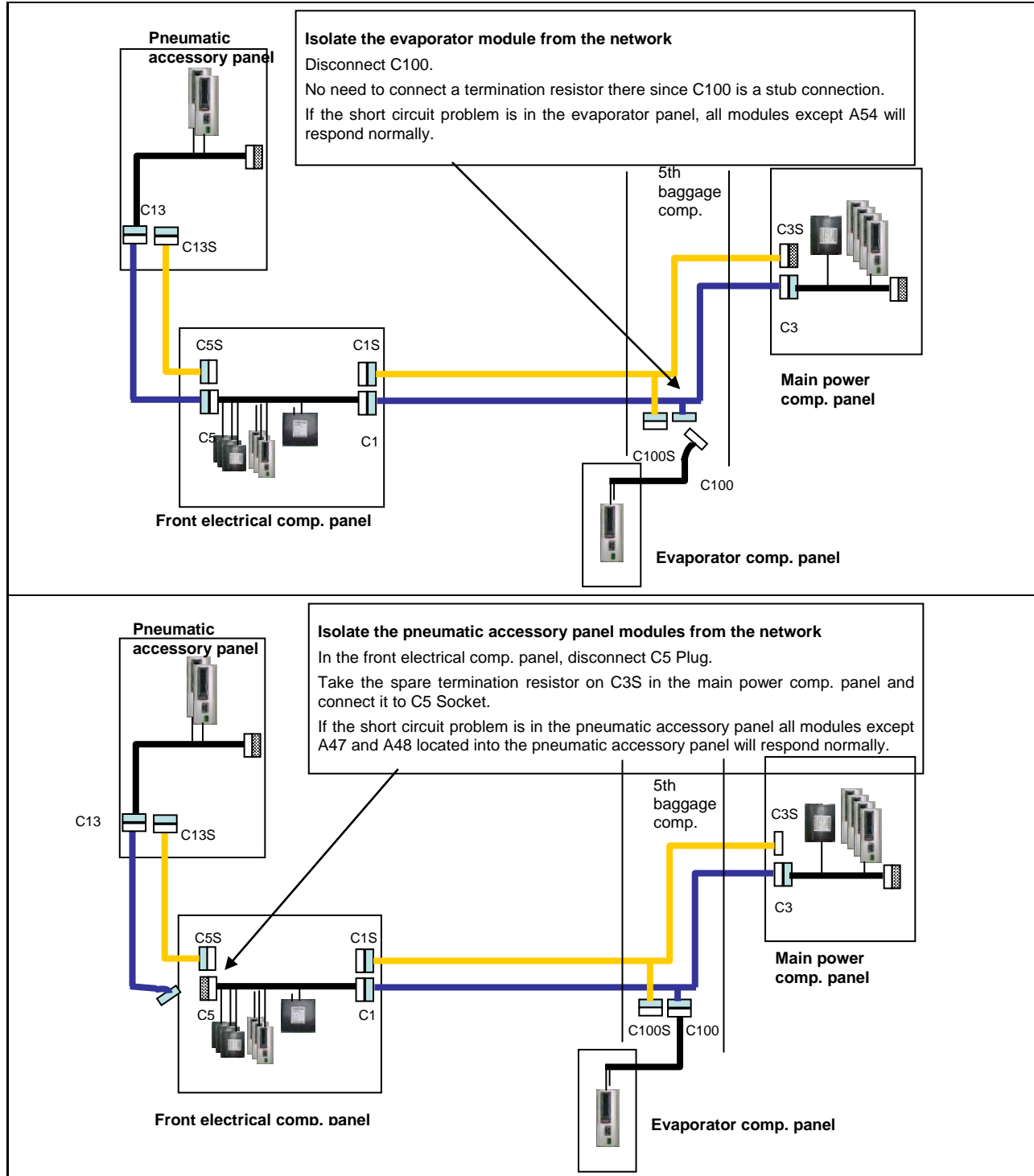
Probing the resistance between the CAN-H and CAN-L wire is a useful method to localize short circuits or open circuit on the CAN network. However, when doing so, make sure none of the modules connected to the CAN line are powered, including wake-up powered modules and battery direct supply module (MCM). Otherwise the measured value is invalid and will always show OL (Open Load). This is because the modules are applying a voltage on the CAN lines and this is fooling the ohmmeter.

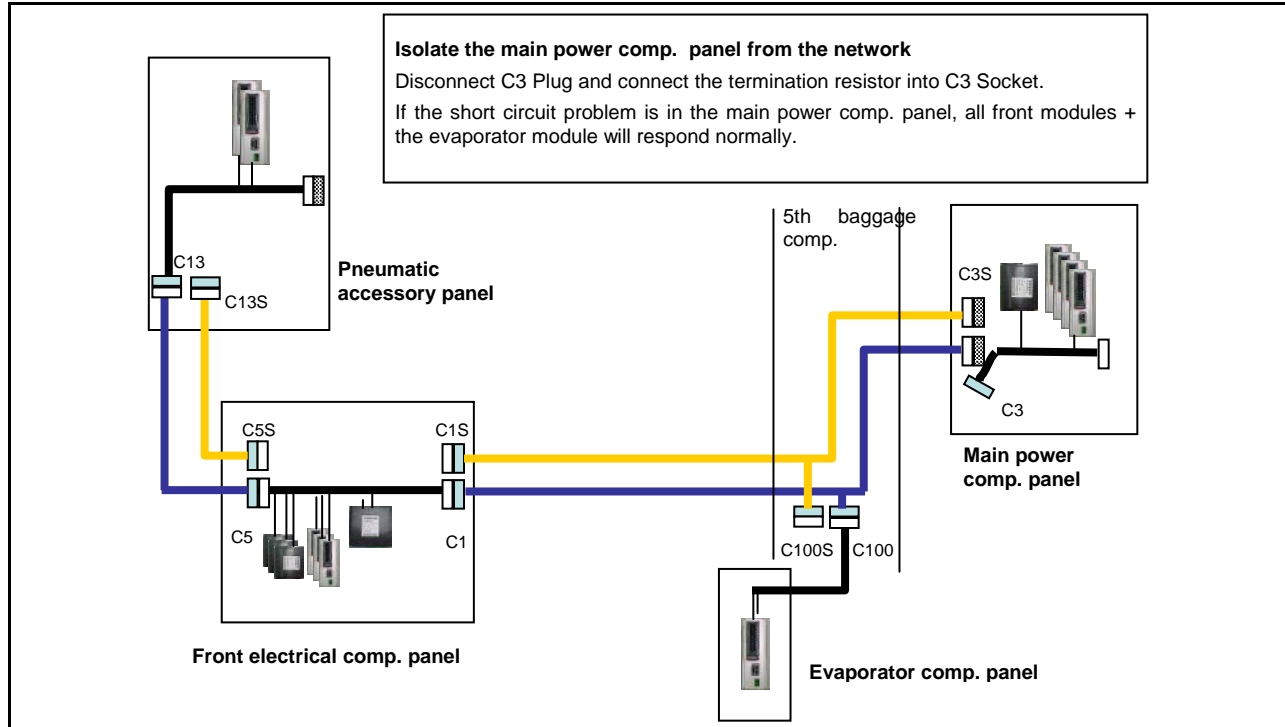
Proceed as follow when probing the CAN line with an ohmmeter in order to get a valid reading:

- Turn ignition key to the OFF position.
- Set the battery master switch to the OFF position to turn all Wake-up modules power to OFF.
- Trip circuit breakers CB2, CB4 and CB6 to remove direct battery power from the MCM.



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CAN wires are not like other common electrical wires.

- Maintaining a proper wire twisting is important. The two yellow and green wires must be twisted and in close contact all along the network to maintain the transmission line impedance.
- A slack handmade twisting is not acceptable.
- There should be no more than 50 mm (2 inches) without twist at the connection points.

We recommend replacing the CAN harnesses instead of trying to repair them.

5.8 ROADSIDE TROUBLESHOOTING

Problem/Symptom	Probable Causes	Actions
Vehicle does not Start	Rear Start selector switch is not at the NORMAL position	1. Check that the rear start selector switch is flipped up to NORMAL start position and battery master 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
	Battery master switch in the battery compartment is at the OFF position (down)	
	CAN network problem (Multiplex)	If the vehicle does not start from the rear:
Module A53 not powered or is defective	1. Verify that module A53 is powered: a) Check DIAGNOSTICS menu of DID. Select FAULT DIAGNOSTIC and ELECTRICAL SYSTEM. The message "No Response ModA53, Active" indicates a power problem on the module or a CAN network problem.	

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Problem/Symptom	Probable Causes	Actions
	<p>Engine ECM does not receive the ignition signal</p> <p>Engine ECM is not powered</p>	<p>b) Check / reset circuit breaker CB5</p> <p>c) Check / replace fuse F65</p> <p>d) Probe gray connector on module to see if it is powered.</p> <p>2. Verify that the engine ECM is powered and get the ignition signal</p> <p>a) Check / reset circuit breaker CB8 Check / replace fuse F74</p> <p>b) Check / reset circuit breaker CB2 Check / replace fuse F78</p>
<p>None of the Multiplexed functions are operating, including the basic limp-home functions (door opening, flashers, wipers in speed 1)</p> <p>"FLIP REAR BREAKER TO INITIATE I/O MODULES PROGRAMMING" pop-up message appears in the DID</p> <p><i>Note: The sunshades are still functioning since these are not multiplexed</i></p>	<p>The program version in the MCM is different than the program in the I/O modules and the MCM is forcing all I/O modules to stay inactive</p>	<p>1. Engage the auto-programming of the I/O modules: Turn the ignition key to the ON position, trip and reset circuit breaker CB6.</p> <p>2. The DID indicates "MUX AUTOPROGRAMMING I/O MODULE PLEASE WAIT" until the reprogramming is complete.</p>
<p>Many secondary functions (not essential for driving) not functioning (interior lighting, driver's area lighting, wiper speed 2 and intermittent)</p> <p>Marker lights and clearance lights are turned ON when setting ignition to the ON position</p>	<p>The MCM module does not receive 24 V power</p> <p>The CAN network is not working. It could be caused by a short on the network, an open circuit, a problem with the MCM or the MCM being disconnected from the network</p>	<p>1. Check / reset circuit breaker CB6 (4th from the top on the right side column) Check / replace fuse F1</p> <p>2. Operate in limp-home mode by starting the vehicle from the engine compartment (REAR START). All functions essential to drive are available</p> <p>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</p>
<p>No temperature control in the passenger area</p> <p>Passenger temperature display indicates two dashes "--"</p>	<p>Problem with the temperature sensor located in the evaporator compartment air intake or the sensor wiring</p>	<p>1. 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</p>

Problem/Symptom	Probable Causes	Actions
<p>Entrance door does not open nor close using the control buttons</p> <p>Defroster fan not functioning</p> <p>Lower windshield wipers not functioning in speed 1 or intermittent</p>	<p>Module A47 is not powered or is faulty</p>	<ol style="list-style-type: none"> 1. Check DIAGNOSTICS menu of DID. 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
<p>Lower windshield wipers not functioning in speed 1 or intermittent</p>	<p>No power on R23</p>	<ol style="list-style-type: none"> 1. Check / replace fuse F18
<p>HVAC condenser fans not functioning in speed 1</p>	<p>Circuit breaker CB7 was manually tripped and not reset</p>	<ol style="list-style-type: none"> 1. Check / reset circuit breaker CB7
<p>HVAC condenser fans not functioning in speed 2</p>	<p>Circuit breaker CB7 was manually tripped and not reset</p>	<ol style="list-style-type: none"> 1. Check / reset circuit breaker CB7
<p>Lower and upper windshield washer not functioning</p> <p>Upper windshield wiper not functioning</p> <p>Defroster fan is functioning but no heat or cooling available in the driver area</p>	<p>Module A46 is not powered or is faulty</p>	<ol style="list-style-type: none"> 1. Check DIAGNOSTICS menu of the DID. 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 4. Probe gray connector on module to see if it is powered.
<p>Low beam headlights and front flasher on left side not functioning</p> <p>Electric horn not functioning</p>	<p>Module A45 is not powered or is faulty</p>	<ol style="list-style-type: none"> 1. Check DIAGNOSTICS menu of the DID. 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

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Problem/Symptom	Probable Causes	Actions
Low beam headlights and flasher on right side not functioning	Module A48 is not powered or is faulty	<p>see if it is powered.</p> <ol style="list-style-type: none"> 1. Check DIAGNOSTICS menu of the DID. 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 this symptom). 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.
Rear flashers not functioning Stoplights and high-mounted stoplight not functioning	Module A51 is not powered or is faulty	<ol style="list-style-type: none"> 1. Check DIAGNOSTICS menu of the DID. 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	<ol style="list-style-type: none"> 1. Check DIAGNOSTICS menu of the DID. 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	<ol style="list-style-type: none"> 1. Check / reset circuit breaker CB3 2. Check DIAGNOSTICS menu of the DID. 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).

Problem/Symptom	Probable Causes	Actions
		<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 1. Check DIAGNOSTICS 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). 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	<ol style="list-style-type: none"> 1. 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	<ol style="list-style-type: none"> 1. 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 activated to indicate a fire in the engine compartment but there is no fire	Short-circuited fire sensor or defective sensor	<ol style="list-style-type: none"> 1. 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	<ol style="list-style-type: none"> 1. 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 F29 blown	<p>Check / reset circuit breaker CB10</p> <p>Check / replace fuse F29</p>
The radiator fan clutch does not function and the engine is overheating		<p>You can manually engage the radiator fan clutch speed 1 or speed 2.</p> <ol style="list-style-type: none"> 1. On the Driver Information Display, select DIAGNOSTICS menu. Select VEHICLE TESTS submenu and then ACTIVATE RADIATOR FAN SPEED 1 or ACTIVATE RADIATOR FAN

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Problem/Symptom	Probable Causes	Actions
		<p>SPEED 2.</p> <p>2. The DID status line will show TEST to confirm the forced activation of the radiator fan clutch. To cancel, turn the ignition switch to the OFF position or press ESCAPE button, select STOP TEST submenu and then press ENTER button twice. TEST will disappear from the DID status line.</p> <p>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.</p>

5.9 ESSENTIAL FUNCTIONS TO OPERATE THE VEHICLE

Even with a defective MCM (Master Chassis 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.

5.9.1 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,

- Windshield washer fluid: Lower windshield washer 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.

5.10 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.

5.11 MULTIPLEX MODULES

5.11.1 MCM

The MCM plays the role of interface between the engine ECM, the transmission TCM, the telltale panel module and other IO-A, IO-B modules. When a multiplex module is being replaced, the MCM will inform the new module of its role and function accordingly to the vehicle options. The MCM also keeps the specific back-up program of the vehicle. So, a specific MCM cannot be removed from a vehicle and installed on another vehicle.

5.11.2 I/O-A

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

5.11.3 I/O-B

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

5.12 MULTIPLEX MODULES REPLACEMENT

I/O-A, I/O-B modules can be replaced and reprogrammed without having to connect a computer to the vehicle. MCM module reprogramming is performed with connection to a computer.

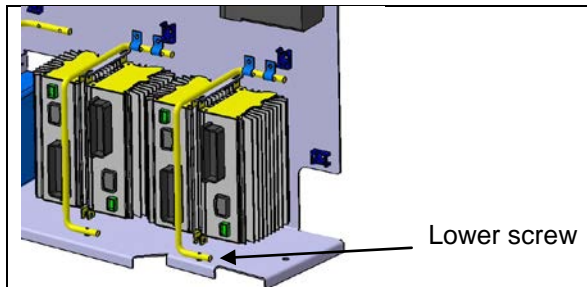


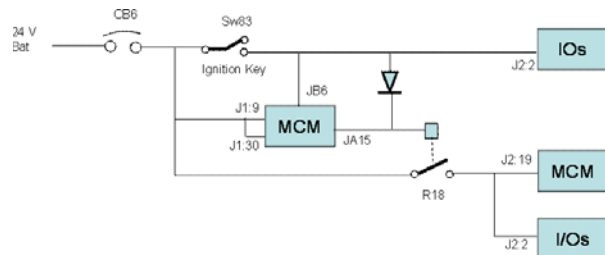
FIGURE 20: IO-B MODULE REMOVAL

5.12.1 Replacing I/O-A Or I/O-B Modules And Initiating Autoprogramming

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

To disconnect the black connector, slide the red latch downwards. 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 I/O-B module, see Fig. 20).

- Reset circuit breaker CB6. This engages the I/O auto programming.
- The DID indicates "MUX AUTOPROGRAMMING I/O MODULE PLEASE WAIT" until the reprogramming is complete unless a higher priority message must be displayed. If this is the case, press ESCape button repeatedly to acknowledge the higher priority messages.
- Check the DIAGNOSTICS menu of the DID. Select FAULT DIAGNOSTICS 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).



JB6 is a wake-up pin

JA15 output remains active for 15 minutes after JB6 is inactive

To initiate reprogramming:

- Switch SW83 (ignition key) closed, providing 24-volt on JB6, I/O modules and R18. All modules get power.
- CB6 is tripped and reset which is forcing MCM reboot.
- When resetting CB6, all modules gets power, MCM goes into Start Mode. I/O modules needing new program will request reprogramming to MCM while in Start Mode.

5.12.2 Replacing The MCM Module

- Set the ignition key to the ON position and leave it in that position at all time while performing this procedure.

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- Inside main power compartment, trip circuit breaker CB6.
- Replace the module.
- Reset circuit breaker CB6.
- The vehicle specific program needs to be uploaded in the MCM. A laptop computer equipped with VPG (Vehicle Program Generator) software must be connected to the DB9 (9-pins) connector (identified C226) found in the electrical harness near the MCM. **Please, contact your Prevest Service Representative if a reprogramming is required.**

6 ALTERNATORS

Two 28-volt 120A, self-regulated, belt driven, air-cooled HD 10 BOSCH alternators are used in the 24 volt electrical system.

If the alternators needed to be removed, reinstall as follows.

1. If necessary, tighten 4 screws fixing alternator support assembly onto engine (item 5). Use Loctite 243 blue (680038) onto the threads.
2. Tighten screws fixing alternator belt tensioner support assembly onto engine (item 1 & 2). Use Loctite 243 blue onto the threads.
3. Also tighten the screw fixing belt tensioner onto alternators support assembly (item 6). Use Loctite 243 blue (680038) onto the threads.

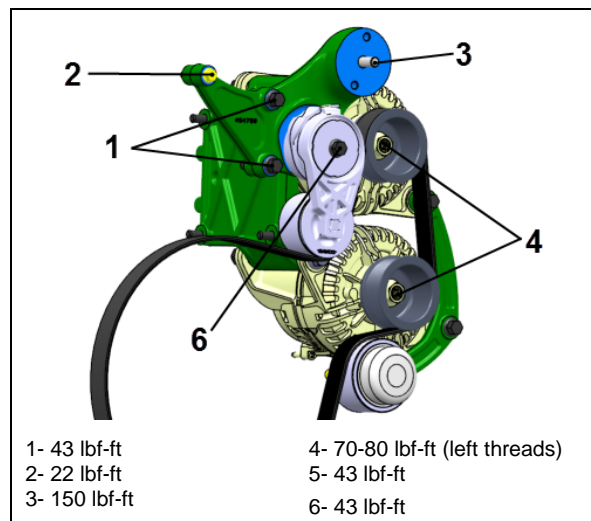


FIGURE 21: ALTERNATORS DRIVE BELT

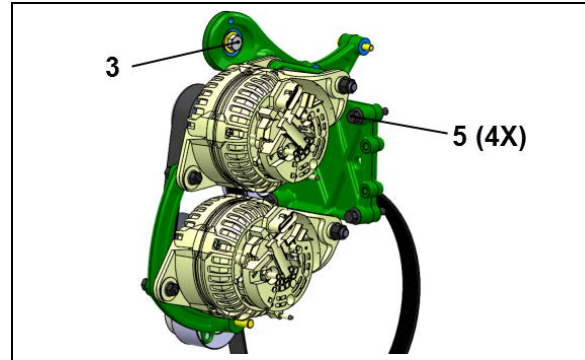


FIGURE 22: ALTERNATORS AND ACCESSORIES MOUNTING TORQUES (H3 COACH SHOWN)

4. If applicable, mount the A/C compressor idler pulley onto alternator belt tensioner support (item 3). Use some Loctite 243 blue (680038) onto the threads.
5. Fix lower and upper alternators loosely to alternators support assembly (bolts 5). Also, mount arched support loosely onto alternators. If applicable, install stone guard below lower alternator.

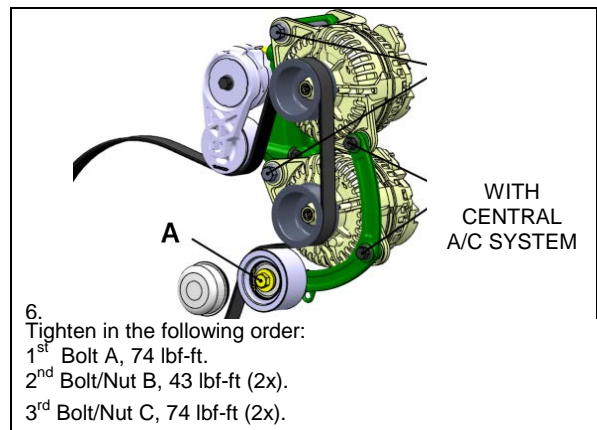


FIGURE 23: ALTERNATOR MOUNTING, TIGHTENING SEQUENCE – CENTRAL A/C SYSTEM

7. In order to assure installation, it is important to tighten the alternator mounting bolts in proper sequence. (fig.23 & fig.24).
8. Mount pulley onto alternator.
9. Install alternator belt.

NOTE

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

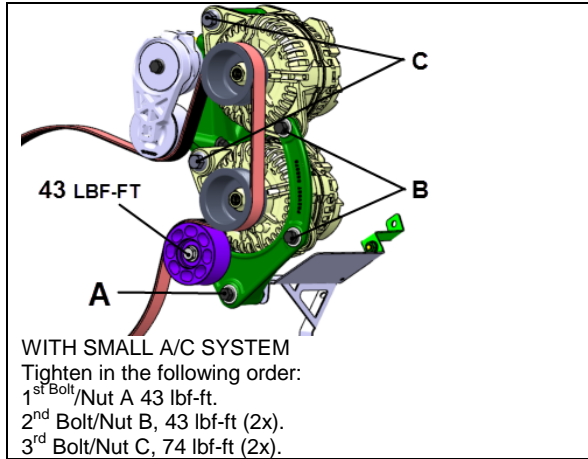


FIGURE 24: ALTERNATOR MOUNTING, TIGHTENING SEQUENCE – SMALL A/C SYSTEM

6.1 ALTERNATOR BRUSH REPLACEMENT

1. Disconnect the electrical harnesses and remove the alternator.
2. Remove the cover located on the rear side of the alternator.
3. Dismount the brush holder and voltage regulator assembly. To do so, remove the 3 screws indicated with arrows.

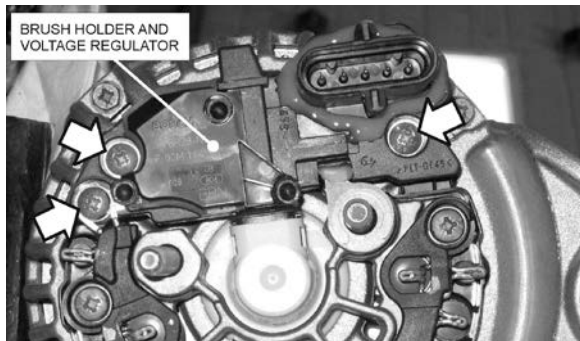


FIGURE 25: BOSCH HD10 BRUSH HOLDER MOUNTING SCREWS

4. Install the new brush holder and tighten the screws.
5. Reinstall the cover. Tighten screw and nuts.
6. Reinstall the alternator loosely.
7. Connect ground harness and (+) positive cable on the lower alternator as shown (figure 26).
10. In order to assure proper installation, it is important to tighten the alternator mounting bolts according to proper sequence (see previous section).

8. On the upper alternator, connect the power harness onto the adaptor. Tighten nut to 10 lbf-ft.

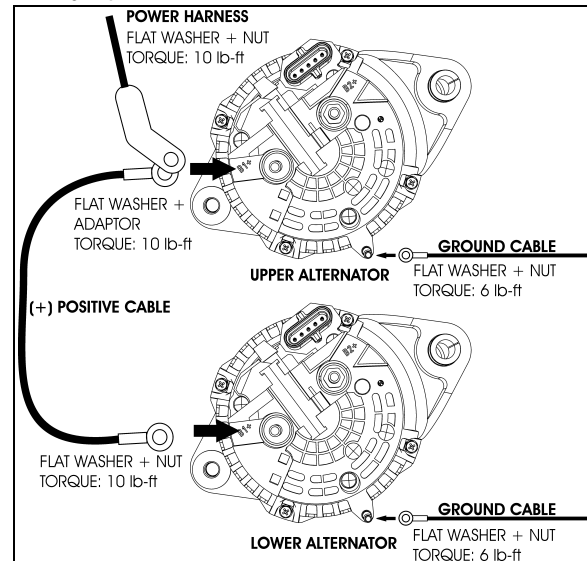


FIGURE 26: TWIN BOSCH HD10 CONNECTIONS

9. Connect the 5-pin connector on both alternators.
10. Apply protective rubber coating (p/n 684013) or similar product on the stud terminals, washers and nuts.



MAINTENANCE

Commuter application

Check Bosch HD10 alternator brushes and replace if necessary after every 50 000 miles (80 000 km).

Other applications

Check Bosch HD10 alternator brushes after every 100 000 miles (160 000 km) and replace if necessary.

6.2 IDENTIFYING THE DEFECTIVE ALTERNATOR

When an alternator is not charging, the instrument cluster ALTERNATOR telltale will illuminate.



ALTERNATOR telltale

To identify which alternator is defective (1=lower alternator, 2=upper alternator), proceed as follows:

1. On the DID (Driver Information Display), select DIAGNOSTICS menu.

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2. Select VIEW ACTIVE FAULTS and then ELECTRICAL SYSTEM.
3. The active electrical system faults will appear. Scroll through the active faults. You will find one of the following messages:

MID (188)	ELECTRICAL SYSTEM
PSID 34	ALTERNATOR 1
FMI (5)	OPEN CIRCUIT

MID (188)	ELECTRICAL SYSTEM
PSID 35	ALTERNATOR 2
FMI (5)	OPEN CIRCUIT

6.3 ALTERNATOR DRIVE BELT

Removal

1. Insert a 3/4" socket drive into the automatic belt tensioner opening.
2. Twist the tensioning arm to slacken belt.
3. Remove belt.

NOTE

Belts specifications may vary. For proper belt selection, always consult your vehicle Coach Final Record.

Installation

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

6.4 ADJUSTMENT

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



MAINTENANCE

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

7 BATTERY EQUALIZER

Vanner "Vann-Guard 70-Series" Battery equalizer is located beside the batteries in battery compartment. Battery Equalizer Owner's Manual (100 amps) is annexed at the end of this section.

For vehicles with PRIME energy management system, a Vanner "Vann-Bus 80 Series" 100amp Battery equalizer with Smart Monitor is installed beside the batteries in the battery compartment. Owner's Manual is annexed at the end of this section.

8 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

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.

9 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 located on the engine compartment R.H. side door (fig. 23). To use it, connect the female plug of an electrical extension cord to the heater plug.

Some converted vehicles may have the heater connected to the coach AC power system. 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.

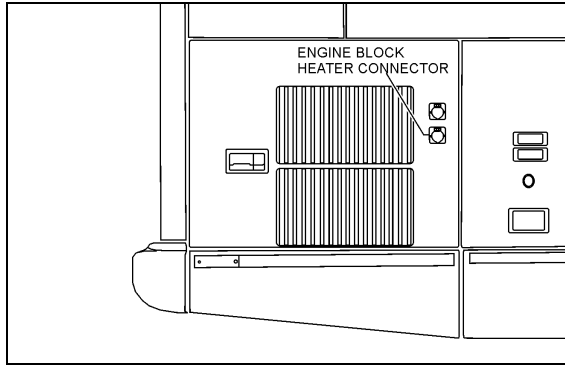


FIGURE 27: ENGINE BLOCK HEATER PLUG LOCATION

9.1 MAINTENANCE

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

10 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.

10.1 HEADLIGHTS

Inner headlights are used for high beam and daytime running light while outer headlights are used for low beam. The inner or outer lamp uses the same single filament halogen bulb part number.

NOTE

If vehicle is equipped with optional Xenon headlights, refer to paragraph 6.1.6.

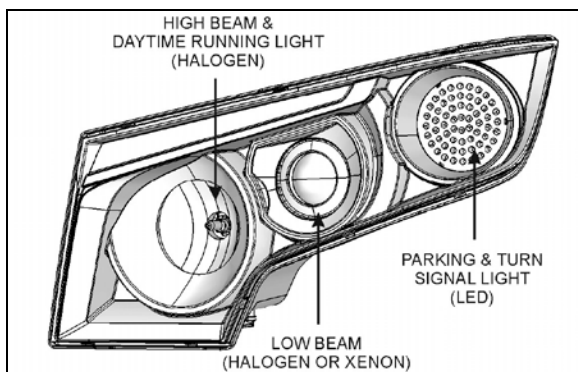


FIGURE 28: HEADLIGHT ASSEMBLY

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10.1.1 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.

10.1.2 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.

10.1.3 Replacing headlight bulbs

The following illustrations show how to gain access to the bulbs. When replacing a bulb, make sure the ignition switch and light switch are off.



CAUTION

- To prevent burning yourself, do not replace the light bulbs while they are hot.
- Halogen bulbs have pressurized gas inside and require special handling. They can burst or shatter if scratched or dropped. Hold a bulb only by its plastic case. Do not touch the glass part of a bulb with bare hands.

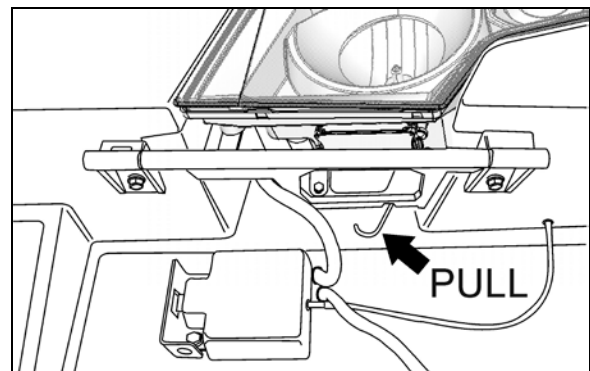


FIGURE 29: ROCKING THE HEADLIGHT ASSEMBLY

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1. First, make sure the ignition switch and light switch are off.
2. Pull on the reclining bumper opening handle located inside the front electrical and service compartment.
3. Pull on the rod shown on figure 29 to pivot the headlight assembly.

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4. Unscrew the cap to gain access to the bulb connector.
5. HALOGEN: turn the bulb base counterclockwise. XENON: Unscrew the Phillips head screws indicated by arrows, pull the retainer and bulb out (fig.30).

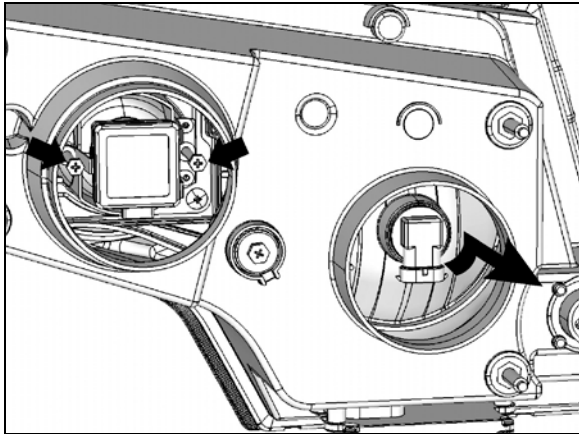


FIGURE 30: HEADLIGHT ASSEMBLY REAR VIEW 06715



CAUTION

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

6. Unplug the connector while depressing the lock release when applicable.
7. Replace bulb, connect to harness and install into mounting hole.

Aiming is not necessary after replacing the bulb. When aiming is necessary, refer to paragraph "HEADLIGHT AIMING".

10.1.4 Replacing Front Turn Signal LED module

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. Rotate the cap to gain access to the LED module.
2. Disconnect the electrical harness connector from the LED module.
3. Unscrew the 3 mounting fasteners and replace LED module.

4. Install wiring connector on back of new turn signal module.

10.1.5 Optional Xenon Headlamp (Low Beam)

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



CAUTION

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



CAUTION

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

NOTE

Do not disrupt headlight adjustment screws.

When switching on the Xenon headlamp using the rocker switch, a 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 30mA 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 stat (< 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 1.58A after one minute for the 24V ballast.

10.1.6 Aiming headlights

Headlights must be properly aimed to provide maximum allowable road illumination. Aiming can be performed without opening headlight assembly. Vertical aiming of each module is provided by one adjusting screw that pivots the entire module in the housing for proper alignment (Fig. 32). There is no adjustment for focus since the module is set for proper focus during manufacturing assembly.

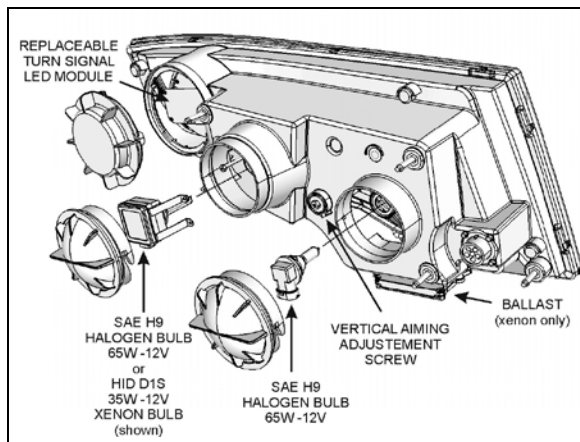


FIGURE 31: HEADLIGHT ASSEMBLY

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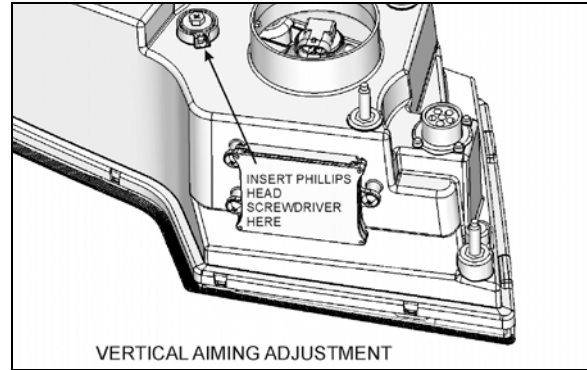


FIGURE 32: VERTICAL AIMING

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10.2 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, a high-mounted stoplight will illuminate simultaneously with the stoplights on the sides for increased safety.

The stop and tail lights are combined in the same 6-LED lamp. The directional signal and license plate 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 sealed unit 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.

10.2.1 Lamp Removal And Replacement

1. Open engine compartment rear door.
2. Unscrew 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.

10.2.2 High-Mounted Stop Light Removal And Replacement

This vehicle is equipped with a high-mounted stop light (LED). This light is a sealed unit 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.

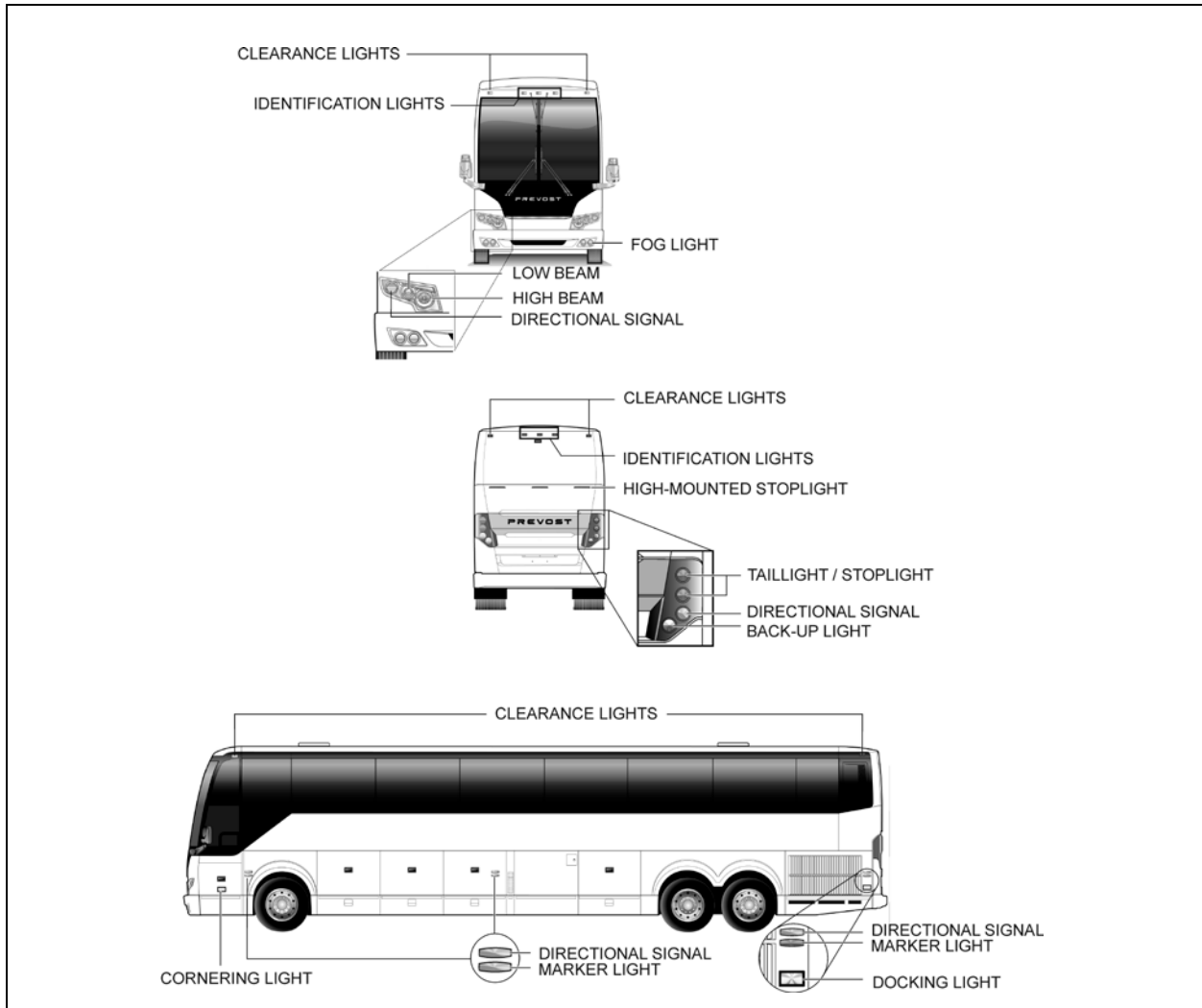


FIGURE 33: VARIOUS LIGHTS LOCATION

18588_4

10.3 LICENCE 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.

10.4 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.

10.4.1 Marker Light Removal And Replacement

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, disconnect and remove the light assembly.
2. Connect and position the new light assembly and install the "Phillips" screws.

10.4.2 Clearance And Identification Light Removal And Replacement

The clearance and identification lights are sealed units (LED) and should be replaced as an assembly in accordance with the following procedure:

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

10.5 DOCKING AND CORNERING LIGHTS

This vehicle is provided with two halogen sealed-beam units that serve as cornering lights. They are mounted on the vehicle as follows: one is mounted on the front L.H. side service compartment door, while the other is located between the front wheel and the entrance door on the R.H. side. The main function of these lights is to increase lateral visibility when turning a corner. These lights are energized simultaneously with the directional lights. On the V.I.P. model, a dashboard-mounted rocker switch may be actuated to cancel this system in special situations.

Two additional halogen sealed-beam units are installed on rear electrical compartment door (R.H.) and radiator door. These lights are used as docking lights and both will illuminate automatically when reverse range is selected to facilitate back-up or docking procedure.

On the V.I.P. model, these lights do not operate automatically when the reverse range is selected, but by means of a dashboard-mounted rocker switch. When actuated, the docking as well as the cornering lights illuminate. Furthermore, a "Low docking" switch, also located on dashboard, allows the use of the docking and cornering lights at a lower intensity when the docking switch is actuated.

10.5.1 Lamp Removal And Replacement

Both docking and cornering sealed-beam units can be changed in accordance with the following procedure:

1. Remove the two "Phillips" screws attaching the retaining ring.
2. Disconnect the light unit connection.
3. Remove the lamp.
4. Position new lamp.
5. Connect and position the light unit.

6. Finally, install the retaining ring and screw.

10.6 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.

10.6.1 Bulb Removal And Replacement

1. Pull on the release handle located in the front electrical and service compartment, near the door lower hinge. The bumper will lower gradually.

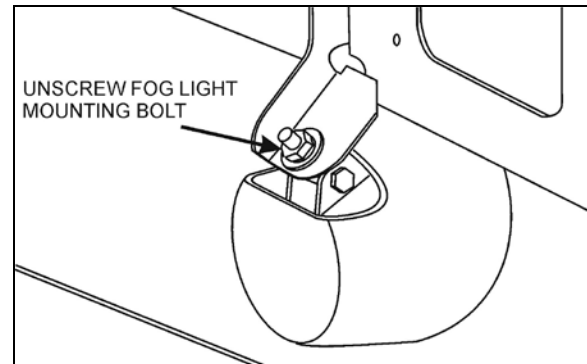


FIGURE 34: FOG LIGHT MOUNTING BOLT

2. From bumper inner side, unscrew the nut fixing the fog light and remove the entire fog light assembly from the bumper.
3. Unscrew the outer ring. Disconnect the light unit connection and remove the bulb.

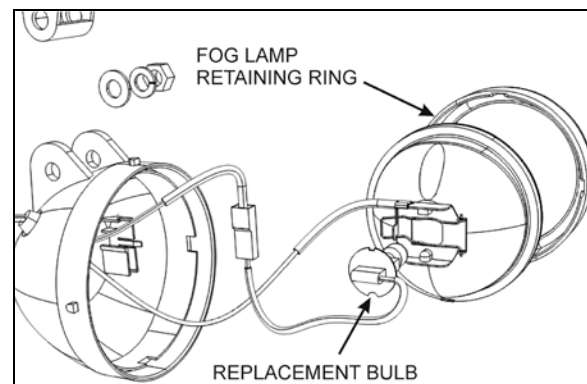


FIGURE 35: FOG LIGHT EXPLODED VIEW



CAUTION

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

4. Install the new bulb, reconnect the light unit and replace in its proper position.
5. Reinstall the outer ring, then return the fog light assembly to its proper location.

Section 06: ELECTRICAL

6. Fasten the fog light mounting nut and securely close the bumper.

11 INTERIOR LIGHTING EQUIPEMENT

11.1 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.

11.1.1 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.36).

NOTE

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

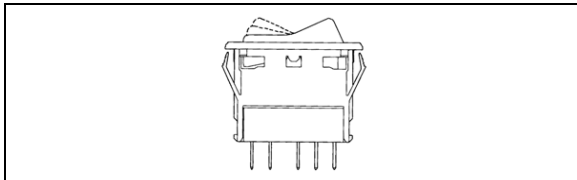


FIGURE 36: SWITCH

11.1.2 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.

11.1.3 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.

11.2 STEPWELL LIGHTS

11.2.1 Coach Entrance

The stepwell lights are illuminated when the door opening system is activated (fig.37).

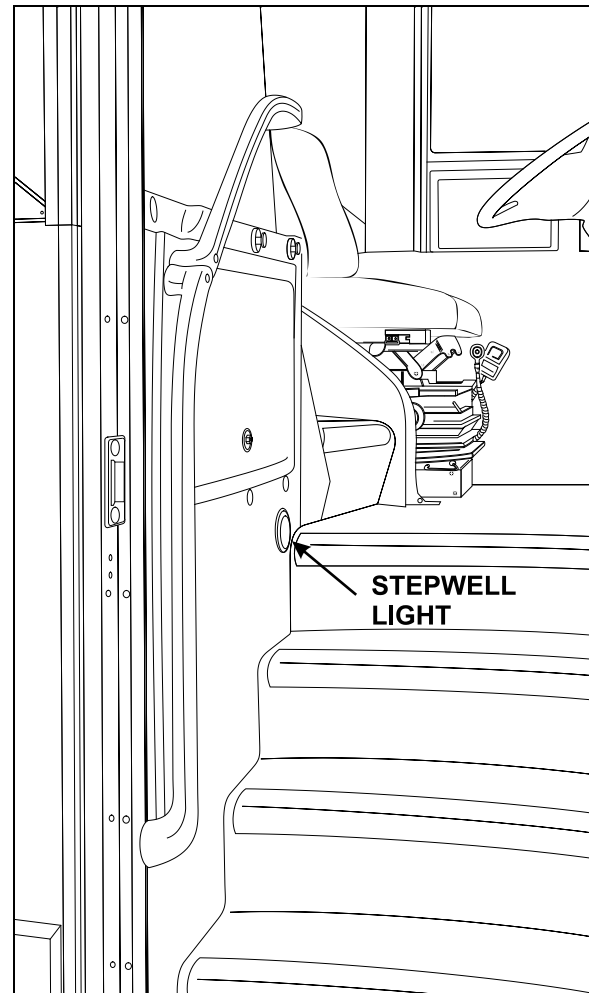


FIGURE 37: COACH ENTRANCE STEPWELL

06492

- Light Removal and Replacement
1. Unsnap the lamp outer ring with a flat head screwdriver and remove it.
 2. Unfasten the three fixing screws, remove and disconnect LED light assembly.

3. Connect and install the new LED assembly in position.
4. Fasten the three fixing screws and replace the lamp outer ring by snapping it back in place.

11.2.2 VIP Entrance

The stepwell light is illuminated when the door opening system is activated (fig.38).

11.2.3 Bulb Removal And Replacement

Proceed as follows to replace 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.

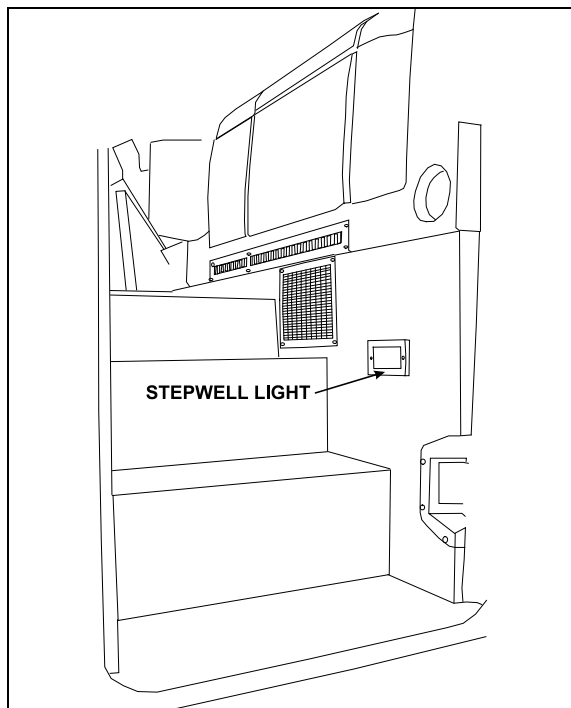


FIGURE 38: VIP ENTRANCE STEPWELL 06507

11.3 LAVATORY NIGHT-LIGHT

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

11.3.1 Bulb Removal And Replacement

Proceed as follows to replace defective bulb:

1. Unscrew the two Phillips-head screws retaining the lens to the lavatory 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.

11.4 DRIVER'S AREA LIGHTS

One halogen ceiling light is installed over the stepwell and another one over the driver's area. These lights are frequently used for nighttime operation when passengers board or leave coach.

11.4.1 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.

11.5 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.

11.5.1 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.

Section 06: ELECTRICAL

2. Remove fluorescent tube from light socket and install a new fluorescent tube.
3. 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.

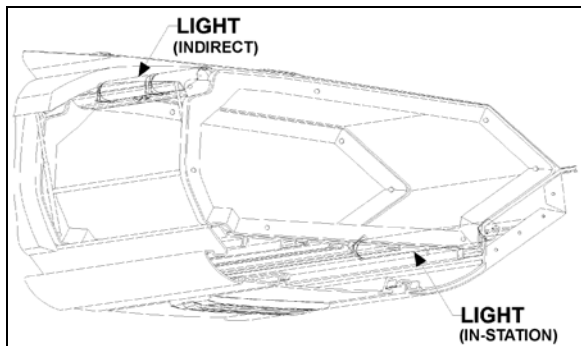


FIGURE 39: PARCEL RACK

06419

11.5.2 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.

11.5.3 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.

11.6 ENGINE COMPARTMENT LIGHTING

Two 24-volts LED module illuminate the engine compartment when the following conditions are met:

1. The engine compartment rear door or curbside door is open.
2. Ignition switch in ON or ACC position.
3. Engine compartment lighting switch on rear engine start panel in ON position.

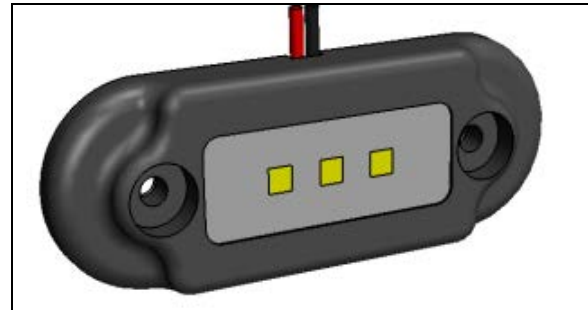


FIGURE 40: ENGINE COMPARTMENT LED MODULE

11.7 LAVATORY LIGHT

The lavatory halogen lights are 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.

Proceed as follows to replace the bulb:

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.

12 LIGHT BULB DATA

Please, refer to your vehicle Parts Manual for selection of replacement light bulbs.

NOTE

Exterior and interior lights can be 12 volts or 24 volts.

13 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.*

AGM Battery

Make.....	Volvo
Model.....	21258363
Type	Absorbed Glass Mat
Terminal type.....	Top Stud
Group size	8A31
Volts	12
Load test amperage	400
Reserve capacity (minutes).....	200
Cold cranking (in amps)	
-At 0°F (-18°C).....	800 (each battery)
Maximum dimensions (inches/mm)	
-Length (including flange).....	12.93/328
-Width.....	6.7/169
-Height (including top posts).....	9.3/237
-Approximate weight (lbs/kg).....	61.7/28

Torque specifications

Battery cable to post..... 10-15 ft-lbf (13-20 N-m)
Battery cover 45-50 ft-lbf (5-6 N-m)

Alternator

Make..... BOSCH
Series HD 10
Amperes 120
Volts 28.4
Output Power 3 Kw
Ground negative
Prevost Number 564119

Battery equalizer

Make..... Vanner
Model..... Vann-Guard 70-Series
Amperes 100 amps

Battery equalizer (with PRIME option)

Make..... Vanner
Model..... Vann-bus 80-Series
Amperes 100 amps

Starter

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

ELECTRICAL CONNECTORS PROTECTION

PROCEDURE NO SAV00002E

**NOVEMBER 2009
REVISION 02**

Kent Sealer

Sprayed sealer. It is used for structure ground connections. It prevents corrosion and ensures maximum contact. Refer to table for proper use.

Apply this product once installation is finished.

Warning: *It is very important to be in a well ventilated area when applying this product.*



680324

Nyogel Grease

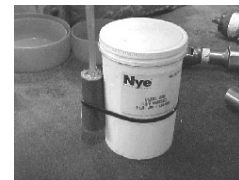
Grease-type product.

It is used to facilitate connectors or terminals insertion.

Refer to table for proper use of Nyogel grease.

It is preferable to apply Nyogel into the female part of connector.

Apply this product as the last assembling operation.



3 Oz. tube: 681095

Container 500g: 683409

“Color Guard” black rubber coating

This product may be applied with a brush.

It is used for structure ground connections or other connections that will most likely not be disconnected later on.

Apply this product once installation is finished.

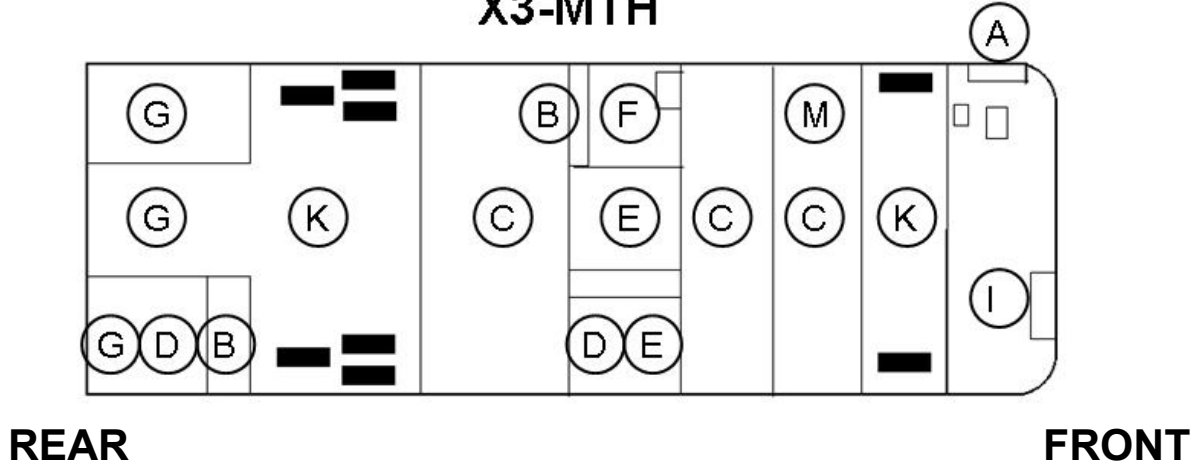
Warning : *Wear goggles and rubber gloves.*



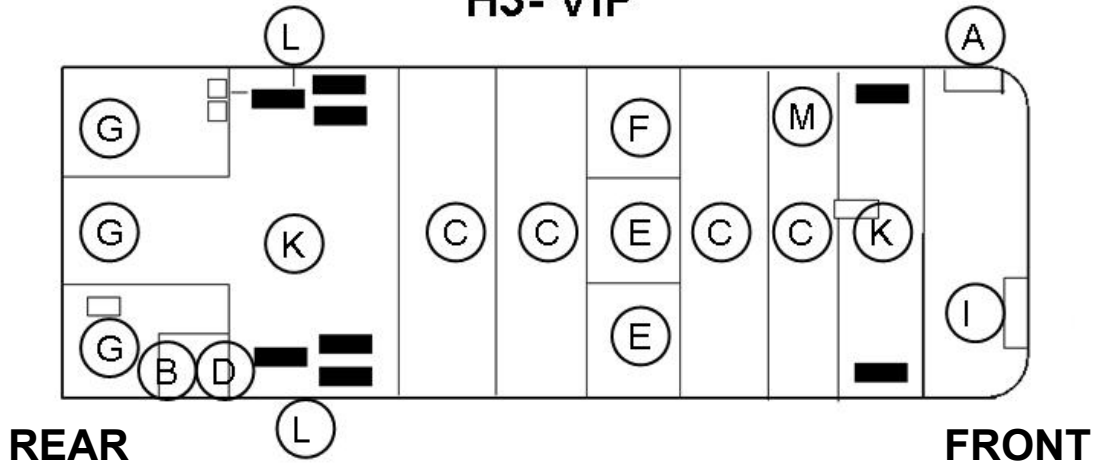
684013

Vehicle Zoning

X3-MTH



H3- VIP



Electrical Connectors Protection Procedure Table

Zone	Component	Model				Product	Note
		MTH	X3	H3	VIP		
A- Front Elect. Compt	Diode Block	X	X	X	X	Nyogel	Accepted to ease connection
A- Front Elect. Compt	Customer Terminal Block	X	X	X	X	Nothing	
A Front Elect. Compt	Terminal Block Electronic Ground	X	X	X	X	Kent	
A- Front Elect. Compt	Structure Ground	X	X	X	X	Kent	
A- Front Elect. Compt	Electronic Module	X	X	X	X	Nothing	
A- Front Elect. Compt	VEC Power	X	X	X	X	Nothing	
A- Front Elect. Compt	70A Relay	X	X	X	X	Nyogel	Accepted to ease connection
A- Front Elect. Compt	Control Relay	X	X	X	X	Nyogel	Accepted to ease connection
A- Front Elect. Compt	All connectors except those specified in this zone	X	X	X	X	Nothing	
A- Front Service Compt	All connectors except those specified in this zone	X	X	X	X	Nothing	
B- Rear Elect. Compt/panel	Customer Terminal Block	X	X	X	X	Nothing	
B- Rear Elect. Compt/panel	Power Terminal Block		X			Nothing	
B- Rear Elect. Compt/panel	Circuit Breaker		X	X	X	Nothing	
B- Rear Elect. Compt/panel	Circuit Breaker	X				Kent	Surface only
B- Rear Elect. Compt/panel	Volvo Air Heater Fuse			X		Nothing	
B- Rear Elect. Compt/panel	Structure Ground		X	X	X	Kent	
B- Rear Elect. Compt/panel	Electronic Module	X	X	X	X	Nothing	
B- Rear Elect. Compt/panel	VEC Power		X	X	X	Nothing	
B- Rear Elect. Compt/panel	VEC Power	X				Kent	Surface only
B- Rear Elect. Compt/panel	70A Relay	X	X	X	X	Nyogel	Accepted to ease connection
B- Rear Elect. Compt/panel	Master Switch Relay		X	X	X	Nothing	
B- Rear Elect. Compt/panel	Master Switch Relay	X				Kent	Surface only
B- Rear Elect. Compt/panel	Control Relay	X	X	X	X	Nyogel	Accepted to ease connection
B- Rear Elect. Compt/panel	200A Power Relay	X	X	X	X	Nothing	
B- Rear Elect. Compt/panel	Power Relay Stud		X			Nothing	
B- Rear Elect. Compt/panel	All connectors except those specified in this zone	X	X	X	X	Nothing	
B- Rear Elect. Compt/panel	Vanner			X	X	Kent	

Zone	Component	Model				Product	Note
		MTH	X3	H3	VIP		
C- Baggage Compt	Structure Ground	X	X	X	X	Color Guard or Kent	
C- Baggage Compt	Door Switch	X	X	X	X	Nyogel	Accepted to ease connection
C- Baggage Compt	Door lock Actuator Module (switch and solenoid)	X	X	X	X	Nyogel	Accepted to ease connection
C- Baggage Compt	Electronic Module	X	X	X	X	Nothing	
C- Baggage Compt	Slide-out Motor	X			X	Nyogel	Accepted to ease connection
C- Baggage Compt	WCL Junction Panel		X	X		Nothing	
C- Baggage Compt	120V Inverter Connector	X	X	X	X	Nothing	
C- Baggage Compt	Stud inverter		X	X		Color Guard or Kent	
C- Baggage Compt	WCL Remote Control		X	X		Nyogel	Accepted to ease connection
C- Baggage Compt	All connectors except those specified in this zone	X	X	X	X	Nothing	
D- Battery Compt	Battery	X	X	X	X	Nyogel	
D- Battery Compt	Structure Ground	X	X			Color Guard or Kent	
D- Battery Compt	Electronic Module	X	X	X	X	Nothing	
D- Battery Compt	All connectors except those specified in this zone	X	X	X	X	Nothing	
D- Battery Compt	Battery Equalizer	X	X			Kent	
E- Condenser Compt	Fuel sender	X	X	X	X	Kent	
E- Condenser Compt	Structure Ground	X	X	X	X	Color Guard or Kent	
E- Condenser Compt	Door Switch	X	X	X	X	Nyogel	Accepted to ease connection
E- Condenser Compt	Condenser Motor	X	X	X	X	Nothing	
F- Evaporator Compt	Diode Block	X		X	X	Nyogel	Accepted to ease connection
F- Evaporator Compt	Structure Ground	X	X	X	X	Color Guard or Kent	
F- Evaporator Compt	Electronic Module	X		X	X	Nothing	
F- Evaporator Compt	Evaporator Motor	X	X	X	X	Color Guard or Kent	
F- Evaporator Compt	200A Power Relay	X		X	X	Nothing	
F- Evaporator Compt	All connectors except those specified in this zone	X		X	X	Nothing	

Zone	Component	Model				Product	Note
		MTH	X3	H3	VIP		
G- Engine Compt	120A Alternator	X	X	X	X	Color Guard	
G- Engine Compt	Booster Block (+)		X	X	X	Color Guard	
G- Engine Compt	Starter Terminal	X	X	X	X	Color Guard	
G- Engine Compt	Volvo Air Element Terminal	X	X	X	X	Color Guard	
G- Engine Compt	Customer Terminal Block	X				Nothing	
G- Engine Compt	Power Terminal Block		X			Color Guard	
G- Engine Compt	Breaker	X				Kent	
G- Engine Compt	Air Heater Fuse & Relay	X	X			Nyogel	Accepted here
G- Engine Compt	Engine Ground	X	X	X	X	Color Guard	
G- Engine Compt	Structure Ground	X	X	X	X	Color Guard	
G- Engine Compt	VEC Power	X				Kent	
G- Engine Compt	Master Switch Relay	X				Kent	
G- Engine Compt	Starter Relay	X	X			Color Guard	
G- Engine Compt	All connectors except those specified in this zone	X	X	X	X	Nothing	
H- Vehicle Exterior	ABS Sensor	X	X	X	X	Nothing	
H- Vehicle Exterior	Docking & Cornering Lamps	X	X	X	X	Nyogel	Accepted to ease connection
H- Vehicle Exterior	Marker Light	X	X	X	X	Nothing	
H- Vehicle Exterior	Mirror	X	X	X	X	Nothing	
H- Vehicle Exterior	Light Module	X	X	X	X	Nothing	
H- Vehicle Exterior	Stop light, Backup light, Directional Signal Light	X	X	X	X	Nothing	
I- Vehicle Interior	Diode Block	X	X	X	X	Nyogel	Accepted to ease connection
I- Vehicle Interior	Junction Block		X	X		Nothing	
I- Vehicle Interior	A3 & A4 Transmission Retarder Hand lever	X	X	X	X	Nyogel	Accepted to ease connection
I- Vehicle Interior	C258 & C259 Multi-function Lever Connector	X	X	X	X	Nyogel	Accepted to ease connection
I- Vehicle Interior	Audio - video Connection		X	X		Nothing	
I- Vehicle Interior	Defrost Compt Ground	X	X	X	X	Kent	
I- Vehicle Interior	Video Plate Direct Ground		X	X		Nothing	
I- Vehicle Interior	Structure Ground		X	X		Kent	
I- Vehicle Interior	Terminal Block Ground		X	X		Nothing	

Zone	Component	Model				Product	Note
		MTH	X3	H3	VIP		
I- Vehicle Interior	Dashboard Switch	X	X	X	X	Nothing	
I- Vehicle Interior	Electronic Module	X	X	X	X	Nothing	
I- Vehicle Interior	Slide-out Motor	X			X	Nyogel	Accepted to ease connection
I- Vehicle Interior	Wiper Motor	X	X	X	X	Nyogel	Accepted to ease connection
I- Vehicle Interior	200A Power Relay	X	X	X	X	Nothing	
I- Vehicle Interior	70A Relay	X	X	X	X	Nyogel	Accepted to ease connection
I- Vehicle Interior	Control Relay	X	X	X	X	Nyogel	Accepted to ease connection
I- Vehicle Interior	All connectors except those specified in this zone	X	X	X	X	Nothing	
I- Vehicle Interior	All components except those specified in this zone	X	X	X	X	Nothing	
K- Front & Rear Wheelhousing	All connectors except those specified in this zone	X	X	X	X	Nothing	
K- Front & Rear Wheelhousing	All components except those specified in this zone	X	X	X	X	Nothing	
L- Compartment above rear wheelhousing	All connectors except those specified in this zone			X	X	Nothing	
L- Compartment above rear wheelhousing	All components except those specified in this zone			X	X	Nothing	
M- Slide-out Panel	All connectors except those specified in this zone	X			X	Nothing	
M- Slide-out Panel	All components except those specified in this zone	X			X	Nothing	

Mitsubishi Electric Corporation (MELCO)

Service Bulletin ME003-P

STARTER MOTORS (105P70)

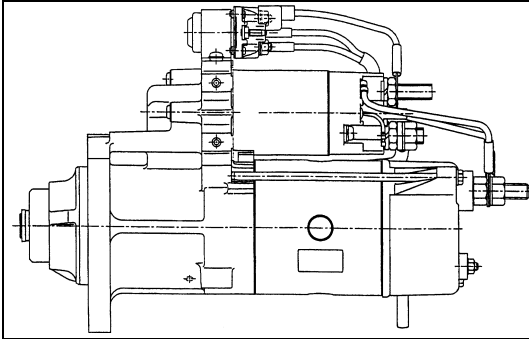


Figure 1 - 105P70 STARTER

A starter is one of the parts installed to the flywheel housing. MELCO's 105P70 starter uses the planetary gear reduction system, actualizing a compact and high-power starter. This starter weighs approximately 30 pounds (13.5 kg), extremely lightweight, and excels in handling.

In addition, this starter uses an overhung mechanism in the output shaft supporting structure designated to protect the inner starter parts from dust or water/oil splash.

1. Principle of operation

- * When handling the starting system, be sure to refer to the wiring diagrams issued by the vehicle manufacturer to insure an understanding of the whole starting circuit.

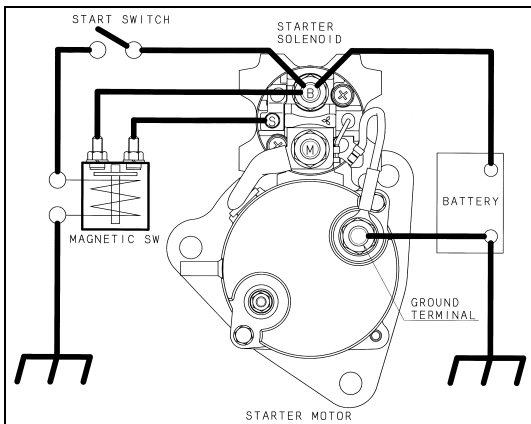


Figure 2 - BASIC STARTING CIRCUIT (GROUND-FLOAT TYPE)

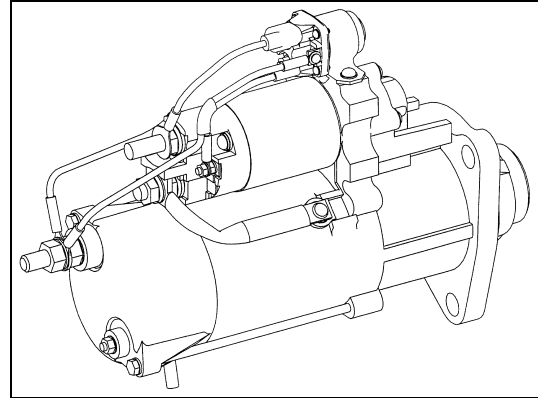


Figure 2 shows the circuit diagram for the 105P70 Ground-float type (sometimes referred to as Insulated or Isolated Ground).

The circuit diagram contains a start switch, a magnetic switch, and a starter solenoid.

When the start switch is closed, the current flows through the magnetic switch windings. The magnetic switch contacts are closed, enabling the current to flow through the windings in the starter solenoid. The clutch is thrust forward with the movement of the plunger and the lever (shown in figures 3), the pinion starts to rotate slowly by the above-mentioned current to engage with the ring gear. When the secure engagement is made, the main contacts in the starter solenoid are closed, and cranking takes place.

When the engine does not start during the initial cranking attempt, the start switch must be turned off within 30 seconds to protect the starter from excessive heat. If the starter motor is operated continuously for 30 seconds, it is necessary to allow the starter motor to be cooled off for at least 2 minutes before the next operation.

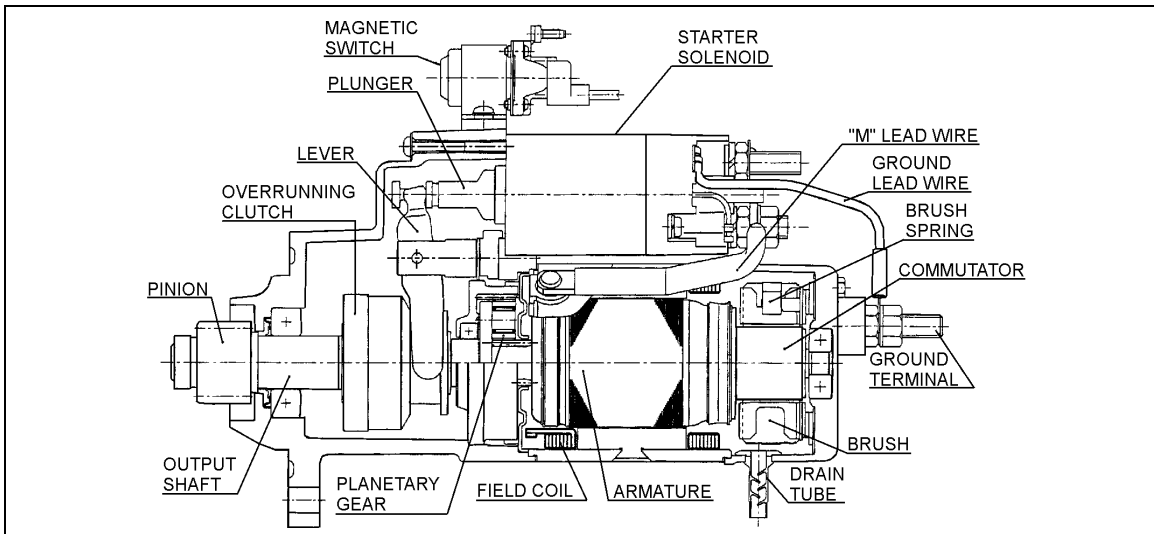


Figure 3 - CROSS-SECTIONAL VIEW (GROUND-FLOAT TYPE)

When the engine starts, the clutch prevents excessive overrun of the armature. Because the clutch is for a short-time rating, the start switch must be turned off immediately after the engine starts.

2. Troubleshooting the starting circuit

If the starting system is not functioning correctly, the following checks will assist in determining which part of the circuit is at fault.

2.1 Battery

To determine the condition of the battery, follow the testing procedure specified by the vehicle manufacturer. Ensure that the battery is fully charged. (If the battery is faulty, the other starting systems cannot be checked.)

2.2 Wiring

Inspect the wiring relating to the starting system for damage. Inspect all connections to the battery, start switch, magnetic switch, and starter solenoid for contact failure due to looseness or rust.

2.3 Magnetic switch (Directly attached to the starter)

Inspect the magnetic switch for its function with the start switch closed (i.e. key switch in the start position) by measuring the voltage between the S-terminal in the starter solenoid and the ground. The switch should

not be closed for more than 3 seconds. If this time is exceeded, the starter solenoid may be damaged.

2.4 Ring gear and pinion

If the battery, wiring, and magnetic switch are in satisfactory condition, it is assumed that a "stuck" condition may be found (this condition is the phenomenon caused when the pinion is caught by the ring gear, thereby resulting in neither pinion rotation nor thrust movement). This only occurs in very rare cases when the ring gear and pinion teeth are damaged on their end faces. Therefore, remove the starter and check the end faces on the ring gear and pinion for damage (burr). If necessary, replace the ring gear and starter.

2.5 Starter

2.5.1 Pinion movement and starter solenoid operation test

As described in figure 4, inspect that the pinion advances forward (no rotation will occur) when a voltage of 16 to 24 V is applied to between the S-terminal in the starter solenoid and the ground. Inspection must be done within 3 seconds for voltage application. If the pinion does not advance forward, replace the starter. The P-coil in the starter solenoid may be layer-shortened, or the pinion sliding area may be clogged.

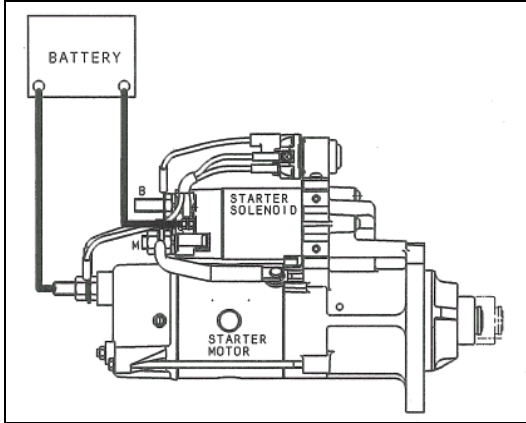


Figure 4 - TESTING PINION MOVEMENT AND PULL-IN WINDINGS (GROUND-FLOAT TYPE)

For the starter switch coils, refer to the switch circuit diagrams for the ground-wire type (ground-float type) shown in figures 5.

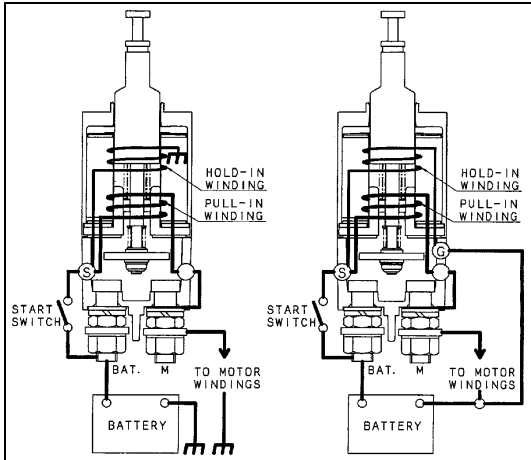


Figure 5 - SOLENOID CIRCUIT (GROUND-FLOAT TYPE)

If the pinion is performing properly, follow the procedure as described below to inspect the H-coil in the starter solenoid.

Remove the M-terminal nut as described in figure 6 and keep the lead wire end in contact with the M-terminal. Apply voltage between the S-terminal and the ground to let the pinion advance forward. Immediately after that, separate the lead wire from the M-terminal and check if the pinion stays in the advanced forward position while voltage is applied to the H-coil only. If the pinion returns, replace the starter. The H-coil is assumed to be layer-short.

* M-terminal nut tightening torque: 20 to 30 N·m

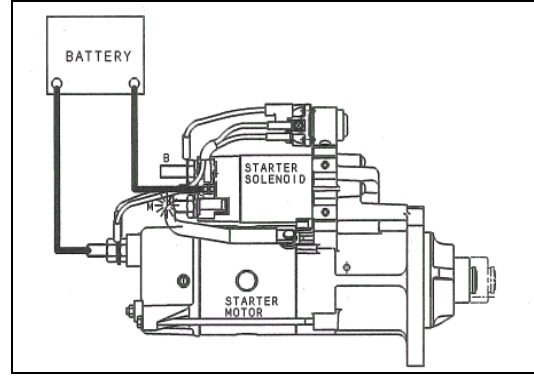


Figure 6 - TESTING HOLD-IN WINDINGS (GROUND-FLOAT TYPE)

Below are the resistance values for the P- and H-coils for reference.

Coil	Resistance (reference)
P-coil	0.072ohm at 68° F
H-coil	1.300 ohm at 68° F

2.5.2 No-load test

The no-load test makes it easy to inspect the starter for functional failure without disassembling. This test can also identify an open/short circuit that is difficult to check when disassembled.

As shown in figure 7, connect the starter, fully charged battery, ammeter, and voltmeter. If possible, connect a resistor suitable for voltage control in parallel with the battery. In addition, use an rpm indicator to measure the revolution speed of the output shaft.

Note: Attention should be given to the output shaft which advances forward to approximately 0.8" (20 mm) and rotates at that position when the starter is operated.

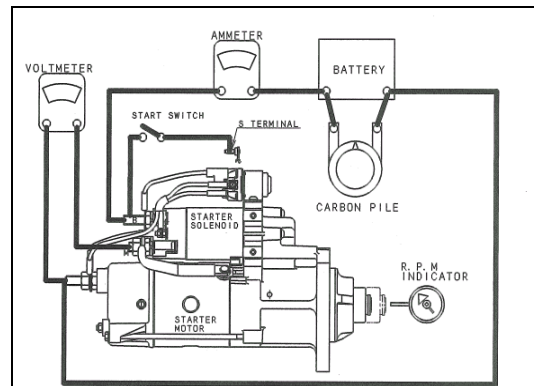


Figure 7 - NO-LOAD TEST CIRCUIT (BODY-GROUND TYPE)

- * If the output shaft does not move, stop voltage application. If voltage continues to be applied, excessive heat will occur in the starter solenoid and give thermal damage to the coil, thereby making it unserviceable.

Inspect that the current and revolution speed satisfy the following standards when the start switch is closed.

Voltage	Current	Speed
23.5 V	125 A max.	3000 rpm min.

It is not necessary to adjust the voltage to the exact value of 23.5 V. If the voltage is slightly higher, the rpm will be proportionately higher, while if the voltage is lower, the rpm will be proportionately lower. The current is independent of the voltage, and can be judged using the above standard.

- * Note that the starter solenoid will not operate unless the voltage between the S-terminal and the ground exceeds 16 V.

Test result and possible cause

1. Rated current draw and revolution speed indicate normal condition of the starter.
2. Low revolution speed and high current draw indicate:
 - a. Too much friction inside starter motor such as clogging, dirt, wearing, faulty bearings
 - b. Shorted circuit inside starter
3. No revolution of the output shaft indicates:
 - a. Grounded M-lead wire or field coils
 - b. Frozen bearings
4. No current draw indicates:
 - a. Open field coils
 - b. Open armature coils
 - c. Broken brush springs, worn brushes, or high insulation resistance between brushes and commutator
5. Extremely low revolution speed and low current draw indicate:

Poor connection between M-terminal and lead wire, or between bracket and brush holder screws (body-ground type only), damaged M-lead wire, damaged

brush pig tails, or poor contact between commutator and brushes

6. High revolution speed and high current draw indicate:

Shorted field coils

- * In case of symptoms 2 to 6, replace the starter, because of the possible failures mentioned above.

2.5.3 Output shaft play

Before reinstalling the starter to the engine, follow the procedure below to inspect the output shaft clearance.

1. Remove the M-terminal nut and keep the lead wire end in contact with the M-terminal.
2. Apply voltage to between the S-terminal and the ground to let the pinion advance forward. Immediately after that, separate the lead wire from the M-terminal. The pinion stays in the advanced forward position until the battery is disconnected.
3. As described in figure 8, measure the distance between the shaft pressed-in and pulled-out positions. The play should be within 0.004" to 0.118" (0.1 to 3.0 mm). If the measured value does not satisfy the standard, replace the starter.

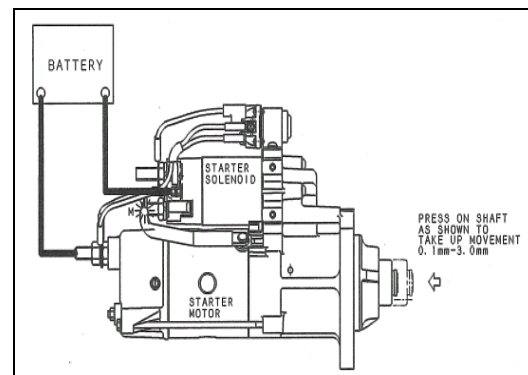


Figure 8 - CHECKING OUTPUT SHAFT CLEARANCE (GROUND-FLOAT TYPE)

Valve-Regulated Lead-Acid (VRLA): Gelled Electrolyte (Gel) and Absorbed Glass Mat (AGM) Batteries

EAST PENN Expertise and American Workmanship

I: INTRODUCTION TO VRLA

- *How it Works*
- *Difference Between VRLA and Flooded*
- *Ideal Applications*

II: AGM & GEL BATTERIES

- *AGM Batteries*
- *Gel Batteries*
- *Similarities Between Gel & AGM*
- *Differences Between Gel & AGM*
- *Gel & AGM Battery Design Advantages*

III: EAST PENN'S VRLA BATTERY DESIGN

- *East Penn's VRLA Features and Benefits*
- *East Penn's Quality Assurance Checks*

IV: GENERAL QUESTIONS ABOUT VRLA BATTERIES

V: GLOSSARY OF TERMS

I. INTRODUCTION TO VRLA

Valve-Regulated Lead-Acid or VRLA, including Gel and AGM (Absorbed Glass Mat) battery designs, can be substituted in virtually any flooded lead-acid battery application (in conjunction with well-regulated charging). Their unique features and benefits deliver an ideal solution for many applications where traditional flooded batteries would not deliver the best results.

For almost three decades, East Penn has been manufacturing valve-regulated batteries using tried and true technology backed by more than 65 years experience. East Penn produces a complete line of Gel, AGM, and conventional flooded products for hundreds of applications. This diverse product offering enables East Penn to be objective as to the advantages of each type of battery. East Penn's VRLA (Gel and AGM) products have the reputation of being the **highest quality VRLA batteries available**.

How it works

A VRLA battery utilizes a one-way, pressure-relief valve system to achieve a "recombinant" technology. This means that the oxygen normally produced on the positive plate is

absorbed by the negative plate. This suppresses the production of hydrogen at the negative plate. Water (H₂O) is produced instead, retaining the moisture within the battery. **It never needs watering, and should never be opened** as this would expose the battery to excess oxygen from the air. In addition to damaging the battery, opening it also voids the warranty.

The difference between VRLA and traditional flooded batteries

Flooded electrolyte batteries do not have special one-way, pressure-relief valves, as they do not work on the recombination principle. Instead, flooded designs utilize a vent to allow gas to escape. They contain liquid electrolyte that can spill and cause corrosion if tipped or punctured. They should not be used near sensitive electronic equipment. They can only be installed "upright." Flooded batteries lose capacity and become permanently damaged if:

- Left in a discharged condition for any length of time (due to sulfation). This is especially true of designs that require water maintenance.
- Continually over-discharged (due to active material shedding). This is especially true of automotive starting types.

Ideal applications for VRLA batteries

Deep Cycle, Deep Discharge Applications

- Marine Trolling
- Sailboats
- Wheelchairs/Scooters
- Portable Power
- Personnel Carriers
- Village Power
- Marine & RV House Power
- Electronics
- Electric Vehicles
- Golf Cars
- Floor Scrubbers
- Renewable Energy (Solar, Wind)
- Commercial Deep Cycle Applications

Standby and Emergency Backup Applications

- UPS (Uninterrupted Power Systems)
- Computer Backup
- Frequency Regulation
- Telephone Switching
- Cable TV
- Emergency Lighting
- Renewable Energy (Solar, Wind)

Other Applications

- Race or High Performance Cars
- Wet Environments
- Diesel Starting
- Vehicles with Start-Stop Systems
- On-Highway Trucking
- Off-Road Vehicles
- Marine & RV Starting
- Cars and Light Trucks with Accessories

II. AGM & GEL BATTERIES

VRLA technology encompasses both gelled electrolyte or gel batteries and absorbed glass mat or AGM batteries. Both types are regulated by special one-way, pressure-relief valves and have significant advantages over flooded lead-acid products.

AGM (Absorbed Glass Mat) batteries

The electrolyte in AGM batteries is completely absorbed in separators consisting of matted glass fibers. This causes them to be spillproof, meaning they don't leak acid like a flooded design if tipped on their side. The glass mats in AGM batteries are wrapped around the positive plate, which helps prevent damage from vibration and extend cycling. The battery's groups are packed tightly in the case partitions also protecting its power producing components. AGM battery designs can have over twice the cycle life of a conventional flooded product in the right application.

Gel or Gelled Electrolyte batteries

The electrolyte in a Gel battery is permanently locked in a highly viscous gelled state instead of the traditional liquid form. Because there is no liquid-type electrolyte, it will not leak out of the battery if tipped on its side. The thick, gelled electrolyte and tightly packed groups also protect the battery's power producing components. Gel battery designs have a superior deep discharge resiliency and can deliver over two to three times the cycle life of an AGM product in the right applications.

Similarities between Gel and AGM VRLA technology

- Batteries utilize special one-way, pressure-relief valves and must never be opened.
- Requires no electrolyte maintenance unlike deep cycle flooded batteries that require frequent checking and adjustment of electrolyte levels.
- Uses a recombination reaction to prevent the escape of hydrogen and oxygen gases normally lost in a flooded lead-acid battery (particularly in deep cycle applications).
- Spillproof design enables installation in virtually any position (upside-down installation is not recommended).
- Has a higher tolerance against damage from deep discharge. These batteries have optimized amounts of electrolyte (which is also referred to as "acid-starved") so that they use the power in the acid before they use the power in the plates. This minimizes the destructive nature of ultra-deep discharges. Ultra-deep discharging is what causes plate shedding, which can destroy a battery.

Major difference between Gel and AGM battery performance

A Gel battery is better suited for super-deep discharge applications, which means it can withstand deeper discharges without damaging the battery's performance. However, due to the physical properties of the gelled electrolyte, Gel battery power declines faster than an AGM battery as the temperature drops below 32°F (0°C). AGM batteries excel for high current, high power applications and in extremely cold environments. AGM batteries deliver a better dual purpose solution for a combination of starting and accessory power.

Advantages of GEL and AGM battery designs

KEY BATTERY BENEFITS	GEL	AGM
Premium maintenance-free design	Yes	Yes
Air transportable	Yes (most sizes)	Yes (many sizes)
Spillproof construction, won't leak if turned sideways	Yes	Yes
Minimizes terminal corrosion	Yes	Yes
Superior deep cycle life and resiliency to deep discharge damage	Yes (Best)	Yes (Good)
Operates at severe angle or on side (won't leak or spill)	Yes	Yes
Low to no gassing	Yes	Yes
Ideal for use around sensitive electronic equipment	Yes	Yes
Extended shelf life, low self-discharge rate	Yes	Yes
Enhanced recharging efficiency	Yes	Yes
Resistance to vibration	Yes	Yes
Delivers the best combination starting, cycling, and deep cycle service	Yes (Good)	Yes (Best)
Operation in cold temperatures	Yes (Good)	Yes (Best)
Cold engine cranking	Low	Yes

III. EAST PENN'S AGM & GEL VRLA BATTERY DESIGN

Features and benefits that make our VRLA batteries unique

East Penn Expertise

East Penn builds VRLA batteries to the highest standards. Our manufacturing process features improved controls using state-of-the-art computers and the latest manufacturing technology and equipment. VRLA batteries produced by East Penn consistently meet the highest quality performance and life standards.

One-Way, Pressure-Relief Valves

A critical feature of any VRLA battery is the quality of the sealing valve. Not only must the valve safely release excessive pressure and gas, but it must also keep the cell from being contaminated by the atmosphere. Oxygen contamination will discharge and eventually ruin a VRLA battery. Our valves are UL recognized and 100% tested. The benefit is **reliable performance and long life**.

Exclusive Gel Formula & Computerized Mixing

Proper gel mixing is critical to life and performance. Our state-of-the-art gel battery manufacturing facility is one of the finest in the world with a proprietary computerized gel mixing operation. Our exclusive formula is mixed using computer control in every stage of the process. **Computer control delivers superior consistency for gel battery performance that is unequaled.** Our temperature-controlled process and specially designed equipment

assures a homogenous gel. Our equipment was designed by our engineers specifically for gel mixing – even down to the contour of the tank bottoms and feed pipe locations.

Exclusive AGM Electrolyte and Filling Process

Our AGM electrolyte contains high purity sulfuric acid and pure, demineralized and deionized water. Avoiding impurities enables the battery to function at the critical performance levels necessary of the recombinant principle utilized in a valve-regulated design. This assures minimized gassing as well as water and capacity loss providing longer service life and sustained performance.

The AGM filling process assures that each cell is saturated with the maximum amount of electrolyte that can be held by the separators, without leaving excess electrolyte that could spill or leak.

Multi-Staged Filling and Vacuuming Operation

Our gel process fills and vacuums each cell several times. This multi-step process assures complete evacuation of air and complete gel-to-plate contact. Our computerized process also weighs every SLI and Stationary battery before and after filling as a check for proper gel levels. The result is a battery with more consistent and reliable performance.

Our AGM topping process assures that the maximum retainable electrolyte quantity is held within the battery separators, to produce a complete electrolyte-to-plate contact optimizing battery performance and power.

Gel Ultra-Premium, Glass Mat, Double Insulating Separators

Another critical component is the separator, which isolates the positive from the negative plate. The separator must allow maximum charge flow between the plates for maximum performance.

East Penn's Gel battery utilizes a separator with two layers:

- The first fiberglass sheet layer maintains compression force over the entire surface of the positive plate prohibiting active material shedding. The fiberglass strands from this layer also prevent shedding by embedding themselves into the surface of the plates. This acts like reinforcing rods in concrete. These extra reinforcements lock the active material to prevent capacity degradation for longer life performance.
- The second layer is a porous organic polymer. The quantity and size of the pores is optimized to balance the performance characteristics of the battery with its life characteristics. This layer has ribs on both sides to allow gel to reach the entire surface of both plates and to maintain the correct plate spacing.

Gel Polyester Element Wrap

To prevent life-shortening mossing in our gel batteries, we use a special polyester fiber sheet that is wrapped around the edge of each element, similar to the wrap in an industrial battery. The result is longer service life.

AGM Ultra-Premium Glass Mat Separators

Variations in separator properties can be detrimental to the AGM battery's functional performance. East Penn uses glass mats that are engineered to have consistency and an ideal balance of critical properties. This attention to detail results in high performance and long life.

- High absorption and retention rate holds acid securely in glass fibers to prevent uneven saturation and acid stratification (see explanation of acid stratification under Acid Stratification Prevention section).
- Thick, highly compressible mats provide padded protection around plates and absorb shock and vibration. This maintains compression force over the entire surface of the positive plate prohibiting shedding, which results in capacity degradation. An AGM separator contains no materials subject to failure from oxidation.
- Low electrical resistance from electrolyte holding fibers and micro-porous composition optimizes current flow between plates for a more efficient transfer of power.
- Durable mats are wrapped around the bottom of the plate and are wider than the plates. This inhibits failures from direct contact electrical plate shorts or shorts from the build-up of material on the battery elements.

Exclusive Alloy Compositions

Our exclusive alloy compositions provide the optimal combination of longer shelf life, more power conductance, enhanced durability, and superior corrosion resistance. By using special grain refiners, we can dramatically improve performance and life. Calcium strengthens the grid for processing in the plant so that its integrity is upheld in the battery to withstand the forces of vibration and shock in service.

Heavy-Duty Grid Style Design for Heavy-Duty Service

East Penn uses a high-performance deep cycle grid designed for durability. The thick grid wires not only lock the active material onto the grid, but also act as "bus bars" to collect and direct the energy to the terminals.

Acid Stratification Prevention

Acid stratification can occur in conventional flooded cells. During charge, acid is released at the plate surfaces. During discharge, acid is consumed at the plate surfaces. Since the concentration is not uniform, diffusion (spontaneous mixing by random molecular motions) begins. If this mixing occurred rapidly, stratification would not occur, but it is relatively slow, allowing lighter parts of electrolyte to "float" toward the surface and heavier parts to "sink" toward the bottom. The top portion of the plates do not perform as well in contact with lower concentration electrolyte. The bottom portion of the plates do not perform as well with the higher concentration and will corrode prematurely. High voltage "equalization" charging is sometimes used in flooded batteries to make gas bubbles that remix the electrolyte.

Immobilized gel or separator-absorbed electrolyte will not "float" or "sink" within itself when a non-uniform concentration exists so it cannot stratify. Therefore, no high-voltage equalizing charge is necessary. Simply recharge at the recommended recharge settings. This means longer life and consistent performance.

Proprietary Case, Cover, and One-Way, Pressure-Relief Valve

We design our own highly functional polypropylene cases, valves, and covers. Many are molded in our on-site, state-of-the-art plastics molding facility. This provides ultimate control of our high performance designs, quality and delivery to our manufacturing plant, assuring you the highest quality battery and most reliable service.

East Penn's Quality Assurance Checks

Below are a few examples of the hundreds of quality checks that are performed on Gel or AGM battery types to assure total confidence in the performance and life of our batteries:

- **Extended Shelf Stand Test.** Before shipment, every battery is required to stand for a period of time and ending voltages are analyzed. This extra quality assurance step verifies that the batteries are optimized for electrical performance.
- **Computer-Enhanced Filling Controls.** During this computerized process, batteries are monitored and filled to exacting levels for precision separator absorption and complete permeation.
- **Multi-Staged Filling and Vacuuming Process.** Every battery is filled and vacuumed several times during this computerized process. Multi-staged vacuuming assures complete electrolyte-to-plate interface.
- **Computerized Polarity Check.** Every battery is checked by computer analysis for proper polarity.
- **Discharge Test.** High-precision calibrated sensors allow computers to monitor the voltage drop during this discharge to assure that every battery performs as designed.
- **Grid Casting Inspections.** Specified checks such as alloy sampling, lead pot temperatures, ladle temperatures, grid weight and thickness analysis assures patented alloy blend and precise conditions for proper grid formation and application into battery production.
- **Acid Mixing Checks.** Regulatory acid temperature and specific gravity monitoring optimizes battery performance and longevity.
- **Paste Mixing Monitoring.** Computer-assisted formula monitoring and extensive acid gravity and temperature checks provide best attributes for paste adhesion, power absorption and delivery performance.
- **Paste-to-Grid Application Monitoring.** Temperature, thickness, weight and line speed analysis assures proper adhesion and extended service life.
- **Curing Checks.** Assures proper time, temperature, and humidity to create the optimal environment to facilitate the curing process.
- **Cast-On-Strap and Assembly Audits.** Monitors lead temperatures, line speed, alloy sampling, weld quality, terminal burn depth, and leak testing all to ensure the final assembled product meets rigid specifications and standards providing a solid construction to support premium VRLA battery products.

IV. GENERAL QUESTIONS ABOUT VRLA BATTERIES

What do I need to know about VRLA battery charging?

All lead-acid batteries release hydrogen from the negative plate and oxygen from the positive plate during charging. VRLA batteries have one-way, pressure-relief valves. Without the ability to retain pressure within the cells, hydrogen and oxygen would be lost to the atmosphere, eventually drying out the electrolyte and separators.

Voltage is electrical pressure (energy per unit of charge). Charge (ampere-hours) is a quantity of electricity. Current (amperes) is electrical flow (charging speed). A battery can only store a certain quantity of electricity. The closer it gets to being fully charged, the slower it must be charged. Temperature also affects charging. If the right voltage is used for the temperature, a battery will accept charge at its ideal rate. If too much voltage is used, charge will be forced through the battery faster than it can be stored.

Reactions other than the charging reaction also occur to transport this current through the battery—mainly gassing. Hydrogen and oxygen may be given off faster than the recombination reaction. This raises the pressure until the one-way, pressure-relief valve opens. The gas lost cannot be replaced. Any VRLA battery will dry out and fail prematurely if it experiences excessive overcharging.

Note: It is too much voltage that initiates this problem, not too much charge — a battery can be “over-charged” (damaged by too much voltage) even though it is not fully “charged.” **Never install any lead-acid battery in a sealed container or enclosure. Hydrogen gas must be allowed to escape.**

Can continual undercharging harm a VRLA battery?

In many respects, undercharging is as harmful as overcharging. Keeping a battery in an undercharged condition allows the positive grids to corrode and the plates to shed, dramatically shortening life. Also, an undercharged battery must work harder than a fully charged battery, which contributes to short life as well.

An undercharged battery has a greatly reduced capacity. It may easily be inadvertently over-discharged and eventually damaged.

Do VRLA batteries have a “memory” like Ni-Cad batteries?

One of the major disadvantages of nickel-cadmium (ni-cad) batteries is that after shallow discharge cycles, the unused portions of the electrodes “remember” the previous cycles and are unable to sustain the required discharge voltage beyond the depth of the previous cycles. The capacity is lost and can only be restored by slowly discharging completely (generally outside the application), and properly recharging. VRLA lead-acid batteries do not exhibit this capacity robbing effect known as memory.

What are the safety precautions for VRLA batteries?

Although all valve-regulated batteries have the electrolyte immobilized within the cell, the electrical hazard associated with batteries still exists. **Work performed on these batteries should be done with the tools and the protective equipment listed below.** Valve-regulated battery installations should be supervised by personnel familiar with batteries and battery safety precautions.

Protective Equipment

To assure safe battery handling, installation and maintenance, the following protection equipment should be used:

- Safety glasses or face shield (Consult application specific requirements)
- Acid-resistant gloves
- Protective aprons and safety shoes
- Proper lifting devices
- Properly insulated tools

Procedures

Consult user manual of specific application for safety & operating requirements. The following safety procedures should be followed during installation: **(Always wear safety glasses or face shield.)**

1. These batteries are sealed and contain no free flowing electrolyte. Under normal operating conditions, they do not present any acid danger. However, if the battery jar, case, or cover is damaged, acid could be present. **Sulfuric acid is harmful to the skin and eyes. Flush affected area with water immediately and consult a physician if splashed in the eyes. Consult MSDS for additional precautions and first aid measures.**
2. Prohibit smoking and open flames, and avoid arcing in the immediate vicinity of the battery.
3. Do not wear metallic objects, such as jewelry, while working on batteries. Do not store un-insulated tools in pockets or tool belt while working in vicinity of battery.
4. Keep the top of the battery dry and clear of all tools and other foreign objects.

5. Provide adequate ventilation as regulated by Federal, State and Local codes and follow recommended charging voltages.
6. Extinguishing media: Class ABC extinguisher. **Note: CO₂ may be used but not directly on the cells due to thermal shock and potential cracking of cases.**
7. **Never** remove or tamper with pressure-relief valves. Warranty void if vent valve is removed.

Can VRLA batteries be installed in sealed battery boxes?

NO! Never install any type of battery in a completely sealed container. Although most of the normal gasses (oxygen and hydrogen) produced in a VRLA battery will be recombined and not escape, **oxygen and hydrogen will escape from the battery in an overcharge condition** (as is typical of any type battery).

These potentially explosive gasses must be allowed to vent to the atmosphere and **must never be trapped in a sealed battery box or tightly enclosed space!**

Does depth of discharge affect cycle life?






Yes! The harder any battery has to work, the sooner it will fail.

The shallower the average discharge, the longer the life. It's important to size a battery system to deliver at least twice the energy required, to assure shallow discharges.

Follow these tips for the longest life:

- Avoid ultra-deep discharges. The definition of ultra-deep discharge may vary with application and battery type.
- Don't leave a battery at a low stage of charge for an extended length of time. Charge a discharged battery as soon as possible.
- Don't cycle a battery at a low state of charge without regularly recharging fully.

Use the highest initial charging current available (up to 30% of the 20-hour capacity per hour) while staying within the proper temperature-compensated voltage range.

▲ DANGER				
 HIGH VOLTAGE... RISK OF SHOCK. DO NOT TOUCH UNINSULATED TERMINALS OR CONNECTORS.	 SHIELD EYES EXPLOSIVE GASES CAN CAUSE BLINDNESS OR INJURY.	 NO • SPARKS • FLAMES • SMOKING	 SULFURIC ACID CAN CAUSE BLINDNESS OR SEVERE BURNS.	 FLUSH EYES IMMEDIATELY WITH WATER. GET MEDICAL HELP FAST.
DO NOT REMOVE VENT VALVE. WARRANTY VOID IF VENT VALVE IS REMOVED.		VENTILATE WELL WHEN IN AN ENCLOSED SPACE AND WHEN CHARGING.		
SEE INSTALLATION, MAINTENANCE AND OPERATION INSTRUCTIONS FOR IMPORTANT SAFETY PRECAUTIONS.			REPAIR SHOULD BE PERFORMED ONLY BY A QUALIFIED SERVICE TECHNICIAN.	

California Proposition 65 Warning

Batteries, battery posts, terminals and related accessories contain lead and lead compounds, and other chemicals known to the state of California to cause cancer and birth defects or other reproductive harm. **Wash hands after handling.**

What is a thermal runaway?

The appropriate charge voltage depends on the battery temperatures. A warmer battery requires a reduced voltage. If the voltage is not reduced, current accepted by the battery increases. When the current increases, the internal heating increases. This can rise to destructive levels if not taken into consideration.

Thermal runaway can be prevented with:

- Temperature compensation monitoring at the battery — not at the charger.
- Limiting charging currents to appropriate levels.
- Allowing for adequate air circulation around the batteries.
- Using timers or ampere-hour counters.
- Using smart chargers that recognize the signature of a thermal runaway event which will shut the charger down.

Why do some VRLA batteries have a concave or convex appearance?

CONCAVE APPEARANCE

The gas pressure in a VRLA battery can be lower than ambient pressure under certain circumstances. This partial vacuum will pull the container walls and cover inward. This may give the ends, sides of each cell, and tops of each cell a noticeable concave (inwardly dished) appearance. This is normal. The product is not defective. Its performance is not compromised in any way. In some situations charging will reduce or eliminate this appearance. Internal gas pressure being lower than external pressure has several potential causes that can operate alone or in combination. The recombination process continues after charging ends consuming most of the headspace oxygen — decreasing internal pressure. An increase in external pressure will result from a decrease in altitude. Cooling the battery reduces the internal gas pressure by contraction and also by causing some water vapor to return to liquid form. Severe discharging shrinks the volume of the internal materials. This leaves more volume for the gas to fill reducing the internal pressure.

CONVEX APPEARANCE

To prevent the permanent loss of gases so that recombination has time to take place, each cell can hold an internal gas pressure above external pressure before venting. Batteries with very large cells will slightly bulge as this normal pressure builds. This is especially noticeable at higher temperatures because the polypropylene case is more pliable when warm. Therefore, a certain amount of bulge is normal. If a battery bulges severely on charge, this is not normal. It is an indication of a blocked valve or an overcharge situation. Such a battery should be removed from service.

V. GLOSSARY TERMS

ACTIVE MATERIAL — The porous structure of lead compounds that produce and store electrical energy within a lead-acid battery. The active material in the positive plates is lead dioxide and that in the negative is metallic sponge lead. When an electrical circuit is created, these materials react with sulfuric acid during charging and discharging according to the following chemical reaction:



AGM (Absorbed Glass Mat) — A type of non-woven separator material comprised almost entirely of glass microfibers that absorbs and retains the electrolyte leaving no free electrolyte in the cell to spill. VRLA batteries made with this material are often referred to as “AGM” batteries.

AMPERE (Amp, A) — The unit of measure of the electron flow rate, or current, through a circuit.

AMPERE-HOUR (Amp-Hr, Ah) — A unit of measure for a battery’s electrical storage capacity, obtained by multiplying the current in amperes by the time in hours of discharge. (Example: A battery that delivers 5 amperes for 20 hours delivers 5 amperes X 20 hours = 100 Amp-Hr of capacity.)

BOOST CHARGE — The process of ensuring that the cells and plates within a battery are charged sufficiently for the battery to perform its desired function. Boost charging is typically done for a short duration at a high current.

CAPACITY — The capacity of a battery is specified as the number of Amp-Hrs that the battery will deliver at a specific discharge rate and temperature. The capacity of a battery is not a constant value and is seen to decrease with increasing discharge rate. The capacity of a battery is affected by a number of factors such as: active material weight, density of the active material, adhesion of the active material to the grid, number, design and dimensions of plates, plate spacing, design of separators, specific gravity and quantity of available electrolyte, grid alloys, final limiting voltage, discharge rate, temperature, internal and external resistance, age, and life history of the battery.

CONTAINER AND COVER — The reservoir and lid containing the battery parts and electrolyte made from impact and acid resistant material such as polypropylene.

CELL — The basic electrochemical current-producing unit in a battery, consisting of a set of positive plates, negative plates, electrolyte, separators, and casing. In a lead-acid battery the cell has an open-circuit voltage of approximately 2-volts. There are six cells in a 12-volt lead-acid battery.

CIRCUIT — An electrical circuit is the path followed by a flow of electrons. A closed circuit is a complete path. An open circuit has a broken, or disconnected, path.

CIRCUIT (Series) — A circuit that has only one path for the flow of current. Batteries arranged in series are connected with negative of the first to positive of the second, negative of the second to positive of the third, etc. If two 12-volt batteries of 50 ampere-hours capacity each are connected in series, the circuit voltage is equal to the sum of the two battery voltages, or 24 volts, and the ampere-hour capacity of the combination is 50 ampere-hours.

CIRCUIT (Parallel) — A circuit that provides more than one path for the flow of current. A parallel arrangement of batteries (usually of like voltages and capacities) has all positive terminals connected to a conductor and all negative terminals connected to another conductor. If two 12-volt batteries of 50 ampere-hour capacity each are connected in parallel, the circuit voltage is 12 volts, and the ampere-hour capacity of the combination is 100 ampere-hours.

COLD CRANK RATING — The cold crank rating refers to number of amperes a lead-acid battery at 0°F (-17.8°C) can deliver for 30 seconds and while maintaining at least 7.2 volts (1.2 volts per cell). This is commonly referred to as CCA (Cold Cranking Amps).

CONDUCTANCE — The ability to transmit current in a circuit or battery.

CORROSION — The chemical or electrochemical reaction between a material, usually a metal, and its environment that produces a deterioration of the material and its properties. The positive lead grids in a battery gradually corrode in service often leading to battery failure. Battery terminals are subject to corrosion if they are not properly maintained.

CURRENT — The rate of flow of electricity, or the movement of electrons along a conductor. It is comparable to the flow of a stream of water. The unit of measure for current is the ampere.

CURRENT (ALTERNATING) (AC) — A current that varies periodically in magnitude and direction. A battery does not deliver alternating current (AC).

CURRENT (DIRECT) (DC) — An electrical current flowing in an electrical circuit in one direction only. A secondary battery delivers direct current (DC) and must be recharged with direct current in the opposite direction of the discharge.

CYCLE — In a battery, one discharge plus one recharge equals one cycle.

DISCHARGING — When a battery is delivering current, it is said to be discharging.

ELECTROLYTE — In a lead-acid battery, the electrolyte is sulfuric acid diluted with water. It is a conductor that supplies water and sulfate for the electrochemical reaction:



ELECTRONIC TESTER — An electronic device that assesses the condition of a battery through an ohmic measurement such as resistance or conductance, typically without drawing large current loads.

ELEMENT — A set of positive and negative plates assembled with separators.

EQUALIZATION CHARGE — The process of ensuring that the cells and plates within a battery are all at full charge and that the electrolyte is uniform and free of stratification. This is normally done by charging the battery under controlled conditions (charge current, time and upper voltage limits are usually specified).

FORMATION — In battery manufacturing, formation is the process of charging the battery for the first time. Electrochemically, formation changes the lead oxide paste on the positive grids into lead dioxide and the lead oxide paste on the negative grids into metallic sponge lead.

GEL — Electrolyte that has been immobilized by the addition of a chemical agent, normally fine silica, to prevent spillage. Batteries made with gelled electrolyte are often referred to as Gel batteries. Gel batteries are one typical type of VRLA battery.

GRID — A lead alloy framework that supports the active material of a battery plate and conducts current.

GROUND — The reference potential of a circuit. In automotive use, the result of attaching one battery cable to the body or frame of a vehicle that is used as a path for completing a circuit in lieu of a direct wire from a component. Today, over 99% of automotive and LTV applications, use the negative terminal of the battery as the ground.

HYDROMETER — A device used to measure the strength (i.e., the concentration of sulfuric acid in the electrolyte) of the electrolyte through specific gravity of the electrolyte.

INTERCELL CONNECTORS — Lead structures that connect adjoining cells in series, positive of one cell to the negative of the next, within a battery.

LOAD TESTER — An instrument that draws current (discharges) from a battery using an electrical load while measuring voltage. It determines the battery's ability to perform under actual discharge conditions.

LOW WATER LOSS BATTERY — A battery that requires little to no water additions under normal operating conditions; also referred to as maintenance-accessible batteries.

MAINTENANCE-FREE — A battery that normally requires no service watering during its lifetime of use.

NEGATIVE — Designating, or pertaining to, electrical potential. The negative battery terminal is the point from which electrons flow during discharge.

OHM — A unit for measuring electrical resistance or impedance within an electrical circuit.

OHM'S LAW — Expresses the relationship between volts (V) and amperes (I) in an electrical circuit with resistance (R). It can be expressed as follows:

$$V = IR$$

Volts (V) = Amperes (I) x Ohms (R). If any two of the three values are known, the third value can be calculated using the above equation.

OPEN CIRCUIT VOLTAGE — The voltage of a battery when it is not delivering or receiving power.

PLATES — Thin, flat structures comprised of a grid and active material. The grid supports the active material and conducts electrons out of the cell. Plates are either positive or negative, depending on the active material they hold.

POSITIVE — Designating, or pertaining to, a kind of electrical potential; opposite of negative. A point or terminal on a battery having higher relative electrical potential. The positive battery terminal is the point to which electrons flow during discharge.

PRIMARY BATTERY — A battery that can store and deliver electrical energy but cannot be recharged. A lead-acid battery is NOT a primary battery.

RESERVE CAPACITY RATING — The time in minutes that a new, fully charged battery will deliver 25 amperes at 27°C (80°F) and maintain a terminal voltage equal to, or higher than, 1.75 volts per cell. This rating represents the time the battery will continue to operate essential accessories if the alternator or generator of a vehicle fails.

RESISTANCE — The opposition to the free flow of current in a circuit or battery. It is commonly measured in Ohms.

SECONDARY BATTERY — A battery that can store and deliver electrical energy and can be recharged by passing direct current through it in a direction opposite to that of discharge. A lead-acid battery is a secondary battery.

SEPARATOR — A porous divider between the positive and negative plates in a cell that allows the flow of ionic current to pass through it, but not electronic current. Separators are made from numerous materials such as: polyethylene, polyvinyl chloride, rubber, glass fiber, cellulose, etc.

SHORT CIRCUIT — An unintended current-bypass in an electric device or wiring. Outside the battery a short circuit is established when a conductive path is established between the two terminals of a battery. Inside a battery, a cell short circuit is the result of contact between the positive and negative plates and will cause a cell to discharge and render the battery useless.

SPECIFIC GRAVITY (Sp. Gr. or SG) — Specific Gravity is a measure of the electrolyte concentration in a battery. This measurement is based on the density of the electrolyte compared to the density of water and is typically determined by the use of a hydrometer (see Hydrometer). By definition, the specific gravity of water is 1.00 and the specific gravity of the sulfuric acid electrolyte in a typical fully charged battery is 1.265-1.285. Specific gravity measurements are typically used to determine if the battery is fully charged or if the battery has a bad cell.

STATE OF CHARGE — The amount of deliverable low-rate electrical energy stored in a battery at a given time expressed as a percentage of the energy when fully charged and measured under the same discharge conditions. If the battery is fully charged the "State of Charge" is said to be 100%.

STRATIFICATION — The unequal concentration of electrolyte due to density gradients from the bottom to the top of a cell. This condition is encountered most often in batteries recharged from a deep discharge at constant voltage without a great deal of gassing. Continued deep cycling of a 'stratified' battery will result in softening of the bottoms of the positive plates. Equalization charging is a way to avoid acid stratification.

SULFATION — The generation or conversion of the lead sulfate discharge in the plates to a state that resists normal recharge. Sulfation often develops when a battery is stored or cycled in a partially discharged state at warm temperatures.

TERMINALS — The electrical structures on the battery to which the external circuit is connected. Typically, batteries have either top-terminals (posts) or side-terminals. Some batteries have both types of terminals (dual-terminal).

VENTS — Mechanisms that allow gasses to escape from the battery while retaining the electrolyte within the case. Flame arresting vents typically contain porous disks that reduce the probability of an internal explosion as a result of an external spark. Vents come in both permanently fixed and removable designs.

VOLT — The unit of measure for electrical potential or voltage.

VOLTMETER — An electronic device used to measure voltage, normally in a digital format.

VOLTAGE DROP — The net difference in the electrical potential (voltage) when measured across a resistance or impedance (ohms). Its relationship to current is described in Ohm's law.

VRLA — Valve Regulated Lead Acid battery. AGM and Gel are the two types of VRLA batteries. These batteries have no "free" liquid electrolyte and in the cell operate on the oxygen recombination cycle, which is designed to minimize water loss. VRLA batteries feature valves that have a one-way, pressure-relief design. These low-pressure valves prohibit air entering the cell while permitting gases to vent from the cell if necessary. The pressure maintained in the battery, though only very slight, is required to facilitate the oxygen recombination reaction, which converts the oxygen generated at the positive plates back into water.

WATT — The unit for measuring electrical power, i.e., the rate of doing work, in moving electrons by, or against, an electrical potential. Formula: Watts = Amperes x Volts.

WATT-HOUR (Watt-Hr, WH) — The unit of measure for electrical energy expressed as Watts x Hours.

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VANN-Guard 70-Series **Battery Equalizer**



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Introduction

Thank you for purchasing a Vanner *VANN-Guard Battery Equalizer*. We are confident that you will be very pleased with its performance because our 70-Series are designed and manufactured by skilled professionals using the highest standards in workmanship. With minimum maintenance and care, you can be assured of many years of trouble free service.

General Description

The Vanner *VANN-Guard Battery Equalizer* is an efficient and highly reliable method of obtaining a 12 volt DC power source from a 24 volt DC electrical system. The *VANN-Guard* makes the batteries look like they are in series and parallel at the same time. In addition to providing regulated 12 volt power, the system ensures that battery voltages remain equal which significantly extends battery life. Ideally suited for vehicle and alternate energy applications, the *VANN-Guard* is designed to save your batteries and the money you would spend replacing them. Users of the Vanner *VANN-Guard* know that it is the most cost effective and dependable solution for dual voltage systems.

A typical system would include a 24VDC power source, such as an alternator or solar array, two 12 volt battery banks in series, and the *VANN-Guard*. The *VANN-Guard* connects to the 24 volt, 12 volt and ground terminals of the battery system. When the 12 volt loads require power, the *VANN-Guard* ensures that the current is taken equally from both batteries, and that the voltages of the two batteries are kept equal. This equalization ensures extended battery life and provides a stable 12 volt supply for operating accessories.

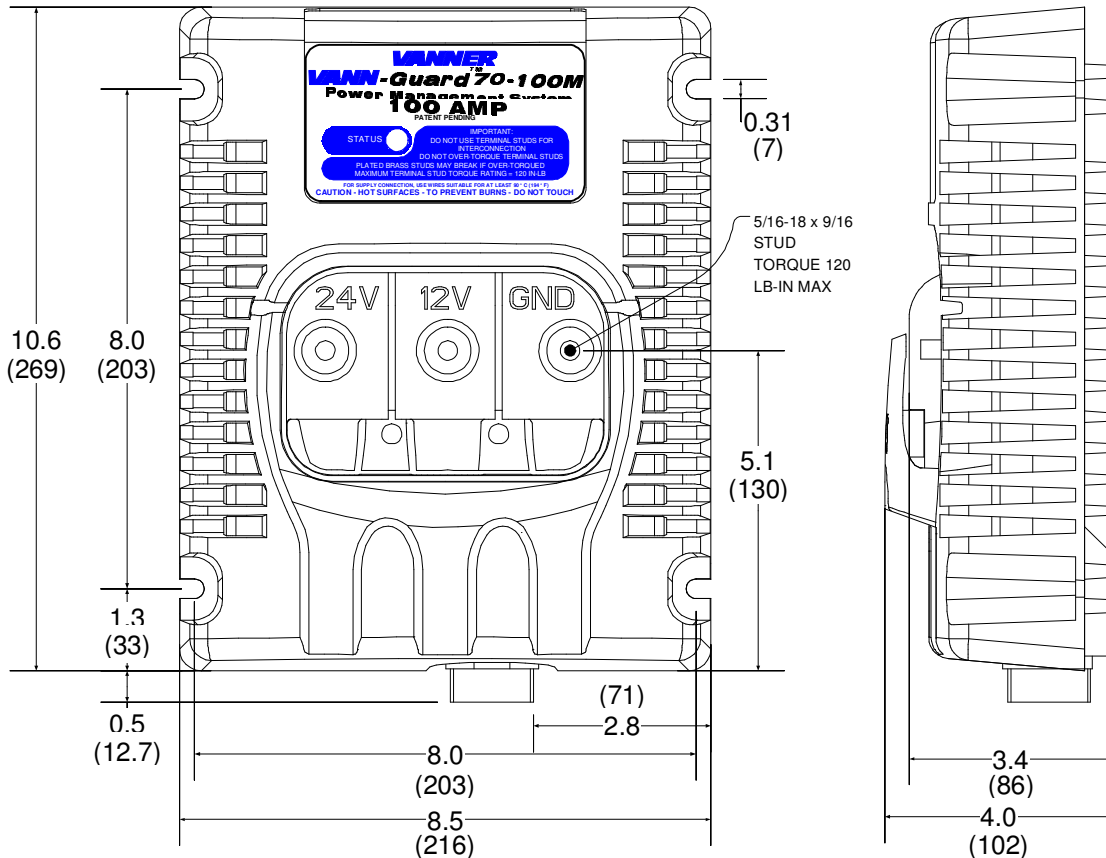
Paralleling VANN-Guard: Models are available which provide 60, 80 and 100 amps of 12 volt DC power. *VANN-Guard Battery Equalizers* may also be operated in parallel to provide more power. For example, two 60 amp units can be installed to provide 120 amps of 12 volt DC power.

NOTE: The Vanner *VANN-Guard Battery Equalizer* is an extremely reliable device and, when installed according to the instructions, will provide reliable operation for an indefinite period of time. However, if a system abnormality should develop that would cause a *VANN-Guard* malfunction, damage to the battery system could result if 12 volt loads are present.

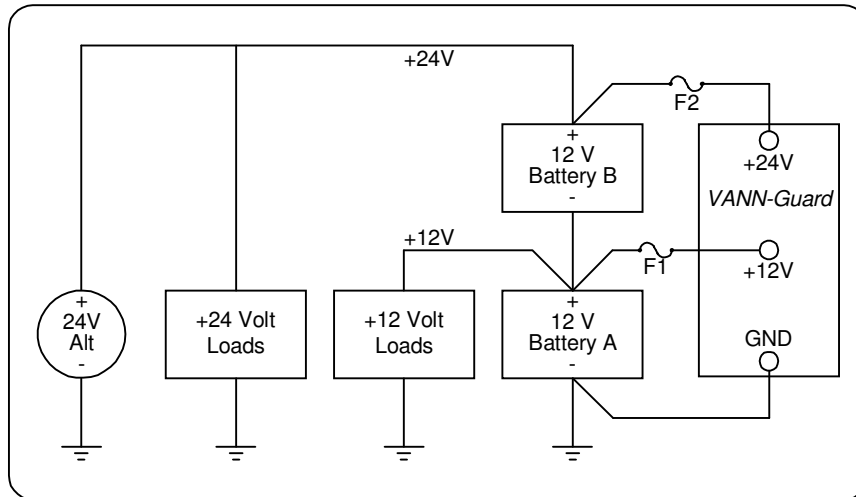
Specifications

70-Series Equalizers			
Model Number	70-60	70-80	70-100
Input Voltage 24v	18 to 32 v		
Efficiency (Peak)	>97%	>97%	>97%
Max 24v Input Amps	32	43	53
Output Voltage	(Input Voltage/2) ±2%		
Output Amps (12v)	0-60	0-80	0-100
Standby Current	17 milliamps nominal at 28.4V		
Operating Temp.	-40°C to +75°C (-40°F to 167°F)		
Storage Temp.	-54°C to +95°C (-65°F to 203°F)		
Serviceable	Yes	Yes	Yes
Environmental Considerations	Cast aluminum enclosure provides protection against salt, fungus, dust, water, fuel vapors and all fluids associated with commercial and off-highway vehicle operations.		
Mounting Location	Mount on a flat surface close to the batteries to allow short cable runs. Location should be protected from battery acid and gases.		
Weights	7.0 lbs.	7.3 lbs.	7.3 lbs.

70-Series Dimensional Specifications



Theory of Operation



In many 24 volt electrical systems it is desirable to tap into the battery system to obtain power for 12 volt loads. This method, while seemingly simple, causes a charge imbalance resulting in Battery B (see diagram) being overcharged, and possibly boiling, while Battery A discharges.

To solve this application problem the Vanner *VANN-Guard* is connected to the battery system at the +24 volt, +12 volt, and ground points. The *VANN-Guard* makes the batteries look like they are in series and in parallel at the same time. The *VANN-Guard* maintains the voltage balance and therefore the charge acceptance rate of each battery. The *VANN-Guard* hold Battery A and B voltages to within 0.05 volts under light loads and to within 0.1 volts at full rated load.

When the voltage of Battery A is higher than or equal to Battery B the *VANN-Guard* is in the standby mode, i.e., it is not transferring power from its 24 volt input to its 12 volt output. When a 12 volt load is present, and Battery A's voltage decreases to just below the voltage of Battery B, the *VANN-Guard* activates and transfers sufficient current from Battery B to Battery A to satisfy the load and maintain an equal voltage and charge in both batteries.

A key advantage of a system containing a Vanner *VANN-Guard*, compared to a DC to DC converter, is that if the 12 volt load requires a momentary surge current which exceeds the rated capacity of the *VANN-Guard*, Battery A will supply the extra current to the load. The *VANN-Guard* will then replenish the energy to Battery A after the surge has passed.

The following scenarios describe the *VANN-Guard Battery Equalizer* operation.

Scenario #1 - 24 volt load present, no 12 volt load present. The system operates as a system would without the *VANN-Guard* whether the alternator is ON or OFF. The *VANN-Guard* is in the standby mode except for making small adjustments to keep the batteries in balance.

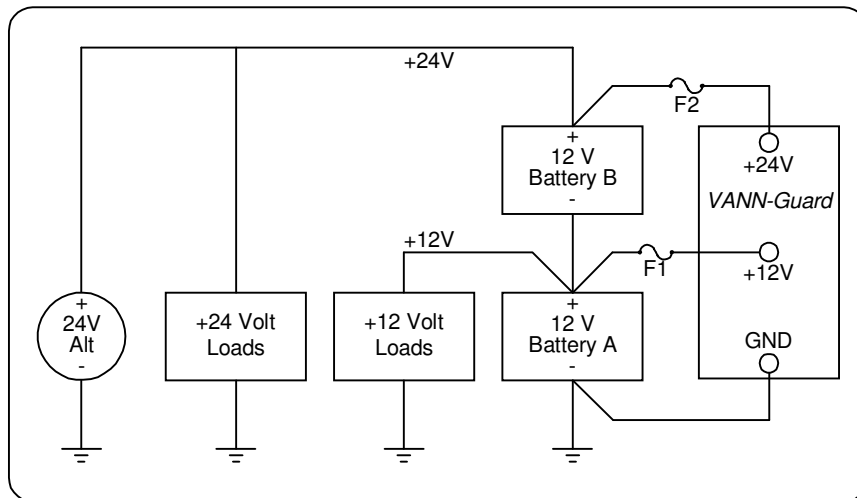
Scenario #2 - Both 24 volt and 12 volt loads present, alternator is OFF. The *VANN-Guard* will insure that both batteries will discharge at the same rate even if different loads are present.

Scenario #3 - Both 24 volt and 12 volt loads present, alternator is ON. The alternator provides 24 volt power to the battery system and to the 24 volt loads. The *VANN-Guard* transfers power from the 24 volt source to the 12 volt load by converting 24 volt power to 12 volts. It will supply sufficient 12 volt power to satisfy the 12 volt load and to maintain battery voltage balance.

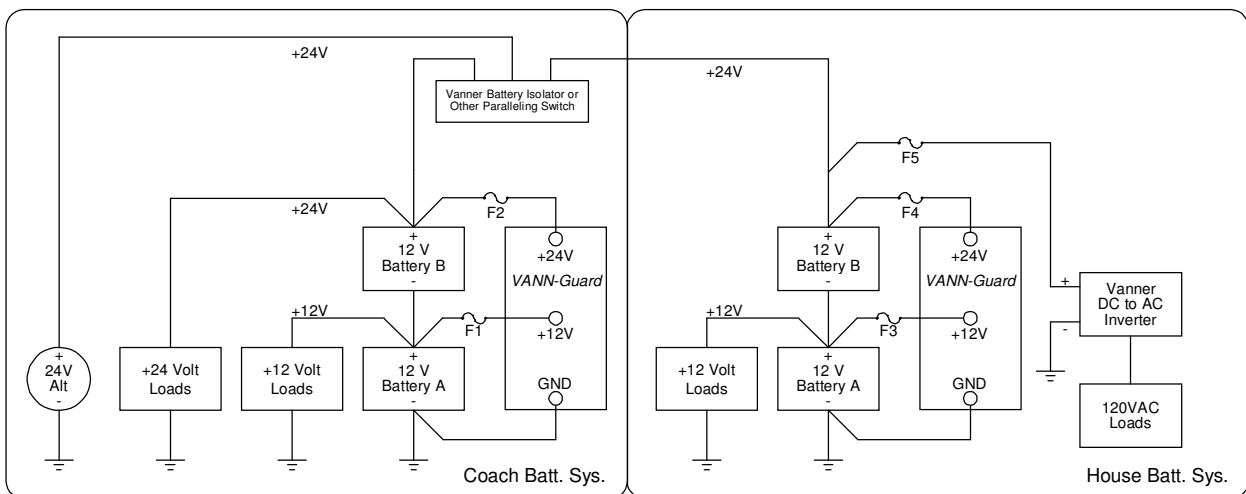
Typical Applications

Vanner *VANN-Guard Battery Equalizers* are used in many types of applications including transit and tour buses, private coaches, heavy trucks and off highway equipment, yachts, and alternative energy systems such as solar powered homes. In addition to *VANN-Guards*, Vanner manufactures a wide range of complementary products such as DC to DC converters, DC to AC inverters, battery charger/conditioners, and battery isolators. The following system diagrams illustrate how these products are used in various applications.

TRANSIT BUS

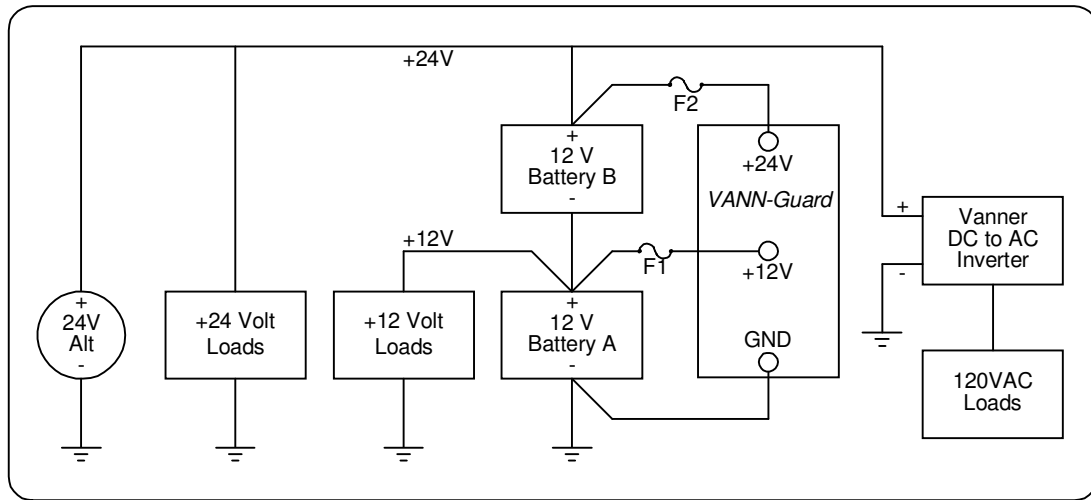


PRIVATE COACH

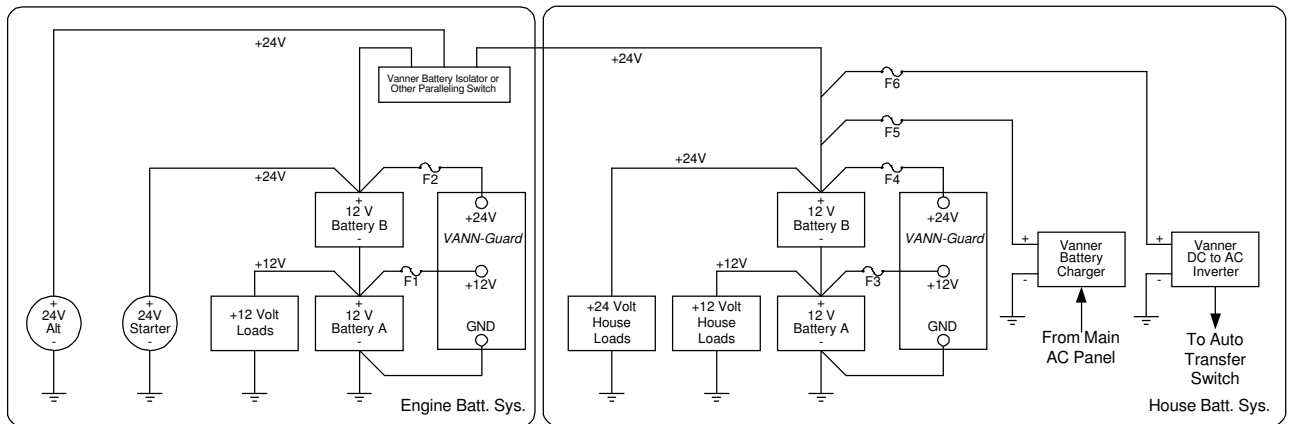


Typical Applications continued:

TOUR/CHARTER COACH



MARINE



Installation Instructions

Do not exceed the specified torque of 120 in-lbs. when connecting cables to the terminal posts (+24, GND, +12) during installation of all the VANN-Guard Models. Torque values higher than specified may damage the product, reduce performance, and/or create hazardous conditions. Products damaged by improper torque are not covered by the warranty.

Do not connect more than one conductor per terminal post on any Vanner VANN-Guard. Multiple wires and cables may overstress internal components, resulting in poor performance or creating hazardous conditions. Products damaged by the installation of multiple conductors per post are not covered by the warranty.

Fault protection devices must be installed between the VANN-Guard and the power source (battery). A fault protection device would be any fuse or circuit breaker properly rated for the maximum DC current obtainable. This advisory is in accordance with SAE, NEC and UL, for mobile power applications. Install per applicable codes or within 18" of the battery. See Wire and Fuse Sizing Chart on page 10 of this manual or contact Vanner at 1-800-227-6937 or pwrsales@vanner.com if assistance is needed in sizing fault protection devices.

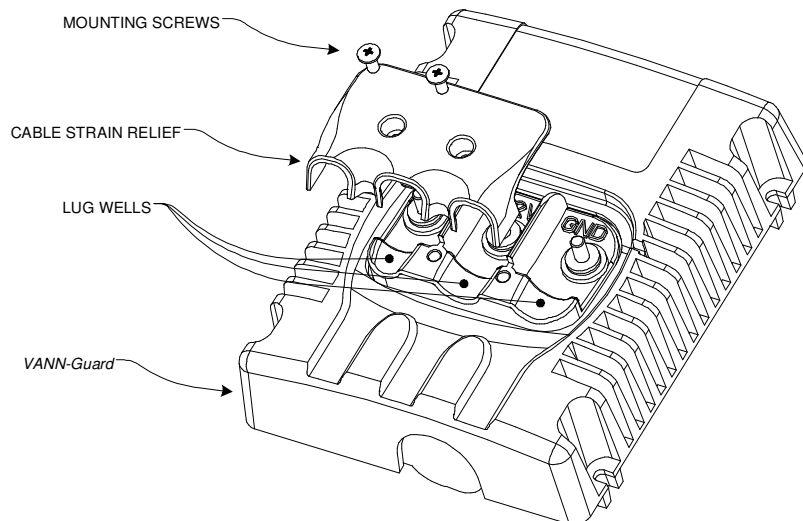
Caution: This equipment tends to produce arcs and sparks during installation. To prevent fire or explosion, compartments containing batteries or flammable materials must be properly ventilated. Safety goggles should always be worn when working near batteries

Mounting Location –The VANN-Guard may be mounted in any orientation, on a flat mounting surface suitable to support the VANN-Guard during application. Do not mount in zero-clearance compartment that may result in the VANN-Guard overheating. Locate so that contact by people is unlikely.

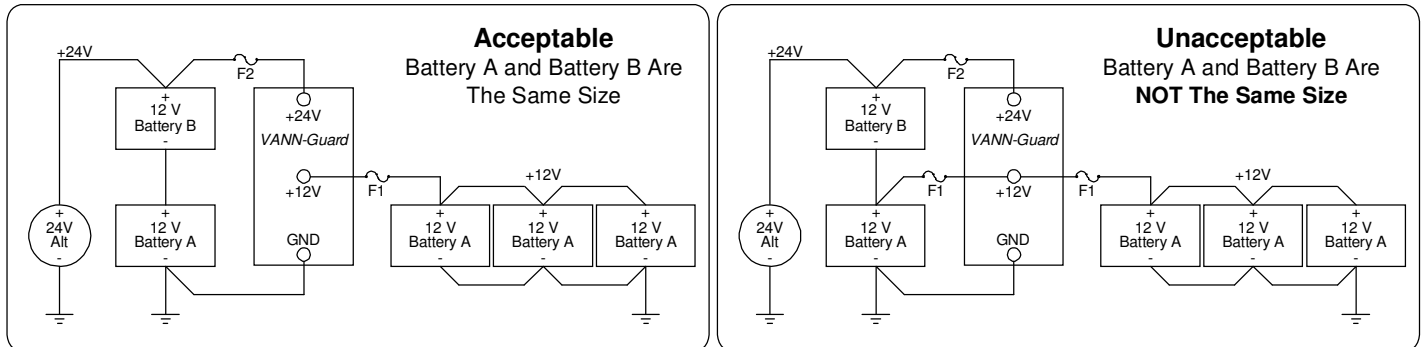
Environmental Protection – Your VANN-Guard has been designed to withstand direct exposure to rain and moisture. The VANN-Guard has also been tested for exposure to direct pressure spray, but continual exposure to direct pressure spraying may reduce the VANN-Guard serviceable life. Any damage due to water contamination is covered by Vanner only through the terms of our factory warranty.

Wiring Sequence– The VANN-Guard is internally protected for reverse polarity. The wiring sequence is not an issue with the VANN-Guard products.

Strain Relief – The VANN-Guard has an integral strain relief. The VANN-Guard is designed with wells for the lug to sit into to resist bolt loosening from cable movement, and the strain relief is designed to further inhibit cable movement. The diagram below shows the proper orientation for the attachment of the strain relief and the #10-32 mounting hardware that is supplied.



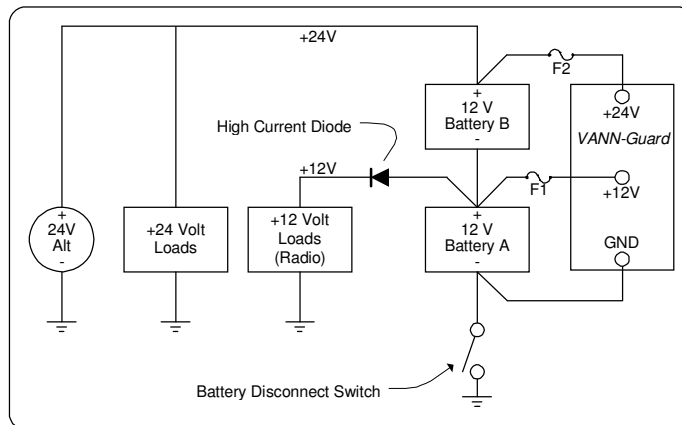
Caution adding 12volt batteries



In certain applications, such as private coach or alternate energy applications, it may be desirable to have additional 12 volt "House Batteries" to operate heavy 12 volt (inverter) loads. Use the *VANN-Guard* to charge the additional batteries.

Connect the *VANN-Guard* 12V terminal to the additional batteries only. Do not connect the *VANN-Guard* 12V terminal to both battery banks as this would make Battery A larger than Battery B. **Damage to Battery B may occur during charging** due to overcharging, if the *VANN-Guard* cannot keep up with the charging system.

Caution using a Ground-Side Battery Disconnect Switch



The system must be wired as shown to prevent Reverse Polarity Damage to polarity sensitive 12 volt loads while the ground-side disconnect switch is open. The *VANN-Guard's* GND terminal must be wired to the battery side of the ground-side disconnect switch circuit for the *VANN-Guard* to work properly.

Install the external High Current Diode, such as Vanner Model 52-75 (45 amp continuous rating) to protect polarity sensitive 12 volt loads if these loads do not already contain input diode protection. This prevents a reverse polarity on the 12 volt equipment when the battery switch is open. The reverse polarity does not come from the *VANN-Guard*, but from any 24 volt equipment that may be turned ON.

Wire Size and temperature rating

Cables connecting the *VANN-Guard* to the batteries must be sufficiently sized to prevent unwanted voltage drops. These voltage drops (loss) must be less than 0.05 VDC between the *VANN-Guard's* +24 volt terminal and the battery +24 volt terminal (Battery B positive terminal), less than 0.10 VDC between the *VANN-Guard's* +12 volt terminal and the battery +12 volt terminal (the jumper between Battery A and Battery B), and less than 0.05 VDC between the *VANN-Guard's* GND terminal and the battery ground terminal (Battery A negative terminal that is connected to chassis ground). In most installations, the *VANN-Guard's* terminals are wired directly to the battery terminals (reference fault protection) to prevent voltage loss that could occur in switch contacts, connections, and long wire runs. Since the *VANN-Guard* can be operated in temperatures up to 75° C, use wire rated at least 90° C. See Wire and Fuse Size Chart.

Wire and Fuse Size Chart

Wire Size AWG	Ring Terminal AMP or UL recognized equal	Max wire length, in feet, between <i>VANN-Guard</i> and battery to keep voltage drop under 0.1 volt. The chart assumes wire carries no other load and wire temperature is below 80° C.			
		70-60	70-80	70-100	2 X 70-100
#8	33462	2.1	XXX	XXX	XXX
#6	33466	3.2	2.4	XXX	XXX
#4	33470	5.9	4.4	3.5	XXX
#2	322870	8.7	6.5	5.2	2.6
#1	321867	10.9	8.2	6.5	3.3
#1/0	321867	13.8	10.4	8.3	4.1
#2/0	321870	17.6	13.2	10.5	5.3
Fuse F1		80 amp	100 amp	125 amp	250 amp
Fuse F2		40 amp	50 amp	80 amp	150 amp

Crimp the ring terminals using **AMP** ROTA-CRIMP 600850 (2/0 - 8ga).

AMP Product Information Center: 800-522-6752

AMP Tooling Assistance Center: 800-722-1111

Testing and Troubleshooting

Before testing the equalizer, be sure all battery connections are good and that fuses F1 and F2 are good.

CAUTION

Servicing of electrical systems should only be performed by trained and qualified technical personnel.

Equipment Required

- VoltMeter having 0.01 volt resolution. (Fluke Model 87 Multimeter recommended).
- Clamp-on amp meter (Fluke Model 36 Clamp-on Meter recommended).

Vanner Repair Service

Vanner offers a quick turn around factory repair service. Send the unit to the address below with a note instructing us to repair it. Include your name, phone number, shipping address (not a P.O. Box Number), and your purchase order number.

Test Procedure for *VANN-Guard 70-Series Battery Equalizer*

The VANN-Guard is working properly if:

1. The 12 volt DC loads are being operated continuously and are within the rated capacity of the VANN-Guard and;
2. Battery A voltage is lower than Battery B by no more than 0.05 to 0.10 volts (measured at the VANN-Guard's +24, +12 and GND terminals).

Vanner *VANN-Guards* are electronically protected against reverse polarity damage therefore the DC connection sequence is not an issue.

Vanner *VANN-Guards* will not function properly unless all three battery connections are made. Battery A and Battery B voltages both must be above 8 volts for the unit to turn ON.

Vanner *VANN-Guards* may be used in parallel with other *VANN-Guards* and Vanner Equalizer models.

Please note that the 24V, 12V and GND stud position and orientation are different on *VANN-Guard 70-Series* than on other Vanner Equalizers.

VANN-Guard Test Procedure:

1. Field-test the equalizer while fully connected to the vehicle batteries. For bench testing, two 12 volt batteries, or two 12 volt power supplies are required. The *VANN-Guard* must be connected to the batteries at GND, 12V and 24V to function properly.
2. If battery voltage is below 24 volts start the vehicle or apply a 24 volt battery charger to the batteries.
3. Turn ON 12 volt DC loads up to the *VANN-Guard's* rated capacity. Measure DC amps on the VANN-Guard +12 cable to verify load amperages.
4. **At the *VANN-Guard*** measure and record:
 - a. Battery A voltage (voltage between the *VANN-Guard's* +12 and GND terminals)
 - b. Battery B voltage (voltage between the *VANN-Guard's* +24 and +12 terminals)
5. Subtract Battery A voltage from Battery B voltage and compare readings.

Voltage Comparison		VANN-Guard Status	
a.	Battery A is lower than Battery B but within 0.05 volt.	OFF	Stand-by Mode. The VANN-Guard will not turn ON until Battery A is lower than Battery B by more than 0.05 volts.
b.	Battery A is lower than Battery B by 0.05 to 0.10 volts.	ON	Normal Operating Mode
c.	Battery A is lower than Battery B by more than 0.10 volts	ON	Self-Protection Mode due to Overload Condition. See below.
d.	Battery A is lower than Battery B by more than 0.10 volts	OFF	The VANN-Guard is not functioning properly.
e.	Battery A is <u>higher</u> than Battery B	Abnormal condition. Suspect Battery B is defective or a 12 volt load is connected to Battery B.	

Overload Condition

An overload condition exists when the 12 volt loads exceed the VANN-Guard's rated capacity. The overload condition will not damage the VANN-Guard, but may cause damage to the batteries.

During the overload, the VANN-Guard's output is limited by internal protection circuits to its Rated Output Amps. The 12 volt amps exceeding the VANN-Guard's output are drawn from Battery A which will begin to draw the batteries out of balance. The VANN-Guard's full Rated Output Amps are maintained as long as Battery A and Battery B remain balanced within 0.10 volt. The internal protection circuits will reduce the VANN-Guard's output as the batteries become further out-of-balance. If Battery A voltage falls below approximately 8 volts the VANN-Guard will shut itself OFF.

To correct the overload condition the 12 volt load must be reduced, or the VANN-Guard's rated capacity must be increased.

Trouble Shooting an Engine No-Start Situation

Situation:

A coach has dead batteries and won't start while jump starting. The coach is equipped with a 24 volt starting and charging system, a 12 volt electronic diesel engine control, a VANN-Guard, and a moderate 12 volt load which cannot be turned OFF. The coach sits for several days and the batteries run completely dead. During jump-starting the engine cranks but does not start due to low voltage on the 12 volt supply. Electrical testing reveals there is no 12 volt output from the VANN-Guard while jump starting even though the VANN-Guard separately tests OK.

Cause:

The 12 volt load which could not be turned OFF first ran both batteries down until the VANN-Guard shut itself OFF due to low voltage. (The VANN-Guard will shut OFF if system voltage falls below 16 volts or if voltage on either battery falls below 8 volts.) Then Battery A alone was drained to near zero volts. As the bus is being jumped, 12 volt loads hold Battery A voltage too low for the VANN-Guard to turn ON and Battery A is too weak to support the 12 volt electronic engine control.

Solution:

Turn OFF all 12 volt loads (turning the battery disconnect switch OFF may accomplish this). Connect the jumper cables but do not crank the engine for two or three minutes. (Both batteries must rise above 8 volts.) The battery disconnect switch can then be turned ON and the bus should have adequate 12 volt power to start.

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Part Number xxxxxxx
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FAULT CODE MANUAL

B7L, B7TL, B12

Preface

The content of this manual has been based upon information from design department at Volvo Bus, Volvo Trucks and external suppliers. Due to problems with retrieving updated documents, new signal specifications etc. we cannot guarantee that the information is 100% correct. Therefore we are very grateful to retrieve any notification about occurrence of incorrect information. We will however, update the manual as soon as we get new information and distribute revised versions to all parties concerned.

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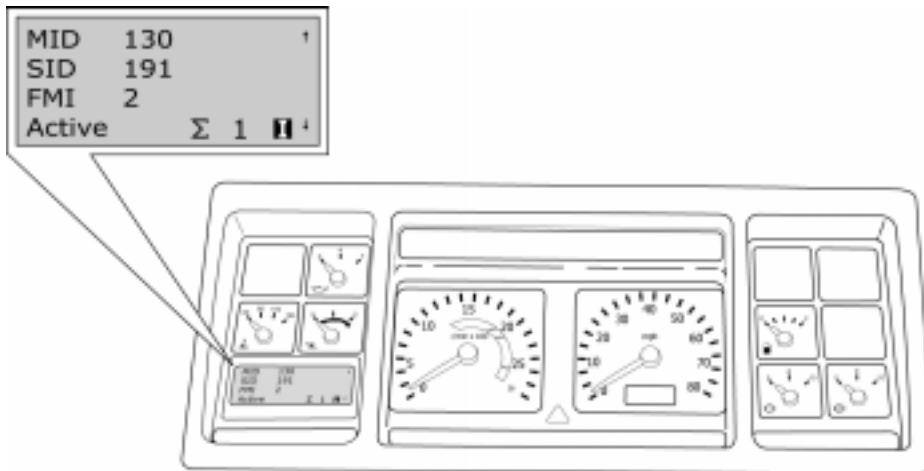
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1. Bus Instrument Cluster (BIC)

The bus instrument cluster contains a number of indicators and lamps that shows the status of different parts of the bus. It can also be used to display faultcodes from the different control units by using the windscreen wiper handle. Normally this procedure is done by using a computer with related software but this manual offers an alternative to that as well as a complete list of all fault codes for each ECU.

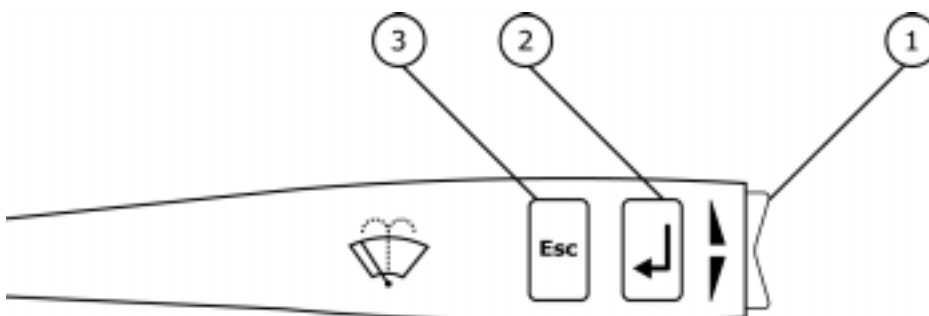
2. The instrument display

At the lower left corner of the instrument cluster there is a small display that can show various information about the bus. From this display it is possible to read the fault codes that may have been set in one or more of the different control units.



3. The windscreen wiper handle

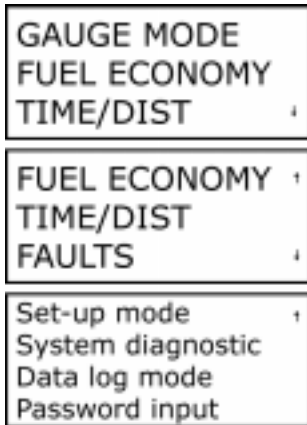
Using the the windscreen wiper handle at the right of the steeringwheel makes it possible to display the error at the lower left corner of the BIC. The errors can be displayed in numerical form and with help of the fault code table in this manual you can draw conclusions of what may have caused the errors.



1. Up/Down buttons, used to browse up or down through the menus.
2. "Return" button, confirms selected choice.
3. "Esc" button, regrets selected choice or moves one step up in the hierarchy.

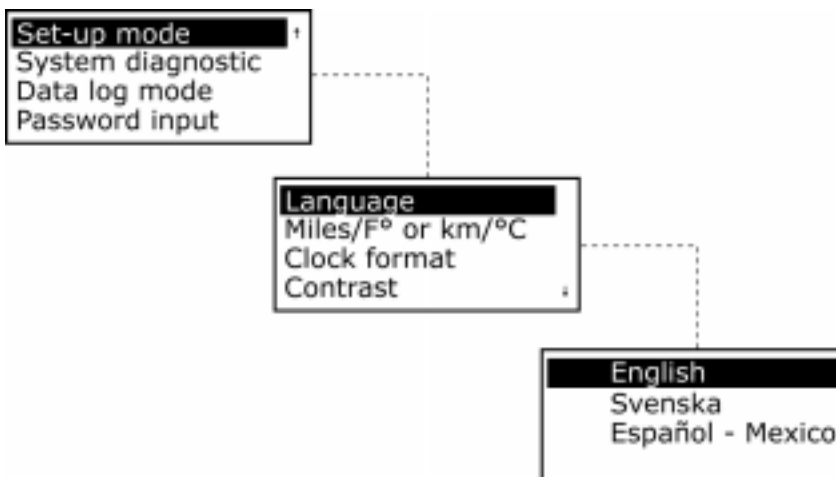
4. Display menus

The image below displays the main menus in the display window. The window can only display three items at once, therefore the up/down button on the windscreen wiper handle must be used to browse through the menus. Simply press the “Return” button on the windscreen wiper handle to enter a desired menu. If you wish to return to the level above just press the “Esc” button on the windscreen wiper handle.



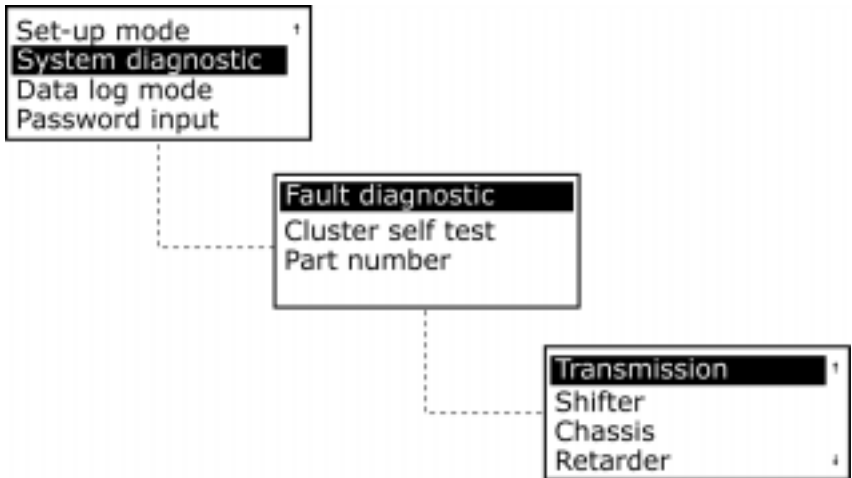
5. Setting the display language

Turn on the ignition on the bus. The display at the lower left corner of the instrument can display an icon of some sort depending on the bus status. If this is the case then press “Esc” on the windscreen wiper handle to go to the main menu. If the language of the display is not English we recommend that you change the language settings of the display. This is done by entering the set-up mode in the display menu. Simply use the up/down button on the windscreen wiper handle and press the “Return” button when the text “Set-up mode” is highlighted. The display now changes to display the submenus to the “Set-up mode” menu. Klick the up/down button to highlight the text “Language” if it is not already highlighted. Press the “Return” button again to enter the choices of languages, select “English” and press the “Return” button once more.



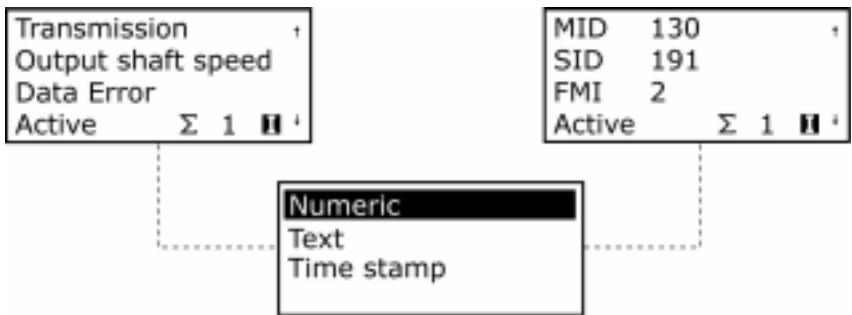
6. Read fault codes from ECU

From the main menu, use the up/down button on the windscreen wiper handle to move down to the “System diagnostic” menu and press the “Return” key.



The line “Fault diagnostic” should now be highlighted, if it’s not you can simply use the up/down button on the windscreen wiper handle to move to that line. Press the “Return” button again and the fault code set in the transmission ECU will now be displayed on the screen.

The fault codes can be displayed in both numeric and text mode. Since the text mode is default you have to change it to numeric manually. This is done by pressing the “Return” button when the display shows the fault code in text mode. A menu with three choices is now shown on the display. Press the “Return” button while the choice “Numeric” is highlighted (it should be highlighted by default).



As in the example above, you can see that the fault code is set in MID 130, the SID number is 191 and the FMI number is 2. By looking at the fault code table for MID 130 (which represents the TECU) you can see that SID number 191 means “Output speed level error” as well as the displaytext shown if your display would have been set to show faults in text mode.

9	130	PID 177	3	Transmission temperature sensor above	Transm. oil temp.
0	130	PID 177	4	Transmission temperature sensor below	Transm. oil temp.
1	130	PID 191	2	Output speed level error	Output shaft speed
2	130	PID 191	11	Output speed measuring overflow	Output shaft speed
3	130	SID 1	3	Solenoid valve B shorted high	Solenoid valve #1
4	130	SID 1	4	Solenoid valve B shorted ground	Solenoid valve #1
5	130	SID 1	5	Solenoid valve B circuit break	Solenoid valve #1

The information about the PID number (or SID, PPID or PSID) together with the explanation of the FMI number associated with the fault might help you to draw a conclusion of what may have caused the error. The image below shows the FMI table which tells what type of fault the FMI number represents.

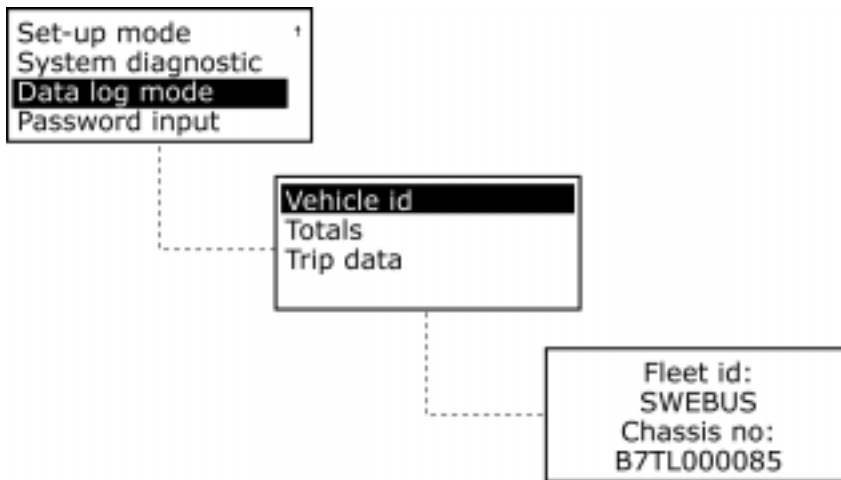
SAE-standard	
FMI	SAE-text
0	Data valid, but above normal operating range.
1	Data valid, but under normal operating range.
2	Intermittent or incorrect data.
3	Abnormally high voltage or short circuit to higher voltage.
4	Abnormally low voltage or short circuit to lower voltage.
5	Abnormally low current or break.
6	Abnormally high current or short circuit to earth.
7	Incorrect response from mechanical system.
8	Abnormal frequency
9	Abnormal update rate
10	Abnormally large variations.
11	Unknown fault.
12	Component fault
13	Out of calibration
14	Special instructions
15	Reserved for future use.

In this case the information MID 130, PID 191, FMI 2 means that the output shaft speed has retrieved intermittent or incorrect data, this gives an initial position to start the fault tracing from. Future revisions of this manual will contain more clearly instructions of how to fix the errors.

7. Comparing chassis number with the VIC

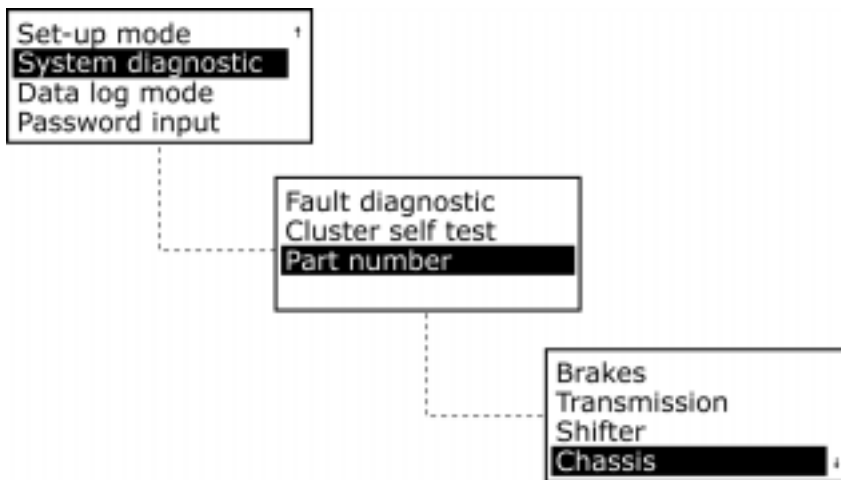
The VIC (Vehicle Identification Card) is a card that comes with every new bus that identifies the chassis number for the bus and the HW/SW id for each control unit.

To check chassis number, select “Data log mode” from the displays main menu and press the “Return” button on the windscreen wiper handle. You now move down one step in the hierarchy and three new choices are presented on the display, select “Vehicle id” and press the “Return” button on the windscreen wiper handle. The fleet id and the chassis number should occur on the display.



8. Comparing HW/SW id with the VIC

Just as with the chassis number the VIC can be used to verify HW/SW id for each ECU in the bus. To read the HW/SW id from a control unit you first select “System diagnostic” from the main menu of the display and press the “Return” button on the windscreen wiper handle. Then select “Part number” from the menu and press the “Return” button on the windscreen wiper handle once again. The menu now displays the different control units in the bus, in this case we want to see the HW/SW id for the chassis control unit (CECM) and therefore we select “Chassis” and press the “Return” button again.



The image below shows the HW/SW id for the CECM, the display cannot display both SW id and HW id at the same time, therefore you have to use the up/down buttons on the windscreen wiper handle to show SW id instead of HW id.

```

MID   164   SW ID
70301493P01*70301452
P01*70301453P01*
    
```

```

MID   164   HW ID :
VOLVO*00000000P01*00
000000:
    
```

9. Fault codes, ABS (MID 136)

MID	(P)PID/SID	FMI	Seriousness	Component/Function	Display text
136	SID 1	1		Air gap	Sensor wheel sp LF
136	SID 1	2		Incorrect tyre	Sensor wheel sp LF
136	SID 1	3		Shorted to UBATT	Sensor wheel sp LF
136	SID 1	4		Shorted to ground	Sensor wheel sp LF
136	SID 1	5		Open circuit	Sensor wheel sp LF
136	SID 1	6		Short circuit	Sensor wheel sp LF
136	SID 1	7		Incorrect pole wheel	Sensor wheel sp LF
136	SID 1	8		Slip	Sensor wheel sp LF
136	SID 1	9		Wires mismatched	Sensor wheel sp LF
136	SID 1	10		Speed drop-out	Sensor wheel sp LF
136	SID 1	11		Abnormal speed (chatter)	Sensor wheel sp LF
136	SID 1	12		Frequency too high	Sensor wheel sp LF
136	SID 2	1		Air gap	Sensor wheel sp RF
136	SID 2	2		Incorrect tyre	Sensor wheel sp RF
136	SID 2	3		Shorted to UBATT	Sensor wheel sp RF
136	SID 2	4		Shorted to ground	Sensor wheel sp RF
136	SID 2	5		Open circuit	Sensor wheel sp RF
136	SID 2	6		Short circuit	Sensor wheel sp RF
136	SID 2	7		Incorrect pole wheel	Sensor wheel sp RF
136	SID 2	8		Slip	Sensor wheel sp RF
136	SID 2	9		Wires mismatched	Sensor wheel sp RF
136	SID 2	10		Speed drop-out	Sensor wheel sp RF
136	SID 2	11		Abnormal speed	Sensor wheel sp RF
136	SID 2	12		Frequency too high	Sensor wheel sp RF
136	SID 3	1		Air gap	Sensor wheel sp L1R
136	SID 3	2		Incorrect tyre	Sensor wheel sp L1R
136	SID 3	3		Shorted to UBATT	Sensor wheel sp L1R
136	SID 3	4		Shorted to ground	Sensor wheel sp L1R
136	SID 3	5		Open circuit	Sensor wheel sp L1R
136	SID 3	6		Short circuit	Sensor wheel sp L1R
136	SID 3	7		Incorrect pole wheel	Sensor wheel sp L1R
136	SID 3	8		Slip	Sensor wheel sp L1R
136	SID 3	9		Wires mismatched	Sensor wheel sp L1R
136	SID 3	10		Speed drop-out	Sensor wheel sp L1R
136	SID 3	11		Abnormal speed	Sensor wheel sp L1R
136	SID 3	12		Frequency too high	Sensor wheel sp L1R
136	SID 4	1		Air gap	Sensor wheel sp R1R
136	SID 4	2		Incorrect tyre	Sensor wheel sp R1R
136	SID 4	3		Shorted to UBATT	Sensor wheel sp R1R
136	SID 4	4		Shorted to ground	Sensor wheel sp R1R
136	SID 4	5		Open circuit	Sensor wheel sp R1R
136	SID 4	6		Short circuit	Sensor wheel sp R1R
136	SID 4	7		Incorrect pole wheel	Sensor wheel sp R1R
136	SID 4	8		Slip	Sensor wheel sp R1R
136	SID 4	9		Wires mismatched	Sensor wheel sp R1R
136	SID 4	10		Speed drop-out	Sensor wheel sp R1R
136	SID 4	11		Abnormal speed	Sensor wheel sp R1R
136	SID 4	12		Frequency too high	Sensor wheel sp R1R

MID	(P)PID/SID	FMI	Seriousness	Component/Function	Display text
136	SID 5	1		Air gap	-
136	SID 5	2		Incorrect tyre	-
136	SID 5	3		Shorted to UBATT	-
136	SID 5	4		Shorted to ground	-
136	SID 5	5		Open circuit	-
136	SID 5	6		Short circuit	-
136	SID 5	7		Incorrect pole wheel	-
136	SID 5	8		Slip	-
136	SID 5	9		Wires mismatched	-
136	SID 5	10		Speed drop-out	-
136	SID 5	11		Abnormal speed	-
136	SID 5	12		Frequency too high	-
136	SID 6	1		Air gap	-
136	SID 6	2		Incorrect tyre	-
136	SID 6	3		Shorted to UBATT	-
136	SID 6	4		Shorted to ground	-
136	SID 6	5		Open circuit	-
136	SID 6	6		Short circuit	-
136	SID 6	7		Incorrect pole wheel	-
136	SID 6	8		Slip	-
136	SID 6	9		Wires mismatched	-
136	SID 6	10		Speed drop-out	-
136	SID 6	11		Abnormal speed	-
136	SID 6	12		Frequency too high	-
136	SID 7	1		Open circuit in- and outlet	Modulator valve LF
136	SID 7	3		Shorted to UBATT	Modulator valve LF
136	SID 7	5		Open circuit	Modulator valve LF
136	SID 7	6		Shorted to ground	Modulator valve LF
136	SID 8	1		Open circuit in- and outlet	Modulator valve RF
136	SID 8	3		Shorted to UBATT	Modulator valve RF
136	SID 8	5		Open circuit	Modulator valve RF
136	SID 8	6		Shorted to ground	Modulator valve RF
136	SID 9	1		Open circuit in- and outlet	Modulator valve L1R
136	SID 9	3		Shorted to UBATT	Modulator valve L1R
136	SID 9	5		Open circuit	Modulator valve L1R
136	SID 9	6		Shorted to ground	Modulator valve L1R
136	SID 10	1		Open circuit in- and outlet	Modulator valve R1R
136	SID 10	3		Shorted to UBATT	Modulator valve R1R
136	SID 10	5		Open circuit	Modulator valve R1R
136	SID 10	6		Shorted to ground	Modulator valve R1R
136	SID 11	1		Open circuit in- and outlet	-
136	SID 11	3		Shorted to UBATT	-
136	SID 11	5		Open circuit	-
136	SID 11	6		Shorted to ground	-
136	SID 12	1		Open circuit in- and outlet	-
136	SID 12	3		Shorted to UBATT	-
136	SID 12	5		Open circuit	-
136	SID 12	6		Shorted to ground	-
136	SID 13	3		Shorted to UBATT	Retard contr relay
136	SID 13	5		Open circuit	Retard contr relay
136	SID 13	6		Shorted to ground	Retard contr relay
136	SID 14	3		Ground diagonal, shorted to UBATT	Valve relay

MID	(P)PID/SID	FMI	Seriousness	Component/Function	Display text
136	SID 14	4		Diag. 1 Voltage, low voltage/open circuit	Valve relay
136	SID 14	5		Ground diagonal, open circuit	Valve relay
136	SID 14	5		ECU-Ground or WL-Ground	Valve relay
136	SID 14	6		Ground diagonal 1, shorted to low	Valve relay
136	SID 14	7		Voltage feeding solenoid valve ABS	Valve relay
136	SID 15	3		Voltage feeding solenoid valve ABS	Valve relay
136	SID 15	4		Voltage feeding solenoid valve ABS	Valve relay
136	SID 15	5		Voltage feeding solenoid valve ABS	Valve relay
136	SID 15	6		Voltage feeding solenoid valve ABS	Valve relay
136	SID 15	7		Valve relay diagonal 2	Valve relay
136	SID 18	3		Diff. Brake Valve, shorted to UBATT	ATC valve L
136	SID 18	5		Diff. Brake Valve, open circuit	ATC valve L
136	SID 18	6		Diff. Brake Valve, shorted to ground	ATC valve L
136	SID 19	3		Diff, lock shorted to UBATT	ATC valve R
136	SID 19	5		Diff, lock open circuit	ATC valve R
136	SID 19	6		Diff, lock shorted to ground	ATC valve R
136	SID 23	5		Warning lamp ABS	Warning light bulb
136	SID 231	5		SAE J1939 Control link	SAE J1939 data link
136	SID 231	6		SAE J1939 Control link	SAE J1939 data link
136	SID 231	9		SAE J1939 Control link	SAE J1939 data link
136	SID 231	12		SAE J1939 Control link	SAE J1939 data link
136	SID 248	2		CAN plausibility	-
136	SID 248	5		CAN open circuit	-
136	SID 248	6		CAN grounded circuit	-
136	SID 248	9		CAN time-out	-
136	SID 248	12		CAN, internal error	-
136	SID 249	5		SAE-J1922 datalink open circuit	-
136	SID 249	6		SAE-J1922 datalink grounded circuit	-
136	SID 249	10		SAE-J1922 bus not free	-
136	SID 251	3		Overvoltage Diag. 1 or 2	Power supply
136	SID 253	1		ASR Configuration	Calibration memory
136	SID 253	2		ABS Configuration	Calibration memory
136	SID 253	2		EEPROM Wheel parameter incorrect	Calibration memory
136	SID 253	12		EEPROM Checksum	Calibration memory
136	SID 254	2		Internal Error	Controller #1
136	SID 254	5		ABS (ASR) ELECTRONIC no loads	Controller #1
136	SID 254	8		Excessive slip / dynotester	Controller #1
136	SID 254	9		Modulator-Valve activation-time	Controller #1
136	SID 254	12		Internal Error	Controller #1

10. Fault codes, BIC (MID 140 & 234)

MID	(P)PID/SID	FMI	Seriousness	Component/function	Display text
140	PID 84	9		Speed	Road speed
140	PID 190	9		Number of revolutions	Engine speed
140&234	SID 240	13		Program memory	Program memory
140&234	SID 253	12		EEPROM	Calibration memory
140&234	SID 253	13		EEPROM	Calibration memory
140&234	SID 254	12		Control unit	Controller #1
140&234	SID 254	13		Control unit	Controller #1
140&234	SID 254	14		Control unit	Controller #1
234	PID 117	9		Brake pressure #1	Brake pressure #1
234	PID 118	9		Brake pressure #2	Brake pressure #2
234	PID 120	9		ZF/Allison oiltemp	Hyd retard oil temp
234	PID 158	0	Yellow lamp	Control unit battery potential	Battery potential
234	PID 175	9		Engine oil temp.	Engine oil temp.
234	PID 177	9		Voith oil temp	Transm. oil temp.
234	PPID 91	9		Brake pressure circuit 3	Brake pressure #3
234	SID 250	2		SAE J1708 data link	SAE J1708 data link
234	SID 250	9	Yellow lamp	SAE J1708 data link	SAE J1708 data link
234	SID 250	12	Yellow lamp	SAE J1708 data link	SAE J1708 data link
234	PSID 1	6		Fuel indication, low level	Output LX:13
234	PSID 2	6	Yellow lamp	Alarm clock, activating	Alarm clock activ.
234	PSID 3	6		Buzzer, danger	Buzzer, alarm
234	PSID 4	6		Buzzer, warning	Buzzer, caution

11. Fault codes, CECM (MID 164)

MID	(P)PID/SID	FMI	Seriousness	Component/Function	Display text
164	PID 43	4			Starting sw. status
164	PID 43	5			Starting sw. status
164	PID 70	3			Park brake switch
164	PID 117	3			Brake pressure #1
164	PID 117	4			Brake pressure #1
164	PID 118	3			Brake pressure #2
164	PID 118	4			Brake pressure #2
164	PPID 191	3			Buzzer
164	PPID 191	4			Buzzer
164	PPID 191	5			Buzzer
164	PSID 20	3			Chassis data link
164	PSID 20	4			Chassis data link
164	PSID 23	3			D data link
164	PSID 23	4			D data link
164	PSID 31	3			Output CECM
164	PSID 31	4			Output CECM
164	PSID 31	5			Output CECM
164	PSID 32	5			Panel switch
164	PSID 33	3			Warning lamp output
164	PSID 34	3			Engine run signal
164	PSID 34	4			Engine run signal
164	PSID 35	3			Ignition output
164	PSID 35	4			Ignition output
164	PSID 35	5			Ignition output
164	PSID 36	3			Steer wheel adjust
164	PSID 36	4			Steer wheel adjust
164	PSID 36	5			Steer wheel adjust
164	PSID 37	3			Fuel shutoff valve
164	PSID 37	4			Fuel shutoff valve
164	SID 231	3			SAE J1939 kontrlänk
164	SID 231	4			SAE J1939 kontrlänk
164	SID 250	3			SAE J1708 infolänk
164	SID 250	4			SAE J1708 infolänk

12. Fault codes, CIM (MID 164)

MID	(P)PID/SID	FMI	Seriousness	Component/function	Display text
164	PSID 31	3			Short-circuit to battery
164	PSID 31	4			Short-circuit to ground
164	PSID 3	4			Alternator not charging
164	PSID 4	4			Alternator not charging
164	PSID 45	4			Alternator not charging
164	PSID 46	4			Alternator not charging

13. Fault codes, EECU (MID 128)

MID	(P)PID/SID	FMI	Seriousness	Component/function	Display text
128	PID 45	3	Yellow lamp	Starting heater status relay	Inlet air heat stat
128	PID 45	4	Yellow lamp	Starting heater status relay	Inlet air heat stat
128	PID 45	5	Yellow lamp	Starting heater status relay	Inlet air heat stat
128	PID 84	9	Yellow lamp	Vehicle speed	Road speed
128	PID 84	11	Yellow lamp	Vehicle speed	Road speed
128	PID 85	9	Yellow lamp	Cruise control, status switch	Cruise control stat
128	PID 91	9	Yellow lamp	Accelerator pedal percentage position	Acc. Pedal pos, %
128	PID 91	11	Yellow lamp	Accelerator pedal percentage position	Acc. Pedal pos, %
128	PID 94	1	Yellow lamp	Feed pressure, fuel	Fuel delivery pres.
128	PID 94	3	Yellow lamp	Feed pressure, fuel	Fuel delivery pres.
128	PID 94	4	Yellow lamp	Feed pressure, fuel	Fuel delivery pres.
128	PID 94	7	Yellow lamp	Feed pressure, fuel	Fuel delivery pres.
128	PID 98	1	Yellow lamp	Oil level sensor engine	Engine Oil Level
128	PID 98	3	Yellow lamp	Oil level sensor engine	Engine Oil Level
128	PID 98	4	Yellow lamp	Oil level sensor engine	Engine Oil Level
128	PID 100	1	Red lamp	Oil pressure sensor engine	Engine Oil Pressure
128	PID 100	3	Yellow lamp	Oil pressure sensor engine	Engine Oil Pressure
128	PID 100	4	Yellow lamp	Oil pressure sensor engine	Engine Oil Pressure
128	PID 102	3	Yellow lamp	Boost pressure sensor	Boost pressure
128	PID 102	4	Yellow lamp	Boost pressure sensor	Boost pressure
128	PID 105	3	Yellow lamp	Boost air temperature sensor	Intake manif temp
128	PID 105	4	Yellow lamp	Boost air temperature sensor	Intake manif temp
128	PID 107	0	Yellow lamp	Drop in pressure air filter	Air filt press drop
128	PID 107	3	Yellow lamp	Drop in pressure air filter	Air filt press drop
128	PID 107	4	Yellow lamp	Drop in pressure air filter	Air filt press drop
128	PID 107	5	Yellow lamp	Drop in pressure air filter	Air filt press drop
128	PID 108	3	Yellow lamp	Atmospheric pressure sensor	Barometric press
128	PID 108	4	Yellow lamp	Atmospheric pressure sensor	Barometric press
128	PID 110	0		Coolant temperature sensor	Eng coolant temp
128	PID 110	3		Coolant temperature sensor	Eng coolant temp
128	PID 110	4		Coolant temperature sensor	Eng coolant temp
128	PID 111	1	Red lamp	Coolant level sensor	Coolant level
128	PID 158	3	Yellow lamp	Battery voltage	Battery voltage
128	PID 172	3	Yellow lamp	Air temperature, inlet	Air inlet temp.
128	PID 172	4	Yellow lamp	Air temperature, inlet	Air inlet temp.
128	PID 174	3	Yellow lamp	Fuel temperature sensor	Fuel temperature
128	PID 174	4	Yellow lamp	Fuel temperature sensor	Fuel temperature
128	PID 175	0	Red lamp	Oil temperature	Engine oil temp
128	PID 175	3	Yellow lamp	Oil temperature	Engine oil temp
128	PID 175	4	Yellow lamp	Oil temperature	Engine oil temp
128	PID 224	2	Yellow lamp	Electronic immobilizer	Vehicle sec. Code
128	PID 224	12	Yellow lamp	Electronic immobilizer	Vehicle sec. Code
128	PID 228	11	Yellow lamp	Calibration Factor (K)	Calibration number

MID	(P)PID/SID	FMI	Seriousness	Component/function	Display text
128	PPID 100	3	Yellow lamp	Outer actuator	Ext. timing act.
128	PPID 100	4	Yellow lamp	Outer actuator	Ext. timing act.
128	PPID 100	5	Yellow lamp	Outer actuator	Ext. timing act.
128	PPID 109	3	Yellow lamp	Exhaust pressure governor EPG3	EPG # 3
128	PPID 109	4	Yellow lamp	Exhaust pressure governor EPG3	EPG # 3
128	PPID 109	5	Yellow lamp	Exhaust pressure governor EPG3	EPG # 3
128	PPID 122	3	Yellow lamp	Compression brake VCB	VCB Compr. Brake st.
128	PPID 122	4	Yellow lamp	Compression brake VCB	VCB Compr. Brake st.
128	PPID 122	5	Yellow lamp	Compression brake VCB	VCB Compr. Brake st.
128	PPID 123	3	Yellow lamp	Exhaust pressure governor EPG2	EPG2 Start/warmhold
128	PPID 123	4	Yellow lamp	Exhaust pressure governor EPG2	EPG2 Start/warmhold
128	PPID 123	5	Yellow lamp	Exhaust pressure governor EPG2	EPG2 Start/warmhold
128	PPID 124	3	Yellow lamp	Exhaust pressure governor EPG1	EPG # 1
128	PPID 124	4	Yellow lamp	Exhaust pressure governor EPG1	EPG # 1
128	PPID 124	5	Yellow lamp	Exhaust pressure governor EPG1	EPG # 1
128	SID 1-6	2	Yellow lamp	Injector	Injector Cylinder (SID#)
128	SID 1-6	3	Yellow lamp	Injector	Injector Cylinder (SID#)
128	SID 1-6	4	Yellow lamp	Injector	Injector Cylinder (SID#)
128	SID 1-6	5	Yellow lamp	Injector	Injector Cylinder (SID#)
128	SID 1-6	7	Yellow lamp	Injector	Injector Cylinder (SID#)
128	SID 1-6	11	Yellow lamp	Injector	Injector Cylinder (SID#)
128	SID 17	3		Fuel shut-off valve	Fuel Valve
128	SID 17	4		Fuel shut-off valve	Fuel Valve
128	SID 17	5		Fuel shut-off valve	Fuel Valve
128	SID 20	2	Yellow lamp	Actuator, injection angle	Timing actuator
128	SID 20	3	Red lamp	Actuator, injection angle	Timing actuator
128	SID 20	4	Red lamp	Actuator, injection angle	Timing actuator
128	SID 20	5	Red lamp	Actuator, injection angle	Timing actuator
128	SID 20	6	Red lamp	Actuator, injection angle	Timing actuator
128	SID 20	7	Red lamp	Actuator, injection angle	Timing actuator
128	SID 20	8	Red lamp	Actuator, injection angle	Timing actuator
128	SID 20	11	Red lamp	Actuator, injection angle	Timing actuator
128	SID 21	2	Yellow lamp	Neelde lifting sensor	Engine position
128	SID 21	3	Yellow lamp	Neelde lifting sensor	Engine position
128	SID 21	8	Yellow lamp	Neelde lifting sensor	Engine position
128	SID 22	2	Yellow lamp	Speed sensor, flywheel	Timing sens crank
128	SID 22	3	Yellow lamp	Speed sensor, flywheel	Timing sens crank
128	SID 22	8	Yellow lamp	Speed sensor, flywheel	Timing sens crank
128	SID 23	2	Yellow lamp	Control rod, actuator	Rack actuator
128	SID 23	3	Red lamp	Control rod, actuator	Rack actuator
128	SID 23	4	Red lamp	Control rod, actuator	Rack actuator
128	SID 23	5	Red lamp	Control rod, actuator	Rack actuator
128	SID 23	6	Red lamp	Control rod, actuator	Rack actuator
128	SID 23	7	Red lamp	Control rod, actuator	Rack actuator
128	SID 23	8	Red lamp	Control rod, actuator	Rack actuator
128	SID 23	11	Red lamp	Control rod, actuator	Rack actuator

MID	(P)PID/SID	FMI	Seriousness	Component/Function	Display text
128	SID 24	2	Red lamp	Control rod position	Rack positoin sens.
128	SID 24	13	Red lamp	Control rod position	Rack positoin sens.
128	SID 64	3	Yellow lamp	Engine speed pump	Tim. Sens inj. Pump
128	SID 64	8	Yellow lamp	Engine speed pump	Tim. Sens inj. Pump
128	SID 70	3	Yellow lamp	Starting heater 1	Air inlet heater 1
128	SID 70	4	Yellow lamp	Starting heater 1	Air inlet heater 1
128	SID 70	5	Yellow lamp	Starting heater 1	Air inlet heater 1
128	SID 230	3	Yellow lamp	Idle switch	Idle valid switch
128	SID 230	4	Yellow lamp	Idle switch	Idle valid switch
128	SID 231	2	Yellow lamp	SAE J1939 Control link	SAE J1939 data link
128	SID 231	9	Yellow lamp	SAE J1939 Control link	SAE J1939 data link
128	SID 231	11	Yellow lamp	SAE J1939 Control link	SAE J1939 data link
128	SID 231	12	Yellow lamp	SAE J1939 Control link	SAE J1939 data link
128	SID 232	3	Yellow lamp	5 V supply to sensor	5 V supply
128	SID 232	4	Yellow lamp	5 V supply to sensor	5 V supply
128	SID 240	2	Red lamp	Programme memory (Flash)	Program memory
128	SID 240	12		Programme memory (Flash)	Program memory
128	SID 250	12	Yellow lamp	SAE J1708 Information link	SAE J1708 data link
128	SID 253	2	Red lamp	Data set memory EEPROM	Calibration memory
128	SID 253	12	Red lamp	Data set memory EEPROM	Calibration memory
128	SID 254	2	Red lamp	Engine control unit (EECU)	Controller #1
128	SID 254	8	Red lamp	Engine control unit (EECU)	Controller #1
128	SID 254	9	Red lamp	Engine control unit (EECU)	Controller #1
128	SID 254	11	Red lamp	Engine control unit (EECU)	Controller #1
128	SID 254	12	Red lamp	Engine control unit (EECU)	Controller #1
128	SID 254	13		Engine control unit (EECU)	Controller #1

14. Fault codes, TECU Voith 863,3 retarders and transmission (MID 130)

MID	(P)PID/SID	FMI	Seriousness	Component/function	Display text
130	PID 40	2	-	Hand brake sensor	Retarder switches
130	PID 65	2	-	Foot brake sensor	Brake pedal switch
130	PID 92	2	-	Software	Engine load, %
130	PID 93	2	-	CAN	Engine torque
130	PID 93	14	-	CAN	Engine torque
130	PID 124	1	-	Low oil level	Transm. oil level
130	PID 152	14	-	ECU-Reset	No. of ECU resets
130	PID 158	1	-	Power supply	Battery potential
130	PID 162	2	-	Gear selector switch	Gear selected
130	PID 177	0	-	Temperature sensor	Transm. oil temp.
130	PID 177	5	-	Temperature sensor	Transm. oil temp.
130	PID 177	6	-	Temperature sensor	Transm. oil temp.
130	PID 177	13	-	Temperature sensor	Transm. oil temp.
130	PID 177	14	-	Temperature sensor	Transm. oil temp.
130	PID 190	11	-	Engine speed	Engine speed
130	PID 191	11	-	Output speed	Output shaft speed
130	PID 234	14	-	Frequency output	Software no.
130	SID 1	12	-	Control solenoid valve turbine brake	Solenoid valve #1
130	SID 4	12	-	Control solenoid valve 4 speed clutch	Solenoid valve #4
130	SID 6	12	-	Solenoid valve converter brake	Solenoid valve #6
130	SID 7	12	-	Control solenoid valve pump brake	Lockup sol. valve
130	SID 8	12	-	Control solenoid valve input clutch	Forward sol. valve
130	SID 17	11	-	Turbine speed	Turbine speed
130	SID 52	13	-	Pressure rise fault	Hydraulic system
130	SID 153	14	-	-	-
130	SID 153	14	-	-	-
130	SID 153	14	-	-	-
130	SID 153	14	-	-	-
130	SID 153	14	-	-	-
130	SID 221	14	-	Power supply for brake sensors	Int sensor supply
130	SID 231	9	-	CAN	SAE J1939 data link
130	SID 233	2	-	Message from safety computer	Controller #2
130	SID 238	14	-	Pushbutton switch lightning	Diagnostic lamp RED
130	SID 239	14	-	Central warning light	Diag. lamp AMBER
130	SID 240	14	-	Software	Program memory

15. Fault codes, ZF HP 502 retarder (MID 222) and transmission (MID 130)

MID	(P)PID/SID	FMI	Seriousness	Component/function	Display text
130	PID 1	0		Transmission slip	Invalid data
130	PID 155	3		Not used dig. Out shorted high	Aux. input/output 1
130	PID 155	12		Internal I/O safety switch error	Aux. input/output 1
130	PID 161	2		Turbine speed level error	Input shaft speed
130	PID 161	11		Turbine speed measuring overflow	Input shaft speed
130	PID 177	0		Transmission oil temperature high	Transm. oil temp.
130	PID 177	3		Transmission temperature sensor above	Transm. oil temp.
130	PID 177	4		Transmission temperature sensor below	Transm. oil temp.
130	PID 191	2		Output speed level error	Output shaft speed
130	PID 191	11		Output speed measuring overflow	Output shaft speed
130	SID 1	3		Solenoid valve B shorted high	Solenoid valve #1
130	SID 1	4		Solenoid valve B shorted ground	Solenoid valve #1
130	SID 1	5		Solenoid valve B circuit break	Solenoid valve #1
130	SID 2	3		Solenoid valve C shorted hig	Solenoid valve #2
130	SID 2	4		Solenoid valve C shorted ground	Solenoid valve #2
130	SID 2	5		Solenoid valve C circuit break	Solenoid valve #2
130	SID 225	3		Operating lamp shorted high	Green lamp
130	SID 225	4		Operating lamp shorted ground	Green lamp
130	SID 253	2		Operating time counter checktime error	Calibration memory
130	SID 253	11		Statistik memory checksum error	Calibration memory
130	SID 253	12		Error read error memory	Calibration memory
130	SID 254	11		Internal system error	Controller #1
130	SID 3	3		Solenoid valve D shorted high	Solenoid valve #3
130	SID 3	4		Solenoid valve D shorted ground	Solenoid valve #3
130	SID 3	5		Solenoid valve D circuit break	Solenoid valve #3
130	SID 4	3		Solenoid valve E shorted high	Solenoid valve #4
130	SID 4	4		Solenoid valve E shorted ground	Solenoid valve #4
130	SID 4	5		Solenoid valve E circuit break	Solenoid valve #4
130	SID 5	3		Solenoid valve F shorted high	Solenoid valve #5
130	SID 5	4		Solenoid valve F shorted ground	Solenoid valve #5
130	SID 5	5		Solenoid valve F circuit break	Solenoid valve #5
130	SID 55	2		D1 current resistor	Clutch actuator
130	SID 55	3		D1 current shorted high	Clutch actuator
130	SID 55	4		D1 current shorted ground	Clutch actuator
130	SID 55	5		D1 current circuit break	Clutch actuator
130	SID 6	3		Solenoid valve G shorted high	Solenoid valve #6
130	SID 6	4		Solenoid valve G shorted ground	Solenoid valve #6
130	SID 6	5		Solenoid valve G circuit break	Solenoid valve #6
130	SID 7	3		Torque converter clutch shorted high	Lockup sol.valve
130	SID 7	4		Torque converter clutch shorted ground	Lockup sol.valve
130	SID 7	5		Torque converter clutch circuit break	Lockup sol.valve
130	SID 8	3		Solenoid valve A shorted high	Forward sol. valve
130	SID 8	4		Solenoid valve A shorted ground	Forward sol. valve
130	SID 8	5		Solenoid valve A circuit break	Forward sol. valve
222	PID 1	3		U_Ret shorted high	Invalid data
222	PID 1	4		U_Ret shorted ground	Invalid data
222	PID 62	14		Reduction of retarder function active	Retard inhibit stat
222	PID 120	0		Retarder oil temperature high	Hyd retard oil temp
222	PID 120	3		Retarder temperature sensor above	Hyd retard oil temp
222	PID 120	4		Retarder temperature sensor below	Hyd retard oil temp
222	SID 10	3		Ret_On Valve shorted high	?

MID	(P)PID/SID	FMI	Seriousness	Component/function	Display text
222	SID 10	4		Ret_On Valve shorted ground	?
222	SID 10	5		Ret_On Valve current circuit break	?
222	SID 11	2		Retarder current resistor	?
222	SID 11	3		Retarder current shorted high	?
222	SID 11	4		Retarder current shorted ground	?
222	SID 11	5		Retarder current circuit break	?
222	SID 12	3		Retarder accumulator shorted high	?
222	SID 12	4		Retarder accumulator shorted ground	?
222	SID 12	5		Retarder accumulator circuit break	?
223	PID 163	2		Shifter encoding error	Gear attained
130, 222, 223	SID 231	2		CAN error	SAE J1939 data link
130, 222, 223	SID 250	2		J1708 busoff	SAE J1708 data link
130, 222, 223	SID 250	9		J1708 error warning	SAE J1708 data link

16. Fault codes, Voith 115v retarder (MID 222)

MID	(P)PID/SID	FMI	Seriousness	Component/function	Display text
222	PID 110	0		Eng. coolant temp.	Eng. coolant temp.
222	PID 110	4		Eng. coolant temp.	Eng. coolant temp.
222	PID 110	5		Eng. coolant temp.	Eng. coolant temp.
222	PID 110	13		Eng. coolant temp.	Eng. coolant temp.
222	PID 120	0		Hyd retard oil temp	Hyd retard oil temp
222	PID 120	4		Hyd retard oil temp	Hyd retard oil temp
222	PID 120	5		Hyd retard oil temp	Hyd retard oil temp
222	PID 120	13		Hyd retard oil temp	Hyd retard oil temp
222	PID 158	0		Control unit, battery potential	Battery potential
222	PID 158	1		Control unit, battery potential	Battery potential
222	PPID 30	13		Retarder current, PWM-valve	Retarder current
222	PPID 31	0		Retarder air press.	Retarder air press.
222	PPID 31	3		Retarder air press.	Retarder air press.
222	PPID 31	5		Retarder air press.	Retarder air press.
222	PPID 34	0		ECU, 12V Output	ECU, 12V Output
222	PPID 34	1		ECU, 12V Output	ECU, 12V Output
222	PPID 54	0		ECU +5V output	ECU +5V output
222	PPID 54	1		ECU +5V output	ECU +5V output
222	PPID 55	0		ECU temperature	ECU temperature
222	SID 2	3		Retard modul. Valve	Retard modul. valve
222	SID 2	4		Retard modul. Valve	Retard modul. valve
222	SID 2	5		Retard modul. Valve	Retard modul. valve
222	SID 2	6		Retard modul. Valve	Retard modul. valve
222	SID 231	2		SAE J1939 data link	SAE J1939 data link
222	SID 231	12		SAE J1939 data link	SAE J1939 data link
222	SID 240	2		Program memory	Program memory
222	SID 250	2		SAE J1708 data link	SAE J1708 data link
222	SID 250	4		SAE J1708 data link	SAE J1708 data link
222	SID 253	2		Calibration memory	Calibration memory
222	PSID 1	3		Power supply relay	Power supply relay
222	PSID 1	6		Power supply relay	Power supply relay
222	PSID 254	3		Controller #1	Controller #1

17. Fault codes, retarder 133

To the right of the bus instrument cluster there is a green checklamp (5022) for the retarder function and fault indications. At every voltage inflow the lamp will normally be lit for five seconds, if the lamp doesn't go out after five seconds have passed, a fault code is set in the retarder. The fault codes set in the retarder can be read via blink codes on the checklamp (5022) which can blink with two different intervals, long blink (2 seconds) to represent multiples of ten and short blink (0,5 seconds) to represent singular. For instance a combination of two long and two short blinks represents the number 22. A short look at the table below shows that 22 means "ABS signal internal control unit error".

The fault codes set in the retarder can be show by first turning the ignition on and off and then on again. Then press the lever to the position 1 and immediately back to position 0. The first fault code will now be displayed as an icon on the control lamp. Repeated movement of the lever between position 1 and position 0 will display the next fault code in line, if the same fault code is shown two times in a row there are no more fault codes set in the retarder.

Code	Description
1	Stop light relay short to ground
2	LS1 short to battery
3	HS 1 short to ground
4	HS 2 short to ground
5	Terminal 15 undervoltage
6	Terminal 15 overvoltage
7	Pilot valve short to ground
8	Tw sensor interruption or short to battery
9	Tw sensor short to ground
10	
11	To sensor interruption or short to battery
12	To sensor short to ground
13	RSS undefined switch condition (closing sequence)
14	RSS short to battery
15	RSS short to ground
16	Tachograph signal interruption
17	Pilot valve interruption or short to battery
18	Tachograph signal short to battery or undefined sign.
19	ABS short to ground
20	
21	ABS undefined level
22	ABS signal internal control unit error
23	Prop valve fault No. 1
24	Prop valve fault No. 2
25	Prop valve fault No. 3
26	Prop valve fault No. 4
27	Prop valve fault No. 5
28	Terminal 30 undervoltage
29	Internal fault conc. Safety component
30	
31	Data record/parameter: faulty coding
32	RKL interruption or short to ground
33	RKL short to battery
34	Missing engine speed signal

Code	Description
35	Internal fault concerning: ROM (CRC check). EEPROM (data record)
36	2/2-way valve fault
37	Non-plausibility of brake pedal operation
38	Pressure sensor fault
41	Time-out > 500ms press signal (VECU)
42	Time-out > 500ms ABS-signal (J1939)
43	J 1939 link "bus off".

18. Fault codes, VECU (MID 144)

MID	(P)PID/SID	FMI	Seriousness	Component/Function	Display text
144	PID 29	3	Yellow lamp	Extra throttle, percentage mode	Second throttle
144	PID 29	4	Yellow lamp	Extra throttle, percentage mode	Second throttle
144	PID 46	1		Wet tank air pressure	Wet tank air press
144	PID 46	3	Yellow lamp	Wet tank air pressure	Wet tank air press
144	PID 46	4	Yellow lamp	Wet tank air pressure	Wet tank air press
144	PID 84	2	Yellow lamp	Road speed	Road speed
144	PID 84	5		Road speed	Road speed
144	PID 84	6		Road speed	Road speed
144	PID 84	8	Yellow lamp	Road speed	Road speed
144	PID 84	12	Yellow lamp	Road speed	Road speed
144	PID 84	13	Yellow lamp	Road speed	Road speed
144	PID 91	3	Yellow lamp	Accelerator pedal position, percentage mode	Acc. pedal pos., %
144	PID 91	4	Yellow lamp	Accelerator pedal position, percentage mode	Acc. pedal pos., %
144	PID 152	12		Control unit, number of resets	No. of ECU resets
144	PPID 69	4	Yellow lamp	Buffered idle switch	Buff. idle val. sw.
144	PPID 70	4	Yellow lamp	Pedal contact, feeding	Output supply #3
144	PPID 71	4	Yellow lamp	Constant speed keeper and retarder, feeding switch	Output supply #4
144	PPID 72	3	Yellow lamp	Accelerator pedal and retarder, feeding sensor	Output supply #1
144	PPID 72	4	Yellow lamp	Accelerator pedal and retarder, feeding sensor	Output supply #1
144	PPID 73	3	Yellow lamp	Extra throttle and wet tank, feeding sensor	Output supply #2
144	PPID 73	4	Yellow lamp	Extra throttle and wet tank, feeding sensor	Output supply #2
144	PPID 75	3	Yellow lamp	Range inhibitor	Range inhibitor
144	PPID 75	4	Yellow lamp	Range inhibitor	Range inhibitor
144	PPID 76	3	Yellow lamp	Brake light status relay	Brakelight output
144	PPID 77	3	Yellow lamp	Compressor, status solenoid valve	Compressor control
144	PPID 77	4	Yellow lamp	Compressor, status solenoid valve	Compressor control
144	PPID 79	3	Yellow lamp	Fault gear shift lock 3/1, status relay	Area inh. sol valve
144	PPID 79	4	Yellow lamp	Fault gear shift lock 3/1, status relay	Area inh. sol valve
144	SID 230	7	Yellow lamp	Idle switch 1	Idle valid switch
144	SID 231	2	Yellow lamp	Control link, SAE J1939	SAE J1939 data link
144	SID 231	12	Yellow lamp	Control link, SAE J1939	SAE J1939 data link
144	SID 240	2	Yellow lamp	Program memory	Program memory
144	SID 243	7	Yellow lamp	Constant speed keeper, set switch (SET+/SET-)	CC Set switch
144	SID 250	2	Yellow lamp	Information link SAE J1708	SAE J1708 data link
144	SID 253	2	Red lamp	Calibration memory	Calibration memory
144	SID 253	13	Red lamp	Calibration memory	Calibration memory
144	PSID 1	7	Yellow lamp	Retarder, set switch	Retard contr SET sw
144	PSID 2	7	Yellow lamp	Idle valid switch 2	Idle valid switch 2
144	PSID 3	7	Yellow lamp	Idle valid switch 3	Idle valid switch 3
144	PSID 4	3	Yellow lamp	Retarder, switch	Retard contr lever

SECTION 07: TRANSMISSION

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1. DESCRIPTION

H3 Series vehicles may be provided with either an Allison automatic transmission or a Volvo I-Shift transmission.

1.1 ALLISON AUTOMATIC TRANSMISSION

The B500 and B500R (with retarder) Allison Transmission has 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.

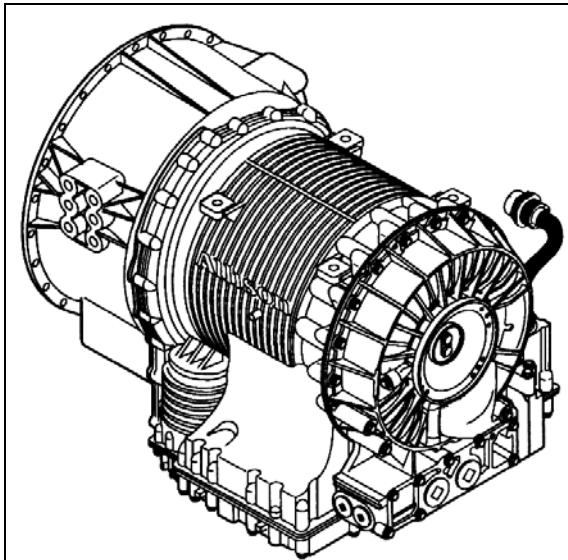


FIGURE 1: ALLISON TRANSMISSION

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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 "9. 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.

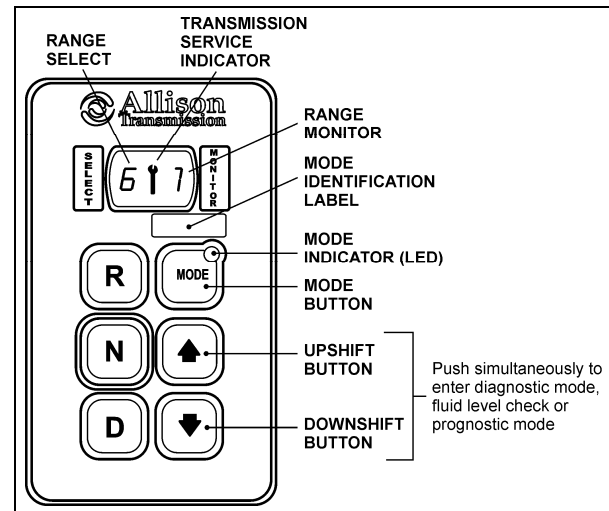


FIGURE 2: ALLISON PUSHBUTTON SHIFT SELECTOR

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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 VOLVO I-SHIFT TRANSMISSION

The Volvo I-Shift transmission is a single countershaft transmission with 12 forward gears and two reverse gears. The I-Shift is an automated mechanical transmission.

If the I-Shift 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.

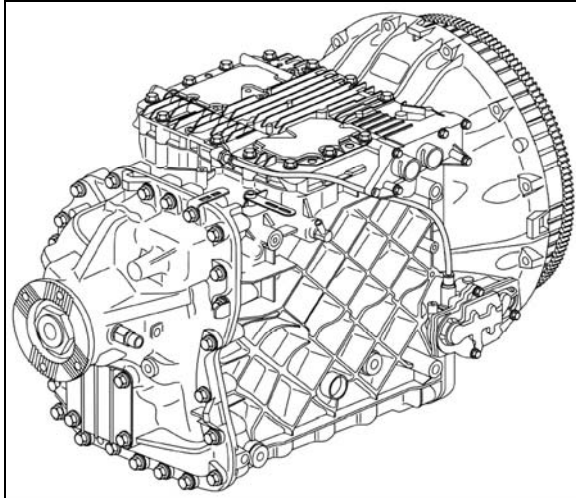


FIGURE 3: VOLVO I-SHIFT TRANSMISSION 07XXX

The transmitted torque (both engine and braking) will be interrupted during gear shifting, in both driving and coasting conditions. There is no clutch pedal and the gear shifting is controlled by the transmission or the driver through the pushbutton shift selector.

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 door; dipstick is located on the radiator side of the engine (Fig. 4).

3.1.1 Manual Fluid level Check

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 using the procedures in Cold Check and Hot Check. 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.

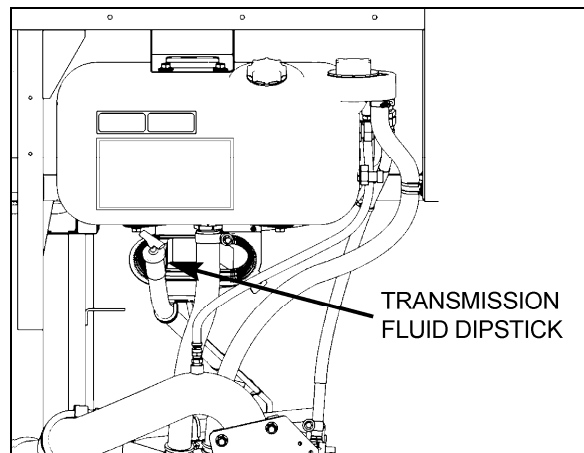


FIGURE 4: OIL LEVEL DIPSTICK (ALLISON) 01195

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.

3.1.2 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. During operation, an overfull transmission can become overheated, leading to transmission damage.

2. Run the engine at idle in «N» (Neutral) for about one minute.
3. Shift to «D» (Drive) and operate the engine for 30 seconds at 1000-1500 rpm; then shift to «R» (Reverse) to clear the hydraulic system of air.
4. Move the vehicle to a level surface, put transmission in «N» (Neutral), and set the parking brake.
5. Finally shift to Neutral (N) and allow the engine to idle (500 - 800 rpm).
6. While the engine is running, remove the dipstick from the tube and wipe it clean (Fig. 4). Insert the dipstick into the fill tube, pushing down until it stops.
7. Remove the dipstick and observe the fluid level. Repeat the check procedure to verify the reading. If the fluid on the dipstick is within the **COLD CHECK** band, the level is satisfactory for operating the transmission until the oil is hot enough to perform a **Hot Check**. If the fluid level **is not** within this band, add or drain fluid as necessary to bring the level within the **COLD CHECK** band.
8. Perform a **Hot Check** at the first opportunity after the normal operating temperature of 160°F to 200°F (71°C to 93°C) is attained.

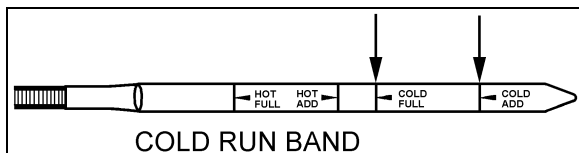


FIGURE 5: COLD CHECK

07050

**CAUTION**

DO NOT operate the transmission for extended periods of time until a **Hot Check** has verified proper fluid level. Transmission damage can result from extended operation at improper fluid level conditions.

**CAUTION**

Obtain an accurate fluid level by imposing the following conditions:

- Engine is idling (500-800 rpm) in «N» (Neutral).
- Transmission fluid is at normal operating temperature.
- The vehicle is on a level surface.

3.1.3 Hot Check

**CAUTION**

The oil **must be hot** to obtain an accurate check because the fluid level rises as temperature increases.

To perform a **Hot Check**, do the following:

1. The **Hot Check** can be performed when the transmission oil reaches the normal operating temperature (160°F to 200°F / 71°C to 93°C). The transmission oil temperature can be checked with the dashboard message center display (MCD) when selecting the Gauge Mode (refer to the "Operator's Manual" for added information).
2. Park the vehicle on a level surface and shift to «N» (Neutral). Apply the parking brake and allow the engine to idle (500 - 800 rpm).
3. Remove the dipstick from the tube and wipe it clean. Insert the dipstick into the fill tube, pushing down until it stops.
4. Remove the dipstick and observe the fluid level. The safe operating level is anywhere within the **HOT RUN** band on the dipstick. Repeat the check procedure to verify the reading.
5. If the level **is not** within this band, add or drain fluid as necessary to bring the level within the **HOT RUN** band.
6. Be sure fluid level checks are consistent. Check level more than once and if readings are not consistent, check to be sure the transmission breather is clean and not clogged. If readings are still not consistent, contact your nearest Allison dealer or distributor.

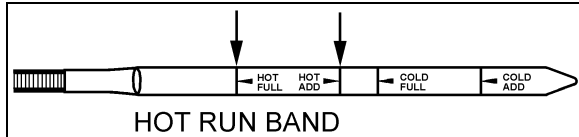


FIGURE 6: HOT CHECK

07049

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 fluid level check using the pushbutton shift selector has priority over the Hot Check.**

3.1.4 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:

DISPLAY	INTERPRETATION
O L...O K	Oil level is correct
O L...L O... 1	Oil Level is LOw 1 quart
O L...L O... 2	Oil Level is LOw 2 quart
O L...L O... 3	Oil Level is LOw 3 quarts
O L...L O... 4	Oil Level is LOw 4 or more quarts
O L...H I... 1	Oil Level is Hlgh 1 quart
O L...H I... 2	Oil Level is Hlgh 2 quarts
O L...H I... 3	Oil Level is Hlgh 3 or more quarts

DISPLAY	INTERPRETATION
O L... - (fc)	Oil Level is invalid. Source of invalid reading is defined by a two-character fault code (fc)

NOTE

Note that the quantities LO 4 and HI 3 are the largest values displayed and that the actual variation in oil level may exceed these numbers.

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.

If the fluid level check cannot be completed, an Invalid for Display fault is reported. This condition is reflected by the display of "OL", followed by "-", followed by one or two additional characters. The displayed characters define the cause of the fault, which may be either a system malfunction or an improper condition for conducting the check.

CODE	CAUSE OF FAULT CODE
OL...-...0X	Waiting period is not complete
OL...-...EL	Engine speed (rpm) too low
OL...-...EH	Engine speed (rpm) too high
OL...-...SN	N (neutral) must be selected
OL...-...TL	Sump oil temperature too low
OL...-...TH	Sump oil temperature too high
OL...-...SH	Output shaft rotation
OL...-...FL	Sensor failure


To exit the Oil Level Display Mode, press any range button: «R», «N» or «D» at any time.

3.1.5 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.

3.1.6 Keeping Fluid 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
<p>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.</p>

3.1.7 Recommended Automatic Transmission Fluid

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 Prevost Parts.

<p>NOTE</p> <p><i>The prognostics package requires the use of TranSynd™ or an Allison approved TES-295 licensed fluid in the transmission and Allison High Capacity filters. If any other fluids or filters are used, Prognostic mode must be disabled. Prognostic information will not be accurate with any other fluids or filters and could result in missed maintenance activities resulting in transmission damage.</i></p>
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- To be sure that 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.

Customers may use TranSynd™/TES 295 equivalent and extend drain intervals. Equivalent TranSynd™ fluid must meet or exceed TES 295 requirements.


Customers may choose from a wide variety of approved Dexron-III® fluids

Customers may choose from a wide variety of approved non-TES 295 like Dexron-III® or approved Schedule 1 TES-389 fluids.

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
<p>Disregarding minimum fluid temperature limits can result in transmission malfunction or reduced transmission life.</p>


<p>NOTE</p> <p><i>The use of an arctic preheat kit is recommended at temperatures below -25°F (-32°C). If a preheat kit is not available, the TCM will restrict full operation until the sump temperature is increased.</i></p>
--

3.1.8 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.

3.1.9 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
<p>If excessive metal contamination has occurred, replacement of the oil cooler and replacement of all bearings within the transmission is recommended.</p>

3.1.10 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.



3.1.11 Control System Prognostics

The transmission control system includes the provision for the user to monitor various transmission operating parameters. Transmission operating parameters monitored by the prognostics feature are:

- Oil Life Monitor
- Filter Life Monitor
- Transmission Health Monitor

<p>NOTE</p> <p><i>The prognostics package requires the use of TranSynd™ or an Allison approved TES-295 licensed fluid in the transmission and Allison High Capacity filters. If any other fluids or filters are used, Prognostic mode must be disabled. Prognostic information will not be accurate with any other fluids or filters and could result in missed maintenance activities resulting in transmission damage.</i></p> <p><i>Refer to TES 295 Approved Fluids list, found under the Service/Fluids heading on the home page of the Allison Transmission web site.</i></p> <p style="text-align: center;">www.allisontransmission.com</p>
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When a specified threshold is detected for any of the serviceable conditions, the TRANSMISSION SERVICE indicator  is illuminated to alert the operator. Failure to attend to the service condition and reset the TRANSMISSION SERVICE indicator within a defined operating period will result in illumination of the CHECK TRANS light on the dashboard telltale panel, indicating the increased probability that the service condition will develop into a more serious condition.

To access the Prognostic Mode functions, simultaneously press the  (Up) and  (Down) arrow buttons repeatedly. See the reference table at the end of this section.

- Oil Life Monitor


The display message denotes the calculated remaining life of the transmission fluid. This value is based on the established life for the required baseline fluid, and then is continuously adjusted for cumulative effects of such operating parameters as operating time, retarder operation, output shaft revolutions and shift frequency.

Display: The display is a two-digit number, denoting percentage of the fluid life which remains. New fluid is displayed as 99%.


The TRANSMISSION SERVICE indicator  will be illuminated, denoting a required change of transmission fluid, when the remaining fluid life reaches approximately 1–2 %. The indicator will be lit steadily upon each initialization of the TCM, and will remain on steady for approximately 1–2 minutes after the first selection of “D” (drive) range each time, until service is performed and the indicator is reset.

Failure to perform maintenance and reset the TRANSMISSION SERVICE indicator within a defined period will result in the illumination of the CHECK TRANS light on the dashboard telltale panel and diagnostic code P0897 Transmission Fluid at Limit will be set.


Reset: The TRANSMISSION SERVICE indicator can be reset by a message over the SAE J1939 communication interface, with the Allison DOC™ for PC diagnostic program, or by depressing and holding the MODE button for ten (10) seconds while the Oil Life Monitor function is displayed. It may also be reset by selecting N-D-N-D-N-R-N on the shift selector, pausing briefly (less than 3 seconds) between each selector movement, with the ignition on and the engine not running.

 CAUTION
<p>Required calendar-based oil & filter change intervals (based on month) still apply because Oil Life Monitor function cannot measure time while ignition power is OFF.</p> <p>If the Oil Life Monitor function has not indicated the need for a fluid change before 60 month (five years) have passed, it will be necessary to change the fluid and filters per calendar requirements and reset the system.</p>

- Filter Life Monitor

The display message denotes operating status of the transmission main fluid filter, based on the measured pressure drop across the filter. The feature is not functional at transmission sump temperatures below 40 °C (105 °F). Both the main and lube filters **must be** changed when the TRANSMISSION SERVICE indicator  shows the main filter should be changed.

Display: An acceptable filter life status is displayed as "OK". An unacceptable filter life status is displayed as "LO".

Once the programmed threshold for maximum filter pressure drop has been observed and verified, the diagnostic code P088A Transmission Filter At/Over Limit will be recorded to indicate that the filter has reached the end of its designed life. At the next initialization of the TCM, the TRANSMISSION SERVICE indicator  will flash for approximately 1–2 minutes after the first selection of "D" (drive) range. Thereafter, the indicator will illuminate and flash upon each TCM initialization, continuing to flash for 1–2 minutes after the first selection of a drive range each time, until service is performed and the indicator is reset.

Failure to perform maintenance and reset the monitor after a calibration-defined number of warnings will result in the illumination of the CHECK TRANS light on the dashboard telltale panel and diagnostic code P088B will be recorded to indicate a highly deteriorated filter.

Reset: The feature will reset automatically when the main fluid filter has been changed and the pressure drop across the filter no longer exceeds the threshold value. A manual reset can be performed by depressing and holding the MODE button for ten (10) seconds while the Filter Life Monitor function is displayed. It may also be reset by selecting N-R-N-R-N-D-N on the shift selector, pausing briefly (less than 3 seconds) between each selector movement, with the ignition on and the engine not running.

- Transmission Health Monitor

The display message denotes clutch life status, as determined by monitored changes and the calculated running clearance of the transmission clutches C1, C2, C3, C4 & C5.

Display: An acceptable clutch life status is displayed as "OK". An unacceptable clutch life status is displayed as "LO". The specific clutch(es) for which the function indicates "LO" cannot be identified with the shift selector. Allison DOC™ for PC-Service Tool displays clutch condition as OK or NOT OK for each clutch, C1 through C5.

The TRANSMISSION SERVICE indicator will be illuminated, indicating the need for clutch maintenance, when the remaining clutch life reaches approximately 10%, or if the running clearance exceeds a maximum value which may indicate a non-wear-related issue. Thereafter, the indicator will be lit upon each initialization of the TCM, and will remain on steady during all vehicle operation until service is performed and the indicator is reset.

Failure to perform maintenance and reset the monitor after a number of warnings will result in the illumination of the CHECK TRANS light on the dashboard telltale panel and diagnostic code P2789 Clutch Adaptive learning at Limit will be set.

Reset: The feature will reset automatically upon elimination of the clutch clearance condition which initiated it. The indicator can also be manually reset using the Allison DOC™ for PC diagnostics program if necessary.

Section 07: TRANSMISSION

The following table illustrates how to access Oil Level Check, Prognostics & Diagnostic Troubleshooting Codes functions on the Allison pushbutton shift selector.

▲ (up) & ▼ (down) arrow buttons pressed simultaneously	Description	SELECT	MONITOR
1 st press	Allison transmission oil level check	" _ "	" _ "
	Other codes will be displayed		
2 nd press	Oil Life Monitor	" O "	" M "
	Oil life remaining will range from 99% down to 00%	Some number from 9 to 0	Some number from 9 to 0
3 rd press	Filter Life Monitor	" F "	" M "
	Present life of filter is OK	" O "	" K "
	Present life of filter is low	" L "	" O "
4 th press	Transmission Health Monitor	" O "	" K "
	Shows "OK" until remaining life of one or more of the clutch(es) wear enough so that the programming changes	" O "	" K "
	One or more of the clutches C1 through C5 have worn enough to change the program	" L "	" O "
5 th press	Display of diagnostic codes	" d "	" 1 "
	Other codes will be displayed		

TABLE 1

Recommended Fluid and Filter Change Intervals Using Dexron-III/Non-TranSynd™/ Non-TES 295 / Mixture							
Severe ³ Coaches or MTH equipped with retarder				General ⁴ Coaches or MTH without retarder			
Fluid	Filters			Fluid	Filters		
	Main	Internal	Lube/ Auxiliary		Main	Internal	Lube/ Auxiliary
12,000 Miles (20 000 km) 6 Months/ 500hrs	12,000 Miles (20 000 km) 6 Months/ 500hrs	Overhaul	12,000 Miles (20 000 km) 6 Months/ 500hrs	25,000 Miles 40 000 km 12 Months/ 1000hrs	25,000 Miles 40 000 km 12 Months/ 1000hrs	Overhaul	25,000 Miles (40 000 km) 12 Months/ 1000hrs

2 inch Control Module (1.75 approximately) – Requires High-Capacity Filter Kit Allison P/N 571709

TABLE 2

Recommended Fluid and Filter Change Intervals ¹ Using 100% TranSynd™/TES 295 Approved Fluid ²							
Severe ³ Coaches or MTH equipped with retarder				General ⁴ Coaches or MTH without retarder			
Fluid	Filters			Fluid	Filters		
	Main	Internal	Lube/ Auxiliary		Main	Internal	Lube/ Auxiliary
150,000 Miles (240 000 km) 48 Months/ 6000hrs	75,000 Miles (120 000 km) 36 Months/ 3000hrs	Overhaul	75,000 Miles (120 000 km) 36 Months/ 3000hrs	300,000 Miles (480 000 km) 48 Months/ 6000hrs	75,000 Miles (120 000 km) 36 Months/ 3000hrs	Overhaul	75,000 Miles (120 000 km) 36 Months/ 3000hrs

¹ Extended TranSynd™/TES 295 fluid and filter change intervals are only allowed with Allison High-Capacity filters.

² Less than 100% concentration of TranSynd™/TES 295 approved fluid is considered a mixture and should utilize non-TES 295 change intervals. If the customer replaces non-TranSynd™/non-TES 295 fluid with TranSynd™/TES 295 equivalent, the change interval recommendations of non-TranSynd™/non-TES 295/mixture must be followed. Upon the next oil change, if the customer reinstall TranSynd™/TES 295 equivalent, the fluid & filter change recommendation outlined in 100% TES 295 approved fluids must be followed.

³ Severe vocation= All retarder, On/Off highway, transit and intercity coach with duty cycle greater than one (1) stop per mile.

⁴ General vocation= intercity coach with duty cycle less than or equal to one (1) stop per mile and all other vocations not listed in severe vocation.

3.1.12 Oil And Filter Change Interval

- Oil And Filter Change Interval With Prognostics Mode Disabled

Allison transmissions are factory fill with **Castrol 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 or TABLE 2" for oil and filter change intervals when PROGNOSTIC MODE is **disabled**. More frequent changes may be required when operations are subject to high levels of contamination or overheating. Filters must be changed at or before recommended intervals.

IMPORTANT NOTE

Allison Transmission recommends that customers use fluid analysis as the primary method for determining fluid change intervals. Many customers have a systematical annual transmission fluid change while, in many cases, fluid analysis could demonstrate that the transmission fluid is still in good condition and a fluid change is not required. In the absence of a fluid analysis program, the fluid change interval listed in TABLE 1 & TABLE 2 should be used.

IMPORTANT NOTE

Your transmission is equipped with **High Capacity filters**. High Capacity filters allow for increased fluid and filter change intervals in transmissions utilizing TES 295 approved fluid/TranSynd™. High Capacity filters eliminate the requirement of the initial 5000 miles (8000km) main filter change.

- Oil And Filter Change Interval With Prognostics Mode Enabled

Oil Life Monitor and Filter Life Monitor of the Prognostics mode provide indicators of required maintenance actions. They are designed to maximize fluid and filter utilization. **Prognostics enabled requires the use of 100% TranSynd™ or an Allison approved TES-295 transmission fluid and Allison High Capacity filters**. If any other fluids or filters are used, Prognostic mode **must be disabled**. Prognostic information will not be accurate with any other fluids or filters and could result in missed maintenance activities resulting in transmission damage.

IMPORTANT NOTE

The following schedule is to be used with Prognostics enabled.

100% concentration of TES-295 Allison approved fluids and Allison High Capacity Filters is **required**. Less than 100% concentration of TES-295 Allison approved fluids are considered a mixture and shall not be used with Prognostics mode or this change schedule. Utilization of previous Non-TES 295 fluid/filter change intervals (Table 1) is required.

	General or Severe Vocation
FLUIDS Prognostics enabled	Change fluid when indicated by TRANSMISSION SERVICE indicator or 60 month (five years) whichever occurs first. In addition, change filters with fluid.
FILTERS Prognostics enabled	Change filters (Main & Lube) when indicated by TRANSMISSION SERVICE indicator between fluid change or 60 month (five years) whichever occurs first.

- Changing The Transmission Oil And Oil Filters

The procedure for changing the transmission oil and oil filters is as follows:

Drain

- The transmission should be at an operating temperature of 160°F (71°C) to 200°F (93°C) 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.

- 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.
- 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).
- 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 Ft-lbs (51-61 Nm).
6. Inspect the drain plug and O-ring. Replace if necessary. Reinstall the drain plug and tighten to 18-24 Ft-lbs (25-32 Nm).
7. Reinstall transmission protective panel.

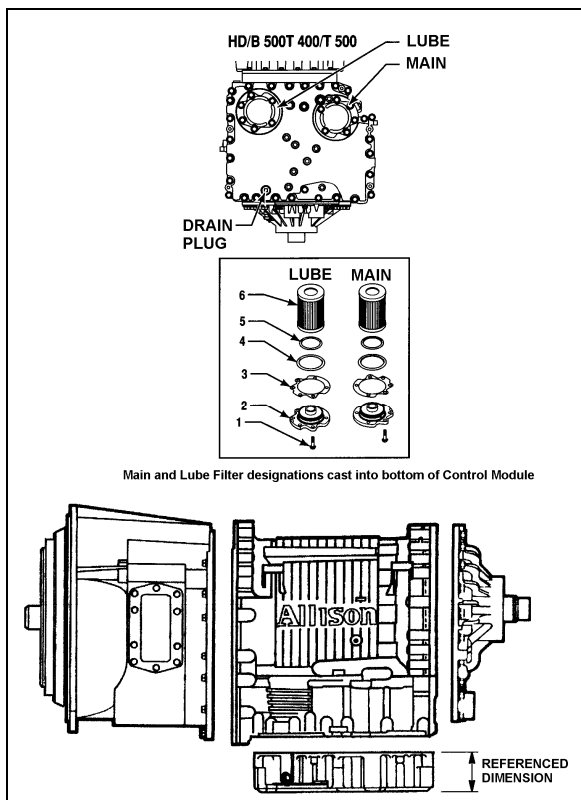


FIGURE 7: DRAIN PLUG AND FILTERS 07052

Fluid loss with filter change only

When changing main and lube filters at recommended intervals, approximate fluid loss for each filter as follows:

- Main filter = 2 quarts (1.9 liters)
- Lube filter = 8 quarts (7.6 liters)

Refill transmission

The amount of refill fluid is less than the amount used for the initial fill. Fluid remains in the external circuits and transmission cavities after draining the transmission.

NOTE

Quantities listed below are approximations and do not include external oil cooler lines.

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 **Fluid Level Check Using Pushbutton Shift Selector** procedure in this section.

3.2 VOLVO I-SHIFT TRANSMISSION

3.2.1 Transmission Oil



CAUTION

Only use Castrol Syntrans SAE 75W85 (Prevost #684516) gearbox oil in the I-Shift transmission. Using non-approved oil can result in damage to transmission components.



CAUTION

Never reuse drained I-Shift oil. The oil must be replaced along with the oil filter. Reusing drained oil can result in damage to transmission components.

Keep the transmission oil at the proper level and change it at the Volvo recommended intervals. Always replace the oil filter when the oil is changed. Always use the Volvo approved synthetic oil whenever adding or changing the transmission oil.

3.2.2 Checking Oil Level

Check the transmission oil level at each service interval. Park the vehicle on a level surface. Check the oil level through the sight glass on the side of the transmission. Add oil as necessary. Always use the correct Volvo approved synthetic oil (Castrol Syntrans SAE 75W85).

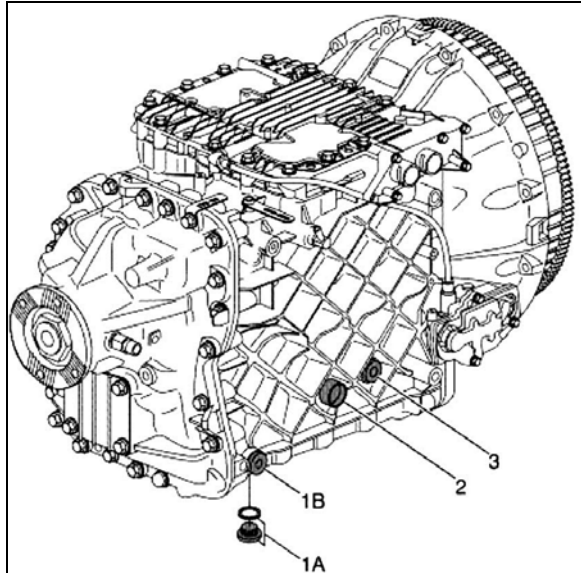


FIGURE 8: I-SHIFT TRANSMISSION OIL CHANGE

- Vehicle should be on horizontal ground when oil is changed;
- Do not check oil level straight after a journey (incorrect measurement). Undertake the check once the transmission oil has cooled down (lower than 104°F or 40 °C);
- Check oil level using transmission sight glass (2) ;

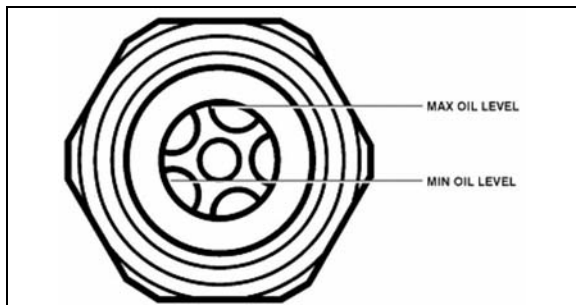


FIGURE 9: SIGHT GLASS FOR CHECKING OIL LEVEL

- Add oil through the oil filling point if necessary (3) ;
- Torque tighten fill plug to 26±4 lb-ft (35±5 Nm).

3.2.3 Oil Change Interval

The length of time a transmission can operate before an oil change is required depends on the quality of the oil used and the vehicle application.



MAINTENANCE

For on-highway applications, change the transmission oil every 800 000 km (500,000 miles) or every 5 years whichever occurs first. This extended oil change interval only applies when using Castrol Syntrans SAE 75W85. Always replace the oil filter when the oil is changed.

For all other vehicle applications and/or when not using Castrol Syntrans SAE 75W85, change the transmission oil every 400 000 km (250,000 miles) or every 3 years whichever occurs first.

Always use Volvo approved synthetic oil (Castrol Syntrans SAE 75W85) whenever changing the transmission oil.

3.2.4 Oil Change

Approximately 15 liters (16 quarts) is needed for a complete oil change.



WARNING

Hot oil can cause burns. DO NOT allow hot oil to contact the skin. When changing oil, wear protective gloves.

Remove the drain plug from under the transmission (1A or 1B, Fig. 8) and allow the oil to drain into a suitable container.

Inspect the drain plug and O-ring. Replace if necessary. Reinstall the drain plug and tighten to 26±4 lb-ft (35±5 Nm).



CAUTION

Always dispose of all lubricants (engine oil, coolant, transmission oil, etc) and filters according to Federal or local regulations.

Change the oil filter (#20779040) at every oil change. Drain the oil filter housing before you remove the filter.

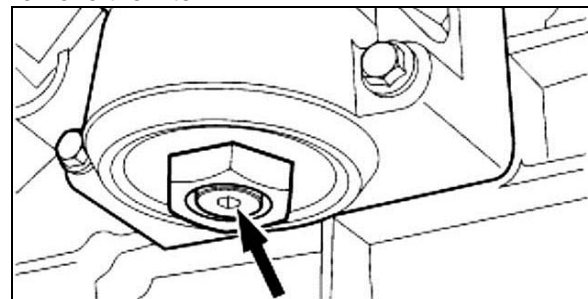


FIGURE 10: OIL FILTER HOUSING DRAIN PLUG

NOTE

Torque tighten oil filter housing drain plug to 16 ± 2 Nm (12 ± 1 lb-ft).

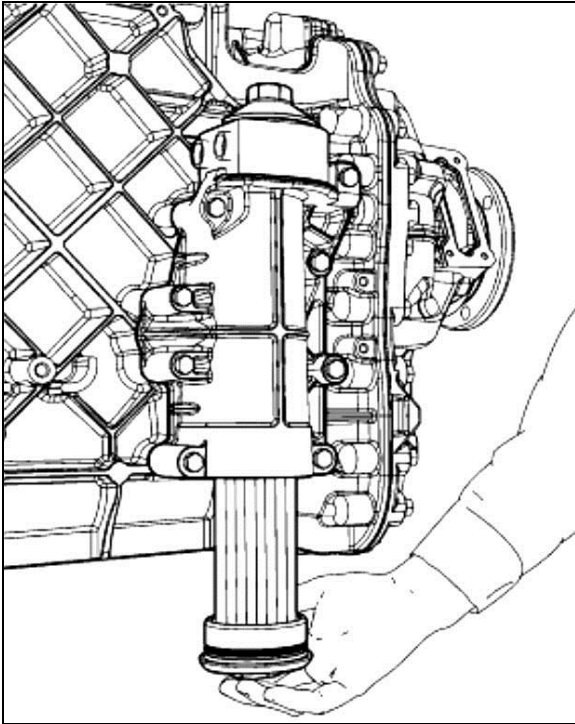


FIGURE 11: OIL FILTER

4. 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, and 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 "3.1.11 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.

NOTE

Remove starter motor located on engine L.H. side. Removing the starter motor will allow access to unfasten the 12 converter-to-flexible plate attaching screws. Remove the plug located below starter motor and install cranking tool (88800014). Cranking the engine to gain access to the attaching screws may be done by turning the cranking tool using a suitable adapter (fig. 12).

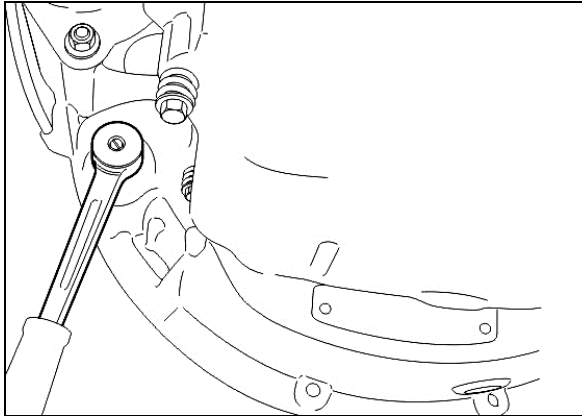


FIGURE 12: VOLVO ENGINE CRANKING POSITION



CAUTION

Do not rotate alternator shaft clockwise to avoid removing tension on belt.

14. 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.

15. Slowly pull transmission straight out to clear the engine.
16. Remove the transmission.

5. TRANSMISSION OIL COOLER REMOVAL

5.1 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. Remove the rear L.H. side tag axle wheel, then remove the rear L.H. side fender panel.
2. Disconnect the two transmission hoses from oil cooler. Cover hose ends and fittings to prevent fluid contamination (fig.13).



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.
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.

5.2 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. Remove the rear L.H. side tag axle wheel, then remove the rear L.H. side fender panel.
3. Disconnect the transmission hoses from oil cooler. Cover hose ends and fittings to prevent fluid contamination.

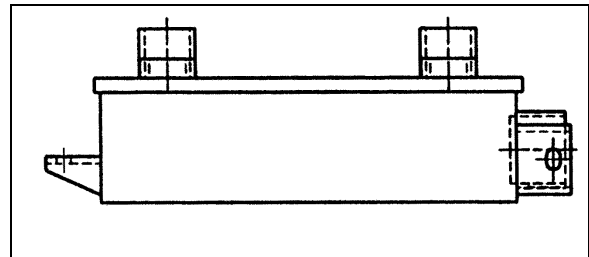


FIGURE 13: COOLER WITH RETARDER 07073



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.

6. CLEANING AND INSPECTION OF 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. Loosen 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
<p>DO NOT pressure wash the transmission electrical connectors. Water and detergent will cause the contacts to corrode or become faulty.</p>

6.1 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.

7. ALLISON TRANSMISSION INSTALLATION


<p>NOTE</p> <p><i>For more clearance between the tag axle and transmission, the tag axle may be unloaded and jacked up, or retracted (if applicable).</i></p> <p><i>With the starter motor removed, align one of the 12 attaching screw holes in the flexible plate with the access opening.</i></p>

1. Place the transmission on a transmission jack.
2. Install a headless guide bolt into one of the 12 threaded holes for flexible plate attaching screws in the flywheel.
3. Lubricate the flywheel center pilot boss with molybdenum disulfide grease (Molycote G, or equivalent).
4. 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
<p>Severe damages and/or personal injury can occur if transmission is not adequately supported.</p>

5. 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
<p>The torque converter housing must be seated against the flywheel housing prior to tightening any screws. DO NOT USE SCREWS TO SEAT THE HOUSING.</p>

6. 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).
7. 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.

<p>NOTE</p> <p><i>Remove the plug located below starter motor and install cranking tool (88800014). Crank the engine to gain access to the threaded holes by turning the cranking tool using a suitable adapter (Refer to fig. 11).</i></p> <p><i>Reinstall starter motor and connect cables.</i></p> <p><i>Reinstall access plug below starter motor.</i></p>

8. Remove jack from under transmission.
9. Connect all sensors.
10. Connect the main wiring harness.
11. Connect the air supply line (steel-braided hose) to the retarder control valve (if applicable).

12. Connect the two transmission oil cooler hoses as they were previously.
13. Reinstall clamps and brackets, and replace locking ties previously removed during removal procedure.
14. Install propeller shaft and its safety guard. Refer to Section 09, "PROPELLER SHAFT".
15. Install transmission dipstick and filler tube.
16. Install cross member under transmission.
17. Install engine splash guards.
18. 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 at back of engine compartment, on R.H. side (Fig. 14) or in the R.H. side rear service compartment.
19. 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.

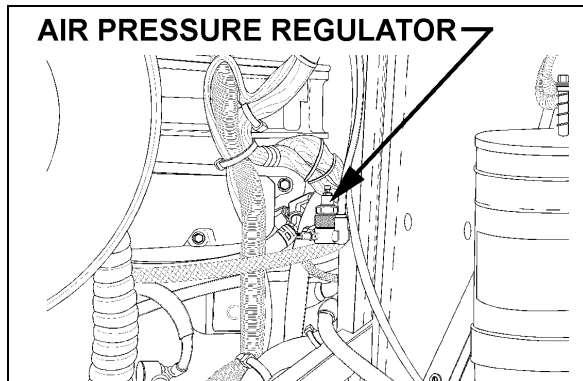


FIGURE 14: AIR PRESSURE REGULATOR (TYPICAL) 07037

8. ALLISON AUTOMATIC TRANSMISSION TROUBLESHOOTING

For complete information about Allison transmission troubleshooting, refer to "Allison 4th Generation Controls – Troubleshooting Manual: 3000 and 4000 Product families (TS3989)".

8.1 4TH GENERATION TRANSMISSION CONTROL MODULE

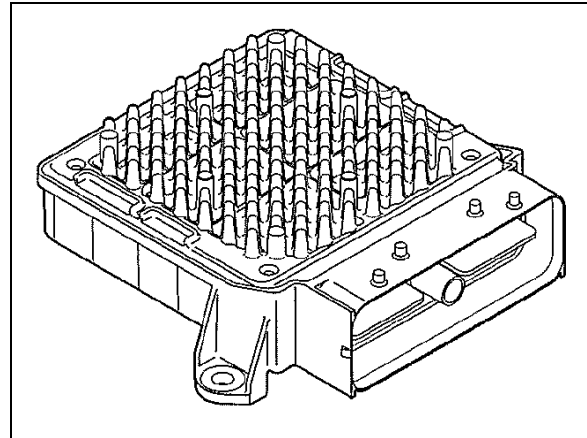


FIGURE 15: TRANSMISSION CONTROL MODULE 07140

The Allison transmission has a new Transmission Control Module (TCM) which involves specific diagnostic incident codes. The TCM unit is located in the coach main power 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 main power compartment 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.

8.2 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.

8.3 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.

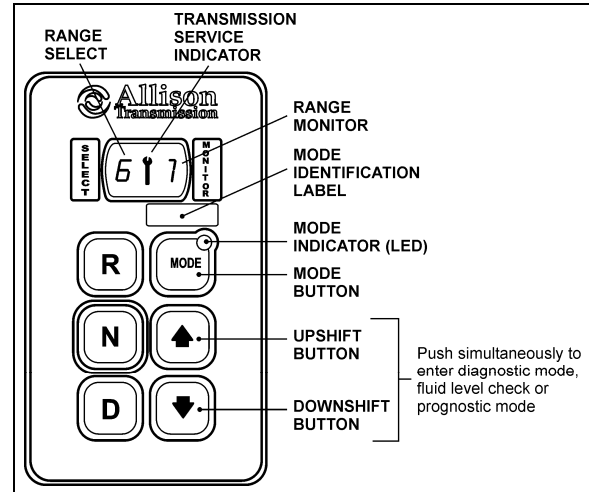


FIGURE 16: ALLISON PUSHBUTTON SHIFT SELECTOR

8.4 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.

8.5 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.

8.6 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.
P0561	System Voltage Performance		
P0562	System Voltage Low		
P0563	System Voltage High		
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)
P0667	TCM Internal Temperature Sensor Circuit Range / Perform		
P0668	TCM Internal Temperature Sensor Circuit Low		
P0669	TCM Internal Temperature Sensor Circuit High		
P0701	Transmission Control System Performance		
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.
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

Section 07: TRANSMISSION

DTC	Description	CHECK TRANS Light	Inhibited Operation Description
P071D	General Purpose Input Fault	Yes	None
P0720	Output Speed Sensor Circuit		
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 6 th Gear Ratio	Yes	DNS, Attempt 5 th , then 3 rd
P0730	Incorrect Neutral Gear ratio		
P0731	Incorrect 1 st Gear ratio	Yes	DNS, Attempt 2 nd , then 5 th
P0732	Incorrect 2 nd Gear ratio	Yes	DNS, Attempt 3 rd , then 5 th
P0733	Incorrect 3 rd Gear ratio	Yes	DNS, Attempt 4 th , then 6 th
P0734	Incorrect 4 th Gear ratio	Yes	DNS, Attempt 5 th , then 3 rd
P0735	Incorrect 5 th Gear ratio	Yes	DNS, Attempt 6 th , then 3 rd , then 2 nd
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
P0847	Transmission Pressure Switch 2 Circuit Low		
P0848	Transmission Pressure Switch 2 Circuit High		
P088A	Transmission Fluid Filter Deteriorated		
P088B	Transmission Fluid Filter Very Deteriorated		
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
P0961	Pressure Control Solenoid (PCS) MM System Performance		
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)
P0965	Pressure Control Solenoid (PCS) 2 System Performance		
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)
P0969	Pressure Control Solenoid (PCS) 3 System Performance		
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)

DTC	Description	CHECK TRANS Light	Inhibited Operation Description
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 2 nd 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)
P2719	Pressure Control Solenoid (PCS) 4 System Performance		
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)
P2728	Pressure Control Solenoid (PCS) 1 System Performance		
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
P2737	Pressure Control Solenoid (PCS) 5 System Performance		
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
P2762	TCC PCS Control Circuit Range / Performance		
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
P2772	Four Wheel Drive Low Switch Circuit Performance		
P278A	Kickdown Input Failed ON	No	Inhibit kickdown operation

Section 07: TRANSMISSION

DTC	Description	CHECK TRANS Light	Inhibited Operation Description
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)
P2813	Pressure Control Solenoid (PCS) 6 System Performance		
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

9. VOLVO I-SHIFT TRANSMISSION TECU FAULT CODES

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
Brake switch	PID65	FMI14	Brake interlock active	Activate: The gearlever is moved from neutral without prior application of the service brake Deactivate: The gearlever is returned to neutral or the vehicle speed is above 5km/h	White lamp is sent together with a pop-up message The transmission will not engage the selected gear (stays in neutral)	Conditions for activation: (and) The brake interlock function is activated (VTNA vehicles only) The vehicle speed is below 5km/h The gear lever is moved from neutral or in folded position without prior activation of the service brake or parking brake Conditions for deactivation: (either) The vehicle speed is above 5km/h The gearlever is returned to neutral or folded position
Calibration memory	SID253	FMI13	Out of range	Active: Flash CS dataset error or program code missing Deactivate: Flash CS OK	Yellow lamp is sent Cranking is inhibited Engine can not start	
Clutch cylinder slip point position	PPID51	FMI13	Calibration value out of range	Activate: 1. The CS in NVRAM is not correct, or 2. The slip point has not been	Yellow lamp is sent The vehicle can not drive	

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
				calibrated Deactivate: Slip point has been successfully calibrated		
Clutch load on plates	PID50	FMI0	Data valid but above normal operational range	Activate: The calculated stored energy is above 200kJ. The energy calculation is time-based for VTNA and physical for others. Deactivate: 7.0s after activation and, energy below 180 kJ or neutral, or driving without clutch slip	Yellow lamp is sent Start gear changed to gear 1 in A/D, for RTC also in M The clutch is overheated The clutch is slowly engaged	Clutch load on plates are set without any filtering
Clutch load on plates		FMI11	Clutch protection active (unidentifiable error)	Activate: Only activated for VTNA. Clutch slip more than 8.0s with vehicle movement less than 0.8m (e.g. hill holding event) Deactivate: 7.0s after activation and, acc pedal released more than 6.0s or neutral, or driving without clutch slip	Yellow lamp is sent Start gear changed to gear 1 in A/D, for RTC also in M There has been unnecessary clutch slip The clutch is slowly engaged	
Clutch load on plates		FMI14	Special instructions	Activate: If there is an attempt to start on a high range gear or above gear 4 in VTNA in manual mode Deactivate: The start gear is changed to an allowed gear	White lamp is sent Not possible to start	This fault code is not saved
Clutch plate wear condition	PID36	FMI0	Data valid but above normal operational range	Activate: The clutch wear is more than or equal to "Service due position" Deactivate: The clutch disc is replaced and calibrated	Yellow lamp is sent If active during a long time the clutch may wear out and become damaged	
Clutch position sensor supply (SEPoC5V)	PPID54	FMI0	Data valid but above normal operational range	Activate: Voltage is above normal range Deactivate: Voltage is within normal range	Yellow lamp is sent Reduced clutch performance Reduced gearbox comfort at start and marshalling	

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FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
					Gear changes are slow	
Clutch position sensor supply (SEPoC5V)		FMI1	Data valid but below operational range	Activate: Voltage is below normal range Deactivate: Voltage is within normal range	Yellow lamp is sent Reduced clutch performance Reduced gearbox comfort at start and marshalling Gear changes are slow	
Clutch system	PSID27	FMI0	Unintentional disengagement of the clutch	Activate: 1. The clutch disengages when not commanded and, 2. There is no active fault code on the SEPoC and, 3. There is no active fault code for low air pressure and, 4. There is no active fault code on any of the clutch cylinder valves and, 5. The PCB temperature is above a specific limit Deactivate: The clutch response is OK	Yellow lamp is sent Slow gear changes Low clutch performance	Detailed conditions to activate/deactivate The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row in order to set the fault code: - The clutch has been engaged for less than 10s with inactive engagement valves - The clutch cylinder position has been at least 1mm below the engaged limit at some point during this time - The clutch leaves the engaged state - The clutch disengagement valves are inactive - There is no active fault code on any of the clutch cylinder position sensor (SEPoC) the clutch valves - There is no active fault code for low air pressure - The PCB temperature is above 10 dgC <i>The fault is deactivated if any of the following conditions are fulfilled:</i> - The clutch has been engaged for more than 20s with inactive engagement valves - There is an active fault code for the clutch cylinder position sensor (SEPoC)
Clutch system		FMI1	Unintentional engagement of the clutch	Activate: 1. The clutch engages when not commanded and, 2. There is no active fault code on the SEPoC and, 3. There is no active fault code for low air pressure and, 4. There is no active fault code on any of the clutch cylinder	Yellow lamp is sent Slow gear changes Low clutch performance	Algorithm for activation/deactivation The following sequence must be passed three times (only once if the fault code-filter is switched OFF) in order to activate: - The clutch is near the disengaged position - All clutch valves are deactivated - The initial average clutch position is calculated during 0.1s - Wait for 3s - The final average clutch position is calculated during

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
				valves and, 5. The PCB temperature is above a specific limit Deactivate: The clutch response is OK		0.1s - If the position has moved more than 1mm in the engagement direction, the FMI is set, else if the clutch has moved less than 0.2mm in the engagement direction the FMI is reset. <i>Additional conditions for activation:</i> - There is no active fault code on any of the clutch cylinder position sensor (SEPoC) the clutch valves low air pressure - The PCB temperature is above 10dgC
Clutch system		FMI7	Mechanical system not responding properly	Activate: 1. The clutch does not disengage/engage properly when commanded 2. There is no active fault code on the SEPoC and, 3. There is no active fault code for low air pressure and, 4. There is no active fault code on any of the clutch cylinder valves and, 5. The PCB temperature is above 10 dgC Deactivate: The clutch response is OK	Yellow lamp is sent Slow gear changes Low clutch performance	Detailed conditions to activate/deactivate One of the following conditions must be fulfilled three times in a row in order to activate the fault: - The clutch position is more than 2mm from the disengaged position, after control of the clutch to the disengaged position during 1.0 s - The clutch position is not in the interval [set point +3mm; set point -1mm] after control of the clutch to near the slip point position during 1.0s - The clutch position is more than 2.5mm from the engaged position, after control of the clutch to the engaged position during 1.0s <i>The fault is deactivated after three successful occurrences, of control of the clutch to the requested position in 0.5s</i> The fault is also deactivated if - There is an active fault on the clutch position sensor - There is an active fault on any of the clutch valves - There is an active fault code for low air pressure - The PCB temperature is below 10 dgC
Clutch system		FMI12	Unintentional clutch slip	Activate: The clutch can not transfer a specific torque without slipping Deactivate: The clutch can transfer a specific torque without slipping	Yellow lamp is sent The engine torque is reduced so that the clutch does not continue to slip	Detailed conditions Activation: - Clutch slip is detected when the engine torque is already reduced below the "Clutch slip warning torque level" in an attempt to prevent clutch slip. The clutch slip warning level is 2500Nm for MD16 (TMF) variants and 2000Nm for other variants (SMF) - There is no active fault on

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FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
						any of: the sensor for the countershaft speed (SECS) the sensor for the clutch position (SEPoC) and the engine torque & engine speed is received from the engine ECU Deactivation: The clutch can transfer the maximum engine torque without slipping the fault is also deactivated at startup of the system
Clutch system		FMI11	Clutch drag	Activate: The clutch transfers too much torque in disengaged position Deactivate: The clutch transfers no torque in disengaged position	Yellow lamp is sent The clutch wear is high	Algorithm for activation/deactivation - Start the check when the counter shaft has been stopped with the brake during slip point calibration when the gearlever is in neutral during normal operation. - Release the brake and check the input shaft speed after 0.5s if input shaft speed > 300rpm, activate this fault code if input shaft speed < 300rpm, deactivate this fault code - Continue with the slip point calibration
Digital input flash NVRAM programming enable (DIEE)	PSID254	FMI3	Voltage above normal or shorted high	Activate: The voltage level for DIEE-pin is high Deactivate: The voltage for the DIEE-pin is low	Yellow lamp is sent Cranking is inhibited Engine can not start All communication with the control unit is disabled except from programming of MSW	The boot-program does not save any fault codes
Digital input flash NVRAM programming enable (DIEE)		FMI3	Voltage above normal or shorted high	Active: The voltage level for DIEE-pin is high Deactivate: The voltage for the DIEE-pin is low	Yellow lamp is sent	If the DIEE-pin is high during normal operation the fault code is saved.
Fast clutch valves low side (VAF-)	PSID5	FMI3	Voltage above normal or shorted high	Activate: The low-side drive is short circuit to Ubatt Deactivate: The low-side drive is OK	Yellow lamp is sent Fast engagement/disengagement disabled Reduced clutch performance Gear changes are slow	
Fast clutch valves low side (VAF-)		FMI6	Current above normal or grounded circuit	Activate: 1. The low-side drive is short circuit to Gnd and 2. There is no active fault code	Yellow lamp is sent Fast engagement/disengagement disabled	

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
				for short circuit to Gnd on VAFE or VAFD Deactivate: The low-side drive is OK	Reduced clutch performance Gear changes are slow	
Gearbox brake	PSID28	FMI7	Mechanical system not responding properly	Activate: The gearbox brake does not brake when the valve is activated	Yellow lamp is sent Slow gear changes at standstill	Detailed conditions The following conditions must be fulfilled for five activations (only one with the fault code-filter switched OFF) of the gearbox brake in order to activate the fault code: - The activation must last for at least 0.2s - There is no active fault code on the sensor for the split cylinder position (SEPoS) - The minimum value of the derivative of the input shaft speed during activation is greater than -500 rpm/s - There is no active fault on any of the gearbox brake valve (VAGB) the sensor for the countershaft speed (SECS) the sensor for the split cylinder position (SEPoS) low air pressure. The following conditions must be fulfilled for one activation of the gearbox brake in order to deactivate: - The minimum value of the derivative of the countershaft speed during the activation is greater than -1000rpm/s The fault is also deactivated if there is an active fault on the countershaft speed sensor (SESC), on the gearbox brake valve (VAGB), or the split position sensor (SEPoS)
Gears 1/R engagement system	PSID25	FMI0	Unintentional disengagement of 1:st gear	Conditions to set the fault code: -The 1/R cylinder leaves the 1:st position -The 1:st cylinder valves are inactive	Yellow lamp is sent Loss of torque	Detailed conditions to activate/deactivate The following conditions must be fulfilled three times (only one time if the fault code filter is switched OFF) in a row in order to set the fault code: (engagement of another gear will reset the count) - The 1/R cylinder position indicates that the 1/R gear leaves the 1:st position - The 1:st cylinder valves are inactive - There is no active fault on any of the sensor for the position of the 1/R cylinder (SEPo1R) the valve for shift

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FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
						to 1:st gear the valve for shift to reverse gear - There is no active fault code for low air pressure <i>Note: The fault will always have the state inactive.</i> Check the fault count and last occurrence to get more information.
Gears 1/R engagement system		FMI1	Unintentional disengagement of reverse gear	Conditions to set the fault code: -The 1/R gear leaves the reverse position -The 1/R cylinder valves are inactive	Yellow lamp is sent Loss of torque	Detailed conditions to activate/deactivate The following conditions must be fulfilled three times (only one time if the fault code-filter is switched OFF) in a row in order to set the fault code: (engagement of another gear will reset the count) - The 1/R cylinder position indicates that the 1/R gear leaves the reverse position - The 1/R cylinder valves are inactive - There is no active fault on any of the sensor for the position of the 1/R cylinder (SEPo1R) the valve for shift to 1:st gear the valve for shift to reverse gear - There is no active fault code for low air pressure <i>Note: The fault will always have the state inactive.</i> Check the fault count and last occurrence to get more information.
Gears 1/R engagement system		FMI2	Unintentional disengagement of neutral gear (1:st and reverse gear cylinder)	Conditions to set the fault code: -The 1/R gear leaves the neutral position -The 1/R cylinder valves are inactive	Yellow lamp is sent Loss of torque	Detailed conditions to activate/deactivate The following conditions must be fulfilled three times (only one time if the fault code-filter is switched OFF) in a row in order to set the fault code: (engagement of another gear will reset the count) - The 1/R cylinder position indicates that the 1/R gear leaves the neutral position - The 1/R cylinder valves are inactive - There is no active fault on any of the sensor for the position of the 1/R cylinder (SEPo1R) the valve for shift to 1:st gear the valve for shift to reverse gear - There is no active fault code for low air pressure <i>Note: The fault will always have the state inactive.</i> Check the fault count and last occurrence to get more information.
Gears 1/R		FMI11	Blocked	Conditions to	Yellow lamp is	Detailed conditions to

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
engagement system			engagement of 1:st gear	<p>set the fault code:</p> <ul style="list-style-type: none"> -The 1:st gear can not engage -There is no active fault code on the SEPo1R -There is no active fault code for low air pressure -There is no active fault code on any of the 1:st and reverse gear cylinder valves 	<p>sent</p> <p>Loss of torque</p> <p>The 1:st gears will not be selected by the system for a short while. After five successful gear changes a new attempt to use 1:st gear may be made</p>	<p>activate/deactivate</p> <p>The following conditions must be fulfilled three times (only one time if the fault code-filter is switched OFF) in a row in order to set the fault code:(engagement of another gear will reset the count)</p> <ul style="list-style-type: none"> - The valve for reaching 1:st gear is activated for at least 0.8s - The 1/R cylinder position sensor indicates that 1:st position is not engaged - There is no active fault on any of the 1/R position sensor (SEPo1R) the valve for shift to 1:st gear the valve for shift to reverse gear - There is no active fault code for low air pressure <p>The fault is deactivated if any of the following conditions are fulfilled:</p> <ul style="list-style-type: none"> - The 1/R position sensor indicates that 1:st position is engaged - There is an active fault code on any of the 1/R position sensor (SEPo1R) the valve for shift to 1:st gear the valve for shift to reverse gear
Gears 1/R engagement system		FMI12	Blocked engagement of reverse gear	<p>Conditions to set the fault code:</p> <ul style="list-style-type: none"> -The reverse gear can not engage 	<p>Yellow lamp is sent</p> <p>The R gear can not engage, but the system will try to engage it as long as the gearlever is in the reverse position</p>	<p>Detailed conditions to activate/deactivate</p> <p>The following conditions must be fulfilled three times (only one time if the fault code filter is switched OFF) in a row in order to set the fault code:</p> <p>(engagement of another gear will reset the count)</p> <ul style="list-style-type: none"> - The valve for reaching the reverse gear is activated for at least 0.8s - The 1/R cylinder position sensor indicates that R position is not engaged - There is no active fault on any of the 1/R position sensor (SEPo1R) the valve for shift to 1:st gear the valve for shift to reverse gear - There is no active fault code for low air pressure. <p>The fault is deactivated if any of the following conditions are fulfilled:</p> <ul style="list-style-type: none"> - The 1/R position sensor indicates that R position is engaged - There is an active fault code on any of the 1/R position sensor (SEPo1R)

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FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
						the valve for shift to 1:st gear the valve for shift to reverse gear
Gears 1/R engagement system		FMI7	Blocked engagement of neutral gear (1:st and reverse gear cylinder)	Conditions to set the fault code: -The neutral gear (1:st and reverse gear cylinder) can not engage	Yellow lamp is sent	Detailed conditions to activate/deactivate The following conditions must be fulfilled three times (only one time if the fault code-filter is switched OFF) in a row in order to set the fault code: (engagement of another gear will reset the count) - The valve for reaching the reverse gear is activated for at least 0.8s - The 1/R cylinder position sensor indicates that neutral position is not engaged - There is no active fault code on any of the 1/R position sensor (SEPo1R) the valve for shift to 1:st gear the valve for shift to reverse gear - There is no active fault code for low air pressure The fault is deactivated if any of the following conditions are fulfilled: - The 1/R position sensor indicates that neutral position is engaged - There is an active fault code on any of the 1/R position sensor (SEPo1R) the valve for shift to 1:st gear the valve for shift to reverse gear
Gears 2/3 engagement system	PSID26	FMI0	Unintentional disengagement of 2:nd gear	Conditions to set the fault code: -The 2/3 cylinder position indicates that the 2/3 gear leaves the 2:nd position - The 2:nd cylinder valves are inactive	Yellow lamp is sent Loss of torque	Detailed conditions to activate/deactivate The following conditions must be fulfilled three times (only one time if the fault code-filter is switched OFF) in a row in order to set the fault code: (engagement of another gear will reset the count) - The 2/3 cylinder position indicates that the 2/3 gear leaves the 2:nd position - The 2:nd cylinder valves are inactive - There is no active fault on any of the sensor for the position of the 2/3 cylinder (SEPo23) the valve for shift to 2:nd gear the valve for shift to 3:rd gear - There is no active fault code for low air pressure <i>Note:</i> The fault will always have the state inactive. Check the fault count and last occurrence to get more information.

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
Gears 2/3 engagement system		FMI1	Unintentional disengagement of 3:rd gear	<p>Conditions to set the fault code:</p> <ul style="list-style-type: none"> -The 2/3 cylinder leaves the 3:rd position - The 3:rd cylinder valves are inactive 	Yellow lamp is sent Loss of torque	<p>Detailed conditions to activate/deactivate</p> <p>The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row in order to set the fault code:</p> <p>(engagement of another gear will reset the count)</p> <ul style="list-style-type: none"> - The 2/3 cylinder position indicates that the 2/3 gear leaves the 3:rd position - The 3:rd cylinder valves are inactive - There is no active fault on any of the sensor for the position of the 2/3 cylinder (SEPo23) the valve for shift to 2:nd gear the valve for shift to 3:rd gear - There is no active fault code for low air pressure <p><i>Note:</i> The fault will always have the state inactive. Check the fault count and last occurrence to get more information.</p>
Gears 2/3 engagement system		FMI2	Unintentional disengagement of neutral gear (2:nd and 3:rd gear cylinder)	<p>Conditions to set the fault code:</p> <ul style="list-style-type: none"> -The 2/3 cylinder leaves the neutral position - The 2/3 cylinder valves are inactive 	Yellow lamp is sent	<p>Detailed conditions to activate/deactivate</p> <p>The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row in order to set the fault code:</p> <p>(engagement of another gear will reset the count)</p> <ul style="list-style-type: none"> - The 2/3 cylinder position indicates that the 2/3 gear leaves the neutral position - The 2/3 cylinder valves are inactive - There is no active fault on any of the sensor for the position of the 2/3 cylinder (SEPo23) the valve for shift to 2:nd gear the valve for shift to 3:rd gear - There is no active fault code for low air pressure <p><i>Note:</i> The fault will always have the state inactive. Check the fault count and last occurrence to get more information.</p>
Gears 2/3 engagement system		FMI11	Blocked engagement of 2:nd gear	<p>Conditions to set the fault code:</p> <ul style="list-style-type: none"> -The 2:nd gear can not engage 	Yellow lamp is sent Loss of torque The 2:nd gear will not be selected by the system for a short while. After five successful gearshifts a new attempt to use	<p>Detailed conditions to activate/deactivate</p> <p>The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row in order to set the fault code:</p> <p>(engagement of another gear will reset the count)</p> <ul style="list-style-type: none"> - The valve for reaching 2:nd

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FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
					2:nd gear may be made	<p>gear is activated for at least 0.8s</p> <ul style="list-style-type: none"> - The 2/3 cylinder position sensor indicates that 2:nd position is not engaged - There is no active fault on any of the 2/3 position sensor (SEPo23) the valve for shift to 2:nd gear the valve for shift to 3:rd gear - There is no active fault code for low air pressure <p><i>The fault is deactivated if any of the following conditions are fulfilled:</i></p> <ul style="list-style-type: none"> - The 2/3 position sensor indicates that 2:nd 2:nd position is engaged - There is an active fault code on any of the 2/3 position sensor (SEPo23) the valve for shift to 2:nd gear the valve for shift to 3:rd gear
Gears 2/3 engagement system		FMI12	Blocked engagement of 3:rd gear	<p>Conditions to set the fault code:</p> <ul style="list-style-type: none"> -The 3:rd gear can not engage 	<p>Yellow lamp is sent</p> <p>Loss of torque</p> <p>The 3:rd gear will not be selected by the system for a short while.</p> <p>After five successful gearshifts a new attempt to use 3:rd gear may be made</p>	<p>Detailed conditions to activate/deactivate</p> <p>The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row in order to set the fault code:</p> <p>(engagement of another gear will reset the count)</p> <ul style="list-style-type: none"> - The valve for reaching 3:rd gear is activated for at least 0.8s - The 2/3 cylinder position sensor indicates that 3:rd position is not engaged - There is no active fault on any of the 2/3 position sensor (SEPo23) the valve for shift to 2:nd gear the valve for shift to 3:rd gear - There is no active fault code for low air pressure <p><i>The fault is deactivated if any of the following conditions are fulfilled:</i></p> <ul style="list-style-type: none"> - The 2/3 position sensor indicates that 3:rd position is engaged - There is an active fault code on any of the 2/3 position sensor (SEPo23) the valve for shift to 2:nd gear the valve for shift to 3:rd gear
Gears 2/3 engagement system		FMI7	Blocked engagement of neutral gear (2:nd and 3:rd gear cylinder)	<p>Conditions to set the fault code:</p> <ul style="list-style-type: none"> -The neutral gear (2:nd 3:rd gear cylinder) can not engage 	<p>Yellow lamp is sent</p>	<p>Detailed conditions to activate/deactivate</p> <p>The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row in order to set the fault code:</p> <p>(engagement of another</p>

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
						gear will reset the count) - The valve for reaching gear (2:nd and 3:rd gear cylinder) is activated for at least 0.8s - The 2/3 cylinder position sensor indicates that neutral position is not engaged - There is no active fault code on any of the 2/3 position sensor (SEPo23) the valve for shift to 2:nd gear the valve for shift to 3:rd gear - There is no active fault code for low air pressure <i>The fault is deactivated if any of the following conditions are fulfilled:</i> - The 2/3 position sensor indicates that neutral position is engaged - There is an active fault code on any of the 2/3 position sensor (SEPo23) the valve for shift to 2:nd gear the valve for shift to 3:rd gear
J1708/J1587	SID250	FMI9	Abnormal update rate	Activate: The FMI shall be set if any of the messages* have not been received on the bus for 30s Deactivate: The FMI shall be cleared if all messages* are sent on the bus *PID190, PID85 and PPID212	Yellow lamp is sent Fault codes can not be read On-vehicle tests can not be performed	
J1939	SID231	FMI2	Data erratic, intermittent or incorrect	Active: This FMI shall be set if the CAN transceiver signals "bus-off" Deactivate: FMI cleared if CAN-transceiver does not signal "bus-off"	Yellow lamp is sent Much reduced gear selection and gear change performance	
Missing data on J1939 form BECU	PSID204	FMI8	Abnormal frequency, pulse width or period	Activate: The FMI shall be set if the wheel speeds from the BECU (MID136) are incorrect Deactivate: The FMI shall be cleared if the wheel speeds from the BECU (MID136) are correct	Yellow lamp Automatic gear selection enters backup mode with gear changes only at certain vehicle speeds	
Missing data on J1939 form BECU		FMI9	Abnormal update rate	Activate: The FMI shall be set if message WSI	Yellow lamp Automatic gear selection enters	

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FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
				from BECU (MID136) is not received within 1s Deactivate: The FMI shall be cleared if message WSI is received at normal rate	backup mode with gear changes only at certain vehicle speeds	
Missing data on J1939 from GECU	PSID207	FMI9	Abnormal update rate	Activate: The FMI shall be set if message VP6 from GECU (MID223) is not received within 1s Deactivate: The FMI shall be cleared if message VP6 is received at normal rate	Yellow lamp Slow response on manual gear changes and slow response when buttons are pressed on the gear lever.	
Missing data on J1939 from the adaptive cruise control	PSID211	FMI9	Abnormal update rate	Activate: The FMI shall be set if message ACC1 from ACC (MID219) is not received within 1s, and ACC is installed Deactivate: The FMI shall be cleared if message ACC1 is received at normal rate	Yellow lamp The retarder ACC function does not work	
Missing data on J1939 from the EMS	PSID200	FMI9	Abnormal update rate	Activate: The FMI shall be set if message EEC1 from EECU is not received within 200ms Deactivate: The FMI shall be cleared if message EEC1 is received at normal rate	Yellow lamp is sent If there is no POWERTRAIN_CAN, automatic gear selection enters backup mode with gear changes only at certain vehicle speeds If there is no Powertrain_CAN and the engine does not receive any messages from the TECU, the gear changes will be slow	
Missing data on J1939 from the light control module (LCM)	PSID210	FMI9	Abnormal update rate	Activate: The FMI shall be set if message VP37 from LCM (MID216) is not received within 10s Deactivate: The FMI shall be cleared if	Yellow lamp The start gear might be wrong Automatic gear selection performance might be reduced a certain time after start	

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
				message VP37 is received at normal rate	Automatic gear selection performance might be reduced a certain time after a trailer has been connected/disconnected	
Missing data on J1939 from the suspension ECU (ECS)	PSID208	FMI9	Abnormal update rate	Activate: The FMI shall be set if message VW from ECS (MID150) is not received within 10s, and ECS is installed Deactivate: The FMI shall be cleared if message VW is received at normal rate	Yellow lamp The start gear might be wrong after loading and unloading	
Missing data on J1939 from VECU	PSID201	FMI8	Abnormal frequency, pulse width or period	Activate: The FMI shall be set if the acc pedal pos or service brake-switch from the VECU (MID144) is incorrect Deactivate: The FMI shall be cleared if the acc pedal pos and service brake-switch from the VECU (MID144) are correct	Yellow lamp If pedal pos is undefined, automatic gear selection enters backup mode with gear changes only at certain vehicle speeds If pedal pos is undefined, gearbox comfort at start and marshalling might be reduced If service brake is undefined, automatic gear selection enters backup mode with gear changes only at certain vehicle speeds	
Missing data on J1939 from VECU		FMI9	Abnormal update rate	Activate: The FMI shall be set if message VP2 from VECU (MID144) is not received within 100ms Deactivate: The FMI shall be cleared if message VP2 is received at normal rate	Yellow lamp Automatic gear selection enters backup mode with gear changes only at certain vehicle speeds Gearbox comfort at start and marshalling might be reduced	
Powertrain CAN	PSID232	FMI2	Data erratic, intermittent or incorrect	Activate: The FMI shall be set if the CAN transceiver	Yellow lamp is sent Reduced automatic gear	This fault code is only valid for vehicles where a Powertrain_CAN link exist between the TECU and the

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FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
				signals "busOFF" Deactivate: The FMI shall be cleared if the CAN-transceiver does not signal "busOFF"	selection and gear change performance	engine.
Powertrain CAN		FMI9	Abnormal update rate	Activate: The FMI shall be set if message VP24/MID128 is not received within 100ms Deactivate: The FMI shall be cleared if message VP24/MID128 is received at normal rate	Yellow lamp is sent Reduced automatic gear selection and gear change performance	
Program memory	SID240	FMI2	Data erratic, intermittent or incorrect	Activate: Flash CS error or program code missing Deactivate: Flash CS OK	Yellow lamp is sent Cranking is inhibited Engine can not start	
Range engagement system	PSID24	FMI0	Unintentional disengagement of low range	Conditions to set the fault code: -The range cylinder leaves the low range position -The range cylinder valves are inactive	Yellow lamp is sent Loss of torque	Detailed conditions to activate/deactivate: The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row, in order to set the fault code: (engagement of another gear will reset the count) - The range cylinder position indicates that range gear leaves the low range position - The range cylinder valves are inactive - There is no active fault on any of the sensor for the position of the range cylinder (SEPoR) the valve for shift to high range the valve for shift to low range - There is no active fault code for low air pressure note: The fault will always have the state inactive. Check fault-count and last occurrence to get more information
Range engagement system		FMI1	Unintentional disengagement of high range	Conditions to set the fault code: -The range cylinder leaves the high range position -The range cylinder valves are inactive	Yellow lamp is sent Loss of torque	Detailed conditions to activate/deactivate: The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row, in order to set the fault code: (engagement of another

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
						gear will reset the count) - The range cylinder position indicates that the range gear leaves the high range position - The range cylinder valves are inactive - There is no active fault on any of the sensor for the position of the range cylinder (SEPoR) the valve for shift to high range the valve for shift to low range - There is no active fault code for low air pressure <i>note:</i> The fault will always have the state inactive. Check fault-count and last occurrence to get more information
Range engagement system		FMI11	Blocked engagement of low range	Conditions to set the fault code: -The low range gear can not engage	Yellow lamp is sent Loss of torque	Detailed conditions to activate/deactivate: The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row, in order to set the fault code: (engagement of another gear will reset the count) - The low range can not engage within 3.8s - The gearbox oil temperature is above 10dgC - There is no active fault code on any of the sensor for the position of the range cylinder (SEPoR) low air pressure the range cylinder valves The fault is deactivated if any of the following conditions are fulfilled: - The range cylinder position sensor indicates that low range is engaged - The gearbox oil temperature is below 10dgC - There is an active fault on any of the sensor for the position of the range cylinder (SEPoR) low air pressure the range cylinder valves
Range engagement system		FMI12	Blocked engagement of high range	Conditions to set the fault code: -The high range gear can not engage	Yellow lamp is sent Loss of torque	Detailed conditions to activate/deactivate: The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row, in order to set the fault code: (engagement of another gear will reset the count) - The high range gear can

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FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
						not engage within 3.8s - The gearbox oil temperature is above 10dgC - There is no active fault on any of the range position sensor (SEPoR) low air pressure the range cylinder valves - There is no active fault code for low air pressure The fault is deactivated if any of the following conditions are fulfilled: - The range cylinder position sensor indicates that high range is engaged - The gearbox oil temperature is below 10dgC - There is an active fault code on any of the range position sensor (SEPoR) low air pressure the range cylinder valves
Sensor for the 1:st and reverse gear cylinder (SEPo1R)	PPID10	FMI2	Data erratic, intermittent or incorrect	Activate: The position sensor is distributing a temperature-signal from the sensor ASIC, if the value from this sensor deviates too much this fault code is triggered. Deactivate:	Yellow lamp is sent Slow gear changes	Detailed conditions to activate / deactivate: Activate: The position sensor is distributing a temperature-signal from the sensor ASIC, if the value from this sensor deviates too much this fault code is triggered, the diagnostics are based upon cross-reference between all four position-sensors. This means that if the value differs more than +/- 20dgC from the average-temp, if the temperature is out of boundary -60dgC to +160dgC or if the temperature changes at a rate higher than 10dgC during 15s, then this fault code is set. Deactivate: Fault code stays until a clear DTC command is received
Sensor for the 1:st and reverse gear cylinder (SEPo1R)		FMI3	Voltage above normal or shorted high	Activate: Status from the ASIC is short circuit to Ubatt Deactivate: Status is OK	Yellow lamp is sent Slow gear changes	
Sensor for the 1:st and reverse gear cylinder (SEPo1R)		FMI5	Current below normal or open circuit	Activate: Status from the ASIC is open circuit Deactivate: Status is OK	Yellow lamp is sent Slow gear changes	
Sensor for the 1:st and reverse gear cylinder (SEPo1R)		FMI6	Current above normal or grounded circuit	Activate: Status from the ASIC is short circuit to Gnd Deactivate: Status is OK	Yellow lamp is sent Slow gear changes	

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
Sensor for the 1:st and reverse gear cylinder (SEPo1R)		FMI13	Calibration value out of range	Activate: The Checksum of the NVRAM is not correct, or the sensor has not been calibrated Deactivate: Sensor signal has been successfully calibrated	Yellow lamp is sent Cranking is inhibited Engine can not start	
Sensor for the inclination of the gearbox (SEIG)	PPID140	FMI2	Data erratic, intermittent or incorrect	Activate: 1. The sensor signal is above or below normal range and 2. The vehicle has been standing still for a specific time Deactivate: The sensor signal is in the normal range	Yellow lamp is sent The start gear might be wrong Gear selection performance might be reduced Downhill and uphill gear change performance may be reduced	
Sensor for the PCB temperature	PPID55	FMI0	Data valid but above normal operational range	Activate: temp above 125dgC Deactivate: temp below 125dgC	Yellow lamp is sent	
Sensor for the position of the 2:nd and 3:rd gear cylinder (SEPo23)	PPID11	FMI2	Data erratic, intermittent or incorrect	Activate: The position sensor is distributing a temperature-signal from the sensor ASIC, if the value from this sensor deviates too much this fault code is triggered. Deactivate:	Yellow lamp is sent Slow gear changes	Detailed conditions to activate / deactivate: Activate: The position sensor is distributing a temperature-signal from the sensor ASIC, if the value from this sensor deviates too much this fault code is triggered, the diagnostics are based upon cross-reference between all four position-sensors. This means that if the value differs more than +/- 20dgC from the average-temp, if the temperature is out of boundary -60dgC to +160dgC or if the temperature changes at a rate higher than 10dgC during 15s, then this fault code is set. Deactivate: Fault code stays until a clear DTC command is received
Sensor for the position of the 2:nd and 3:rd gear cylinder (SEPo23)		FMI3	Voltage above normal or shorted high	Activate: Status from the ASIC is short circuit to Ubatt Deactivate: Status is OK	Yellow lamp is sent Slow gear changes	
Sensor for the position of the 2:nd and 3:rd		FMI5	Current below normal or open circuit	Activate: Status from the ASIC is open circuit Deactivate: Status is OK	Yellow lamp is sent Slow gear changes	

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FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
gear cylinder (SEPo23)						
Sensor for the position of the 2:nd and 3:rd gear cylinder (SEPo23)		FMI6	Current above normal or grounded circuit	Activate: Status from the ASIC is short circuit to Gnd Deactivate: Status is OK	Yellow lamp is sent Slow gear changes	
Sensor for the position of the 2:nd and 3:rd gear cylinder (SEPo23)		FMI13	Calibration value out of range	Activate: The Checksum of the NVRAM is not correct, or the sensor has not been calibrated Deactivate: Sensor signal has been successfully calibrated	Yellow lamp is sent Cranking is inhibited Engine can not start	
Sensor for the position of the range (SEPoR)	PID31	FMI2	Data erratic, intermittent or incorrect	Activate: The position sensor is distributing a temperature-signal from the sensor ASIC, if the value from this sensor deviates too much this fault code is triggered. Deactivate:	Yellow lamp is sent Slow gear changes	Detailed conditions to activate / deactivate: Activate: The position sensor is distributing a temperature-signal from the sensor ASIC, if the value from this sensor deviates too much this fault code is triggered, the diagnostics are based upon cross-reference between all four position-sensors. This means that if the value differs more than +/- 20dgC from the average-temp, if the temperature is out of boundary -60dgC to +160dgC or if the temperature changes at a rate higher than 10dgC during 15s, then this fault code is set. Deactivate: Fault code stays until a clear DTC command is received
Sensor for the position of the range (SEPoR)		FMI3	Voltage above normal or shorted high	Activate: Status from the ASIC is short circuit to Ubatt Deactivate: Status is OK	Yellow lamp is sent Slow gear changes	
Sensor for the position of the range (SEPoR)		FMI5	Current below normal or open circuit	Activate: Status from the ASIC is open circuit Deactivate: Status is OK	Yellow lamp is sent Slow gear changes	
Sensor for the position of the range (SEPoR)		FMI6	Current above normal or grounded circuit	Activate: Status from the ASIC is short circuit to Gnd Deactivate: Status is OK	Yellow lamp is sent Slow gear changes	
Sensor for the position of the range		FMI13	Calibration value out of range	Activate: The Checksum of the NVRAM is not correct, or the	Yellow lamp is sent Cranking is inhibited	

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
(SEPoR)				sensor has not been calibrated Deactivate: Sensor signal has been successfully calibrated	Engine can not start	
Sensor for the position of the Split (SEPoS)	PID32	FMI2	Data erratic, intermittent or incorrect	Activate: The position sensor is distributing a temperature-signal from the sensor ASIC, if the value from this sensor deviates too much this fault code is triggered. Deactivate:	Yellow lamp is sent Slow gear changes	Detailed conditions to activate / deactivate: Activate: The position sensor is distributing a temperature-signal from the sensor ASIC, if the value from this sensor deviates too much this fault code is triggered, the diagnostics are based upon cross-reference between all four position-sensors. This means that if the value differs more than +/- 20dgC from the average-temp, if the temperature is out of boundary -60dgC to +160dgC or if the temperature changes at a rate higher than 10dgC during 15s, then this fault code is set. Deactivate: Fault code stays until a clear DTC command is received
Sensor for the position of the Split (SEPoS)		FMI3	Voltage above normal or shorted high	Activate: Status from the ASIC is short circuit to Ubatt Deactivate: Status is OK	Yellow lamp is sent Slow gear changes	
Sensor for the position of the Split (SEPoS)		FMI5	Current below normal or open circuit	Activate: Status from the ASIC is open circuit Deactivate: Status is OK	Yellow lamp is sent Slow gear changes	
Sensor for the position of the Split (SEPoS)		FMI6	Current above normal or grounded circuit	Activate: Status from the ASIC is short circuit to Gnd Deactivate: Status is OK	Yellow lamp is sent Slow gear changes	
Sensor for the position of the Split (SEPoS)		FMI13	Calibration value out of range	Activate: The Checksum of the NVRAM is not correct, or the sensor has not been calibrated Deactivate: Sensor signal has been successfully calibrated	Yellow lamp is sent Cranking is inhibited Engine can not start	
Sensor for the pressure of the supply air (SEPrSA)	PID37	FMI0	Data valid but above normal operational range	Activate: 1. Sensor signal is in normal range 2. Pressure is above 10.0 [bar] Deactivate: 1. Sensor signal is	Yellow lamp is sent reduced clutch performance	

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FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
				in normal range 2. Pressure is below 10.0 [bar]		
Sensor for the pressure of the supply air (SEPrSA)		FMI1	Data valid but below operational range	Activate: 1. Sensor signal is in normal range 2. Pressure is below 5.0 [bar] Deactivate: 1. Sensor signal is in normal range 2. Pressure is above 5.0 [bar]	Yellow lamp is sent The symbol for compressed air, gearbox is sent Gear changes may be absent Reduced clutch performance	
Sensor for the pressure of the supply air (SEPrSA)		FMI3	Voltage above normal or shorted high	Activate: The sensor signal is above normal range Deactivate: The sensor signal is in normal range	Yellow lamp is sent	
Sensor for the pressure of the supply air (SEPrSA)		FMI5	Current below normal or open circuit	Activate: The sensor signal is below normal range Deactivate: The sensor signal is in normal range	Yellow lamp is sent	
Sensor for the speed on the counter shaft (SESC)	PID161	FMI1	Data valid but below operational range	Activate: 1. The sensor signal is within normal range and, 2. The counter shaft speed differs from both the main shaft speed (SESM) and the vehicle speed received from the vehicle ECU when the counter shaft is rotating Deactivate: 1. The sensor signal is within normal range 2. The counter shaft speed and the main shaft speed are equal when the counter shaft is rotating	Yellow lamp is sent Reduced gear change performance Gearbox brake up shifts can not be used Slip point can not be updated which will give reduced performance at starts Start gear engagement only possible at standstill and when the vehicle speed is high enough to synchronize the main box with the engine	Detailed condition to activate: The following conditions must be fulfilled for a time of 2.0s in order to activate: A gear (not neutral) is engaged in the gearbox The value of the input shaft speed calculated from the main shaft speed sensor (SESM) is more than 300rpm, or the value of the input shaft speed calculated from the counter shaft speed sensor (SESC) is more than 300rpm -The values of the input shaft speed calculated from the counter shaft speed sensor (SESC) and the main shaft speed sensor (SESM) differ more than 50rpm -The values of the input shaft speed calculated from the counter shaft speed sensor (SESC) and the vehicle speed received from the vehicle ECU differ more than 30rpm -The values of the input shaft speed calculated from the main shaft speed sensor (SESM) and the vehicle speed received from the vehicle ECU differ less than 30rpm -There is no active fault on any of -The sensor for the main shaft speed (SESM)

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
						<p>-The sensor for the position of the split cylinder (SEPoS) -The sensor for the position of the shift cylinder1R (SEPo1R) -The sensor for the position of the shift cylinder 23 (SEPo23) -The sensor for the position of teh range cylinder (SEPoR)</p> <p>The fault is deactivated if the following conditions are fulfilled for a time of 2.0s: -A gear (not neutral) is engaged in the gearbox -The value of the input shaft speed calculated from the countershaft speed sensor (SESC) is more than 300rpm, or -the value of the input shaft speed calculated from the main shaft speed sensor (SESM) is more than 300rpm -The values of the input shaft speed calculated from the countershaft speed sensor (SESC) and the main shaft speed sensor (SESM) differ less than 50rpm The fault is also deactivated if the following conditions are fulfilled for a time of 2.0s: -A neutral gear is engaged in the gearbox -The engine speed is above 400rpm -The clutch is engaged -Direct or indirect split is engaged -The values of the input shaft speed is calculated from the counter shaft speed sensor (SESC) and the engine speed received from the engine ECU differ less than 50 rpm The fault is also deactivated if the signal from the countershaft speed sensor (SESC) is not within normal range or if there is an active fault code on any of: -The clutch position sensor (SEPoC) -The sensor for the position of the split cylinder (SEPoS) -The sensor for the position of the shift cylinder1R (SEPo1R) -The sensor for the position of the shift cylinder 23 (SEPo23) -The sensor for the position</p>

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FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
						of teh range cylinder (SEPoR)
Sensor for the speed on the counter shaft (SESC)		FMI4	Voltage below normal or shorted low	<p>Activate: The sensor signal is below normal range.</p> <p>Deactivate: The sensor signal is within normal range</p>	<p>Yellow lamp is sent</p> <p>Reduced gear change performance</p> <p>Gearbox brake up shifts can not be used</p> <p>Slip point cannot be updated which will give reduced performance at starts</p> <p>Start gear engagement only possible at standstill and when the vehicle speeds is high enough to synchronize the main box with the engine</p>	
Sensor for the speed on the counter shaft (SESC)		FMI5	Current below normal or open circuit	<p>Activate: The sensor signal is above normal range</p> <p>Deactivate: The sensor signal is within normal range</p>	<p>Yellow lamp is sent</p> <p>Reduced gear change performance</p> <p>Gearbox brake up shifts can not be used</p> <p>Slip point cannot be updated which will give reduced performance at starts</p> <p>Start gear engagement only possible at standstill and when the vehicle speed is high enough to synchronize the main box with the engine</p>	
Sensor for the speed on the main shaft (SESM)	PID160	FMI1	Data valid but below operational range	<p>Activate: 1. Sensor signal is within normal range and 2. The main shaft speed differs from both the value of the countershaft speed and the vehicle speed received from the vehicle ECU</p> <p>Deactivate: 1. Sensor signal is within normal range and,</p>	<p>Yellow lamp is sent</p> <p>Reduced gear change performance</p> <p>Reduced gear change comfort</p>	<p>Detailed condition to activate:</p> <p>The following conditions must be fulfilled for a time of 2.0s in order to activate:</p> <p>A gear (not neutral) is engaged in the gearbox</p> <p>The value of the input shaft speed calculated from the main shaft speed sensor (SESM) is more than 300rpm, or the value of the input shaft speed calculated from the counter shaft speed sensor (SESC) is more than 300rpm</p> <p>The values of the input shaft</p>

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
				<p>2. <i>The main shaft speed and the counter shaft speed are equal when the main shaft is rotating</i></p>		<p>speed calculated from the main shaft speed sensor (SESM) and the counter shaft speed sensor (SESC) differ more than 50rpm The values of the input shaft speed calculated from the main shaft speed sensor (SESM) and the vehicle speed received from the vehicle ECU differ more than 30rpm The values of the input shaft speed calculated from the counter shaft speed sensor (SESC) and the vehicle speed received from the vehicle ECU differ less than 30rpm There is no active fault on any of The sensor for the countershaft speed (SECS) The sensor for the position of the split cylinder (SEPoS) The sensor for the position of the shift cylinder1R (SEPo1R) The sensor for the position of the shift cylinder 23 (SEPo23) The sensor for the position of teh range cylinder (SEPoR) The following conditions must be fulfilled for a time of 2.0s in order to deactivate: A gear (not neutral) is engaged in the gearbox The value of the input shaft speed calculated from the main shaft speed sensor (SESM) is more than 300rpm, or the value of the input shaft speed calculated from the counter shaft speed sensor (SESC) is more than 300rpm The value of the input shaft speed calculated from the main shaft speed sensor (SESM) and the counter shaft speed sensor (SESC) differ less than 50rpm The fault is also deactivated if The sensor signal (SESM) is not within normal range There is an active fault on any of The sensor for the countershaft speed (SECS) The sensor for the position of the split cylinder (SEPoS) The sensor for the position of the shift cylinder1R (SEPo1R) The sensor for the position of the shift cylinder 23 (SEPo23)</p>

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FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
Sensor for the speed on the mainshaft (SESM)		FMI2	Data erratic, intermittent or incorrect	<p>Activate: The sensor indicates wrong traveling direction</p> <p>Deactivate: The sensor indicates correct traveling direction</p>	Yellow lamp is sent Reduced gear change performance	<p>The sensor for the position of the range cylinder (SEPoR)</p> <p>Detailed conditions to activate The following conditions must be fulfilled for a time of 2.0s in order to activate: The input shaft speed calculated from the countershaft speed sensor (SESC) is above 300 rpm and the clutch is engaged or The input shaft speed calculated from the countershaft speed sensor (SECS) is above 600 rpm, the clutch position is more engaged than the slip point and the engine speed is received from the engine ECU and above 600rpm. A forward gear is engaged in the gearbox and the main shaft speed sensor (SESM) indicates reverse movement or a reverse gear is engaged and the main shaft speed sensor (SESM) indicates forward movement There is no other active fault on the sensor for the main shaft speed (SESM) There is no active fault on any of: -The sensor for the countershaft speed (SECS) -The sensor for the clutch position (SePoC) -The sensor for the position of the split cylinder (SePoS) -The sensor for the position of the shift cylinder (1R SEPo1R) -The sensor for the position of the shift cylinder (23 SEPo23) -The sensor for the range cylinder (SEPoR)</p> <p>The fault is deactivated if the following conditions are fulfilled for a time of 2.0s: The input shaft speed calculated from the counter shaft speed sensor (SECS) is above 300 rpm and the clutch is engaged or The input shaft speed calculated from the counter shaft speed sensor (SECS) is above 600 rpm, the clutch position is more engaged than the slip point and the engine speed is received from the engine ECU and above 600rpm A forward gear is engaged in the gearbox and the main</p>

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
						shaft speed sensor (SESM) indicates forward movement or A reverse gear is engaged and the main shaft speed sensor (SESM) indicates reverse movement. The fault is also deactivated if the main shaft speed sensor (SESM) signal is not within normal range, or if there is an active fault on any of the sensors: -The sensor for the countershaft speed (SECS) -The sensor for the clutch position (SePoC) -The sensor for the position of the split cylinder (SePoS) -The sensor for the position of the shift cylinder (1R SEPo1R) -The sensor for the position of the shift cylinder (23 SEPo23) -The sensor for the range cylinder (SEPoR)
Sensor for the speed on the main shaft (SESM)		FMI3	Voltage above normal or shorted high	Activate: Signal or supply voltage is above normal range Deactivate: Signal and supply voltage is in normal range.	Yellow lamp is sent Reduced gear change performance Reduced gear change comfort	
Sensor for the speed on the main shaft (SESM)		FMI4	Voltage below normal or shorted low	Activate: Signal and supply voltage is below normal range. Deactivate: Signal and supply voltage is within normal range	Yellow lamp is sent Reduced gear change performance Reduced gear change comfort	
Sensor for the speed on the main shaft (SESM)		FMI5	Current below normal or open circuit	Activate: 1.Signal voltage is below normal range and, 2. Supply voltage is in the normal range Deactivate: Signal and supply voltage is in the normal range	Yellow lamp is sent Reduced gear change performance Reduced gear change comfort	
Sensor for the temperature of the gearbox oil (SETeGO)	PID177	FMI0	Data valid but above normal operational range	Activate low: 1.The sensor signal is in normal range 2. Temperature is above 100dgC during 18000s Deactivate low: 1. The sensor signal is in normal range	Low: Yellow lamp is sent Symbol for high gearbox oil temperature is lit Medium: Yellow lamp is sent Symbol for high gearbox oil	Gearbox oil temperature fault codes are only set if the vehicle has oil temperature sensor functionality installed

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FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
				<p>2. Temperature is below 100dgC</p> <p>Activate medium: 1. The sensor signal is in normal range 2. Temperature above 120dgC during 600s</p> <p>Deactivate medium: 1. The sensor signal is in normal range 2. Temperature is below 120dgC</p> <p>Activate high: 1. The sensor signal is in normal range 2. Temperature is above 140dgC during 30s</p> <p>Deactivate high: 1. The sensor signal is in normal range Temperature is below 140dgC</p>	<p>temperature is lit</p> <p>High: Red lamp is sent Symbol for high gearbox oil temperature is lit</p>	
Sensor for the temperature of the gearbox oil (SETeGO)		FMI4	Voltage below normal or shorted low	<p>Activate: The sensor signal is below normal range</p> <p>Deactivate: The sensor signal is in normal range</p>	Yellow lamp is sent	
Sensor for the temperature of the gearbox oil (SETeGO)		FMI5	Current below normal or open circuit	<p>Activate: The sensor signal is above normal range</p> <p>Deactivate: The sensor signal is in normal range</p>	Yellow lamp is sent	
Sensor position of the clutch (SEPoC and SEPoCINV)	PID33	FMI2	Data erratic, intermittent or incorrect	<p>Activate: The difference between clutch positions indicated by the sensor signal (SEPoC) and the inverted sensor signal (SEPoC INV) is to large and both signals is within normal range</p> <p>Deactivate: The difference between clutch positions indicated by the sensor signal (SEPoC) and the inverted sensor signal (SEPoC</p>	<p>Yellow lamp is sent</p> <p>Reduced clutch performance</p> <p>Reduced gearbox comfort at start and marshalling</p> <p>Gear changes are slow</p>	<p>The PID 33 fault code should not be set if there is an active fault code on the clutch position sensor supply (PPID 54)</p> <p>The clutch position sensor has four connectors: one supply, one ground and two connectors for the sensor signal. With correct input the input voltage of the sensor signal, the inverted sensor signal and the sensor supply, they will follow the nominal relation (Usepoc + Usepoc_inv) / Usepoc5V = 100%</p>

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
				INV) is normal		
Sensor position of the clutch (SEPoC and SEPoCINV)		FMI3	Voltage above normal or shorted high	<p>Activate: Sensor signal is short circuit to Ubatt or sensor supply, when at least one of the sensor signals is above normal range.</p> <p>Deactivate: No sensor signal is above normal range</p>	<p>Yellow lamp is sent</p> <p>Reduced clutch performance</p> <p>Reduced gearbox comfort at start and marshalling</p> <p>Gear changes are slow</p>	The PID 33 fault code should not be set if there is an active fault code on the clutch position sensor supply (PPID 54)
Sensor position of the clutch (SEPoC and SEPoCINV)		FMI5	Current below normal or open circuit	<p>Activate: 1. Open circuit on any of the sensor signals is detected when: one of the sensor signals is within normal range and the other sensor signal is below normal range</p> <p>2. Open circuit on ground, detected when both the sensor signals are within the normal range and the sum of the sensor signals is above a specific value</p> <p>Deactivate: No activation condition is no longer fulfilled</p>	<p>Yellow lamp is sent</p> <p>Reduced clutch performance</p> <p>Reduced gearbox comfort at start and marshalling</p> <p>gear changes are slow</p>	The PID 33 fault code should not be set if there is an active fault code on the clutch position sensor supply (PPID 54)
Sensor position of the clutch (SEPoC and SEPoCINV)		FMI12	Faulty device or component	<p>Activate: Both sensor signals are below normal when:</p> <ol style="list-style-type: none"> Status of the sensor ASIC reports internal fault on the sensor, or Short circuit to Gnd on any of the sensor signals, or Open circuit on supply, or Short circuit between the two sensor signals <p>Deactivate: Both sensor signals are not below normal level</p>	<p>Yellow lamp is sent</p> <p>Reduced clutch performance</p> <p>Reduced gearbox comfort at start and marshalling</p> <p>gear changes are slow</p>	The PID 33 fault code should not be set if there is an active fault code on the clutch position sensor supply (PPID 54)
Sensor position of the clutch		FMI13	Calibration value out of range	<p>Activate: 1. The CS in NVRAM is not correct</p> <p>2. The cylinder</p>	<p>Yellow lamp is sent</p> <p>Cranking is inhibited</p>	The PID 33 fault code should not be set if there is an active fault code on the clutch position sensor

Section 07: TRANSMISSION

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
(SEPoC and SEPoCINV)				has not been calibrated Deactivate: Sensor signal has been successfully calibrated	Engine can not start	supply (PPID 54)
Slow clutch valves low side (VAS-)	PSID6	FMI3	Voltage above normal or shorted high	Activate: The low-side drive is short circuit to Ubatt Deactivate: The low-side drive is OK	Yellow lamp is sent Slow engagement/disengagement disabled Reduced clutch performance, especially at start and marshalling	
Slow clutch valves low side (VAS-)		FMI6	Current above normal or grounded circuit	Activate: 1. The low-side drive is short circuit to Gnd and 2. There is no active fault code for short circuit to Gnd on VASE or VASD Deactivate: The low-side drive is OK	Yellow lamp is sent Slow engagement /disengagement disabled Reduced clutch performance, especially at start and marshalling	
Split engagement system	PSID23	FMI0	Unintentional disengagement of indirect split	Conditions to set the fault code: -The split cylinder position leaves the indirect position -The split cylinder valves are inactive	Yellow lamp is sent Loss of torque	Detailed conditions to activate/deactivate: The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row, in order to set the fault code: (engagement of another gear will reset the count) - The split cylinder position indicates that split gear leaves the indirect position - The split cylinder valves are inactive - There is no active fault on any of the sensor for the position of the split cylinder (SEPoS) the valve for shift to direct split the valve for shift to indirect split - There is no active fault code for low air pressure note: The fault will always have the state inactive. Check fault-count and last occurrence to get more information
Split engagement system		FMI1	Unintentional disengagement of direct split	Conditions to set the fault code: -The split cylinder position leaves the direct position -The split	Yellow lamp is sent Loss of torque	Detailed conditions to activate/deactivate: The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row, in order to set the fault

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
				cylinder valves are inactive		code: (engagement of another gear will reset the count) - The split cylinder position indicates that split gear leaves the direct position - The split cylinder valves are inactive - There is no active fault on any of the sensor for the position of the split cylinder (SEPoS) the valve for shift to direct split the valve for shift to indirect split - There is no active fault code for low air pressure Note: The fault will always have the state inactive. Check fault-count and last occurrence to get more information
Split engagement system		FMI2	Unintentional disengagement of neutral split	Conditions to set the fault code: -The split cylinder position leaves the neutral position -The split cylinder valves are inactive	Yellow lamp is sent	Detailed conditions to activate/deactivate: The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row, in order to set the fault code: (engagement of another gear will reset the count) - The split cylinder position indicates that split gear leaves the neutral position - The split cylinder valves are inactive - There is no active fault on any of the sensor for the position of the split cylinder (SEPoS) the valve for shift to direct split the valve for shift to indirect split - There is no active fault code for low air pressure Note: The fault will always have the state inactive. Check fault-count and last occurrence to get more information
Split engagement system		FMI11	Blocked engagement of indirect split	Conditions to set the fault code: -The indirect split gear can not engage	Yellow lamp is sent Loss of torque Only direct split gears will be selected by the system for a short while. After five successful gearshifts a new attempt to use indirect split may be made	Detailed conditions to activate/deactivate: The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row, in order to set the fault code: - The split valve for reaching indirect split is activated for at least 0.8s - The split cylinder position sensor indicates that indirect position is not engaged - There is no active fault on any of the sensor for the

Section 07: TRANSMISSION

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
						<p>position of the split cylinder (SEPoS) the valve for shift to direct split the valve for shift to indirect split</p> <ul style="list-style-type: none"> - There is no active fault code for low air pressure <p>The fault is deactivated if any of the following conditions are fulfilled:</p> <ul style="list-style-type: none"> - The split cylinder position sensor indicates that indirect position is engaged - There is an active fault code on any of the sensor for the position of the split cylinder (SEPoS) the valve for shift to direct split the valve for shift to indirect split
Split engagement system		FMI12	Blocked engagement of direct split	<p>Conditions to set the fault code:</p> <ul style="list-style-type: none"> -The direct split gear can not engage 	<p>Yellow lamp is sent</p> <p>Loss of torque</p> <p>Only indirect split gears will be selected by the system for a short while. After five successful gearshifts a new attempt to use direct split may be made</p>	<p>Detailed conditions to activate/deactivate:</p> <p>The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row, in order to set the fault code:</p> <ul style="list-style-type: none"> - The split valve for reaching direct split is activated for at least 0.8s - The split cylinder position sensor indicates that direct position is not engaged - There is no active fault on any of the sensor for the position of the split cylinder (SEPoS) the valve for shift to direct split the valve for shift to indirect split - There is no active fault code for low air pressure <p>The fault is deactivated if any of the following conditions are fulfilled:</p> <ul style="list-style-type: none"> - The split cylinder position sensor indicates that direct position is engaged - There is an active fault code on any of the sensor for the position of the split cylinder (SEPoS) the valve for shift to direct split the valve for shift to indirect split
Split engagement system		FMI7	Blocked engagement of neutral split	<p>Conditions to set the fault code:</p> <ul style="list-style-type: none"> -The neutral split gear can not engage 	<p>Yellow lamp is sent</p> <p>Eco roll is not available</p>	<p>Detailed conditions to activate/deactivate:</p> <p>The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row, in order to set the fault code:</p> <ul style="list-style-type: none"> - The split valve for reaching neutral split is activated for at least 0.8s - The split cylinder position sensor indicates that neutral

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
						position is not engaged - There is no active fault on any of the sensor for the position of the split cylinder (SEPoS) the valve for shift to direct split the valve for shift to indirect split - There is no active fault code for low air pressure The fault is deactivated if any of the following conditions are fulfilled: - The split cylinder position sensor indicates that neutral position is engaged - There is an active fault code on any of the sensor for the position of the split cylinder (SEPoS) the valve for shift to direct split the valve for shift to indirect split
TECU Power supply	PID158	FMI0	Data valid but above normal operational range	Activate: 24V system: above 36V 12V system: above 19V Deactivate: 24V system: below 36V 12V system: below 19V	Yellow lamp is sent	
TECU Power supply		FMI1	Data valid but below normal operational range	Activate: 24V system: below 17V 12V system: below 9V Deactivate: 24V system: above 17V 12V system: above 9V	Yellow lamp is sent Reduced gearbox performance	
Valve for activating the PTO number 1 (VAP1)	PSID20	FMI3	Voltage above normal or shorted high	Activate: The high side drive is short circuit to Ubatt Deactivate: The high side drive is OK	Yellow lamp is sent The valve is activated The PTO can not be deactivated Reduced gear change comfort	PTO fault codes are only set if the PTO exists
Valve for activating the PTO number 1 (VAP1)		FMI5	Current below normal or open circuit	Activate: The high side drive is open circuit Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated The PTO does not work	
Valve for activating the PTO number 1 (VAP1)		FMI6	Current above normal or grounded circuit	Activate: The high side drive is short circuit to Gnd Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated The PTO does not work	
Valve for activating the PTO number 2 (VAP2)	PSID21	FMI3	Voltage above normal or shorted high	Activate: The high side drive is short circuit to Ubatt Deactivate: The	Yellow lamp is sent The valve is activated The PTO can not	

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FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
				high side drive is OK	be deactivated Reduced gear change comfort	
Valve for activating the PTO number 2 (VAP2)		FMI5	Current below normal or open circuit	Activate: The high side drive is open circuit Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated The PTO does not work	
Valve for activating the PTO number 2 (VAP2)		FMI6	Current above normal or grounded circuit	Activate: The high side drive is short circuit to Gnd Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated The PTO does not work	
Valve for fast disengagement of the clutch (VAFD)	PSID3	FMI3	Voltage above normal or shorted high	Activate: 1. The high-side drive is short circuited to Ubatt and 2. there is no active fault code for short circuit to Ubatt on VAF- Deactivate: The high-side drive is OK	Yellow lamp is sent Fast engagement/disengagement disabled Reduced clutch performance Gear changes are slow	
Valve for fast disengagement of the clutch (VAFD)		FMI5	Current below normal or open circuit	Activate: The high-side drive is open circuit Deactivate: The high side drive is OK	Yellow lamp is sent Fast disengagement disabled Reduced clutch performance Gear changes are slow	
Valve for fast disengagement of the clutch (VAFD)		FMI6	Current above normal or grounded circuit	Activate: The high-side drive is short circuit to Gnd Deactivate: The high-side drive is OK	Yellow lamp is sent Fast disengagement disabled Reduced clutch performance Gear changes are slow	
Valve for fast engagement of the clutch (VAFE)	PSID1	FMI3	Voltage above normal or shorted high	Activate: 1. The high-side drive is short circuited to Ubatt and, 2. there is no active fault code for short circuit to Ubatt on VAF- Deactivate: The high-side drive is OK	Yellow lamp is sent Fast engagement/disengagement disabled Reduced clutch performance Gear changes are slow	
Valve for fast engagement of the clutch (VAFE)		FMI5	Current below normal or open circuit	Activate: The high-side drive is open circuit Deactivate: The high side drive is OK	Yellow lamp is sent Fast engagement disabled Reduced clutch performance Gear changes are slow	
Valve for fast		FMI6	Current above normal or	Activate: The high-side drive is	Yellow lamp is sent	

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
engagement of the clutch (VAFE)			grounded circuit	short circuit to Gnd Deactivate: The high-side drive is OK	Fast engagement disabled Reduced clutch performance Gear changes are slow	
Valve for shifting to direct split (VADS)	SID37	FMI3	Voltage above normal or shorted high	Activate: The high side drive is short circuit to Ubatt Deactivate: The high side drive is OK	Yellow lamp is sent The valve is activated Indirect and neutral split gears are missing Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds	
Valve for shifting to direct split (VADS)		FMI5	Current below normal or open circuit	Activate: The high side drive is open circuit Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated Split gears are missing Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds	
Valve for shifting to direct split (VADS)		FMI6	Current above normal or grounded circuit	Activate: The high side drive is short circuit to Gnd Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated Split gears are missing Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds	
Valve for shifting to gear 1 (VAG1)	PSID12	FMI3	Voltage above normal or shorted high	Activate: The high side drive is short circuit to Ubatt Deactivate: The high side drive is OK	Yellow lamp is sent The valve is activated Gears are missing Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds	
Valve for shifting to gear 1 (VAG1)		FMI5	Current below normal or open circuit	Activate: The high side drive is open circuit Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated Gears are missing	

Section 07: TRANSMISSION

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
					Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds	
Valve for shifting to gear 1 (VAG1)		FMI6	Current above normal or grounded circuit	Activate: The high side drive is short circuit to Gnd Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated Gears are missing Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds	
Valve for shifting to gear 2 (VAG2)	PSID14	FMI3	Voltage above normal or shorted high	Activate: The high side drive is short circuit to Ubatt Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated Gears are missing Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds	
Valve for shifting to gear 2 (VAG2)		FMI5	Current below normal or open circuit	Activate: The high side drive is open circuit Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated Gears are missing Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds	
Valve for shifting to gear 2 (VAG2)		FMI6	Current above normal or grounded circuit	Activate: The high side drive is short circuit to Gnd Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated Gears are missing Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds	
Valve for shifting to gear 3 (VAG3)	PSID15	FMI3	Voltage above normal or shorted high	Activate: The high side drive is short circuit to Ubatt Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated Gears are missing Automatic gear selection enters	

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
					faulty gearbox mode with gear changes only at certain vehicle speeds	
Valve for shifting to gear 3 (VAG3)		FMI5	Current below normal or open circuit	Activate: The high side drive is open circuit Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated Gears are missing Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds	
Valve for shifting to gear 3 (VAG3)		FMI6	Current above normal or grounded circuit	Activate: The high side drive is short circuit to Gnd Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated Gears are missing Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds	
Valve for shifting to gear reverse (VAGR)	PSID13	FMI3	Voltage above normal or shorted high	Activate: The high side drive is short circuit to Ubatt Deactivate: The high side drive is OK	Yellow lamp is sent The valve is activated Gears are missing Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds	
Valve for shifting to gear reverse (VAGR)		FMI5	Current below normal or open circuit	Activate: The high side drive is open circuit Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated Gears are missing Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds	
Valve for shifting to gear reverse (VAGR)		FMI6	Current above normal or grounded circuit	Activate: The high side drive is short circuit to Gnd Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated Gears are missing Automatic gear selection enters faulty gearbox mode with gear	

Section 07: TRANSMISSION

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
					changes only at certain vehicle speeds	
Valve for shifting to high range (VAHR)	SID35	FMI3	Voltage above normal or shorted high	Activate: The high side drive is short circuit to Ubatt Deactivate: The high side drive is OK	Yellow lamp is sent The valve is activated Low range gears are missing Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds	
Valve for shifting to high range (VAHR)		FMI5	Current below normal or open circuit	Activate: The high side drive is Open circuit Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated Range gears are missing Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds	
Valve for shifting to high range (VAHR)		FMI6	Current above normal or grounded circuit	Activate: The high side drive is short circuit to Gnd Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated Range gears are missing Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds	
Valve for shifting to indirect split (VAIDS)	SID38	FMI3	Voltage above normal or shorted high	Activate: The high side drive is short circuit to Ubatt Deactivate: The high side drive is OK	Yellow lamp is sent The valve is activated Direct and neutral split gears are missing Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds	
Valve for shifting to indirect split (VAIDS)		FMI5	Current below normal or open circuit	Activate: The high side drive is open circuit Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated Split gears are missing Automatic gear selection enters faulty gearbox mode with gear	

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
					changes only at certain vehicle speeds	
Valve for shifting to indirect split (VAIDS)		FMI6	Current above normal or grounded circuit	Activate: The high side drive is short circuit to Gnd Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated Split gears are missing Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds	
Valve for shifting to low range (VALR)	SID36	FMI3	Voltage above normal or shorted high	Activate: The high side drive is short circuit to Ubatt Deactivate: The high side drive is OK	Yellow lamp is sent The valve is activated High range gears are missing Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds	
Valve for shifting to low range (VALR)		FMI5	Current below normal or open circuit	Activate: The high side drive is open circuit Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated Range gears are missing Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds	
Valve for shifting to low range (VALR)		FMI6	Current above normal or grounded circuit	Activate: The high side drive is short circuit to Gnd Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated Range gears are missing Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds	
Valve for slow disengagement of the clutch (VASD)	PSID4	FMI3	Voltage above normal or shorted high	Activate: 1. The high-side drive is short circuit to Ubatt and 2. There is no active fault code for short circuit to Ubatt on VAS- Deactivate: The high-side drive is OK	Yellow lamp is sent Slow engagement/disengagement disabled Reduced clutch performance, especially at start and marshalling	

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FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
Valve for slow disengagement of the clutch (VASD)		FMI5	Current below normal or open circuit	Activate: The high-side drive is open circuit Deactivate: The high-side drive is OK	Yellow lamp is sent Slow disengagement disabled Reduced clutch performance	
Valve for slow disengagement of the clutch (VASD)		FMI6	Current above normal or grounded circuit	Activate: The high-side drive is short circuit to Gnd Deactivate: The high-side drive is OK	Yellow lamp is sent Slow disengagement disabled Reduced clutch performance	
Valve for slow engagement of the clutch (VASE)	PSID2	FMI3	Voltage above normal or shorted high	Activate: 1. The high-side drive is short circuit to Ubatt and 2. There is no active fault code for short circuit to Ubatt on VAS- Deactivate: The high-side drive is OK	Yellow lamp is sent Slow engagement/disengagement disabled Reduced clutch performance, especially at start and marshalling	
Valve for slow engagement of the clutch (VASE)		FMI5	Current below normal or open circuit	Activate: The high-side drive is open circuit Deactivate: The high-side drive is OK	Yellow lamp is sent Slow engagement disabled Reduced clutch performance, especially at start and marshalling	
Valve for slow engagement of the clutch (VASE)		FMI6	Current above normal or grounded circuit	Activate: The high-side drive is short circuit to Gnd Deactivate: The high-side drive is OK	Yellow lamp is sent Slow engagement disabled Reduced clutch performance, especially at start and marshalling	
Valve for the gearbox brake (VAGB)	PSID22	FMI3	Voltage above normal or shorted high	Activate: The high side drive is short circuit to Ubatt Deactivate: The high side drive is OK	Red lamp is sent The valve and the brake are activated The gearbox will be damaged if the vehicle drives The prop shaft has to be removed to move the vehicle	
Valve for the gearbox brake (VAGB)		FMI5	Current below normal or open circuit	Activate: The high side drive is open circuit Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated Shifting to the start gear takes long time	
Valve for the gearbox brake		FMI6	Current above normal or grounded circuit	Activate: The high side drive is short circuit to Gnd	Yellow lamp is sent The valve can not be activated	

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
(VAGB)				<i>Deactivate:</i> The high side drive is OK	Shifting to the start gear takes long time	

10. VOLVO I-SHIFT TRANSMISSION GSECU FAULT CODES

PID/PPID SID/PSID	FMI	LAMP	CONTENT	TEXT	COMMENT	CONSEQUENCES
SID231	2	None	SAE J1939 Data Link	-	-	Redundancy on J1587
SID237	3	CHECK	Start enable device	Check Gear Selector System at next stop	Only for EMS1.xx vehicles	Start relay not working
SID240	2	CHECK	Program memory	Gear Selector System failure	Boot	Not possible to engage gear
SID250	9	None	SAE J1708 /J1587 data link	-	-	-
SID253	2	CHECK	Program memory	Gear Selector System failure	-	Not possible to engage gear
SID254	12	CHECK	Controller #1	Gear Selector System failure	-	Not possible to engage gear
PSID9	12	CHECK	Gear level position sensors	Check Gear Selector System at next stop	-	Not possible to engage/change gear
PSID36	7	CHECK	Output actuator (REPS)	Check Gear Selector System at next stop	-	Fault displayed after ignition OFF. Risk of battery discharge if main circuit breaker is not opened when vehicle is not used
PSID36	12		Output actuator (REPS)	Check Gear Selector System at next stop	-	Gearbox not supplied
PSID42	2	None	Ignition signals	-	-	Power supply always on
PSID200	9	None	Data Link, MID128	Check Gear Selector System at next stop	Only for AMT-C, Boot	Affects RT only (can be sent for VT)
PSID201	9	None	Data Link, MID144	Check Gear Selector System at next stop	Only for AMT-C, Boot	Affects RT only (can be sent for VT)
PSID205	9	None	Data Link, MID130	Check Gear Selector System at next stop	Boot	Affects RT only (can be sent for VT)

PID/PPID SID/PSID	FMI	LAMP	CONTENT	TEXT	COMMENT	CONSEQUENCES
PSID214	9	None	Data Link, MID249	-	Only when second gear selector is installed, Boot	Not possible to switch to/from secondary gear lever

11. SPECIFICATIONS

ALLISON AUTOMATIC TRANSMISSION WITH OR WITHOUT RETARDER

H3 Buses

Gross input power (maximum).....500 HP (335 kW)
 Gross input torque (maximum) 1525 Lbf-ft (2068 Nm)
 Rated input speed (minimum-maximum) 1600-2300 rpm

H3-45 VIP

Gross input power (maximum).....525 HP (392 kW)
 Gross input torque (maximum) 1650 Lbf-ft (2237 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:

First3.51:1
 Second..... 1.91:1
 Third..... 1.43:1
 Fourth..... 1.00:1
 Fifth0.74:1
 Sixth0.64:1
 Reverse 4.80:1

Ratio coverage:

6 speed5.48:1

- o 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 (26.5 liters)

Oil Filters:

Make Allison Transmission
 Type Disposable cartridge

Prevost part number (2-filters replacement kit)571709

VOLVO I-SHIFT TRANSMISSION

Oil System:

Oil type..... CASTROL SYNTRANS 75W85
Oil change..... 16 US qts (15 liters)

Oil Filter:

Make Volvo
Type Disposable cartridge
Prevost Part Number.....20779040

DRAFT

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Gear Selector Control Module (GSCM) MID
223, Diagnostic Trouble Code (DTC), Guide

Gear Selector Control Module (GSCM) MID 223, Diagnostic Trouble Code (DTC), Guide

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Information is subject to change without notice.
Illustrations are used for reference only and may differ slightly from the actual vehicle
being serviced. However, key components addressed in service information are
represented as accurately as possible.

DRAFT

MID 223 Gear Selector Control Module

The manufacturer scan tool is the preferred tool for performing diagnostic work. Contact your local dealer for more information or visit "www.premiumtechttool.com".

System Overview

A gear selector control module (GSCM) located under the dash board receives operator input signals from the gear selector that is mounted to the left of the drivers seat, along with steering wheel mounted gear selector buttons. The GSCM interpret these signals and communicates the information to the transmission control module (TCM) via the SAE J1939 data link. The GSCM also communicates on the SAE J1587 data link for diagnostic purposes and serve as a redundancy to the SAE J1939 data link in case of data link failure.

The selector includes gear positions of R (reverse), N (neutral), D (drive), and M (manual). The drive and

manual are both used for selecting the forward gears in the transmission. With the selector in the drive position the transmission will shift as an automatic, performing gear selections and shifting without driver input. When the manual position is selected, the driver can use the steering wheel selector buttons to choose gears.

In situations where the I-Shift is unintentionally left in gear with the parking brake applied, the TCM will automatically go to neutral when the ignition switch is turned off. This is done to avoid the transmission getting stuck in gear due to drive line "torque up".

Limp Home Mode

Note: Limp Home Mode should only be used to get a vehicle to a safe or secure location. It is not meant for driving any distance.

In the event the that a transmission malfunction occurs, "Limp Home Mode" can be activated. This mode is only meant to get a vehicle to a safe or secure location. To activate, press the ??????? button on the gear selector and then select the D position on the gear selector to active

"Limp Home Mode". When activated, L is displayed as the driving mode in the instrument panel digital information display (DID). In "Limp Home Mode", only forward gears 1, 3 and 5 are available. To selector or change a gear while in this mode the vehicle has to be stationary. The "Limp Home Mode", will automatically be deactivated when the ignition is turned off.

DRAFT

Gear Selector Control Module (MID 223), Diagnostic Fault Codes (DTC)

The manufacturer scan tool is the preferred tool for performing diagnostic work. Contact your local dealer for more information or visit "www.premiumtechttool.com".

The electronic control units (ECUs) on the SAE J1587 data link communicate according to the SAE J1587 standard. The standard has been extended with supplements (PPID, PSID). The diagnostic trouble codes (DTCs) set by the ECUs contain information that is described by the following abbreviations.

MID	Message Identification Description: Identification of a control unit.	SID	Subsystem Identification Description: Identification of a component.
PID	Parameter Identification Description: Identification of a parameter (value).	PSID	Proprietary Subsystem Identification Description: Unique identification of a component.
PPID	Proprietary Parameter Identification Description: Unique identification of a parameter (value).	FMI	Failure Mode Identifier: Identification of fault types.

FMI Table

FMI	Display Text	SAE Text
0	Too high value	Data valid, but above the normal work range
1	Too low value	Data valid, but below the normal work range
2	Incorrect data	Data erratic, Intermittent or incorrect
3	Electrical fault	Voltage above normal or shorted high
4	Electrical fault	Voltage below normal or shorted low
5	Electrical fault	Current below normal or open circuit
6	Electrical fault	Current above normal or grounded circuit
7	Mechanical fault	Mechanical system not responding properly
8	Mechanical or electrical fault	Abnormal frequency, pulse width or period
9	Communication fault	Abnormal update rate
10	Mechanical or electrical fault	Abnormal rate of change
11	Unknown fault	Failure mode not identifiable
12	Component fault	Bad intelligent device or component
13	Incorrect calibration	Out of calibration
14	Unknown fault	Special instructions
15	Unknown fault	Reserved for future assignment by SAE Data Formal Subcommittee

Diagnostic Trouble Code (DTC) List

PSID

- "MID 223 PSID 9, Gear Selector, Position", page 5
- "MID 223 PSID 36, Relay Power Supply", page 5
- "MID 223 PSID 42, Signals Key", page 6
- "MID 223 PSID 200, Communication Interference, Data Link, Engine Control Module (ECM)", page 6
- "MID 223 PSID 201, Communication Interference, Data Link, Vehicle Electronic Control Unit (VECU)", page 7
- "MID 223 PSID 205, Communication Interference, Data Link, Transmission Control Module (TCM)", page 7
- "MID 223 PSID 214, No Data From Bodybuilders Module (BBM)", page 8

SID

- "MID 223 SID 231, SAE J1939 Data Link", page 8
- "MID 223 SID 237, Relay, Starter Motor", page 8
- "MID 223 SID 240, Program Memory", page 9
- "MID 223 SID 250, SAE J1587 Data Link", page 9
- "MID 223 SID 253, Calibration Memory EEPROM", page 9

- "MID 223 SID 254, Hardware Fault", page 9

DRAFT

MID 223 PSID 9, Gear Selector, Position

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 12	<ul style="list-style-type: none"> Faulty device or component 	<ul style="list-style-type: none"> The sensor signals do not correspond with valid value 	<ul style="list-style-type: none"> Yellow check lamp illuminated Some or all stalk actions are not working It is not possible to select gear 	<ul style="list-style-type: none"> Wiring harness or connectors Gear position sensor

MID 223 PSID 36, Relay Power Supply

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 7	<ul style="list-style-type: none"> Mechanical system not responding properly 	<ul style="list-style-type: none"> The relay does not release 	<ul style="list-style-type: none"> Yellow check lamp illuminated Fault displayed after ignition OFF Risk of battery discharge if main circuit breaker is not opened when vehicle is not used 	<ul style="list-style-type: none"> Relay
FMI 12	<ul style="list-style-type: none"> Faulty device or component 	<ul style="list-style-type: none"> 0 voltage at Pin 1 	<ul style="list-style-type: none"> It is not possible to drive the vehicle 	<ul style="list-style-type: none"> Short circuit of output to ground when relay is active

DRAFT

MID 223 PSID 42, Signals Key

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 2	<ul style="list-style-type: none"> Data erratic, intermittent, or incorrect 	<ul style="list-style-type: none"> Inconsistency between hard-wired ignition signal and ignition signal read on network 	<ul style="list-style-type: none"> Transmission supplied and Optidriver fully functional until main circuit breaker is opened Risk of battery discharge if main circuit breaker not opened when vehicle not used Transmission not supplied and vehicle immobilized after main circuit breaker has been cycled 	<ul style="list-style-type: none"> Wiring harness or connectors Blown fuse

MID 223 PSID 200, Communication Interference, Data Link, Engine Control Module (ECM)

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 9	<ul style="list-style-type: none"> Abnormal update rate 	<ul style="list-style-type: none"> Message missing on SAE J1939 data link from the ECM 	<ul style="list-style-type: none"> Downhill help disabled 	<ul style="list-style-type: none"> Open circuit in SAE J1939 data link between gear selector control module (GSCM) and ECM

DRAFT

MID 223 PSID 201, Communication Interference, Data Link, Vehicle Electronic Control Unit (VECU)

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 9	<ul style="list-style-type: none"> Abnormal update rate 	<ul style="list-style-type: none"> Message missing on SAE J1939 data link from the VECU 	<ul style="list-style-type: none"> Temporary manual mode disabled Downhill help disabled Return to drive disabled 	<ul style="list-style-type: none"> Open circuit in SAE J1939 data link between gear selector control module (GSCM) and VECU

MID 223 PSID 205, Communication Interference, Data Link, Transmission Control Module (TCM)

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 9	<ul style="list-style-type: none"> Abnormal update rate 	<ul style="list-style-type: none"> Message missing on SAE J1939 data link from the TCM 	<ul style="list-style-type: none"> No memorization during 1.5 sec of direction change requests when vehicle is moving Temporary manual mode disabled 	<ul style="list-style-type: none"> Open circuit in SAE J1939 data link between gear selector control module (GSCM) and TCM

DRAFT

MID 223 PSID 214, No Data From Bodybuilders Module (BBM)

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 9	<ul style="list-style-type: none"> Abnormal update rate 	<ul style="list-style-type: none"> Message missing on SAE J1939 data link from the BBM 	<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> N/A

MID 223 SID 231, SAE J1939 Data Link

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 2	<ul style="list-style-type: none"> Data erratic, intermittent, or incorrect 	<ul style="list-style-type: none"> SAE J1939 data link communication does not work 	<ul style="list-style-type: none"> Gear lever commands slower (SAE J1587 data link) No memorization during 1.5 sec of direction change requests when vehicle is moving Temporary manual mode disabled Downhill help disabled Return to drive disabled 	<ul style="list-style-type: none"> Wiring harness or connectors

MID 223 SID 237, Relay, Starter Motor

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 3	<ul style="list-style-type: none"> Voltage above normal or shorted high 	<ul style="list-style-type: none"> Vehicle won't start 	<ul style="list-style-type: none"> Yellow check lamp illuminated Vehicle won't start 	<ul style="list-style-type: none"> Relay Wiring harness or connectors

DRAFT

MID 223 SID 240, Program Memory

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 2	<ul style="list-style-type: none"> Data erratic, intermittent, or incorrect 	<ul style="list-style-type: none"> Fault data in program memory The control unit is not programmed 	<ul style="list-style-type: none"> Yellow check lamp illuminated Gear selector control module (GSCM) no function except supply the relay Unable to shift out of neutral position 	<ul style="list-style-type: none"> GSCM not programmed Program memory

MID 223 SID 250, SAE J1587 Data Link

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 9	<ul style="list-style-type: none"> Abnormal update rate 	<ul style="list-style-type: none"> The SAE J1587 data link is not working 	<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> A control module is being programmed Wiring harness or connectors

MID 223 SID 253, Calibration Memory EEPROM

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 2	<ul style="list-style-type: none"> Data erratic, intermittent, or incorrect 	<ul style="list-style-type: none"> Fault in main software 	<ul style="list-style-type: none"> Yellow check lamp illuminated Use of default values of parameters 	<ul style="list-style-type: none"> The gear selector control module (GSCM) is not programmed Software

MID 223 SID 254, Hardware Fault

Type of fault:	FMI Description:	Fault Condition:	Possible Symptoms:	Possible Cause:
FMI 12	<ul style="list-style-type: none"> Faulty device or component 	<ul style="list-style-type: none"> Internal fault in control unit 	<ul style="list-style-type: none"> Yellow check lamp illuminated It is not possible to drive the vehicle 	<ul style="list-style-type: none"> Gear selector control module (GSCM)

SECTION 09: PROPELLER SHAFT

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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 Spicer Life Series SPL250" type with tubular shafts. It is provided with two heavy-duty universal joints (Fig. 1).

The propeller shaft has a half round end yoke at each end. The slip yoke is connected to the differential by a half round end yoke with two needle bearings.

The other extremity (tube yoke assembly) is connected to the transmission by a half round end yoke with two needle bearings (Allison transmission) or a flange yoke and companion flange with two needle bearings (I-Shift Transmission).

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 LIFE SERIES DRIVESHAFTS Service Manual" annexed to this section.

Where applicable:

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

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 H3-41, H3-45, VIP Parts Manual, Section 9.

3.2 LUBRICATION

Lubricate propeller shaft universal joints periodically, every 100,000 miles (160 000 km) or every 6 months, whichever comes first. Apply grease gun pressure to the lube fitting. Use a good quality lithium-base grease such as: NLGI No.2 E.P. Grease (suitable for most temperatures). Refer to "Spicer Life Series Driveshafts Service Manual", under heading, "Lubrication Procedures – Universal Joints".

NOTE

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

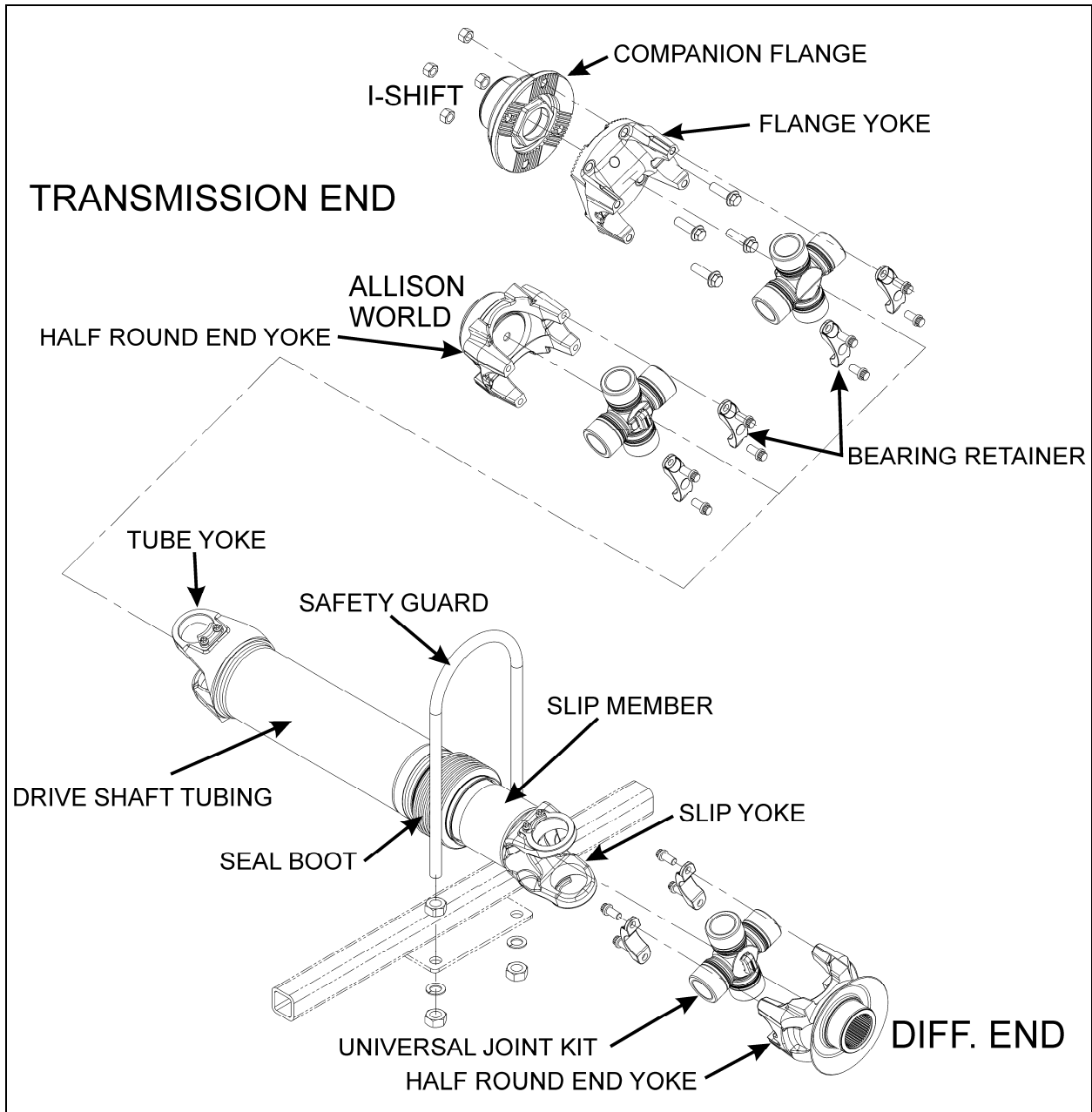


FIGURE 1: PROPELLER SHAFT ASSEMBLY

09003

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 Life Series Driveshafts Service Manual*".

6. SPECIFICATIONS

PROPELLER SHAFT

H3 VEHICLES EQUIPPED WITH AN AUTOMATIC WORLD TRANSMISSION

Make Hayes-Dana Inc.
Series..... SPL250
Prevost number580087
Length.....835 mm

H3 COACHES EQUIPPED WITH I-SHIFT TRANSMISSION

Make Hayes-Dana Inc.
Series..... SPL250
Prevost number580085
Length.....820 mm

SECTION 10: FRONT I-BEAM AXLE

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1. DESCRIPTION

The Dana Spicer S84U 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 king pin, 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.

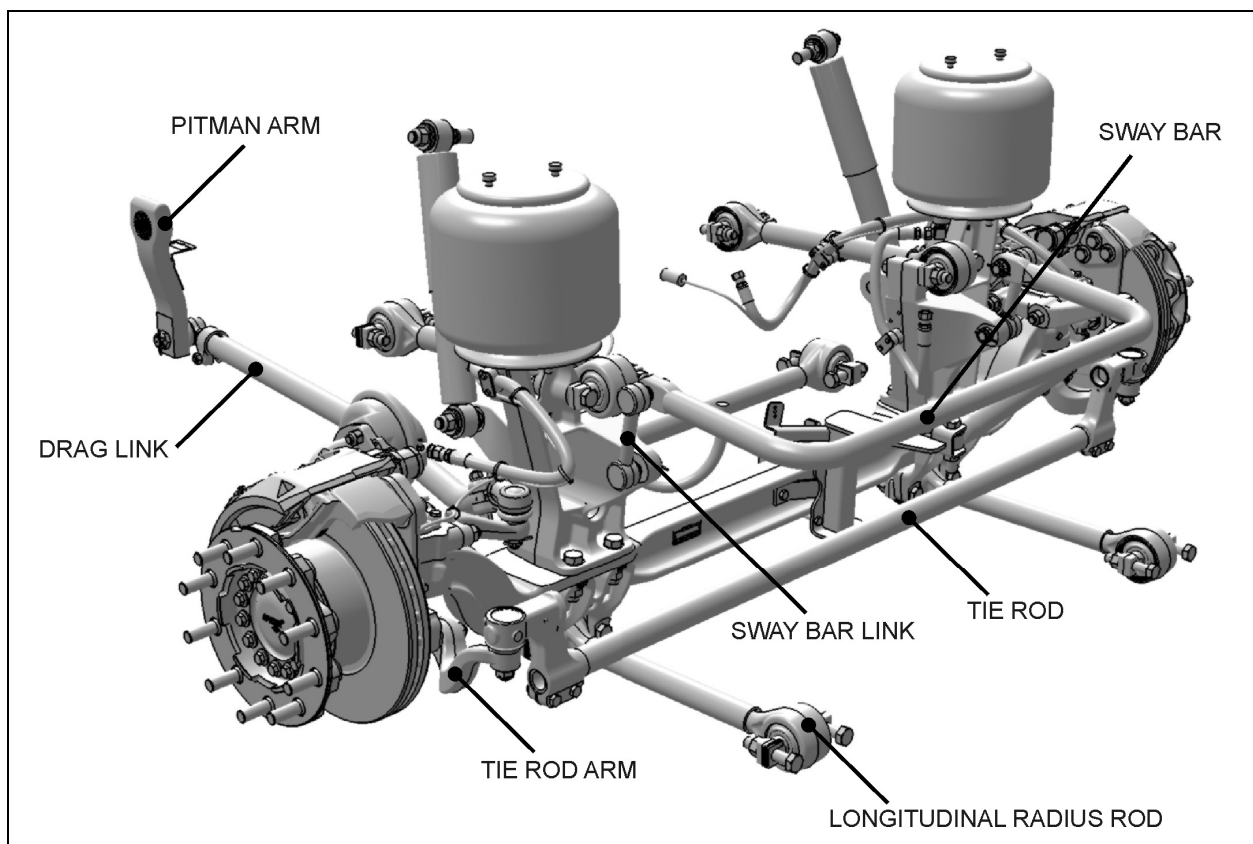
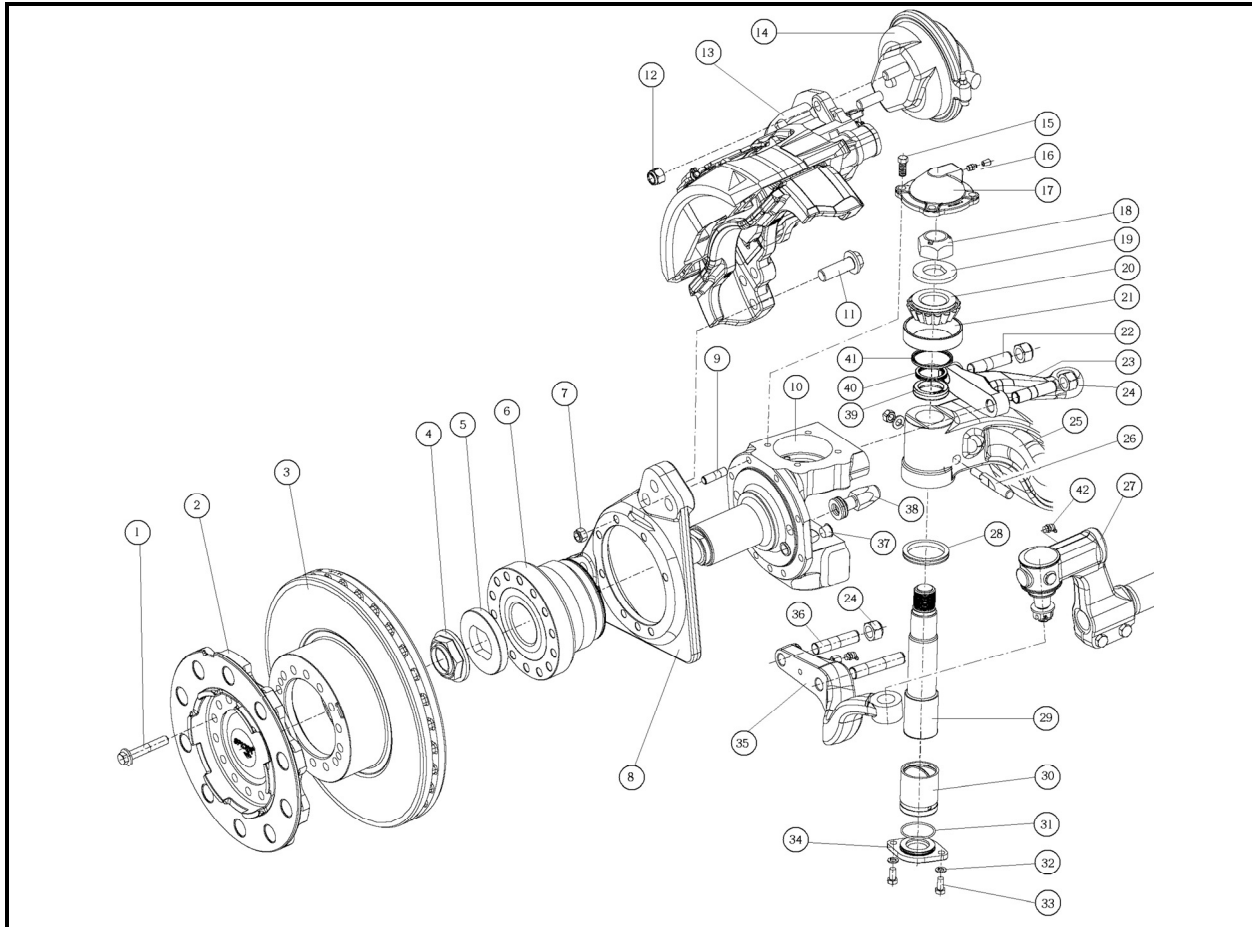


FIGURE 1: FRONT AXLE ASSEMBLY


10025



TYPICAL S84U AXLE

ITEM	DESCRIPTION	QTY	ITEM	DESCRIPTION	QTY		
1	Flanged Bolt	161-197 lbf-ft	28	26	Draw key, Nut, Washer	51-62 lbf-ft	2
2	Hub		2	27	Tie Rod End		2
3	Brake Disc		2	28	V" Ring Seal		2
4	Stake Hub Nut	563-687 lbf-ft	2	29	Kingpin		2
5	Collet Washer		2	30	Kingpin - Bushing		2
6	Hub Bearing		2	31	O-Ring Seal		2
7	Nut - Self Lock	85-103 lbf-ft	16	32	Washer		4
8	Brake Mounting Bracket		2	33	Screw	26-32 lbf-ft	4
9	Stud		16	34	Cap - Knuckle Bottom		2
10	Knuckle		2	35	Bottom Steering Lever		2
11	Brake Fixing - Bolt	325-375 lbf-ft	12	36	Bottom Steering Lever - Stud		4
12	Nut - Self Lock	133-155 lbf-ft	4	37	Abs Sensor - Bush		2
13	Brake		1	38	Back Lock - Stop Bolt	85-103 lbf-ft	2
14	Brake Chamber		2		Front Lock - Stop Bolt	85-103 lbf-ft	1
15	Screw	51-62 lbf-ft	8	39	Sleeve - Knuckle Bearing		2
16	Grease Fitting		4	40	Shim .005"		8
17	Cap - Knuckle Top		2		Shim .010"		8
18	Nut - Self Lock	500-700 lbf-ft	2		Shim .015"		8
19	Washer		2		Shim .008"		4
20	Bearing Cone		2		Shim .006"		2
21	Bearing Cup		2	41	Oil Seal		2
22	Steering Lever - Stud		4	42	Grease Fitting		2
23	Steering Lever		2				
24	Nut - Self Lock		4				
25	Axle, I-Beam		1				

2. LUBRICATION

 <h3 style="margin: 0;">MAINTENANCE</h3>
<p>Knuckle pins are provided with grease fittings for pressure lubrication. These grease fittings should be serviced every 6,250 miles (10 000 km) or every six months whichever comes first.</p> <p>Good quality lithium-base roller bearing mineral grease NLGI No.1 and 2 like Shell Retinax LX are recommended.</p>

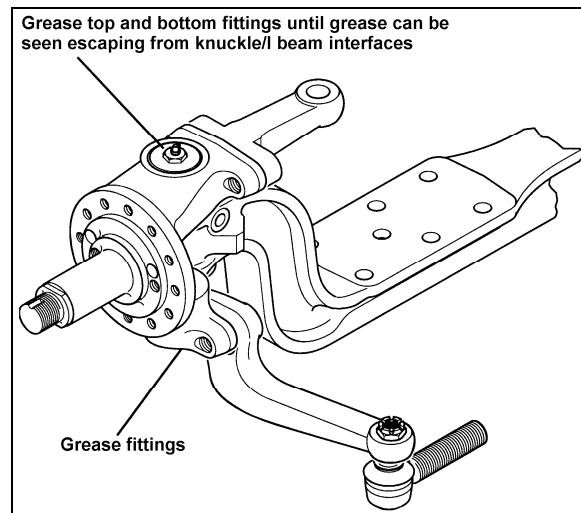


FIGURE 2: FRONT AXLE GREASING POINTS


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.


 <h3 style="margin: 0;">CAUTION</h3>
<p>Should removal of a locking device be required when undergoing repairs, disassembly or adjustments, always replace with a new one.</p>

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 34; Vehicle Jacking Points) until vehicle body is approximately 20 inches (508 mm) from the floor. Place jack stands under frame. Remove the wheels (if required, refer to Section 13, "Wheels, Hubs and Tires").

 <h3 style="margin: 0;">CAUTION</h3>
<p>Use only the recommended jacking points as outlined in section 18 "Body".</p>

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.

 <h3 style="margin: 0;">WARNING</h3>
<p>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.</p>

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

5.1 STEERING KNUCKLE (KING) PIN INSPECTION



MAINTENANCE

An inspection should be made at intervals of 30,000 miles (48 000 km) or twice a year whichever comes first.

Aspects to be considered are:

- **Lateral slackness**
- **Vertical slackness**

NOTE

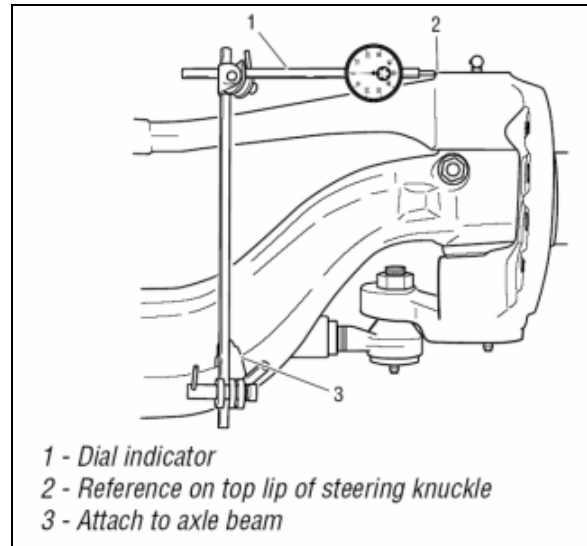
Before commencing checks, apply parking brake, raise wheels off ground and support axle on stands.

5.1.1 Checking Lateral Slackness

Following regular and thorough greasing practices will maximise bushing life. This procedure measures the upper & lower bushing wear due to side and vertical loading. While this is being carried out, the brake must be applied.

Upper Bushing Lateral Inspection

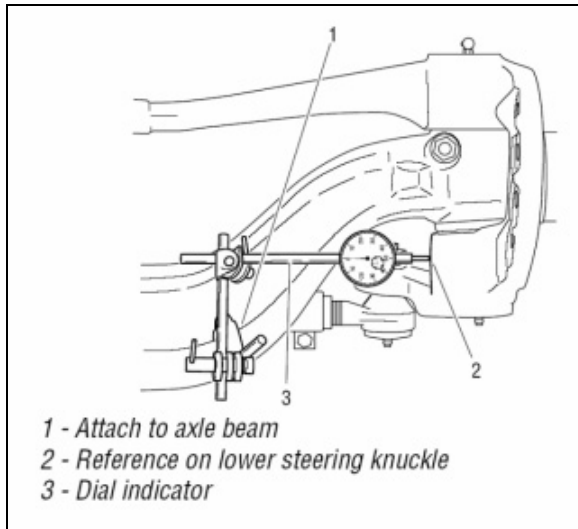
1. Mount dial indicator on the axle. Reference the upper part of the steering knuckle.
2. Move the tire and wheel assembly in and out with a push/pull motion and have an assistant record the dial indicator reading.
3. Replace the upper bushing if readings are in excess of 0.020" (0.5mm).
4. If displacement exceeds stated allowance then need for bush / bearing attention and possible renewal, is in evidence.



Lower Bushing Lateral Inspection

1. Mount dial indicator on the axle. Reference the base of the lower arm on the steering knuckle.
2. Move the tire and wheel assembly in and out with a push/pull motion and have an assistant record the dial indicator reading.
3. Replace the upper bushing if readings are in excess of 0.020" (0.5mm).

4. If displacement exceeds stated allowance then need for bush / bearing attention and possible renewal, is in evidence.



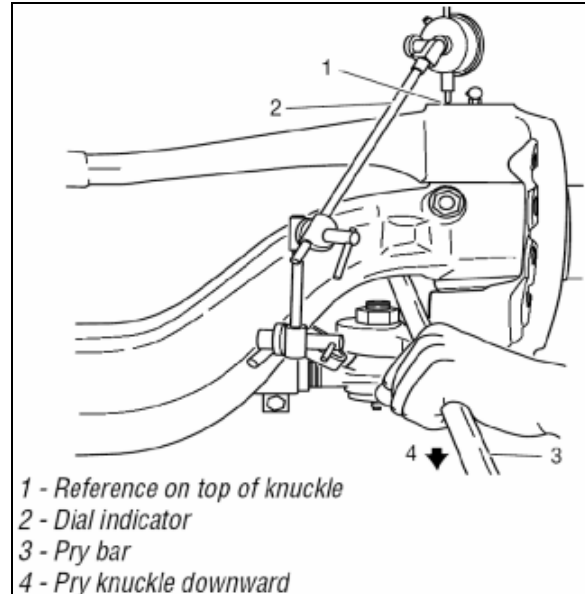
NOTE

To avoid inaccurate measurements, be careful not to let the knuckle turn while moving assembly in and out. Applying brakes will help lock wheel assembly.

Locate indicator on a smooth, flat surface for best reading.

5.1.2 Checking Vertical Slackness

1. This is measured by a dial indicator anchored to axle beam and having its pointer placed vertical against swivel top.
2. Place a jack against underside of swivel and, while applying a lifting force, observe any movement on indicator dial.
3. **If vertical movement is evident and it exceeds 0.040" (1.02mm)** then readjustment of swivel is required by adjusting thickness of bearing adjusting washers.



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 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. See Section 13, *"Wheels, Hubs and Tires"*.
 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.

6.2 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 6.1, *"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.

6.3 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 6.1, *"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.

6.4 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. The steering stopper screw must be in contact before the steering stabilizer reaches the end of the stroke.
6. This must be done for a full left 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.

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).

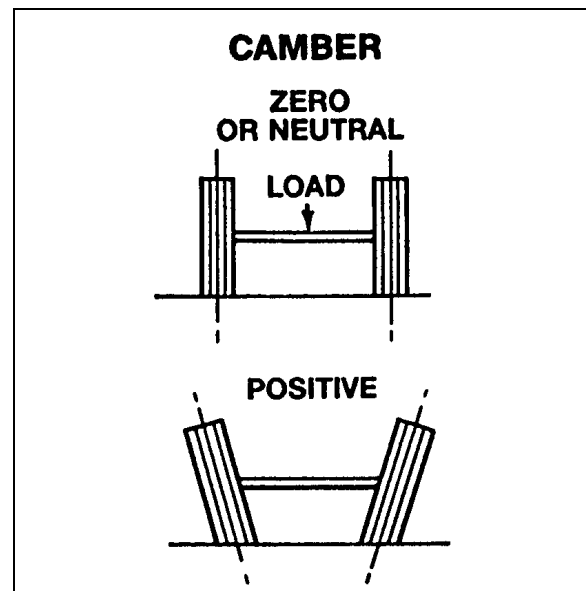


FIGURE 3: CAMBER

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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, adjust the wheel bearings and repeat the check. If the reading is still not within speci-

fications, verify the steering knuckle pins and axle center.

3. See instructions in "DANA SPICER Maintenance Manual Model NDS and Maintenance Manual NDS Axles" annexed at the end of this section.
4. 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.

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

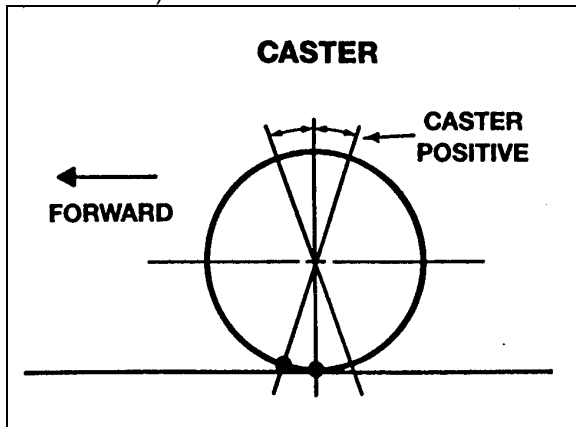


FIGURE 4: CASTER

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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 (Prevost #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.

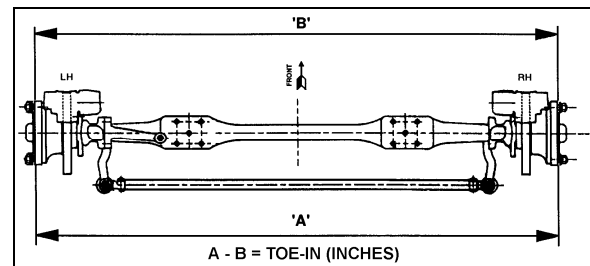


FIGURE 5: TOE-IN MEASUREMENT

10008B

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.

Use static wheel alignment systems which work with angle measurements only, such as Josam or Hunter systems. Static alignment specifications are listed in the following tables:

FRONT WHEEL ALIGNMENT SPECIFICATIONS WITH I-BEAM AXLE			
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
Total toe (A minus B), (degrees)	0.04	0.06	0.08

Refer to Section 16: Suspension for the IFS (independent front suspension) wheel alignment specifications

NOTE

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

7. TROUBLESHOOTING

CONDITION	CAUSE	CORRECTION
Tires wear out quickly or have uneven tire tread wear.	<ol style="list-style-type: none"> 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. 	<ol style="list-style-type: none"> 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.	<ol style="list-style-type: none"> 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. 	<ol style="list-style-type: none"> 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 damaged steering arm, steering top lever or tie rod assembly.	<ol style="list-style-type: none"> 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. 	<ol style="list-style-type: none"> 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.

Section 10: FRONT I-BEAM AXLE

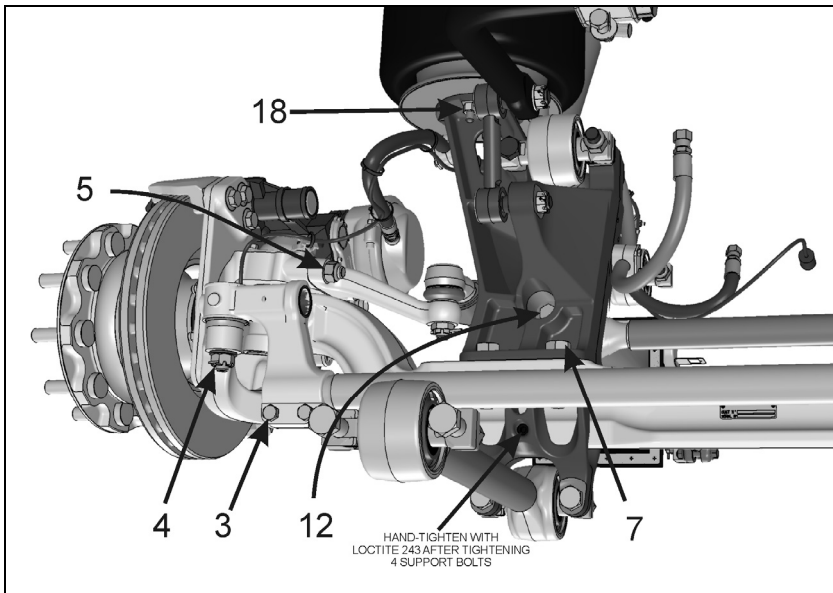
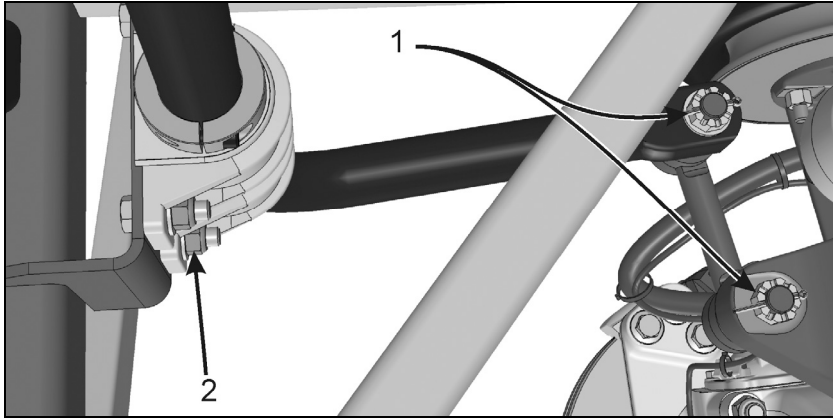
Worn or damaged steering ball stud.	<ol style="list-style-type: none"> 1. Drag link fasteners tightened past specified torque. 2. Lack of lubrication or incorrect lubricant. 3. Power steering stops improperly adjusted. 	<ol style="list-style-type: none"> 1. Replace damaged part(s), tighten drag link fasteners to specified torque. 2. Lubricate linkage with specified lubricant. 3. Adjust stops to specified dimension.
Worn king pins and knuckle bushings.	<ol style="list-style-type: none"> 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. 	<ol style="list-style-type: none"> 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.	<ol style="list-style-type: none"> 1. Caster not adjusted properly. 2. Wheels and/or tires out-of balance. 3. Worn steering stabilizer cylinder. 	<ol style="list-style-type: none"> 1. Adjust caster. 2. Balance or replace wheels and/or tires. 3. Replace steering stabilizer cylinder.

8. SPECIFICATIONS

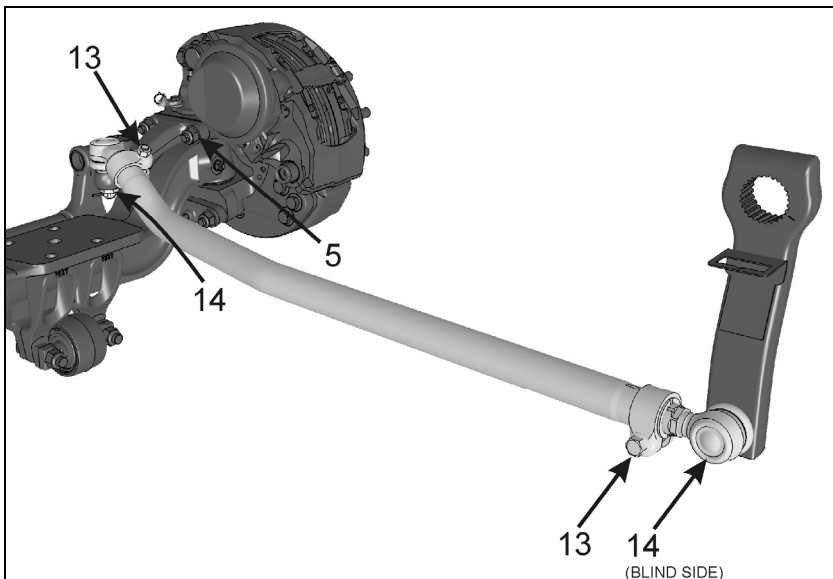
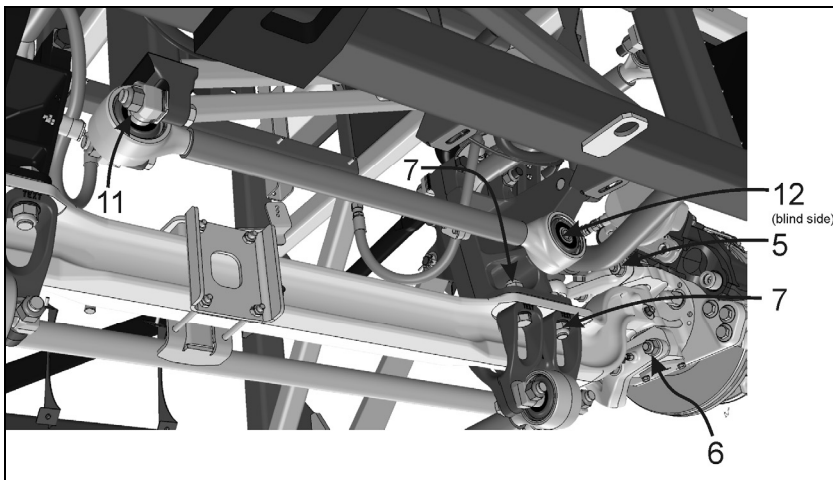
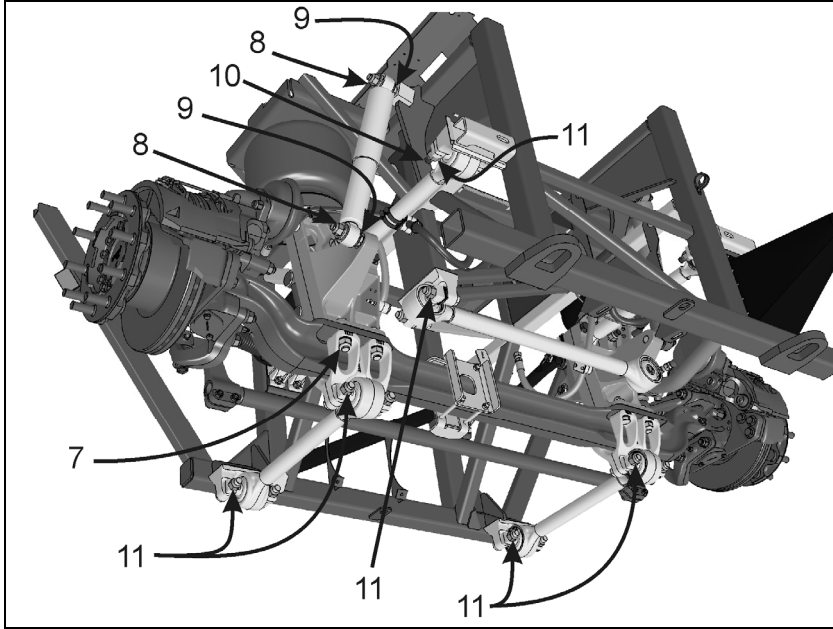
Front Axle

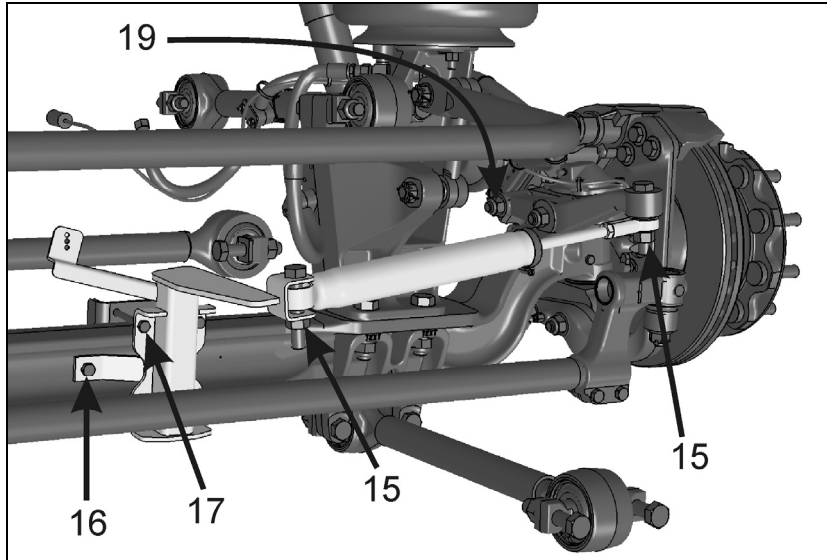
Make DANA SPICER EUROPE
 Model NDS
 Front Track 84.4 inches (2 145 mm)
 Rated load capacity 16,500 lbs (7 500 kg)

9. TORQUE SPECIFICATIONS



Section 10: FRONT I-BEAM AXLE





The following table lists the tightening torques which do require a specific torque value. When no torque specifications are indicated, use the Standard Torque Specifications table found in Section 00: General Information of the Maintenance Manual.

SPECIFIC TORQUE TABLE 1 – FRONT I-BEAM AXLE SUSPENSION & STEERING				
REFERENCE	DESCRIPTION	QTY	TORQUE DRY (lbf-ft / Nm) <i>threads must be free of oil or other lubricant</i>	
1	SWAY BAR LINK, UPPER AND LOWER NUTS	4	165-200	224-271
2	SWAY BAR BUSHING BRACKET	8	80-100	108-136
3	TIE ROD END CLAMP BOLTS	4	65-75	88-102
4	TIE ROD END BALL PIN NUTS	2	150-200	203-271
5	STEERING ARM STUD NUTS	2	285-315	386-427
6	TIE ROD ARM STUD NUTS	4	285-315	386-427
7	I-BEAM AXLE MOUNT NUTS	8	230-280	311-378
8	SHOCK ABSORBER UPPER & LOWER MOUNTING NUTS	2	99-121	134-164
9	SHOCK ABSORBER PINS, UPPER & LOWER	2	350-400	475-545
10	RADIUS ROD RETAINING STUDS	4	90-100	122-136
11	RADIUS ROD RETAINING NUTS	18	225-255	305-346
12	TRANSVERSE RADIUS ROD TAPER PIN NUT	1	171-209	232-283
13	DRAG LINK CLAMP BOLTS	2	118-133	160-180
14	DRAG LINK BALL JOINT STUD NUT	2	150-200	203-271
15	STEERING DAMPER NUTS	2	100-120	135-160
16	STEERING DAMPER BRACKET BOLT	1	39-45	53-61
17	STEERING DAMPER BRACKET NUTS	4	29-34	39-46
18	AIR SPRING NUT	4	31-38	42-52

Section 10: FRONT I-BEAM AXLE

SPECIFIC TORQUE TABLE 1 – FRONT I-BEAM AXLE SUSPENSION & STEERING			
REFERENCE	DESCRIPTION	QTY	TORQUE DRY (lb-ft / Nm) <i>threads must be free of oil or other lubricant</i>
19	STEERING DAMPER ARM NUTS	2	285-315 386-427

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

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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.

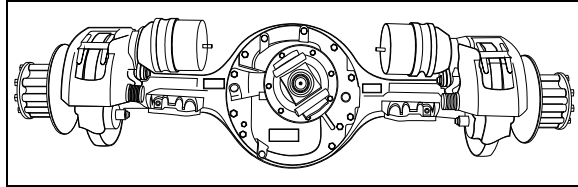


FIGURE 1: DRIVE AXLE

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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.

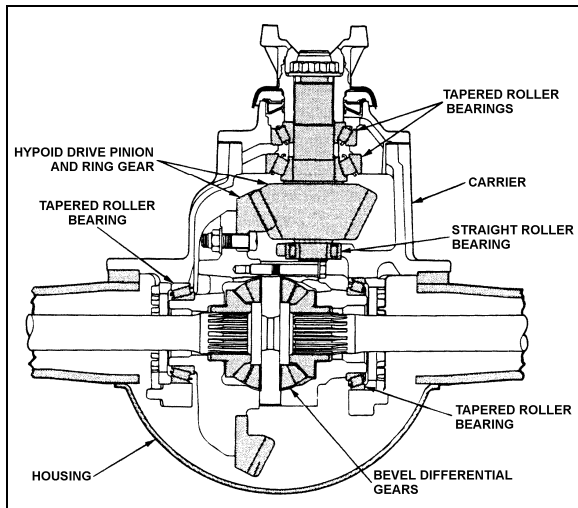


FIGURE 2: DIFFERENTIAL ASSEMBLY

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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.

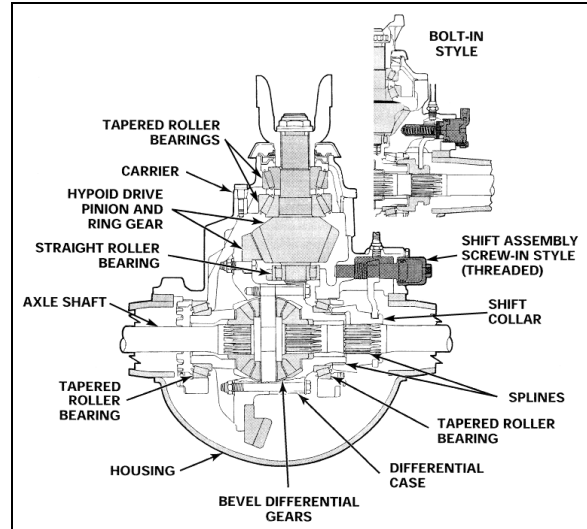


FIGURE 3: DRIVER-CONTROLLED DIFFERENTIAL LOCK

1.3 DRIVE AXLE LUBRICATION

Use Multigrade gear oil 85W140 meeting MIL-PRF-2105-E, tested and approved to SAE J2360. If temperature drops below 10°F (-12°C), 80W90 should be used, and below -15°F (-26°C), 75W90 should be used. Additional lubrication information is covered in the Meritor Technical Bulletin "Approved Rear Drive Axle Lubricants" annexed to this section.

In extreme conditions, or for better performance, fill with synthetic gear oil.



MAINTENANCE

Check oil level and add (if necessary) every 25,000 miles (40 000 km) or according to the fleet maintenance interval, whichever comes first (Fig. 4).



MAINTENANCE

Change differential oil and clean the breathers, magnetic fill and drain plugs, every 100,000 miles (160 000 km) or once a year, whichever comes first.

If using full synthetic gear oil, change differential oil and clean the breathers, magnetic fill and drain plugs, every 250,000 miles (400 000 km) or every four years, whichever comes first.

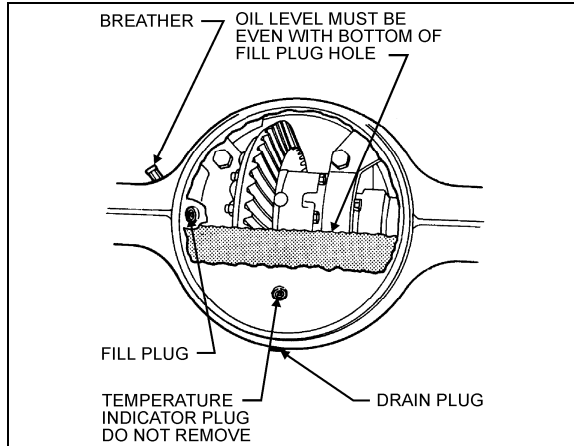


FIGURE 4: DIFFERENTIAL HOUSING BOWL

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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.

MAINTENANCE

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

DANGER

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 190°F (88°C) 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

DANGER

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 250°F (120°C).

6. Install and tighten the fill plug to 35-50 lbf-ft (48-67 Nm).

Section 11: REAR AXLES

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".

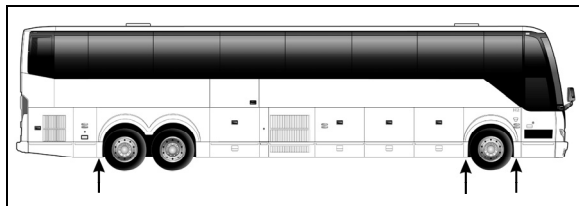


FIGURE 5: JACKING POINTS ON FRAME 18524

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 the 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).

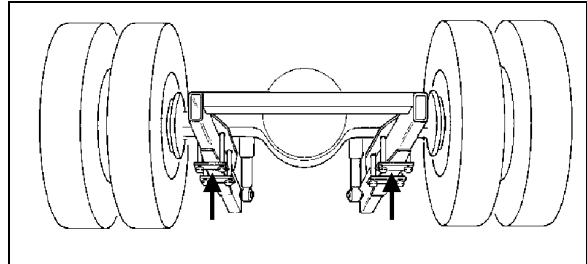


FIGURE 6: JACKING POINTS ON DRIVE AXLE H3B762

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 1/2 inch from ground. Secure in this position with safety stands, and release parking brake.
3. Install wheel mount sensors on front and drive axles (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 for front axle alignment (fig.7), adjust drive axle according to specifications' chart below. Use static wheel alignment systems which work with angle measurements only, such as Josam or Hunter systems. Static alignment specifications are listed in the following tables:

•

DRIVE AXLE ALL VEHICLES			
Alignment / value	Minimum value	Nominal value	Maximum value
Thrust angle (deg.)	±0.11°		
Total Toe (deg.)	0.18 Toe-in	0	0.18 Toe-in

TAG AXLE ALIGNMENT

- Remove and reinstall all wheel mount sensors on the drive and tag axes (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. For example, the sensor from the right side of the front axle is mounted on the left side of the tag axle.

- Adjust tag axle according to specifications' chart below in reference with drive axle. Use static wheel alignment systems which work with angle measurements only, such as Josam or Hunter systems.

TAG AXLE			
Alignment / value	Minimum value	Nominal value	Maximum value
Thrust angle (deg.)	-0.02	0	0.02
Total toe (deg.)	0.08° toe-in	0°	0.02° toe-out

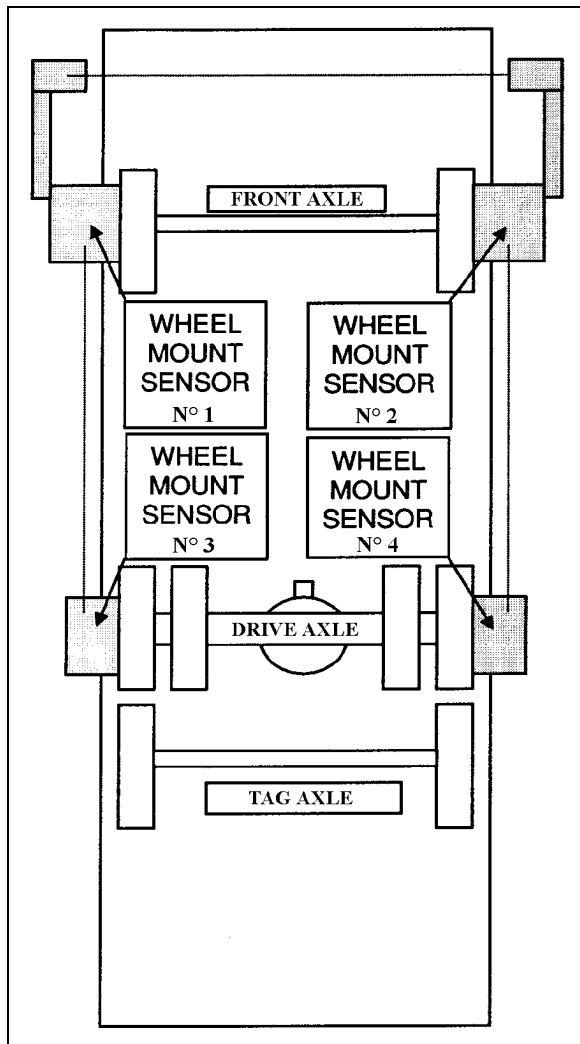


FIGURE 7: FRONT & DRIVE AXLE ALIGNMENT 11025

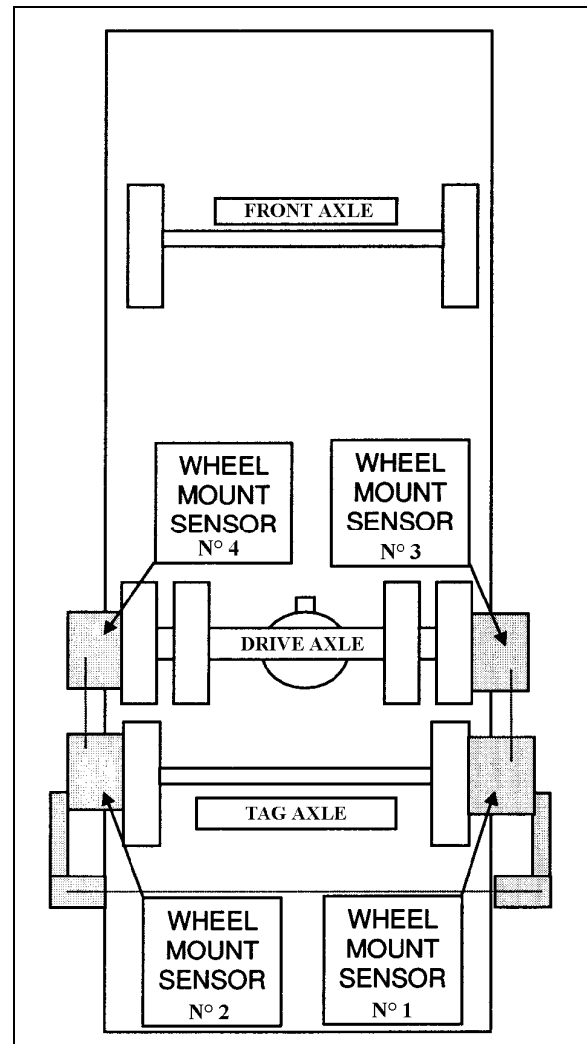


FIGURE 8: TAG AXLE ALIGNMENT 11026

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:

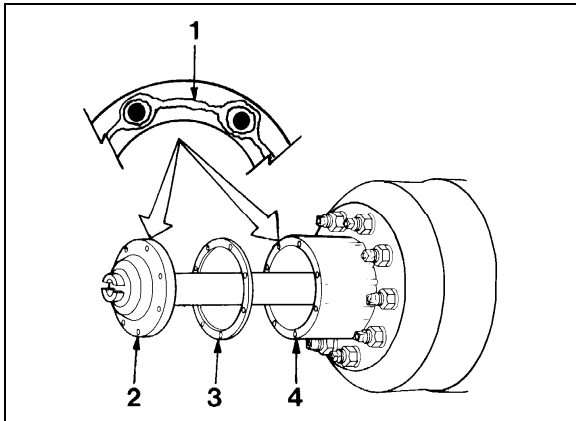


FIGURE 9: AXLE SHAFT INSTALLATION 11003

- 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* (Prevost 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 and 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)

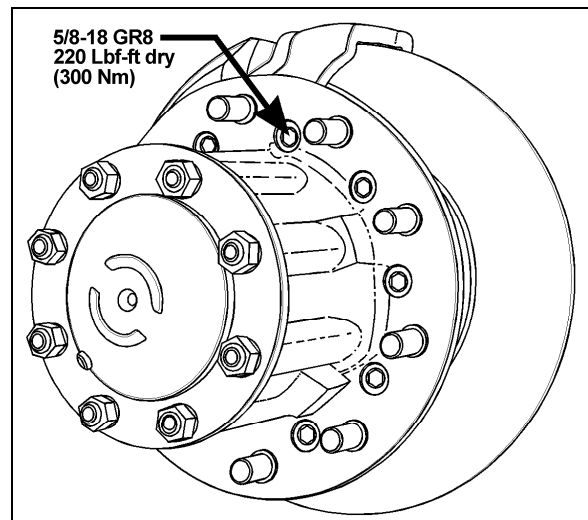


FIGURE 10: TORQUE SPECIFICATION


2. TAG AXLE

The tag axle is located behind the drive axle. It carries a single wheel and tire on each side.

2.1 UNLOADING OR RETRACTING TAG AXLE

One optional system allows unloading of the tag axle air springs without raising the axle, while the other system enables unloading and raising of the tag axle (refer to the "OPERATOR'S MANUAL" for location of controls). Both of these systems have 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
Do not use tag axle in raised position for an extended period. Raising tag axle increases load on the drive axle, suspension and tires.
Do not drive vehicle with tag axle raised when speed is exceeding 9mph (15 km/h).
In order to prevent damage to the suspension, always raise the tag axle before lifting the coach.


The tag axle service brakes operate only when the axle is in normal driving (loaded) position.

2.2 RETRACTING TAG AXLE FOR REPAIR PURPOSES

- Connect an external air pressure line to the emergency fill valve in the engine compartment.
- Lift the tag axle by pushing the lever forward.

 WARNING
Install a protective cover to prevent unfortunate lever operation while work is being carried out under the vehicle.

- Raise the vehicle using the lifts.


 WARNING
Lift manufacturers recommended lowering the vehicle to the ground or installing some safety stands before activating the suspension to prevent the lifts from becoming unstable.

- For added safety, install nylon sling over tag axle shock absorbers.

2.3 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.


 MAINTENANCE
Front and tag axle hub bearings need to be checked every 30,000 miles (48 000 km).
NOTE
<i>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 10.</i>

2.4 REMOVAL AND REINSTALLATION

2.4.1 Removing Tag Axle Only

The following procedure deals with the removal of the tag axle while keeping the air springs installed. The method used to support the axle and suspension components during removal and disassembly depends upon local conditions and available equipment.

- Connect an external air pressure line to the emergency fill valve in the engine compartment.
- Lift the axle by pushing the lever forward.

 WARNING
Install a protective cover to prevent unfortunate lever operation while work is being carried out under the vehicle.

- Disconnect tag axle air springs pneumatic hoses and install valves or plugs.
- Raise the vehicle using the lifts.
- Dismount tag axle components.
- Before reinstalling air spring hoses, make sure there is no pressure left inside by opening the valves or unloading tag axle.

2.4.2 Removing Tag Axle Along With Suspension Components

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).

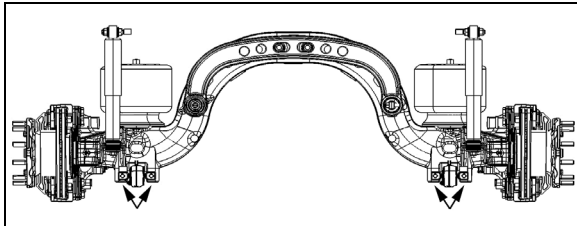


FIGURE 11: JACKING POINTS ON TAG AXLE 11023

4. 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.

2.4.3 Removing Transversal radius Rod

Unfasten bolts and nuts fixing transversal radius rod ball joint to rear underframe.

Install extractor tool G32952 onto transversal rod.

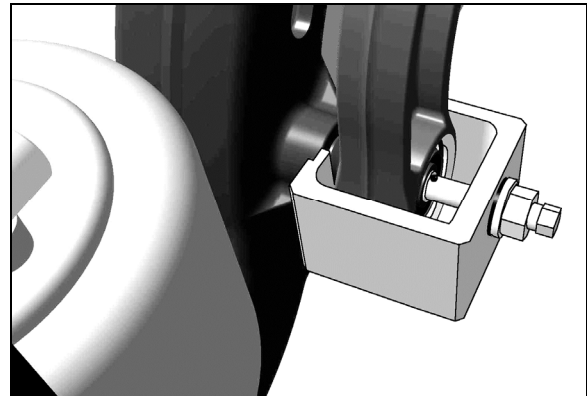


FIGURE 12: INSTALLING EXTRACTOR TOOL



CAUTION

It is strongly suggested to use the extractor tool in order to remove transversal radius rod.

Partially unscrew ball joint fixing bolt. Tighten extractor threaded rod.


Supporting the transversal radius rod at all times, gradually extract transversal radius rod from tag axle.

2.5 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.

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.

 **CAUTION**
 If this setting is altered significantly, it will cause excessive tire wear.

3. SPECIFICATIONS

Drive Axle

MakeMeritor
 Drive track..... 76.7 inches (1 949 mm)
 Gear typeHypoid
 Axle type Full floating
 Lube capacity41 pints (19,3 liters)

Drive axle ratio

Allison Transmission

I-Shift transmission

3.58:1 option

2.50:1

3.91:1 standard

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

MakePrevost
 Rear track 83.6 inches (2 124 mm)
 Axle type Forged

NOTE
The tag axle alignment consists in aligning the tag axle parallel to the drive axle.



Approved Rear Drive Axle Lubricants

CAUTION

You must fill Meritor axles with Meritor-specified lubricants only. Do not fill an axle with non-approved lubricants, which will void Meritor's warranty. Damage to axle components also can result.

To avoid axle component damage, fill Meritor axles with approved lubricants only. Using non-approved lubricants also will void Meritor's warranty.

For complete lubrication information, refer to Maintenance Manual 1, Preventive Maintenance and Lubrication. To obtain this publication, call ArvinMeritor's Customer Service Center at 800-535-5560, or visit Literature on Demand on our website at meritorhvs.com.

Table A: Oil Change Intervals and Specifications for All Rear Drive Axles

Vocation or Vehicle Operation	Linehaul	Intercity Coach	City Delivery, School Bus, Fire Truck, Motorhome	Construction, Transit Bus, Refuse, Yard Tractor, Logging, Heavy Haul, Mining, Oil Field, Rescue
Initial Oil Change	Not required			
Check Oil Level Add the correct type and amount of oil as required.	Every 25,000 miles (40 000 km), or the fleet maintenance interval, whichever comes first		Every 10,000 miles (16 000 km), once a month, or the fleet maintenance interval, whichever comes first	Every 5,000 miles (8000 km), once a month, or the fleet maintenance interval, whichever comes first ①
Petroleum-Based Oil Change on Axle with or without Pump and Filter System ②	Every 100,000 miles (160 000 km), or annually, whichever comes first		Every 50,000 miles (80 000 km), or annually, whichever comes first	Every 25,000 miles (40 000 km), or annually, whichever comes first
Synthetic Oil Change on Axle with or without Pump and Filter System ③	Every 500,000 miles (800 000 km), or every 4 years, whichever comes first	Every 250,000 miles (400 000 km), or every 4 years, whichever comes first	Every 250,000 miles (400 000 km), or every 3 years, whichever comes first	Every 100,000 miles (160 000 km), or every 2 years, whichever comes first ④
Filter Change on Axle with Pump and Filter System	Every 100,000 miles (160 000 km)			

① For continuous heavy-duty operation, check the oil level every 1,000 miles (1600 km).

② All ArvinMeritor GL5 approved gear lubricants have been SAE J2360 tested and approved. A current list of approved oils is available at www.pri.sae.org/PRI/IMprograms/Lubricant.

③ These intervals apply to approved semi-synthetic and full synthetic oils only. For a list of approved extended-drain axle oils, refer to **Table C** or **Table D**.

④ The change interval for transit buses can be increased to **150,000 miles** or **3 years**, whichever comes first, contingent upon:
1) documented 10% fleet oil sampling with results below ArvinMeritor guidelines per Maintenance Manual 1,
2) minimum of six magnets in housing (61163/ 71163 drive axles come standard with six magnets in housing), and
3) use of approved extended-drain interval lubricants per **Table B**. (Drive axles excluded are: RC-26-633/634 and RC-26/27-720.)

Table B: Axle Oil Specifications

	Gear Oil Type	A.P.I. Specification	SAE Viscosity Grade	ArvinMeritor Specification	SAE Specification	Outside Temperature
Standard Drain Lubricants	Petroleum with EP additives	GL-5	85W/140	O76-A	SAE J2360 Tested and Approved	Above +10°F (-12°C)
			80W/140	O76-B		Above -15°F (-26°C)
			80W/90	O76-D		Above -15°F (-26°C)
			75W/90	O76-E		Above -40°F (-40°C)
			75W	O76-J		From -40°F (-40°C) to +35°F (+2°C)
			75W/140	O76-L		Above -40°F (-40°C)
Extended-Drain Lubricants	Petroleum with Extended-Drain Base Oils and EP additives	GL-5	75W/90, 80W/90, 80W/140 or 75W/140	O76-Q, O76-R	SAE J2360 Tested and Approved	Depends on viscosity. Refer to the viscosity grades listed above.
	Petroleum with Semi-Synthetic Base Oils and EP additives		80W/90	O76-P		Above -15°F (-26°C)
	Fully Synthetic Base Oil and EP additives		75W/140	O76-M		Above -40°F (-40°C)
	Fully Synthetic Base Oil and EP additives		75W/90	O76-N		Above -40°F (-40°C)

Table C: Extended-Drain-Approved Synthetic Axle Oil Suppliers – United States Distributors

Name of Lubricant	Viscosity	Manufacturer
Allied Mag Synthetic EP	75W/90, 80W/140	Allied Oil and Supply Incorporated
Altra Syntec GT-7	75W/90, 80W/140	Allegheny Petroleum Products
Amalie Synthetic Gear Lubricant	75W/90, 80W/140	Amalie Refining Company
Amoco Ultimate Multipurpose Gear Lube	75W/90, 80W/140	Amoco Oil Company
Archer Synthetic	75W/90, 80W/140	McCollister & Co.
Brad Penn Full Syn. Hypoid Gear Lube	75W/90, 80W/140	American Refining Group
Bulldog Syn Gear Lube	75W/90, 80W/140	Mack Truck Company
Chevron Delo Synthetic Gear Lubricant	75W/90	Chevron Global Lubricants
Chevron RPM Synthetic Gear Lubricant	75W/90, 80W/140	Chevron Global Lubricants
Citgo Synthetic Gear Lube	75W/90, 80W/140	Citgo Petroleum Corporation
Coastal HD	75W/90, 80W/140	Coastal Unilube Inc.
Dyna-Plex 21C Synzol	75W/90, 80W/140	Universal Lubricants
Dyno-Tech HD	75W/90, 80W/140	Chemtool Inc.
Emgard EP	75W/90, 80W/140	Cognis Corporation
Emgard FE Fuel Efficient Synthetic Gear Lubricant	75W/90	Cognis Corporation
Emgard Synthetic Gear Lubricant	75W/90, 80W/140	Cognis Corporation
Emgard 2986	75W/90	Cognis Corporation
Fleerite Synthetic	75W/90, 80W/140	International Truck & Engine Group
FS Synthetic	75W/90, 80W/140	Growmark
Gear Plus Super EW	75W/90, 80W/140	Pennzoil-Quaker State

Table C: Extended-Drain-Approved Synthetic Axle Oil Suppliers – United States Distributors

Name of Lubricant	Viscosity	Manufacturer
Gibraltar Syn-Gear	75W/90, 80W/140	David Weber Oil Company
Gulf Syngear	75W/90, 80W/140	Gulf Oil
Hi-Tek Synthetic	75W/90, 80W/140	Industrial Oils Limited
Imperial SGO	75W/90, 80W/140	IPAC
Lubemaster Syn EP	75W/90, 80W/140	Lubemaster (A Division of Certified Labs)
Maxtron GL	75W/90, 80W/140	Country Energy LLC
Mobil Delvac Synthetic Gear Oil	75W/90, 80W/140	ExxonMobil Corporation
Mobilube SHC	75W/90, 80W/140	ExxonMobil Corporation
Monarch Syngear Plus	75W/90, 80W/140	Royal Manufacturing Co. Inc.
Mystik Synguard SX-7000	75W/90, 80W/140	Cato Oil and Grease Company
NEO	75W/90, 80W/140	Neo Lubricants
Pennzoil Long-Life EW	75W/90, 80W/140	Shell Oil U.S.
Quaker State FCI Synthetic	75W/90, 80W/140	Shell Oil U.S.
Raloy Transintex Plus EP	75W/90, 80W/140	Raloy Lubricantes S. A. de C.V.
Roadranger FE Fuel Efficient Synthetic Gear Lubricant	75W/90	Eaton Corporation
Roadranger Synthetic Gear Lubricant	75W/90, 80W/140	Eaton Corporation
Schaeffer Synthetic EP	75W/90, 80W/140	Schaeffer Manufacturing Company
SHP Gear Lube	75W/90, 80W/140	Kendall Lubricants
Spirax S	75W/90, 80W/140	Shell Lubricants
SYN HD Gear Oil	75W/90, 80W/140	Lyondell Lubricants
Syn. Axle Lubricant 12345841	75W/90, 80W/140	General Motors Service Parts
Syncon HP Synthetic Gear Oil	75W/90, 80W/140	Conoco Lubricants
SYN-EP Gear Lubricant	75W/90, 80W/140	Black Bear Company Incorporated
Synergy Syn. Gear Lube EP	75W/90, 80W/140	Northland Products Company
Syn-Gear	75W/90, 80W/140	Castrol Heavy Duty Lubricants, Inc.
Syngear EP	75W/90, 80W/140	American AGIP
Synolec	75W/90, 80W/140	Lubrication Engineers Incorporated
Synpro	75W/90, 80W/140	Fina Oil and Chemical Company
Syn-Star GL	75W/90, 80W/140	Texaco Lubricants Company
Synsure Synthetic Lubricant	75W/90, 80W/140	D-A Lubricant Company Incorporated
Syn-Tech EP	75W/90, 80W/140	Benz Oil
Syntex 2700	75W/90, 80W/140	Texas Refinery Corporation
Texaco Syn-Star GL	75W/90, 80W/140	Chevron Global Lubricants
Traxon E Synthetic	75W/90, 80W/140	Petro-Canada Lubricants Centre
Triton Syn Lube EP	75W/90, 80W/140	76 Lubricants
United Syn	75W/90, 80W/140	McCollister & Co.
Valvoline HD Synthetic Gear Oil EP	75W/90, 80W/140	Valvoline Incorporated

Table D: Additional Extended-Drain-Approved Axle Oil Suppliers

CANADA:

Name of Lubricant	Viscosity	Manufacturer
HDH Synthetic	75W/90, 80W/140	Irving Oil Limited
NEMCO Syngear	75W/90, 80W/140	NemCo Resources Limited
Sonic MP Gear Oil	75W/90, 80W/140	Federated Cooperatives Limited
Titan Syndrive	75W/90, 80W/140	Fuchs Lubricants Canada Limited

MEXICO:

Name of Lubricant	Viscosity	Manufacturer
Akron Axle Synthetic	75W/90, 80W/140	Mexicano de Lubricantes, S.A. de C.V.
Q.S. Synquest Gear	80W/140	Commercial Importada, S.A. de C.V.
Sun Gear Gold Syn	75W/90, 80W/140	Aceites Y Parafinas Industriales
Syn-Star GL	75W/90, 80W/140	Productos Texaco, S.A. de C.V.
Transintex Plus EP	75W/90, 80W/140	Raloy Lubricantes, S.A. de C.V.

AUSTRALIA/NEW ZEALAND:

Name of Lubricant	Viscosity	Manufacturer
Synstar GL	75W/90, 80W/140	Caltex Oil Pty. Limited
Syntrax E	75W/90, 80W/140	Castrol Australia PTY Limited
TransGear S	80W/140	BP Oil Company
Tutela Truck FE Axle	80W/140	Fiat Lubrificanti

Other Approved Extended-Drain Gear Oils

Name of Lubricant	Viscosity	Manufacturer
Delo Gear Lubricant ESI	80W/90, 85W/140	Chevron Global Lubricants
PED 6449	75W/90	Chevron Global Lubricants
Pennzoil Long-Life EW	75W/90, 80W/140	Shell Lubricants
SAF-AM	80W/90	Castrol Heavy Duty Lubricants
Shell Spirax EW	75W/90, 80W/140	Shell Lubricants
Synergyn Blended Synthetic	80W/90	Synergyn Racing Products
Texaco Star Gear Lubricant	80W/90, 85W/140	Chevron Global Lubricants
Triton Syn Lube LDO	75W/90, 80W/140	76 Lubricants
Super Three Star	75W/90, 80W/140	Kendall

For Meritor R-170 Axles Equipped With Traction Equalizer®

Meritor's R-170 axles with Traction Equalizer normally operate with either standard petroleum, semi-synthetic or full-synthetic oils.

When to Use "Limited Slip Friction Modifiers"

Occasionally the Traction Equalizer will "slip" or "stick." When this happens, you will hear intervals of shrill noises when the vehicle operates at low speed or when the vehicle makes sharp turns. You can correct this condition by adding "limited slip friction modifiers."

NOTE: "Limited slip friction modifiers" usually deteriorate more quickly than extreme pressure (EP) additives. Shorten the lubricant change schedule if you add a friction modifier.

- **At the initial lubricant change interval for an R-170 equipped with Traction Equalizer:** Replace the factory-installed lubricant with an approved lubricant and one of the additives specified in the following table.
- **After the initial change interval:** Change the lubricant and the additive at or before 50,000 miles (80 000 km).

Specifications

For all GL-5 oils (petroleum oil or synthetic), add one of the following modifiers specified in the following table.

Manufacturer	Specification
DSL-178	Guardsman Products
Equa-Torque #2411 and #2414	Sta-Lube Corporation
Lubrizol #6178	Lubrizol Corporation

Quantities for R-170 Axles With and Without Traction Equalizer

WITH Traction Equalizer	WITHOUT Traction Equalizer
40 pints oil (18.9 liters) + 3 pints additive (1.4 liters)	43 pints oil (20.3 liters)

Lubrication Analysis Recommendations

Meritor recommends using a lubricant analysis program. Perform lubricant analysis at regularly-scheduled preventive maintenance intervals. Refer to Maintenance Manual 1, Preventive Maintenance and Lubrication, for drive axle differential oil analysis guidelines.

ArvinMeritorTM

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Maintenance Manual Update

Applying Loctite® Ultra Grey Flange Sealant 5699/Meritor Part Number 2297-Z-7098

Hazard Alert Messages

Read and observe all Warning and Caution hazard alert messages in this publication. They provide information that can help prevent serious personal injury, damage to components, or both.

⚠ WARNING

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

When you apply some silicone gasket materials, a small amount of acid vapor is present. To prevent serious personal injury, ensure that the work area is well-ventilated. Read the manufacturer's instructions before using a silicone gasket material, then carefully follow the instructions. If a silicone gasket material gets into your eyes, follow the manufacturer's emergency procedures. Have your eyes checked by a physician as soon as possible.

Procedures

1. Remove all old gasket material from both the axle and the carrier surfaces. Figure 1.

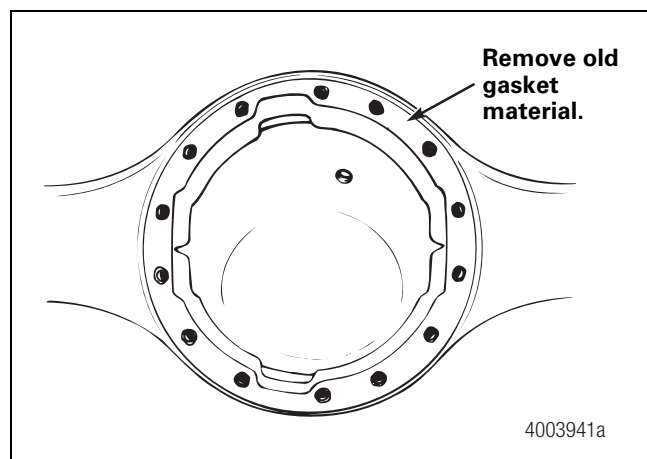


Figure 1

2. Clean the surfaces where you will apply the silicone gasket material. Remove all oil, grease, dirt and moisture. Figure 1.
3. Dry both surfaces.

⚠ CAUTION

The amount of silicone gasket material applied must not exceed a 0.125-inch (3 mm) diameter bead. Too much gasket material can block lubrication passages and result in damage to the carrier or axle components.

4. Apply a 0.125-inch (3 mm) diameter continuous bead of Loctite® Ultra Grey Flange Sealant 5699, Meritor part number 2297-Z-7098, around one surface. Also apply the gasket material around the edge of all fastener holes on that surface. Figure 2.

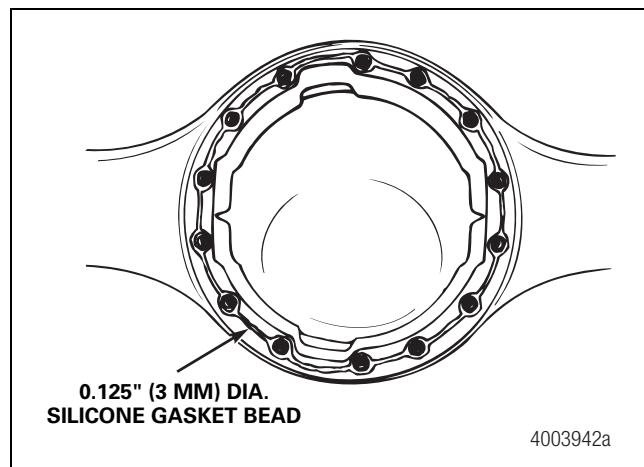


Figure 2

5. Assemble the components immediately to permit the silicone gasket material to compress evenly between the parts. Tighten the fasteners to the required torque value for that size fastener.
6. Wait 20 minutes before filling the assembly with lubricant.

Maintenance Manuals

The information in this Technical Bulletin updates the following Maintenance Manuals.

MM	Title	Date
5B	Tandem Axle Forward Rear Drive Units	09-88
5J	Single-Reduction Hypoid Drive Unit	08-79
5P	Tandem Axle Forward Rear Drive Units	03-91
6C	Double-Reduction Differential Carriers	08-84
7A	Hypoid Planetary Two-Speed Differential Carriers	08-90
12	Heavy-Duty Front Drive Steer Axles	11-98

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SECTION 12: BRAKE AND AIR SYSTEM

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Section 12: BRAKE AND AIR SYSTEM

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 pneumatic relay valves (R-14), 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 is provided with spring-loaded emergency/parking brakes, which are applied automatically whenever the control valve supply pressure drops below 60 psi (413 kPa). The optional emergency/parking brake overrule system allows the driver to release spring brakes, and to move the vehicle to a safe parking place, such as in the case of a self-application of these brakes due to a drop in air pressure.

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 (FIGURE 1).

Two additional air reservoirs may be installed on the vehicle: the kneeling air tank and emergency/ parking brake overrule air tank.

3.1 MAINTENANCE

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

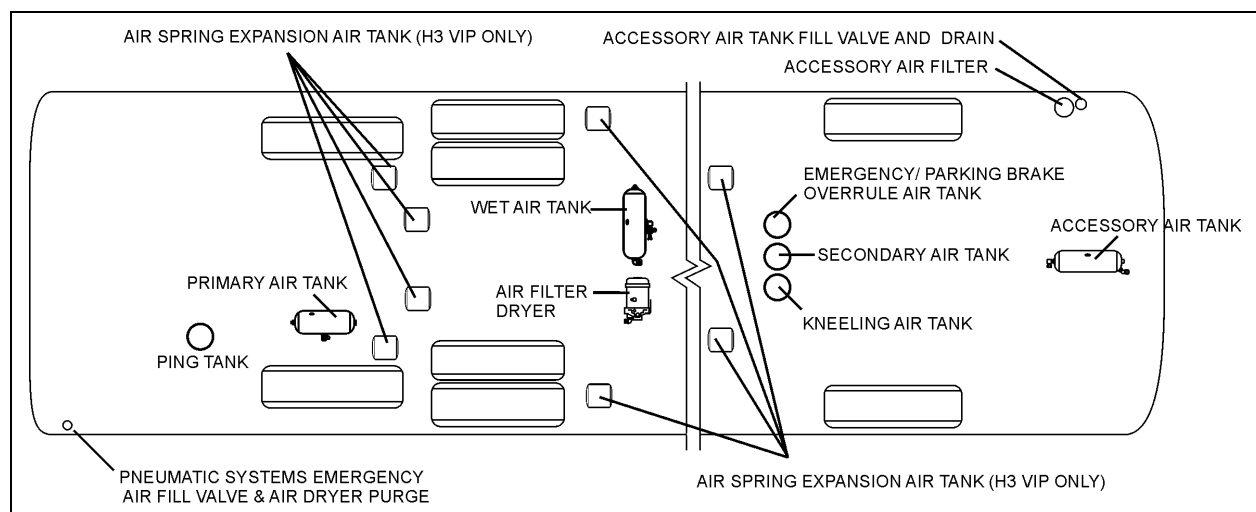


FIGURE 1: AIR TANKS LOCATION

12196

3.1.1 Wet Air Tank

This reservoir, located in front and above the 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 12,000 miles (20 000 km), or once a year, whichever comes first.

3.1.2 Primary Air Tank

This reservoir is located above the tag axle, and is provided with a bottom drain valve. It is recommended to purge the primary air tank every 12,500 miles (20 000 km) or once a year, whichever comes first.

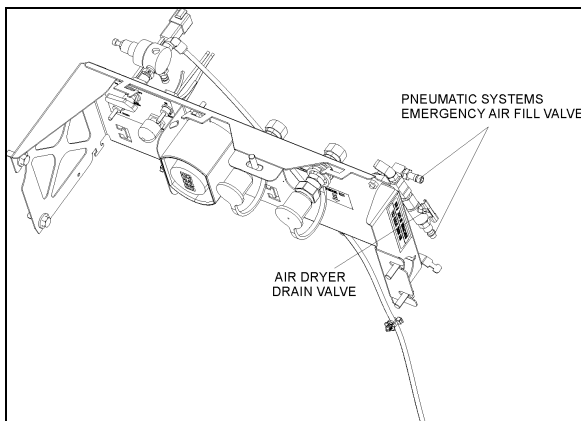


FIGURE 2: REAR VALVE LOCATION 12219

3.1.3 Accessory Air Tank

The accessory air tank is installed at the ceiling of spare wheel compartment and is provided with a bottom drain valve. Purge daily using the remote drain valve located in the front service compartment (Figure 3). Purge the reservoir by its drain valve every 12,500 miles (20 000 km) or once a year, whichever comes first.

3.1.4 Emergency/Parking Brake Override Air Tank

Installed on vehicles equipped with this option, this reservoir is located in the front wheelhousing. 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.

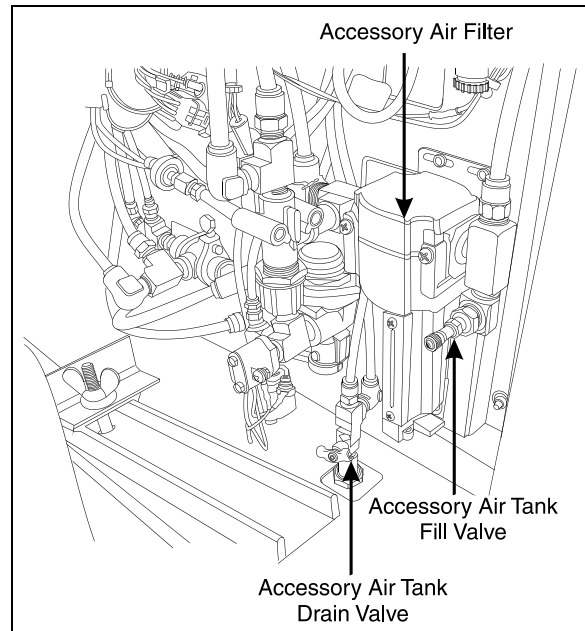


FIGURE 3: FRONT SERVICE COMPARTMENT 12130

3.1.5 Secondary Air Tank

Located in the front wheelhousing, this tank is set between the optional Emergency/Parking Brake override air tank and the Kneeling air tank. 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.

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 (FIGURE 1), and is provided with a bottom drain valve. Purge this reservoir every 12,500 miles (20 000 km) or once a year, whichever comes first.

3.1.7 I-Shift Transmission Air Tank

Installed on vehicles equipped with this option, this reservoir is located in the rear wheelhousing next to the expansion tanks. 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.

3.2 PING TANK

The ping tank is located in the engine compartment and 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.

Section 12: BRAKE AND AIR SYSTEM

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 compartment R.H. side door (Fig 2.).



CAUTION

Maximum allowable air pressure is 140 psi (965 kPa). Air filled through these two points will pass through the standard air filtering system provided by Prevost. Do not fill system by any other point on the system.

The front valve is located in the front electrical and service compartment close to R.H. side of doorframe (Figure 3).

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 to wet air tank, primary air tank, secondary air tank and accessories air tank for brakes, suspension and accessories systems while the front fill valve will supply air to accessories only.

5. ACCESSORY AIR FILTER

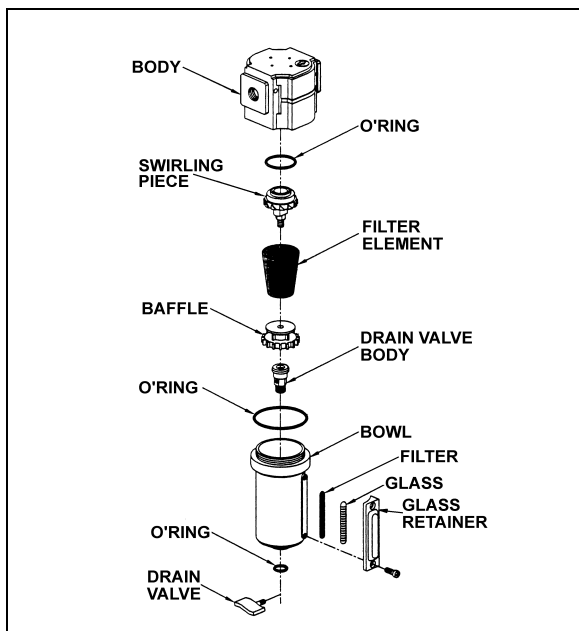


FIGURE 4: ACCESSORY AIR FILTER

12088

This filter is located inside the front electrical and service compartment (Figure 3). 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 (Figure 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 (Figure 4).

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" or "Owner's Manual"), are fed from pressure transducer installed on the DC-4 double check valve, located on the pneumatic accessories 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 publication box. 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

Meritor Wabco air dryer port identification

PORT	DESCRIPTION
1	From compressor
21	To wet tank
3	Exhaust
4	To compressor
6	Electrical control

Torque for connections:

3/8"-18 NPTF= 12 lbf-ft

1/4"-18 NPTF= 12 lbf-ft

1/2"-14 NPTF= 37 lbf-ft

Safety valve dynamic pressure: 290 psi.

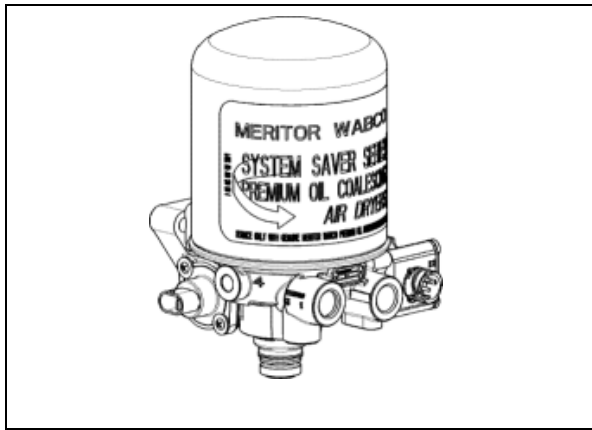


FIGURE 5: MERITOR WABCO AIR FILTER DRYER

The electric air dryer is controlled by the multiplex system. If the air dryer should for some reason become powerless, it will cease to function and the desiccant will become *wet through*, while the compressor will continue to charge. Relief is provided via the safety valve.

By using the information from the vehicle electronic system, the air dryer and compressor control is optimized, so that drying of the air is guaranteed and fuel consumption is reduced. This will be noticed as a different compressor start/stop pattern.

The air dryer has a built-in function to prevent freezing or blockage. The function provides temporary relief (air dryer blow clean) at engine shut down. This function eliminates the problem of freezing on a stationary vehicle.

An additional function at vehicle start-up prevents the compressor from charging air during engine cranking and start-up.

The air filter/dryer is located in front of rear wheelhousing above drive axle. 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 air dryer purge valve located in the engine compartment and accessible through the engine compartment R.H. side door. The air filter/dryer has a built-in governor to maintain the system between 108 and 123 psig.

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

7.1 REPLACING THE DESICCANT CARTRIDGE

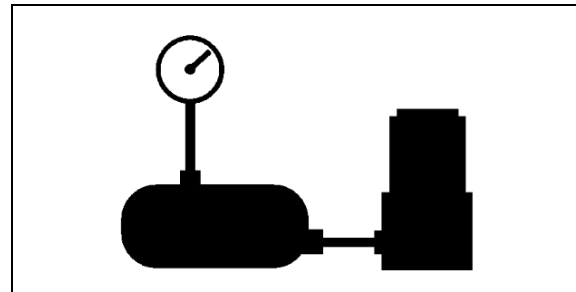


FIGURE 6: COMPRESSOR/AIR DRYER FAULT ICON¹²²²⁷

This Icon appears in the DID then it may be time to replace the desiccant cartridge.

Using PTT, look for a “Cartridge Lifetime Exceeded” fault code along with this icon to confirm the need for cartridge replacement.

Once desiccant cartridge is replaced, *reset service parameters* using PTT.

NOTE

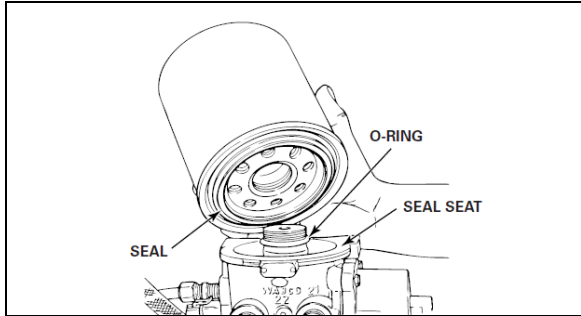
By using PTT it is also possible to read off the calculated remaining mileage to the next desiccant replacement. The total pumped air volume by the compressor can also be read off.

To replace the desiccant cartridge:

1. Release air dryer pressure by opening the air dryer drain valve (Figure 2).
2. Loosen and remove the old cartridge. Use strap wrench if necessary.
3. Remove and discard O-ring from dryer base.
4. Inspect and clean seal seat. Repair any minor damage.
5. Lubricate and install new O-ring on stem.

Section 12: BRAKE AND AIR SYSTEM

6. Lubricate cartridge seal.
7. Thread replacement cartridge onto the base until the seal touches the base. Then, tighten the cartridge ONE additional turn. DO NOT OVERTIGHTEN.



7.2 AIR LEAK CHECK / WARNING

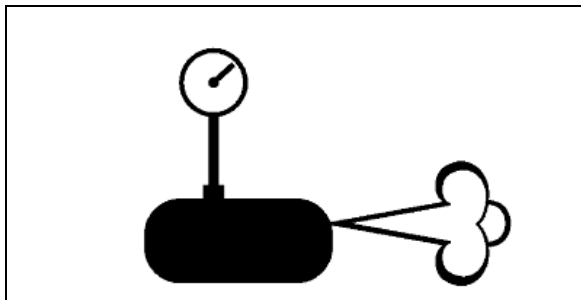


FIGURE 7: AIR LEAK CHECK / WARNING ICON 12228

This icon may appear in the DID if the compressor is charging abnormally which is usually an indication of an air leak.

8. AIR LINES

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, 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, Supply/Delivery
Yellow	Parking Brake
Blue	Suspension
Black	Accessory
Brown	Trailer Brake

8.1 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 or belt tensioner air cylinder 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.

8.2 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.

8.3 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.

8.4 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.

8.5 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 small A/C compressor and accessories alternator drive belt tensioner, 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 at the back of the engine starting control panel. It is used to limit the air pressure in belt tensioners to 45 ± 2 psi (310 ± 15 kPa) (Figure 7).

The optional regulator is located in the engine compartment and is 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	45 ± 2	310 ± 15
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 pressure regulating valve and wash all metal parts in a cleaning solvent (Figure 6). 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.

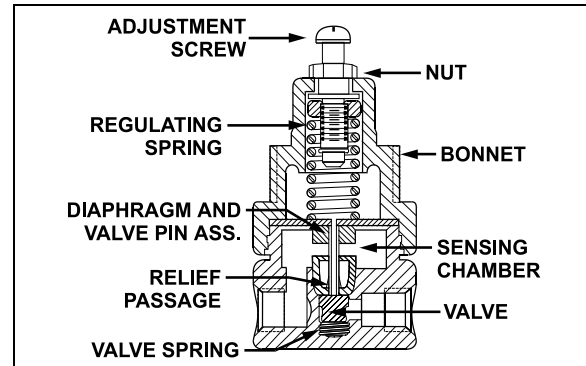


FIGURE 8: AIR PRESSURE REGULATING VALVE 12141A

9.2 PRESSURE SETTING PROCEDURE

Remove the dust cap from the pressure check port (Figure 7). Attach a pressure gauge at this port and check the pressure reading. If the pressure reading is incorrect, adjust as follows:

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

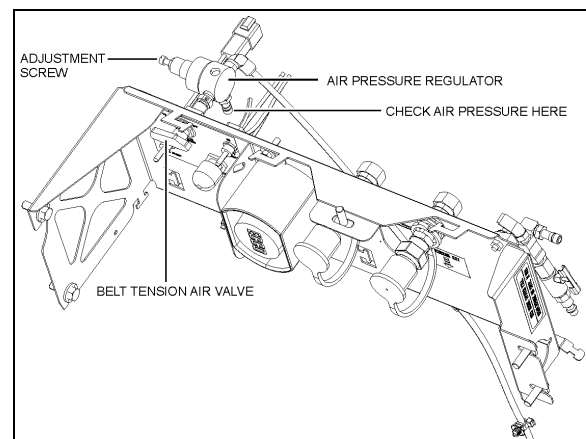


FIGURE 9: AIR PRESSURE REGULATOR 12143

10. AIR COMPRESSOR

The Wabco System Saver 636 Twin Cylinder air compressor is located on the alternator side of the engine, at the flywheel end (Figure 8). Its function is to provide and maintain air under pressure to operate devices in brake and air systems.

Section 12: BRAKE AND AIR SYSTEM

The compressor is driven by the ring 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.

Maintenance and repair information on the Wabco 636 Twin Cylinder air compressor is supplied in the applicable booklet annexed at the end of this section.

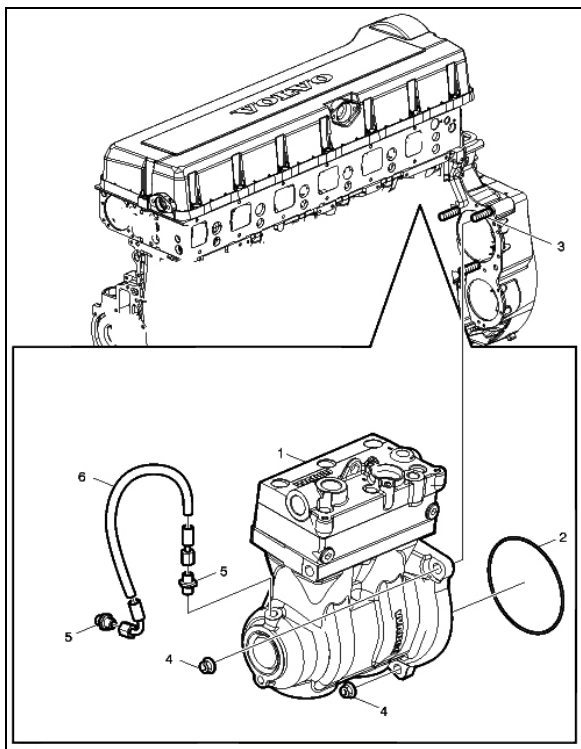


FIGURE 10: AIR COMPRESSOR LOCATION 03061

Item	Description	Notes
1	Air Compressor	Wabco 636
2	O-ring	
3	Stud (3)	M12
4	Flange Nut (3)	Torque to 63lb-ft (85 Nm)
5	Nipple (2)	
6	Hose Assembly	

10.1.1 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. Access the compressor by the engine R.H. side compartment. Identify and disconnect all air, coolant and oil lines from the compressor assembly.
4. Remove the three compressor flange mounting nuts.
5. Slide air compressor rearward to disengage the hub from coupling. Remove the air compressor.

Remove and retain the oil supply tube that runs between the compressor and the engine
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 60 psi (414 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 11: 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 (Figure 9).

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.

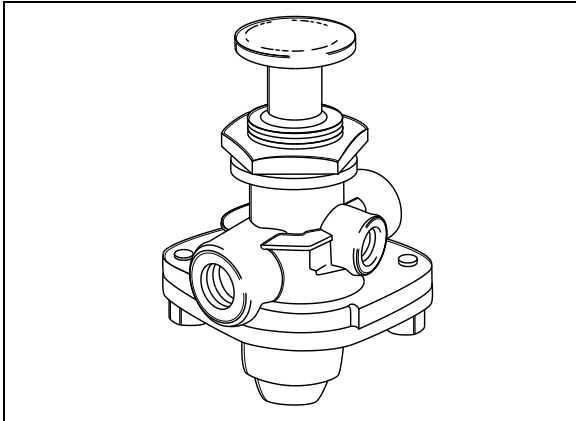


FIGURE 12: RD-3 12136

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

A flip-flop control valve mounted on the L.H. lateral console is provided to unload and lift tag axle air springs. 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.

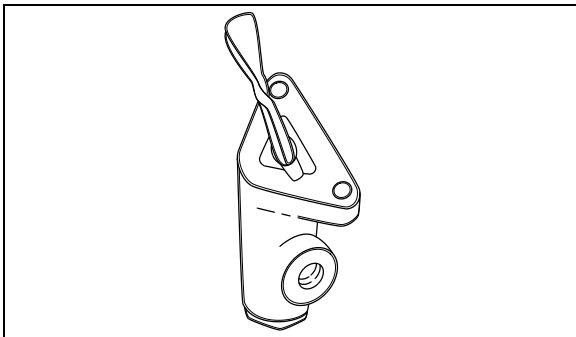


FIGURE 13: TW-1 12138

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 (Figure 12).

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 (Figure 12).
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.

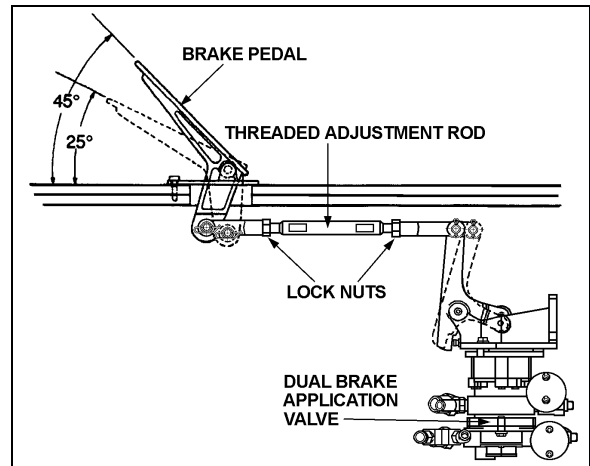


FIGURE 14: BRAKE PEDAL ADJUSTMENT 12208

15. STOPLIGHT SWITCHES

Two Electro-pneumatic stoplight switches are mounted on the dual brake application valve (E-10P). 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.

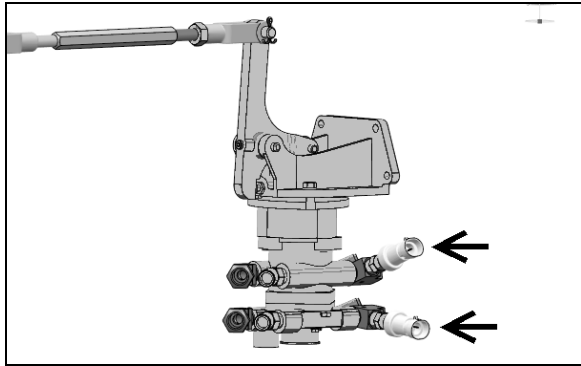


FIGURE 15: STOPLIGHTS PRESSURE SWITCH 12139

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-14)

The primary air system includes two 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 R-14 valve located above the drive axle supplies the drive axle service brake air line, while the other R-14 valve supply the tag axle 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.

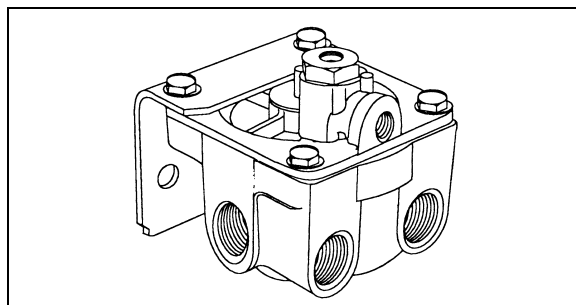


FIGURE 16: R-14 12207

18. ANTILOCK TRACTION RELAY VALVE (ATR-6)

The ATR-6 Antilock Traction Relay valve is a service relay valve fitted with a modified cover containing a control solenoid. It contains both air and electric components to provide the service braking and traction control (differential braking) as well as ESC advanced stability system ABS functions. It is located above the front axle.

Maintenance and repair information on these valves is supplied in the applicable booklet annexed to this section under reference number SD-13-4861.

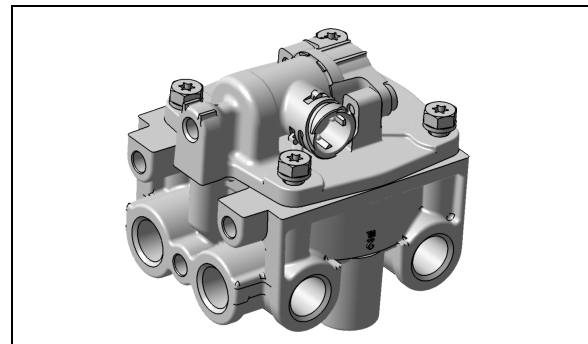


FIGURE 17: ATR-6

19. SPRING BRAKE VALVE (SR-7)

The spring brake valve is located above the drive axle. 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.

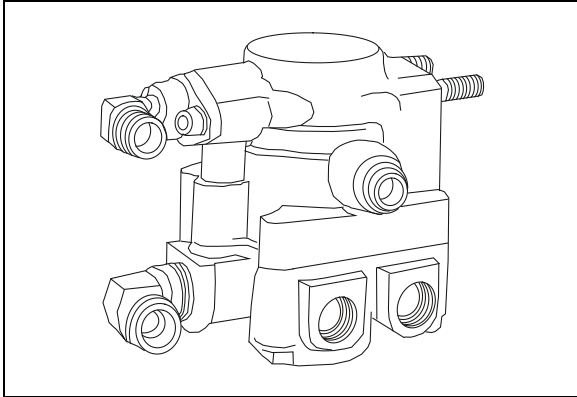


FIGURE 18: SR-7

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 (Figure 17). One valve is installed on the manifold block, and insures at all times a minimum pressure of 75 psi (517 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.

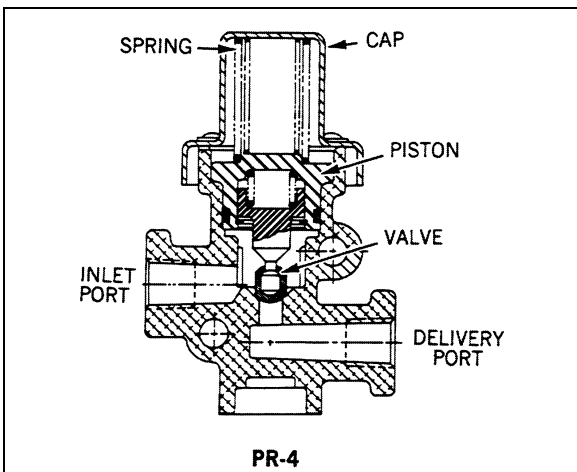


FIGURE 19: PR-4

12077

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 FIGURE 1 for accessory air tank location).

21. 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 accessories 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.

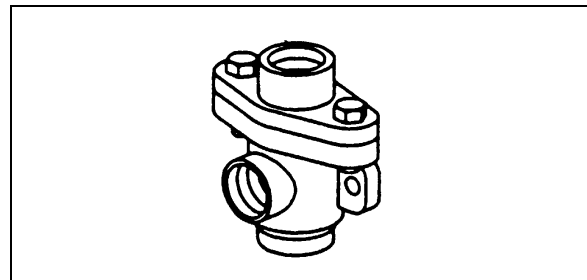


FIGURE 20: DC-4

12134

22. 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.

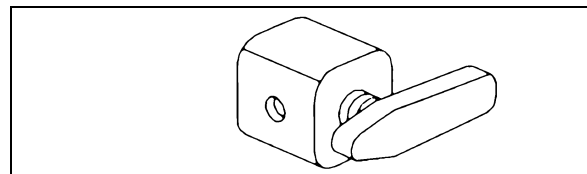


FIGURE 21: THREE WAY VALVE

12186

22.1 INTERIOR VALVE MAINTENANCE

When needed, this valve can be changed according to the following procedure:

1. Unscrew the front R.H. decorative panel in order to access the valve.
2. Unscrew and remove the valve handle.
3. Unscrew and remove the valve retaining ring.
4. Push the valve inside the console.
5. Disconnect the air tubes.

- Reverse the procedure to install a new valve.

23. AIR HORN VALVE

The air horn solenoid valve is located in the front service compartment. The air horn activating button is on the center of the steering wheel. Refer to section 23 "ACCESSORIES" for more information.

24. 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.
- Faulty pressure sensor.
- Engine speed too low.

Air pressure rises above a normal setting:

- Defective air gauge (registering incorrectly).
- Air filter/dryer built-in governor poorly adjusted or defective.

Air pressure drops quickly when engine is stopped:

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

25. 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 60 psi (413 kPa). The optional parking brake override system can cancel the parking brakes, enabling the driver to move the vehicle to a safe parking place. To operate this system, push down and hold the control knob located on the R.H. side of the driver's seat (see "*Operator's Manual*" for more details).

Furthermore, brake application or release, which is sped up by a pneumatic relay valve (R-14), 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.

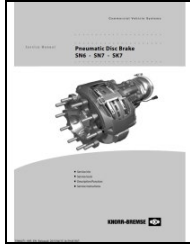
Brake and air system maintenance consists of periodic inspections. Check all parts for damage and brake adjustment (refer to subsequent headings in this section for more details). Ensure all fasteners are tight (refer to "*Specifications*" for recommended tightening torques).

26. AIR BRAKES

DISC BRAKES

Knorr-Bremse SN7 disc brakes are used on all axles. The front and drive axle discs are actuated by 24 inch² effective area air brake chambers, while on tag axle, the brake chambers have a 16 inch² effective area for service brake. The *Knorr-Bremse SN7* brakes are supplied with automatic clearance (slack) adjusters as standard equipment for easier adjustment.

For detailed maintenance procedures, refer to **Knorr-Bremse Pneumatic Disc Brake Y006471 Service Manual** included on the technical manuals CD and available on Prevest Technical Publications site.



At each pad replacement, make sure the caliper operates smoothly over its full range of movement. If the caliper shows the following signs, replacement of the guide sleeve (6c, fig 20), guide pin, screw (39) and cap is required.

- excessive or abnormal play
- movement along guide pins is hard or impossible (due to corrosion or dirt)
- A missing guide pin cap

26.1 INSPECTION POINTS

The following inspection points will ensure long-life and trouble-free operation of the disc brake.

MAINTENANCE

Moisture and dirt is the enemy. So, as a general recommendation, special care should be awarded to the condition of the various sealing elements, boots and caps to prevent any moisture or dirt intrusion in the caliper. Any missing or damaged sealing element, boot or cap should be replaced immediately.

MAINTENANCE

Every 3 months, check brake pad wear visually. This is independent of any electronic wear indicator fitted to the vehicle.

MAINTENANCE

With every pad replacement:

Check correct operation of the slack adjuster (see *Knorr-Bremse Pneumatic Disc Brake Y006471 Service Manual*)

Check that caliper operates smoothly over its full range of movement.

Inspect all sealing elements boots and caps.

Additionally, inspect the tappet and boot assemblies (13, Figure 20), the adjuster cap (37) and the sealing elements (9, 58) for correct fitting and condition as well as the caliper bearing in the area of the rubber bush/guide sleeve (6) (see *Knorr-Bremse Pneumatic Disc Brake Y006471 Service Manual*).

MAINTENANCE

Annually:

Check the caliper running clearance and the correct fitting and condition of the caliper cover, the slack adjuster cap and sliding pin covers.

These frequencies are a minimum. Depending on the operating conditions of the vehicle, these inspections may need to be carried-out more frequently.

If an individual wheel has heated abnormally, Please refer to Bendix *BW7514_Single wheel end thermal overload checklist*. This checklist will help you through standard verifications required by the brake manufacturer before filing a warranty claim.

Section 12: BRAKE AND AIR SYSTEM

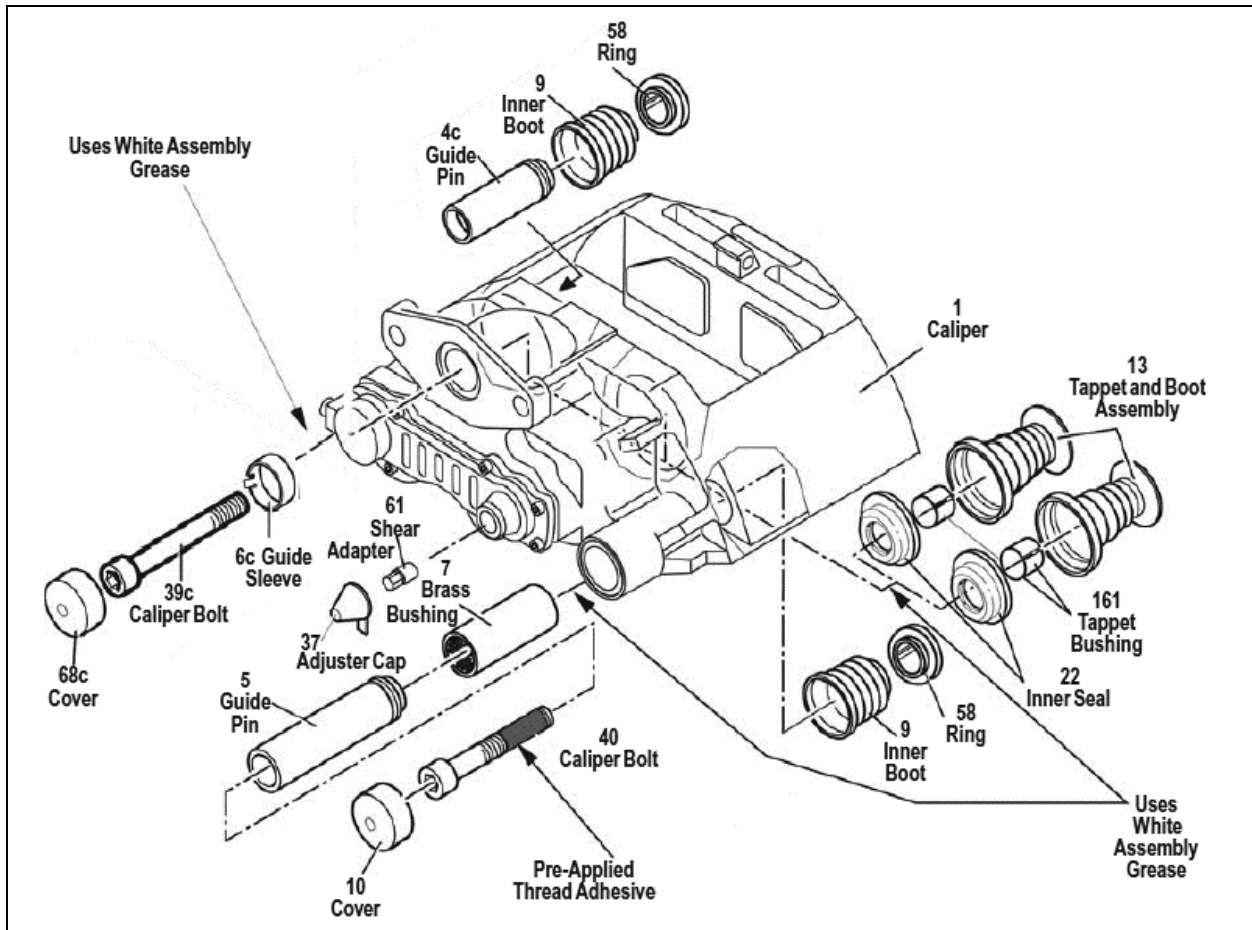


FIGURE 22: BRAKE COMPONENTS

26.2 PAD REPLACEMENT PROCEDURE

Brake pad replacement procedure has slightly changed with the introduction of the new N2G slack adjuster on our vehicles.

After fitting new pads, Adjuster (thru shear adapter) has to be turned clockwise until the pads come into contact with the disc. Then turn back the adjuster **three clicks** to give the correct running clearance.

Please refer to KB manual for the latest brake pad replacement procedure.

26.3 CHECKING 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 0.079 in (2 mm). 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.

26.3.1 Drive Axle – Equipped With a Solid Rubber Bushing and Exposed Guide Pin

The condition of the pads can be visually determined without removing the wheel by checking the position of the caliper (1) compared to the fixed guide pin (4).

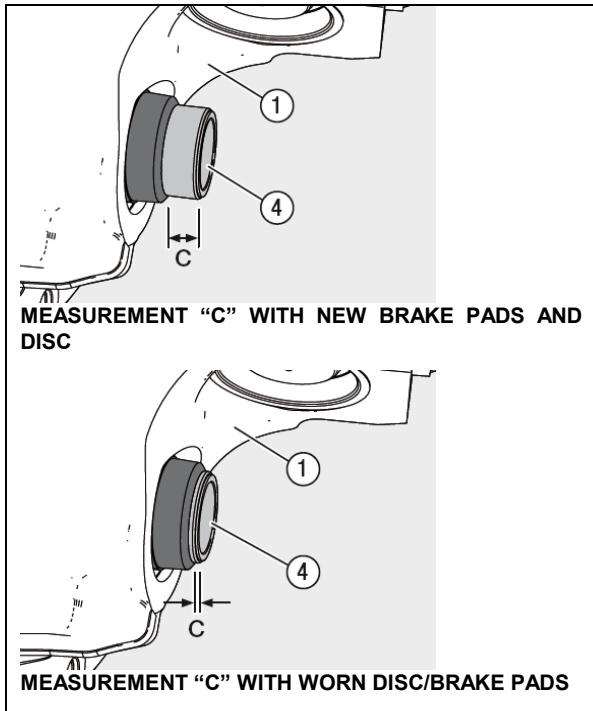


FIGURE 23: BRAKE PAD WEAR CHECK ON DRIVE AXLE

If measurement “C” is less than 0.039” (1 mm), this condition requires a check of the brake pad thickness and the brake disc with the wheel removed. If any minimal tolerance limits have been reached, the pads and/or disc must be changed.

26.3.2 Front and Tag Axle – Equipped With Visual Wear Indicator

The condition of the pads can be visually determined without removing the wheel by checking the position of the caliper compared to the tip of the wear indicator (if installed) or carrier.

In one variant of the visual wear indicator (Figure 22), if the side of the caliper (flat surface around guide pin cap) lines up with the tip of the wear indicator (i.e. measurement A would be 0.0 in), the brake pad thickness and the brake disc must be checked with the wheel removed. If any minimal tolerance limits have been reached, the pads and/or disc must be changed.

Alternately, brake pad wear can be checked using carrier to caliper position. When points “P” and “R” align the brake pad thickness and brake disc must be checked with the wheels removed

(Fig 24). If any minimal tolerance limits have been reached, the pads and/or disc must be changed.

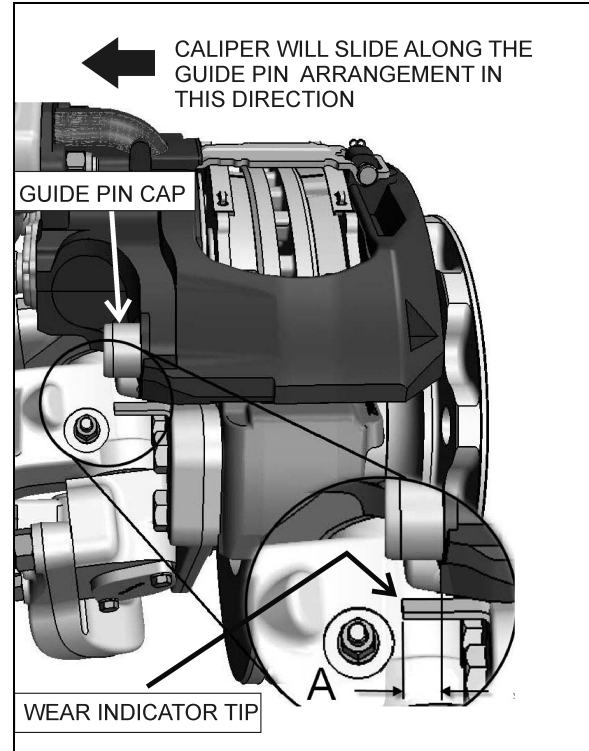


FIGURE 24: BRAKE PAD WEAR CHECK ON FRONT AND TAG AXLE
12119

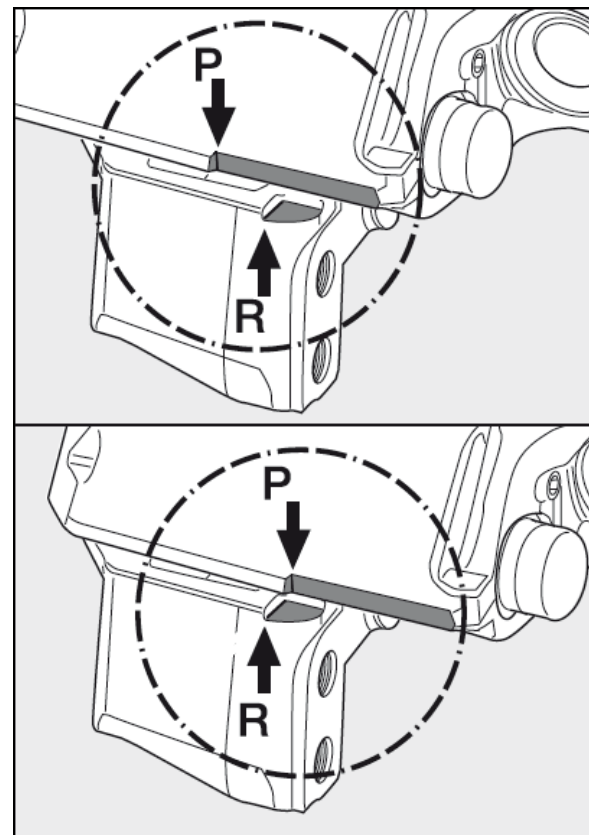


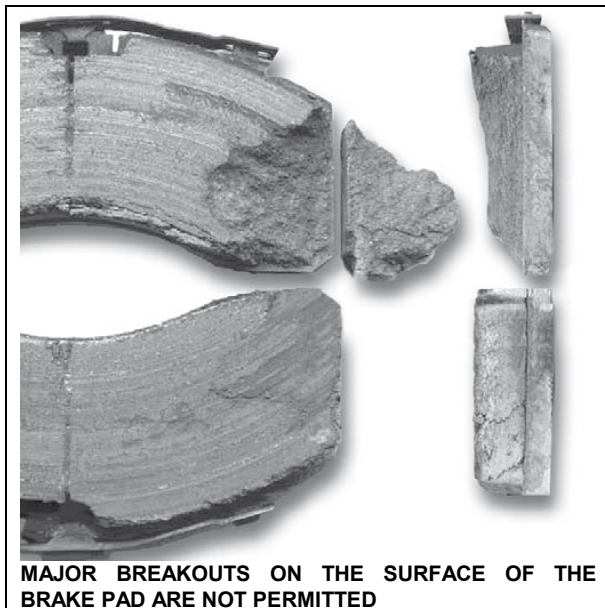
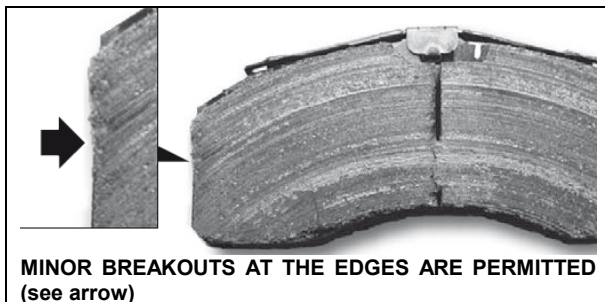
FIGURE 25: PAD WEAR CHECK FRONT AND TAG AXLE

material: 0.433 in (11 mm)

26.4 BRAKE PADS AND DISCS MINIMAL TOLERANCE LIMITS

26.4.1 Brake Pads

The thickness of the pads must be checked regularly dependent on the usage of the vehicle. The pads should be checked corresponding to any legal requirements that may apply. Even if a wear indicator is fitted and connected, this must be at least every 12 months.



If the thickness of the friction material at its thinnest point is less than 0.079 inch or 2 mm (measurement C), the pads must be replaced.

- A= Overall thickness of new brake pad: 1.18 in (30 mm)
- B= Back plate SN7 type: 0.354 in (9 mm)
- C= Minimal thickness of friction material: 0.079 in (2 mm)
- D= Minimum allowed thickness in worn condition for back plate and friction

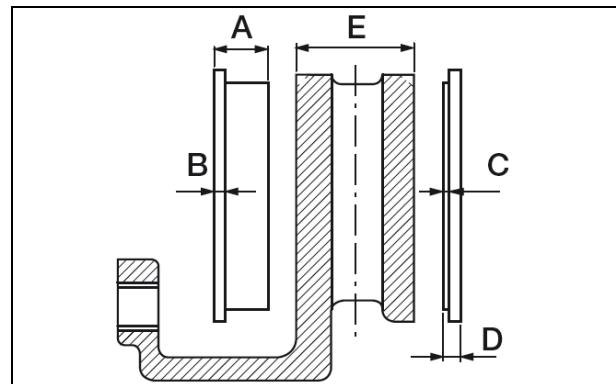


FIGURE 26: FRONT AXLE BRAKE AIR CHAMBER 12158

26.4.2 Brake Disc

Measure the thickness of the brake disc at the thinnest point. Be aware of possible burring at the edge of the disc.

- E= Total thickness of the brake disc
 - New condition = 1.77 in (45mm)
 - Worn condition = 1.457 in (37mm) (the disc must be replaced)
 - If the disc dimension E ≤ 1.535 in (39mm), it is recommended that the disc should be renewed when the brake pads are changed.

Refer to **Knorr-Bremse Pneumatic Disc Brake Y006471 Service**.

26.5 CALIPER RUNNING CLEARANCE

The Knorr/Bendix air disc brake is designed to move freely, with minimal force. By pushing and pulling the caliper in an axial direction by hand (see arrows in Figure 25), a movement of 0.6 - 1.1 mm must be possible.

If, even using a high level of hand pressure (no tools), the caliper is not moveable, the caliper guidance must be further examined.

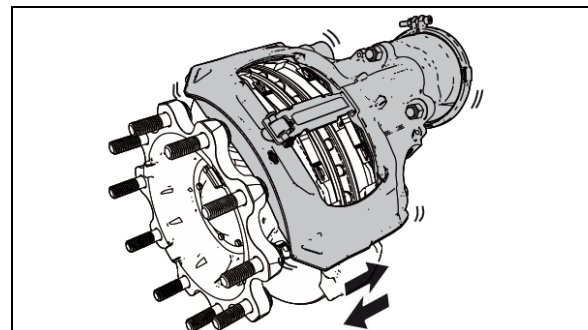


FIGURE 27: RUNNING CLEARANCE

26.6 TORQUE SPECIFICATIONS

For proper caliper maintenance, refer to the following figures.

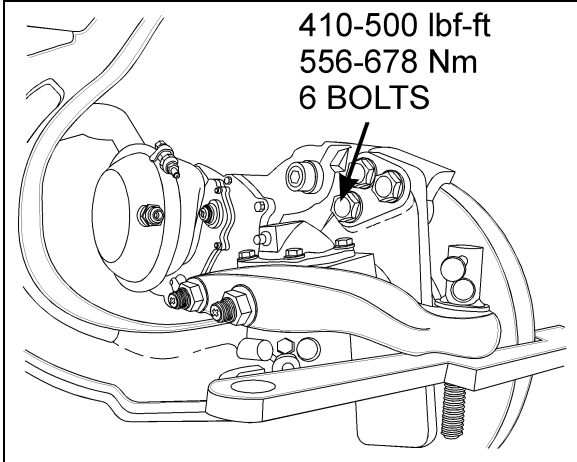


FIGURE 28: TORQUE SPECIFICATION 12145

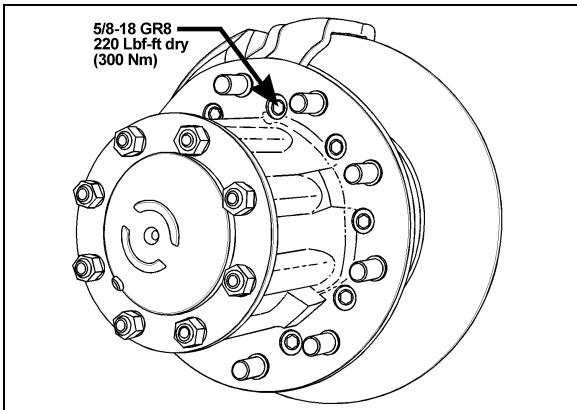



FIGURE 29: TORQUE SPECIFICATION 11030

27. 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.

 **WARNING**

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

Section 12: BRAKE AND AIR SYSTEM

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.

28. 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.

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 15 seconds or less.
6. Air filter/dryer built-in governor cut-out. Cuts out at the correct pressure of 144 psi \pm 3 (847 \pm 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 13 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 122-144 psi (841- 993 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 1 minute while observing air pressure gauge on the dash-board.
3. Pressure drop should not be more than 3 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 122-144 psi (841- 993 kPa) and foot brake applied, coat all air line connections and brake pneumatic compo-

nents 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.

29. BRAKE AIR CHAMBER

This vehicle uses “Knorr-Bremse” brake chambers on all axles. The 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 28.

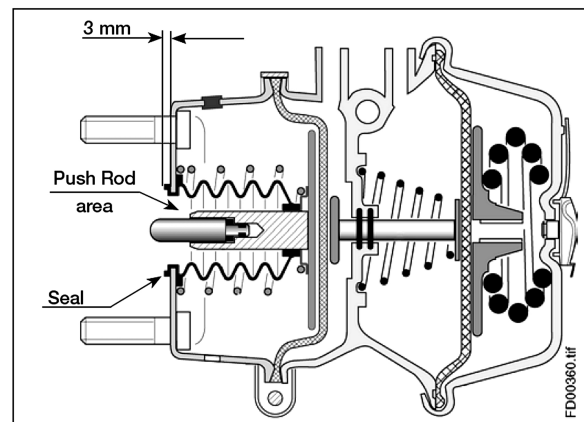


FIGURE 30: DRIVE AXLE BRAKE AIR CHAMBER

The front and tag axle brake air chambers are used only for service brake duty (FIGURE 29).

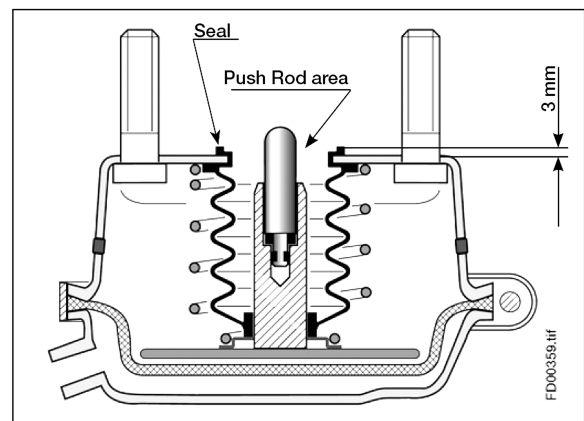


FIGURE 31: DRIVE AXLE BRAKE AIR CHAMBER

Section 12: BRAKE AND AIR SYSTEM

29.1 MAINTENANCE

Every 6,250 Miles (10 000 km) or twice a year, whichever comes first depending on type of operation:

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 airtightness 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 over-tighten** 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.

29.2 EMERGENCY/PARKING BRAKE MANUAL RELEASE



DANGER

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 1/4 turn (clockwise) to anchor it into the spring plate. Install the flat washer and nut, and then turn the nut clockwise to cage the spring. Repeat on the opposite side.



DANGER

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.

29.3 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.


29.4 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.

29.5 BRAKE CHAMBER DISASSEMBLY

 DANGER
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:
<ul style="list-style-type: none"> ○ Prevost 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.

<p>NOTE</p> <p><i>To gain access to a given brake air chamber, the corresponding wheel can be removed (refer to Section 13: "Wheels, Hubs and</i></p>
--

<p><i>Tires").</i></p>

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.

30. 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.

<p>NOTE</p>

Section 12: BRAKE AND AIR SYSTEM

ABS is active on service brake, transmission retarder, engine 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.

30.1 TROUBLESHOOTING AND TESTING

For troubleshooting and testing of the vehicle's anti-lock braking system, refer to Bendix applicable booklet annexed to this section under reference number SD-13-4869.

30.2 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.

30.3 BENDIX EC-60 ADVANCED CONTROLLER

This control unit, also known as ABS module, is located in the front electrical and service compartment. 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.

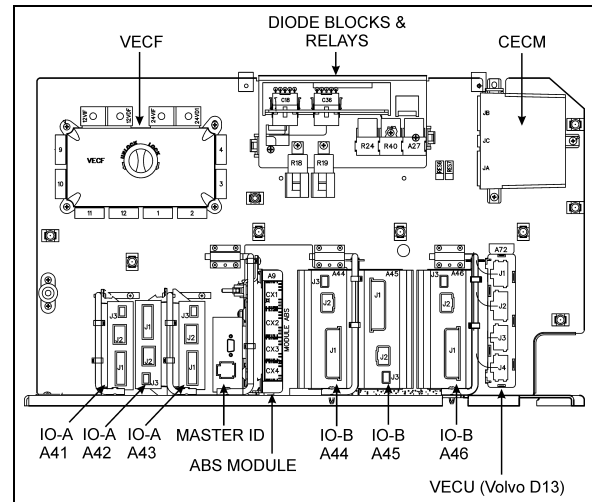


FIGURE 32: ABS ECU LOCATION 12198



CAUTION

In order to protect the ABS electronic control unit from voltage surges, always disconnect before performing any welding procedure on vehicle.

30.4 SENSORS

The sensors are mounted on the front and drive axle wheel hubs (Figure 31). 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.

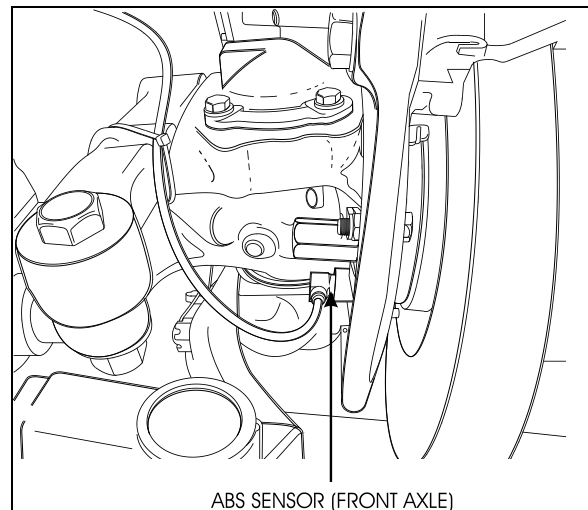


FIGURE 33: ABS SENSOR LOCATION 12153

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 (Prevost #680460) before reinstallation. Refer to paragraph "Sensor Installation" for details.


NOTE

The resistance value, when sensors are checked as a unit, must be equal to 1,75 kohms. 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.

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 (Prevost #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.

30.4.1 Spring clip

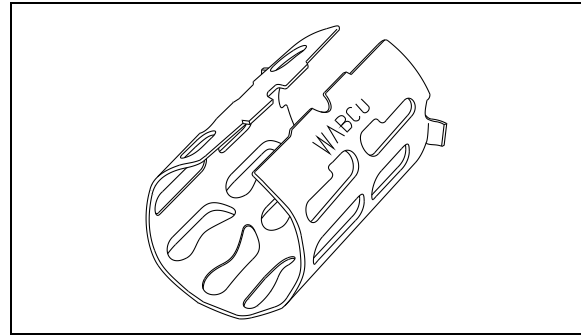


FIGURE 34: SPRING CLIP 12161

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 (Figure 32).

Maintenance

The spring clip requires no specific maintenance.

31. BENDIX AUTOMATIC TRACTION CONTROL (ATC) – ELECTRONIC STABILITY CONTROL (ESC)

In addition to the ABS function, vehicle is equipped with a Traction Control System (TCS) feature. This feature is provided by the Bendix EC-60 advanced controller. Bendix refers to this feature as **Automatic Traction Control (ATC)**. Bendix ATC can improve vehicle traction during acceleration, and lateral stability while accelerating through curves. ATC utilizes **Engine Torque Limiting (ETL)** where the ECU communicates with the engine's controller and/or **Differential Braking (DB)** where individual wheel brake applications are used to improve vehicle traction.

The EC-60 advanced model controller also provides an ABS-based Electronic Stability Control (ESC) feature. Bendix refers to it as **ESC Electronic Stability Control**.

The Bendix ESC system is an ABS-based stability system that enhances vehicle stability by both reducing engine throttle and by applying vehicle braking based on actual vehicle dynamics

ESC stability system consists of Yaw Control (YC) and Roll Stability Program (RSP) features.



CAUTION

Even with ESC-equipped vehicles, the driver remains responsible for ensuring vehicle stability during operation.



MAINTENANCE

ABS & ELECTRONIC STABILITY CONTROL SYSTEMS

Every 12 months,

Check the proper functioning of ABS and ESC systems. To do so, perform the "Component Test" using Bendix ACom Diagnostics software.

Bendix ACom Diagnostics software is available for download at www.bendix.com.

31.1 COMPONENTS

31.1.1 The EC-60™ controller's ABS function utilizes the following components:

- Six (6) Bendix® WS-24™ wheel speed sensors. Each sensor is installed with a Bendix Sensor Clamping Sleeve;
- Five (5) Bendix® Pressure Modulator Valves (M-32QR);
- Dash-mounted vehicle ABS Indicator Lamp;
- Service brake relay valve;
- Dash-mounted trailer ABS Indicator Lamp.

31.1.2 The EC-60™ controller's ATC function utilizes the following components:

- Drive axle traction control valve;
- Dash-mounted ESC/TCS status/indicator lamp (also serves as the ESC status/indicator lamp);
- Dash-mounted TCS Mud/Snow switch;
- J1939 serial communication to engine control module.

31.1.3 The EC-60™ controller's ESC/RSP function utilizes the following components:

- Front Axle Traction Control Valve integral to the service brake relay valve;

- Dash-mounted ESC/TCS status/indicator lamp (also serves as the ATC status/indicator lamp);
- Bendix SAS-70 Steering Angle Sensor (mounted to the steering column);
- Bendix YAS-70 Yaw Rate/Lateral Acceleration Sensor (mounted to a cross member forward of the drive axle);
- Brake Demand Sensors (installed in the primary and secondary delivery circuits);
- Load Sensor (installed in the suspension air spring);
- An additional Modulator Valve (Bendix® M-32QR™ Pressure Modulator Valve) that controls pressure applied to the trailer brakes during system intervention.

31.2 BENDIX M-32QR PRESSURE MODULATOR VALVE

This Bendix M-32QR (quick release) Pressure Modulator Valve (PMV) is operated by the EC-60 controller to modify driver applied air pressure to the service brakes during ABS, ATC, RSP or YC activation. The PMV is an electro pneumatic control valve and is the last valve that air passes through on its way to the brake chamber. The modulator hold and release solenoids are activated to "modulate" or "control" the brake pressure during an antilock braking event. The hold solenoid is normally open and the release solenoid is normally closed, such that the PMV nominally allows air to flow through. This design allows for air delivery to brake chambers in the event of electrical trouble. This is an "On/Off" type valve, i.e., during an antilock activity, the valve exhausts air from the brake chamber when in a ABS event, the electronic unit senses that the corresponding wheel speed is decreasing in relation to the other wheels.

The Advanced EC-60 controller also utilizes an additional PMV for control of the trailer service brakes during stability interventions.

6s/5m Configuration

Prevost vehicles utilize a 6 sensors/5 pressure modulator valves configuration, with the tag axle having two sensors, but only one Pressure Modulator Valve. In this case, the PMV controls both wheels on the tag axle. The tag axle wheels would receive equal brake pressure, based on the wheel that is currently experiencing the most wheel slip.

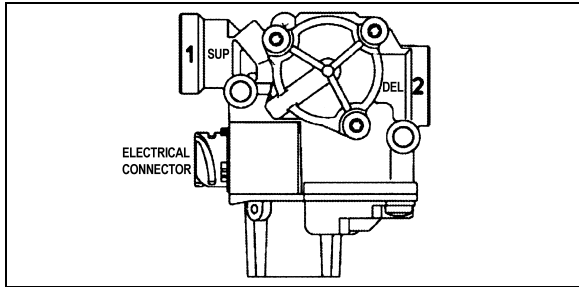


FIGURE 35: M-32QR PRESSURE MODULATOR VALVE

Maintenance

Maintenance, removal and installation information of this valve is supplied in Bendix booklet annexed at the end of this section under reference number SD-13-4870.

31.3 ADVANCED ABS WITH ELECTRONIC STABILITY CONTROL (ESC)

Overview

Bendix ESC stability system reduces the risk of rollovers, jackknifing and other loss of control. ESC features include Roll Stability Program (RSP) and Yaw Control. During operation, the ECU of the Bendix Advanced ABS system constantly compares performance models to the vehicle's actual movement, using the wheel speed sensors of the ABS system, as well as lateral, yaw, and steering angle sensors. If the vehicle shows a tendency to leave an appropriate travel path, or if critical threshold values are approached, the system will intervene to assist the driver.

Roll Stability Program

Bendix RSP, an element of the overall ESC system, addresses rollover conditions. In the case of a potential roll event, the ECU will override the throttle and quickly apply pressure at all wheel ends to slow the vehicle combination. The level of braking application during an RSP event will be proportional to roll risk.

Yaw Stability

Yaw stability counteracts the tendency of a vehicle to spin about its vertical axis. During operation, if the friction between the road surface and the tires is not sufficient to oppose lateral (side) forces, one or more of the tires can slide, causing the vehicle to spin. These events are referred to as either an "under-steer" situation (where there is a lack of vehicle response to steering input due to the slide on the front axle) or an "over-steer" (where the vehicle's rear end slides out due to tire slide on the rear axle) situation. Factors that influence yaw stability are:

wheelbase, suspension, steering geometry, weight distribution front to rear, and vehicle track width.

Yaw Control

Yaw Control corresponds to a wide range of low to high friction surface scenarios including rollover, jackknife and loss of control. It is the recommended system for all power vehicles and especially critical for vehicles pulling trailers. In the case of vehicle slide (over-steer or under-steer situations), the system will reduce the throttle and then brake one or more of the "four corners" of the vehicle (in addition to potentially applying the trailer brakes), thus applying a counter-force to better align the vehicle with an appropriate path of travel.

For example, in an over-steer situation, the system applies the "outside" front brake; while in an under-steer condition, the "inside" rear brake is applied.



DANGER

Bendix ESC system may reduce the vehicle speed automatically.

ESC can make the vehicle **decelerate automatically**. ESC can slow the vehicle with or **without the operator applying the brake**, and **even when the throttle is being applied**.

31.4 BENDIX® SAS-70 STEERING ANGLE SENSOR

The Steering Angle Sensor (SAS) is used to provide driver steering input to the controller. It reports the steering wheel position to the controller utilizing a dedicated serial communications link that is shared with the YAS-70 sensor. The controller supplies the power and ground inputs to the SAS-70 sensor.

The SAS-70 sensor installed on Prevost vehicles is the 90° connector.

31.4.1 Removal of the steering angle sensor

Service Checks:

1. Check all wiring and connectors. Some installations also include an intermediate connector from the steering angle sensor to the main vehicle wire harness. Make sure all connections are free from visible damage.
2. Examine the sensor. Make sure the sensor, its mounting screws, and the interface between the hub and the steering column are not damaged.

Section 12: BRAKE AND AIR SYSTEM

Diagnostics:

The steering angle sensor is only operational in conjunction with an Advanced ECU. No independent diagnostics can be performed on the sensor.

Removal:

1. Remove steering column upper, middle and lower covers.
2. The steering angle sensor is located near the universal joint.
3. Unplug sensor cable assembly from body of sensor. Squeeze the mounting tabs and pull gently on connector until it disengages.
4. Disconnect steering column upper U-joint.
5. Unscrew all three of the mounting screws that hold the body of the sensor to the steering column body.
6. Slide the sensor over the column to remove. Take note if the sensor label is facing upward or downward.

Installation:

1. Obtain a new sensor. The sensor is not repairable in the field.
2. Slide the sensor over the column. The center hub of the sensor must be aligned with the corresponding notch in the column. The sensor label should be facing in the same direction as the removed sensor.
3. Reconnect the steering column U-joint.
4. Assemble the column non-moving plate with three self-locking screws.
5. Tighten screws between 48 lbf-ft (65 Nm) and 74 lbf-ft (100 Nm).
6. Reconnect the connector. Ensure that there will be no force applied to the sensor because the connector is pulling on the sensor body.
7. If the wire harness leading to the sensor is being replaced, ensure that it is adequately tie wrapped so that the full motion of the steering column can be achieved without pulling apart the connectors.
8. Reinstall the steering column covers. The sensor is not protected against dirt or water intrusion, so care must be taken not to introduce these elements during installation.

Steering Angle Sensor Calibration

The steering angle sensor calibration can only be achieved when the sensor is powered by the Advanced ABS ECU. No stand-alone sensor calibration can be carried out. The calibration procedure is performed using Bendix® ACom™ Diagnostic V4.0 or higher. See “Troubleshooting Diagnostic Trouble Codes: Steering Angle Sensor (SAS-60)” for the calibration procedure using this tool.

The sensor **must** be recalibrated after any of these situations:

- Replacement of the steering angle sensor;
- Any opening of the connector hub from the steering angle sensor to the column;
- Any maintenance or repair work on the steering linkage, steering gear or other related mechanism;
- Adjustment of the wheel alignment or wheel track;
- After an accident that may have led to damage of the steering angle sensor or assembly.



WARNING

If the steering angle sensor is not properly recalibrated as needed, the yaw control system may not function properly, which can result in incidents leading to loss of vehicle control.

32. FITTING TIGHTENING TORQUES

NTA-Type Plastic Tubing: Hand tighten nut. From that point, tighten using a wrench the number of turns indicated in the following chart.

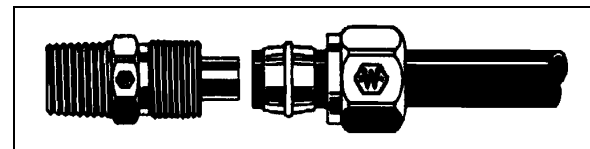


FIGURE 36: HOSE FITTING

12055

Tubing diameter (inch)	Number of additional turns required following manual tightening
1/4	3
3/8 to 1/2	4
5/8 to 3/4	3 ½

NOTE
 Use Loctite pipe sealant to seal pipe thread
 (Prevost number 680098).

33. SPECIFICATIONS

Air Compressor

Make.....Meritor Wabco
 Model..... SS636
 Capacity (at 1250 rpm).....37.4 cfm (1,059 m³/min.)

Air Dryer

Make.....Meritor Wabco
 Model..... System Saver

Flip-Flop Control Valve

Make..... Bendix Westinghouse
 Model..... TW-1
 Type On-Off

Emergency/Parking Brake Control Valve

Make..... Bendix Westinghouse
 Model..... PP-1
 Automatic release pressure 60 psi (414 kPa) nominal

Emergency/Parking Brake Override Control Valve

Make..... Bendix Westinghouse
 Model..... RD-3

Dual Brake Application Valve

Make..... Bendix Westinghouse
 Model..... E-10P

Spring Brake Valve

Make..... Bendix Westinghouse
 Model..... SR-1

Section 12: BRAKE AND AIR SYSTEM

Pressure Protection Valve

Make..... Bendix Westinghouse
Model..... PR-4
Nominal closing pressure 70 psi (482 kPa)
Prevost number 641137

Shuttle-Type Double Check Valve

Make..... Bendix Westinghouse
Model..... DC-4

Air Pressure Regulator

Make..... Norgren
Adjustable output range 0-80/85 psi (0-552/586 kPa)
Recommended pressure setting 75 psi (517 kPa)

Air Filter Element

Make..... Norgren
Type With manual drain

Front Axle Brake Chambers

Make..... Knorr-Bremse
Type 24-inch

Drive Axle Brake Chambers

Make..... Knorr-Bremse
Type 24-inch as service -24-inch as emergency

Tag Axle Brake Chambers

Make..... Knorr-Bremse
Type 16-inch

Brake Lining (All Axles)

Make..... Knorr-Bremse



Effective Date: 12/02/05

Subject: Bendix Air Disc Brake Pad Replacement on Prevost Car Vehicles

Prevost Car and Bendix Spicer Foundation Brake LLC are issuing this product notification about the potential brake performance degradation associated with use of non-approved, aftermarket replacement friction materials on Bendix® and Knorr-Bremse air disc brakes.

A compatible combination of disc pads and rotor material is essential for the safe and reliable performance of air disc brakes and also helps to extend the useful life of both parts.

Prevost Car and Bendix Spicer Foundation Brake worked together to optimize the disc pad and rotor material combination (“the friction couple”) for use with Bendix® air disc brakes. Prevost Car and Bendix offer service replacement parts that maintain the same quality and compatibility as the original equipment pads and rotors.

Recent benchmarking tests by Bendix Spicer Foundation Brake with two different non-approved aftermarket brake pad brands indicate that there is a significant risk of brake performance degradation when non-approved friction materials are used with Bendix or Knorr-Bremse air disc brakes. The aftermarket pads tested demonstrated the following shortcomings:

- At high operating temperatures the non-approved pads had approximately 20% lower friction level than the original equipment friction material.
- During fade testing, brake torque was 50% to 60% of original material levels.
- Significant brake torque reduction was experienced at increased temperatures.
- Tests to replicate stops on mountain roads and other severe service conditions showed significant performance reductions.
- Insufficient pad strength caused cracking across the friction material.

- Shear testing of the friction material adhesion resulted in the friction material completely separating from the backing plate in many instances.
- Pad wear was accelerated.
- Early rotor cracking symptoms were observed much earlier than for typical genuine parts.

Based on our tests, Prevost Car and Bendix Spicer Foundation Brake LLC strongly recommend against the use of non-approved aftermarket brake pads and service parts on Bendix and Knorr-Bremse air disc brakes. Brake performance, reliability and service life can be seriously degraded if non-approved aftermarket replacement parts are used in Bendix and Knorr-Bremse air disc brake systems.

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 Prevost Car nor Bendix Spicer Foundation Brake LLC will accept any air disc brake-related warranty returns or claims.

**BRAKE DUST WARNING:
AVOID CREATING DUST WHEN WORKING WITH
BRAKE PADS DUE TO POSSIBLE CANCER AND
LUNG DISEASE HAZARD.**

While Bendix Spicer Foundation Brake LLC does not offer asbestos-containing brake linings or disc pads, the long-term effects of certain non-asbestos fibers have not been determined. Current OSHA Regulations cover exposure levels to some, but not all, components of non-asbestos linings and pads. The following precautions should be used when handling these materials:

- Avoid creating dust. Compressed air or dry brushing must never be used to clean brake assemblies or the work area.

(Continued over)

- Brake workers must take steps to minimize their exposure to airborne brake lining particles. Procedures to reduce exposure include: working in a well-ventilated area, segregating areas where brake work is performed, using local filtered ventilation systems or enclosed cells with filtered vacuums for all brake work. Respirators approved by the Mine Safety and Health Administration (MSHA) or National Institute for Occupational Safety and Health (NIOSH) should be worn at all times during brake servicing.
- Workers must wash before eating or drinking, should not use tobacco products in any form, shower after working, and not wear work clothes home. Work clothes should be vacuumed using a high efficiency particulate filter (HEPA) vacuum and laundered separately without shaking.
- OSHA Regulations regarding testing, disposal of waste and methods of reducing exposure for asbestos are set forth in 29 Code of Federal Regulations §1910.001. These Regulations provide valuable information which can be utilized to reduce exposure to airborne particles.
- Material Safety Data Sheets on Bendix® air disc brake pads, as required by OSHA, are available from Bendix Spicer Foundation Brake LLC.





Start Here

All foundation brakes are designed to convert kinetic energy (energy of motion) into heat and work (to stop the vehicle).

Air disc brakes work the same way and in everyday operation — compared to drum brakes — will produce higher braking temperatures and cool off faster. Also, air disc brakes will often have differences in temperatures at wheel ends on the same axle. The actual temperatures reached will depend on the vehicle configuration, vocation and brake usage.

This document is intended to help technicians identify instances where an individual wheel end has evidence of thermal overload, and check for potential causes.

Bendix® Air Disc Brake Checklist for Identifying Single Wheel End Thermal Overload

Follow all General Safety Guidelines (see final page.)

SECTION ONE: Inspect the Vehicle

Question One:

Do any of the rotors have bright orange or red color edges? Check the box(es) on the vehicle diagram to the right for any found.



Normal

Evidence of thermal overload

Question Two:

Are any of the calipers coated with a bright orange or red colored dust? Check the box(es) on the vehicle diagram to the right for any found.



Normal

Evidence of thermal overload

Question Three:

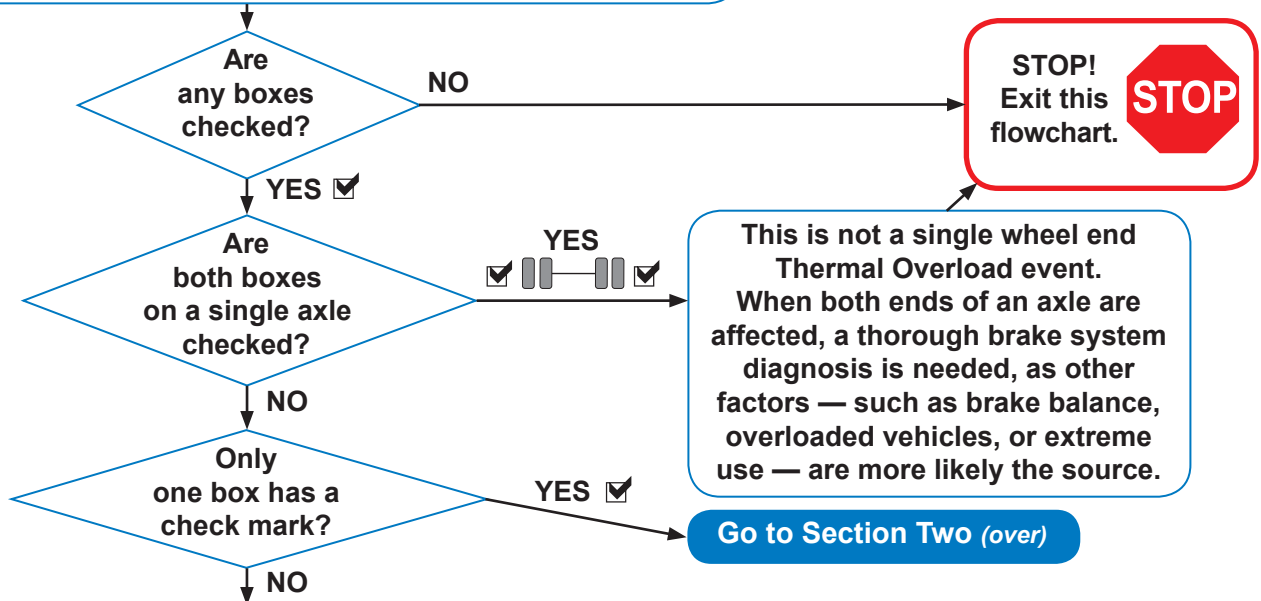
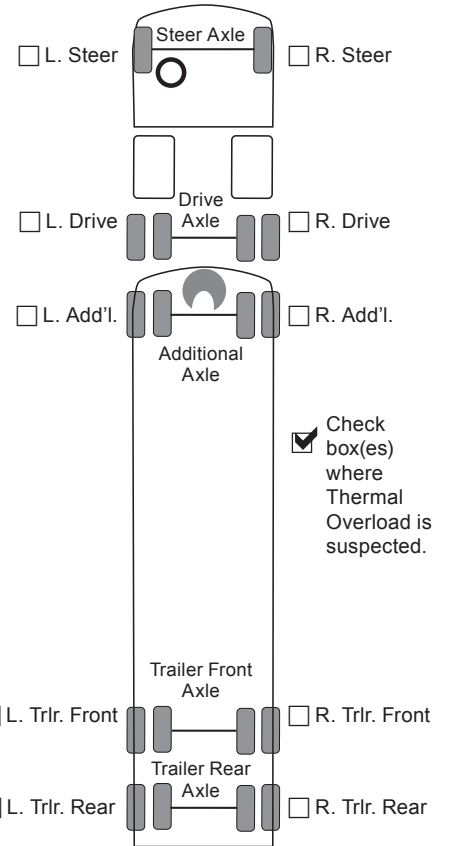
Are any tappets and/or guide pin boots heat damaged? Check the box(es) on the vehicle diagram to the right for any found.



Typical

Evidence of thermal overload

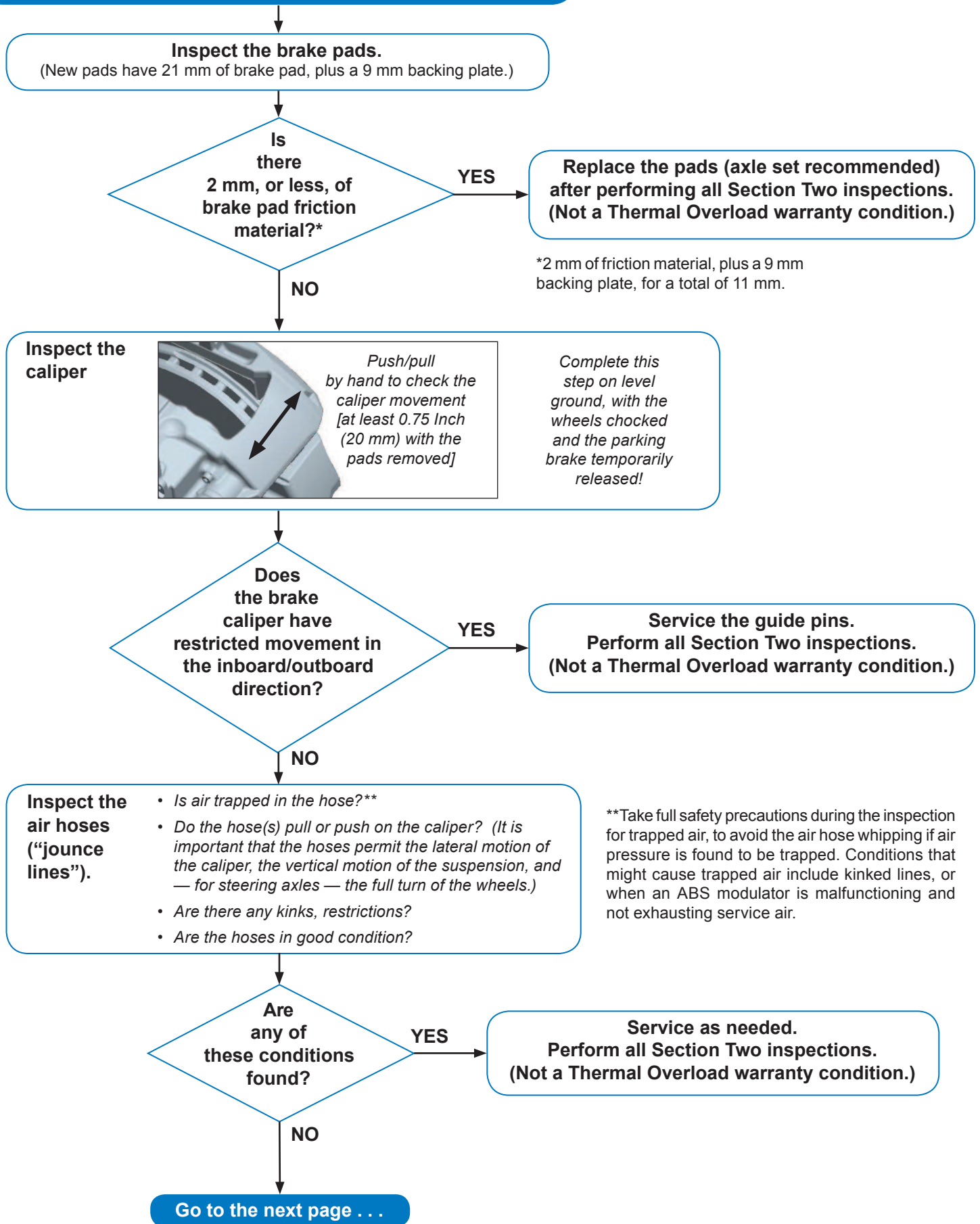
Evidence of thermal overload



In cases where more than one wheel end is affected — but on different axles — complete a separate checklist for each brake being examined.

SECTION TWO: Investigate Other Potential External Causes

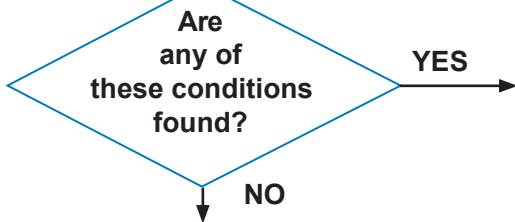
- Follow all Safe Maintenance Practices (see final page.)



SECTION TWO *Continued*

Inspect the actuator. On level ground, with the wheels chocked, cage the spring brake actuator (if equipped) per the manufacturer's guidelines, remove and inspect the actuator.

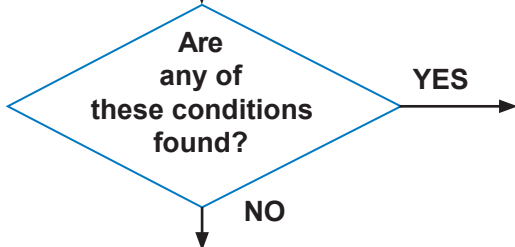
- Is there visible damage?
- In the installed position, was the lowest drain plug sealed?
- Is the seal in poor condition/damaged?
- Does the push-rod extend further than 15 mm from the mounting face?



Service the actuator.
(Not a Thermal Overload warranty condition.)


With the actuator removed, inspect the internal caliper surfaces through the actuator push rod opening.

- Is there visible damage, rust, water?
- With the pads removed, use a screw driver to depress the lever. Does the lever have a restricted range of motion? (The lever must touch the caliper body when fully retracted.)



Replace the caliper. Inspect the rotor.
(Not a Thermal Overload warranty condition.)

No Section Two external causes found? Replace the caliper. Where applicable, process a thermal overload warranty claim.

Where other external causes were found, perform service and exit this flowchart. 

Actions When Replacing a Caliper

Replacement:

- Replace the caliper on the affected wheel end and all the pads at both ends of the axle.
- Inspect the rotor according to the guidelines in Service Data sheet SD-23-7541.

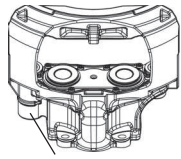
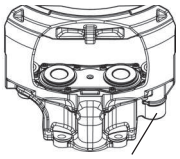
If the brake assembly is still under warranty coverage:

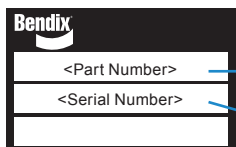
- File a claim. Clearly state the claim is for a single axle thermally overloaded brake. The claim must include photographs of the rotor from both ends of the affected axle.
- Return the caliper from the affected wheel end, and label the caliper with the claim number.
- Return the pads from both sides of the affected axle (LH and RH set of pads). Please clearly label the parts with the wheel position and claim number.
- Please include this completed checklist, the photographs of the rotors, and a copy of the warranty claim with the returned parts.

VIN #: _____ Claim #: _____

Vehicle Make: _____ Vehicle Model: _____

Mileage: _____

Bendix® ADB22X® Air Disc Brake Replacement Part Numbers		
Caliper/Carrier		
Axial Bolt 12 degree	Right Fixed Pin	K081142
	Left Fixed Pin	K081143
Vertical Bolt 12 degree	Right Fixed Pin	K081256
	Left Fixed Pin	K081257
 		
		Left Fixed Pin Right Fixed Pin
Please note that replacement caliper/carrier bolts (available from the vehicle manufacturer) are recommended.		
Caliper Only		
12 degree	Right Fixed Pin	K081258
	Left Fixed Pin	K081259



Caliper Part Number: _____

Caliper Serial Number: _____

(Air Disc Brake Label)

Bendix TechTeam Help Line: 1-800-AIR-BRAKE, (1-800-247-2725), option 2-1. Mon. - Fri., 8 a.m. - 6 p.m.
Reference Document:
 Service Data: SD-23-7541 Bendix® ADB 22X™, ADB 22X-V™ Air Disc Brakes. Go to the document library at www.bendix.com for free downloads of Service Data Sheets and warranty policies.

SAFE MAINTENANCE PRACTICES

⚠ WARNING! PLEASE READ AND FOLLOW THESE INSTRUCTIONS TO AVOID PERSONAL INJURY OR DEATH:

When working on or around a vehicle, the following general precautions should be observed at all times:

1. Park the vehicle on a level surface, apply the parking brakes, and always block the wheels. Always wear safety glasses. Where specifically directed, the parking brakes may have to be released, and/or spring brakes caged, and this will require that the vehicle be prevented from moving by other means for the duration of these tests/procedures.
2. Stop the engine and remove ignition key when working under or around the vehicle. When working in the engine compartment, the engine should be shut off and the ignition key should be removed. Where circumstances require that the engine be in operation, **EXTREME CAUTION** should be used to prevent personal injury resulting from contact with moving, rotating, leaking, heated or electrically charged components.
3. Do not attempt to install, remove, disassemble or assemble a component until you have read and thoroughly understand the recommended procedures. Use only the proper tools and observe all precautions pertaining to use of those tools.
4. If the work is being performed on the vehicle's air brake system, or any auxiliary pressurized air systems, make certain to drain the air pressure from all reservoirs before beginning ANY work on the vehicle. If the vehicle is equipped with a Bendix® AD-IS® air dryer system or a dryer reservoir module, be sure to drain the purge reservoir.
5. Following the vehicle manufacturer's recommended procedures, deactivate the electrical system in a manner that safely removes all electrical power from the vehicle.
6. Never exceed manufacturer's recommended pressures.
7. Never connect or disconnect a hose or line containing pressure; it may whip. Never remove a component or plug unless you are certain all system pressure has been depleted.
8. Use only genuine Bendix® brand replacement parts, components and kits. Replacement hardware, tubing, hose, fittings, etc. must be of equivalent size, type and strength as original equipment and be designed specifically for such applications and systems.
9. Components with stripped threads or damaged parts should be replaced rather than repaired. Do not attempt repairs requiring machining or welding unless specifically stated and approved by the vehicle and component manufacturer.
10. Prior to returning the vehicle to service, make certain all components and systems are restored to their proper operating condition.
11. For vehicles with Automatic Traction Control (ATC), the ATC function must be disabled (ATC indicator lamp should be ON) prior to performing any vehicle maintenance where one or more wheels on a drive axle are lifted off the ground and moving.

⚠ WARNING: Not all wheels and valve stems are compatible with Bendix Air Disc Brakes. Use only wheels and valve stems approved by the vehicle manufacturer to avoid the risk of valve stem shear and other compatibility issues.

⚠ WARNING: AVOID CREATING DUST. POSSIBLE CANCER AND LUNG DISEASE HAZARD.

While Bendix Spicer Foundation Brake LLC does not offer asbestos brake linings, the long-term effects of some non-asbestos fibers have not been determined. Current OSHA Regulations cover exposure levels to some components of non-asbestos linings, but not all. The following precautions must be used when handling these materials.

- Avoid creating dust. Compressed air or dry brushing must never be used for cleaning brake assemblies or the work area.
- Bendix recommends that workers doing brake work must take steps to minimize exposure to airborne brake lining particles. Proper procedures to reduce exposure include working in a well-ventilated area, segregation of areas where brake work is done, use of local filtered ventilation systems or use of enclosed cells with filtered vacuums. Respirators approved by the Mine Safety and Health Administration (MSHA) or National Institute for Occupational Safety and Health (NIOSH) should be worn at all times during brake servicing.
- Workers must wash before eating, drinking or smoking; shower after working, and should not wear work clothes home. Work clothes should be vacuumed and laundered separately without shaking.
- OSHA Regulations regarding testing, disposal of waste and methods of reducing exposure for asbestos are set forth in 29 Code of Federal Regulations §1910.001. These Regulations provide valuable information which can be utilized to reduce exposure to airborne particles.
- Material Safety Data Sheets on this product, as required by OSHA, are available from Bendix. Call 1-800-247-2725 and speak to the Tech Team or e-mail techteam@bendix.com

SECTION 13: WHEELS, HUBS & TIRES

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1. WHEELS

The vehicle is equipped with hub-mounted wheels as standard equipment, all studs and nuts have right-hand threads. Either steel wheels or optional aluminum-polished wheels may be installed on the vehicle except inner drive wheels which are always steel wheels. Both are mounted with radial tubeless tires.

Except for customer special request, all wheel dimensions are 22.50 X 9.0 inches (571.5 X 228.6 mm) for 315/80 R 22.5 "L" tires.

NOTE

Wheel dimensions 22.50 X 10.5 (571.5 X 266.7 mm) for 365/70 R 22.5 tires are standard on VIP front and tag axles.

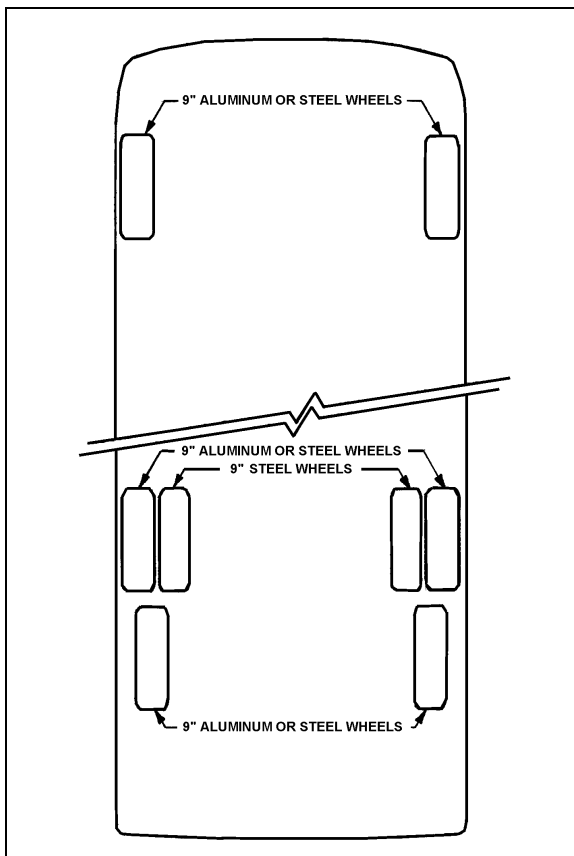


FIGURE 1: ALUM/STEEL WHEEL ARRANGEMENT 13001

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 again after 100 miles (160 km) to allow setting in of clamping surfaces.



CAUTION

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.

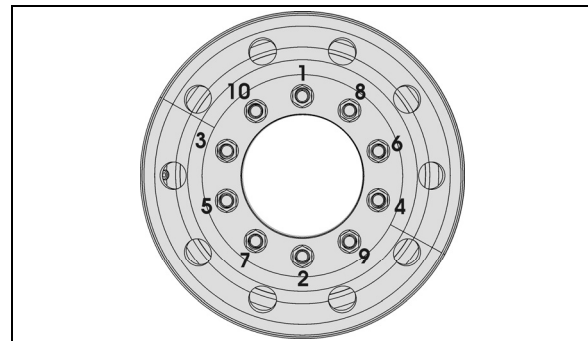


FIGURE 2: TIGHTENING SEQUENCE

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.
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.

Section 13: WHEELS, HUBS & TIRES

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 REMOVAL

1. Remove outer wheel;
2. Remove inner wheel.

3.3 INNER WHEEL INSTALLATION

Mount the wheel over studs, being careful not to damage stud threads;

3.4 OUTER WHEEL INSTALLATION

With inner and outer wheels installed, tighten the 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.

NOTE

On dual wheel assemblies, position the wheels with the tire valves 180° 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. 5);
2. Retighten the hex stud nut to 450 - 500 lbf-ft (610 - 680 Nm).

Repeat for each of the 10 "hex stud nuts" according to the tightening sequence in figure 2.



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 3/4-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 (Prévoist #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 (Prévoist #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 (Prévoist #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.

	<h2>WARNING</h2>
<p>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.</p>	

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;

	<h2>CAUTION</h2>
<p>Damage to the dial gauge could occur if it strikes a wheel balancing weight.</p>	

3. If the variation in lateral run-out exceeds 0.0625 inch (1,6 mm), the wheel must be replaced.

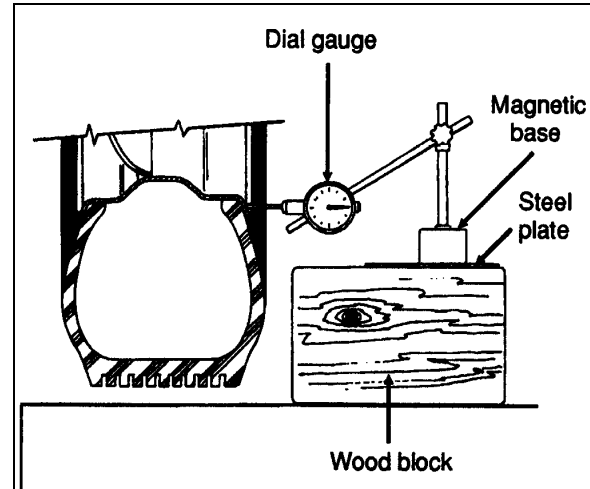



FIGURE 3: DIAL GAUGE INSTALLATION

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.

	<h2>WARNING</h2>
<p>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.</p>	

6. WHEEL STUDS

Stripped threads may be the result of excessive torque 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.

Section 13: WHEELS, HUBS & TIRES

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).

6.1 DRIVE AXLE STUDS

Hub-mounted wheels are mounted with M22 x 1.5 studs and an M22 flange nut.

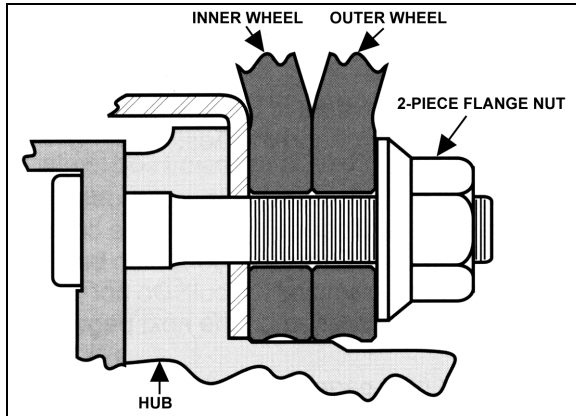


FIGURE 4: DRIVE AXLE WHEELS 13007

6.2 FRONT AND TAG AXLE STUDS

Wheel is hub mounted on front and tag axle (M22 x 1.5 thread).

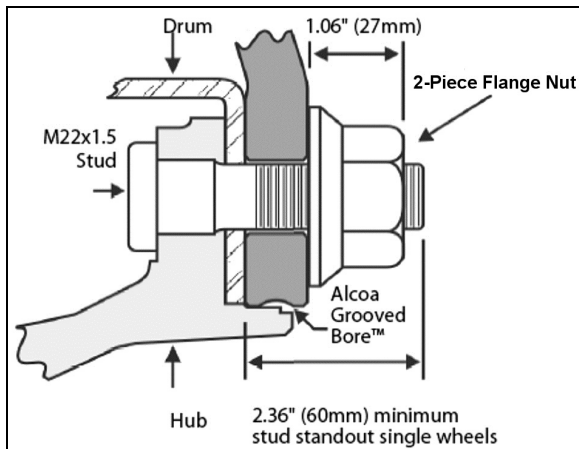


FIGURE 5: SINGLE WHEEL 13025

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.

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.

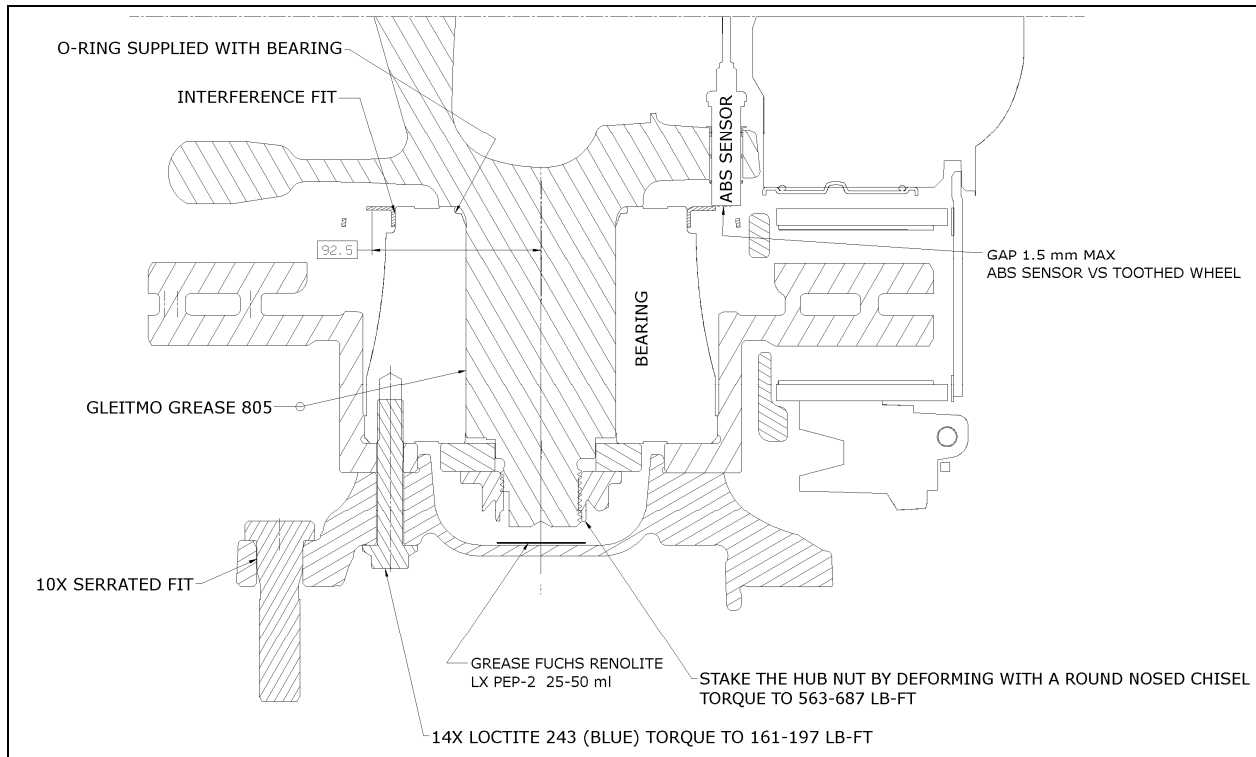


FIGURE 6: FRONT & TAG AXLE WHEEL HUB

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



MAINTENANCE

An inspection should be made at intervals of 30,000 miles (48 000 km) or once a year whichever comes first.

- 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 0.004" (0.105mm) for a new bearing in a used hub and 0.008" (0.20mm) for a bearing which has been in service.

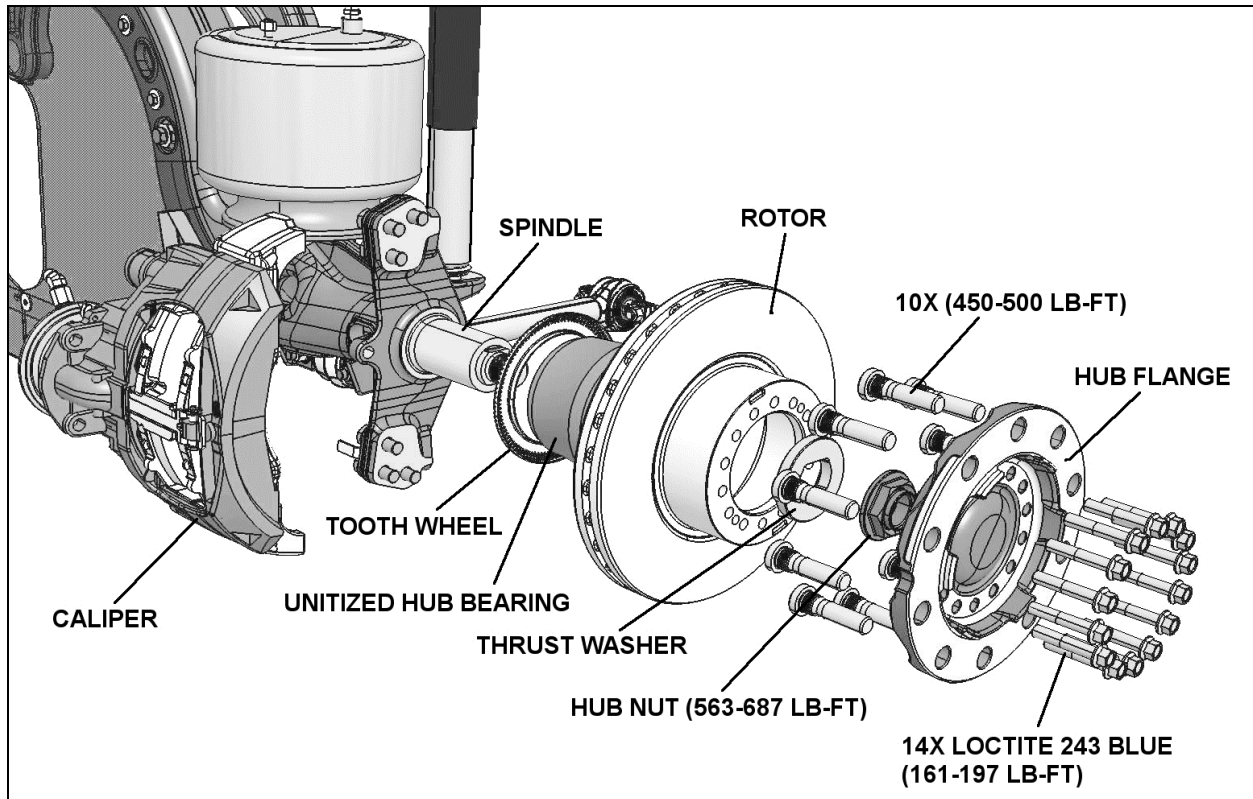


FIGURE 7: FRONT & TAG AXLE HUB AND ROTOR ASSEMBLY

NOTE

If original bearing unit is re-fitted, and end-float is measured at 1 mm, with hub not fully tightened to correct torque [563-687 lb-ft (763-931 Nm)], 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.

8.2 HUB BEARING REMOVAL

- Stop engine and apply parking brake.
- Loosen wheel nuts about one turn (do not remove the nuts). This is not necessary if equipped with hydraulic powered gun.
- Raise the vehicle by its jacking points on the body. See Section 18, "Body", under heading "Vehicle Jacking Points".
- Unscrew wheel hex stud nuts (10) and remove the wheel.
- Unscrew hub flange hex cap screws (14).

- Remove hub flange and rotor.
- Unscrew hub nut.
- Remove hub nut and thrust washer.
- Remove unitized hub bearing by hand or use a puller if necessary.

8.3 HUB BEARING INSTALLATION

- Clean spindle using EFX degreaser (Prevost #685313).
- Lubricate part of spindle where bearing will be located, use Gleitmo 805 grease (Prevost #685274).
- Slide unitized hub bearing over spindle and position using insertion tool #32950.
- Clean thrust washer and hub nut using EFX degreaser.
- Install thrust washer and hub nut then torque hub nut to [563-687 lb-ft (763-931 Nm)].
- Stake the hub nut by deforming with a round nosed chisel.
- Clean hub bearing, rotor and hub flange clamping surfaces using EFX degreaser.
- Install rotor onto hub bearing.

- Add some grease (25-50 ml) (Fuchs Renolite LX PEP-2) (Prevost #685325) into the bottom of the hub flange cap. Mount hub flange onto rotor.
- Apply some Loctite 243 blue onto cap screw threads then secure hub flange and rotor to unitized hub bearing using cap screws (14). Torque to [161-197 Lb-Ft (218-267 Nm)] (Refer to figure 2 for tightening sequence).
- Mount the wheel over studs, being careful not to damage stud threads.
- 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.
- 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.

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, 1/4 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

Section 13: WHEELS, HUBS & TIRES

selection). Lubricate, then install outer bearing cone. Adjust bearing and lock.

8. 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 (IF APPLICABLE)

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 forward baggage compartment, on the R.H. side.

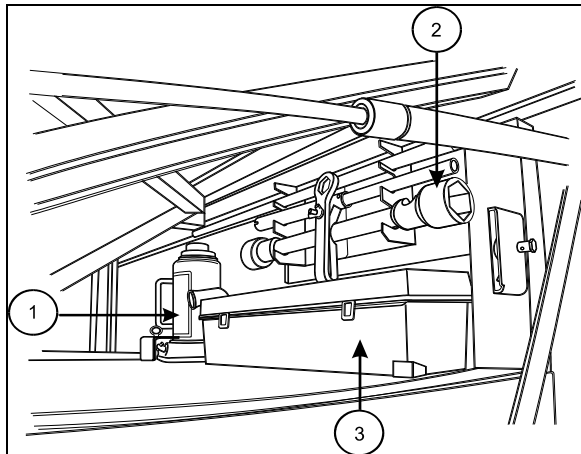


FIGURE 8: WARNING REFLECTORS LOCATION 23376

The spare wheel is stored in a dedicated compartment behind the front bumper. To access, pull the release handle located in the front electrical and service compartment. Although the bumper is heavy, sprung hinges permit one person operation.

When closing bumper compartment, make sure bumper is securely installed.

NOTE

Converted vehicles contain no spare wheel. Access to compartment is also obtained by pulling the release handle located in the front service compartment.



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 SUPER SINGLE TIRE REPLACEMENT

Increase tire pressure to 125 PSI if you are using the supplied 365/70 R 22.5 spare tire to replace a super single tire on the drive axle.

In this particular configuration, spare wheel is to be used for emergency situation only and for temporary use.

- Do not exceed 50 mph (80 km/h).
- Repair and re-install original super single wheel and tire as soon as possible.

Adapt your driving while riding with spare tire.

10.2 PULLING OUT SPARE WHEEL

To pull out spare wheel, open reclining bumper according to the previous instructions

Untighten the pressure screw holding the tire in place. Lift the pressure screw arm and move to the side. Pull the spare wheel out of the compartment.

NOTE

The pressure screw arm must return to its initial position otherwise, the bumper cannot be latched in upper position.

NOTE

Store damaged wheel in spare tire compartment. Repair and balance the flat tire as soon as possible.

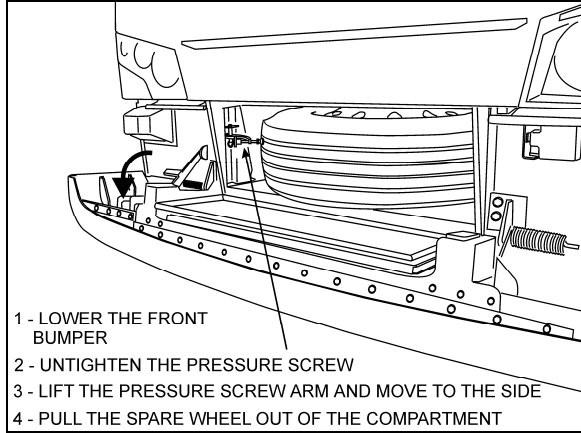


FIGURE 9: SPARE WHEEL AND TIRE 18415

NOTE

The jack and wheelnut wrench are stored at the ceiling of the forward baggage compartment, on the R.H. side..

The jack/tools kit contains a:

1. 30 ton hydraulic jack;
2. Wheel nut wrench and lever.
3. Triangular reflectors kit.

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.

10.3 CHANGING A FLAT TIRE

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".

DANGER

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.

10.4 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. 10). 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.

Section 13: WHEELS, HUBS & TIRES

11.1 INFLATION PRESSURE

- Vehicles equipped with BERU TPMS

On vehicles equipped with the Beru Tire Pressure Monitoring System (TPMS), it is better to use the TPMS display as the primary reference to judge when tire pressure need adjustment.

The TPMS presents pressure readings of each tire as a +/- deviation from the wanted target.

If a tire reads within +/- 3 PSI no adjustment is needed.

If a tire reads -4 PSI and below, re-inflate by the marked amount.

If a tire reads +4 PSI and above, deflate by the marked amount.

Relying on the TPMS system is better than relying on a hand gage since the TPMS is temperature compensated and remain accurate no matter if the tires are cold or hot.

Tires take up to 3 hours to get down to ambient temperature after a ride. A common mistake consist of checking pressure while the tires have not fully cooled down which leads into under-inflated tires. Relying on the TPMS eliminate this mistake.

Running tires at optimal pressure reduce tire wear, improve safety and fuel economy.

NOTE

It is more accurate to use the TPMS display to set the tire pressures than a pressure gauge.

The TPMS target pressures are factory set to equal the prevailing tire pressure at delivery time.

When tire pressures are increased to account for higher vehicle weight, the TPMS set point need to be increased accordingly.

- Vehicles not equipped with BERU TPMS

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.

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"

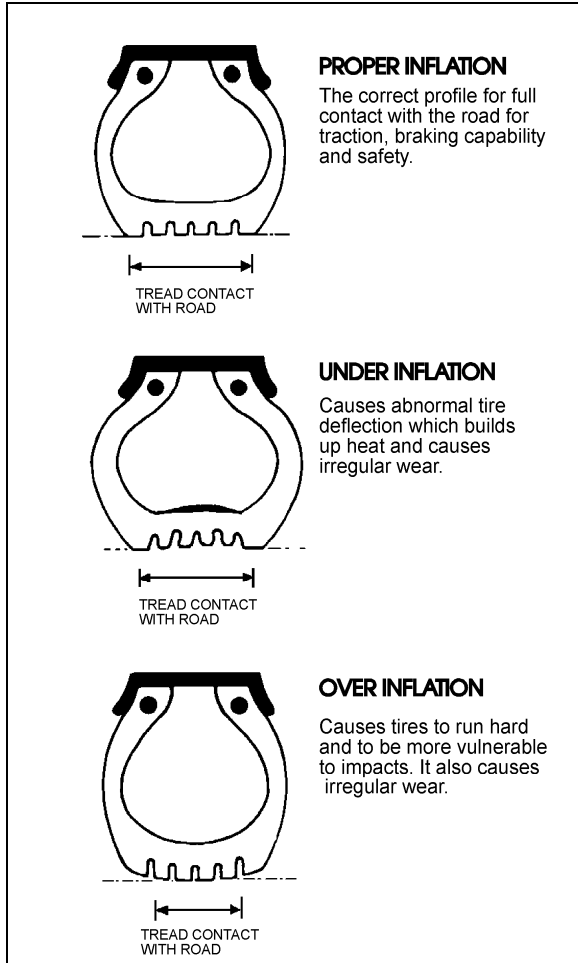


FIGURE 10: TIRE INFLATION 13009

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 Prevost 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.

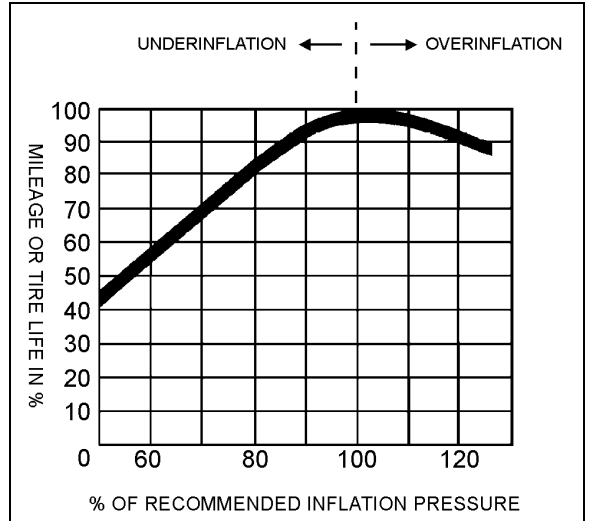


FIGURE 11: TIRE LIFE / INFLATION PRESSURE 13010

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 (including 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 load range "L"

ALUMINUM WHEELS (except inner drive axle wheel on coaches)

Wheel size..... 9" X 22.5"
 Wheel nut torque..... 450 - 500 lbf-ft (610 - 680 Nm)
 Tire size.....315/80 R 22.5 load range "L"

WHEELS ON VIP (Front & Tag axle)


Wheel size..... 10.5" X 22.5"
 Wheel nut torque..... 450 - 500 lbf-ft (610 - 680 Nm)
 Tire size..... 365/70 R 22.5


OPTIONAL WHEELS ON VIP (Drive axle)


Wheel size..... 14" X 22.5" hub mounted wheel
 Wheel nut torque..... 450 - 500 lbf-ft (610 - 680 Nm)
 Tire size..... 455/55 R 22.5

RECOMMENDED TIRE INFLATION PRESSURE AT MAXIMUM LOAD (cold)

<i>NOTE</i>
<i>Vehicle is delivered with the specific inflation pressure certification plate according to the tire selection.</i>

 WARNING
Special tire selection may lower maximum allowable speed limit, even below posted speed limit. For maximum safety, check with tire manufacturer.

 CAUTION
In the case of a converted vehicle, weigh fully loaded and pressurize according to tire manufacturer's recommendations.

 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)Prevost #683529
 Aluminum Wheel Polish (16 Oz bottle)Prevost #683528
 Aluminum Wheel Sealer (13 Oz bottle)Prevost #683527

SECTION 14: STEERING

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1. STEERING SYSTEM

1.1 I-BEAM FRONT 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 (Figure 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.

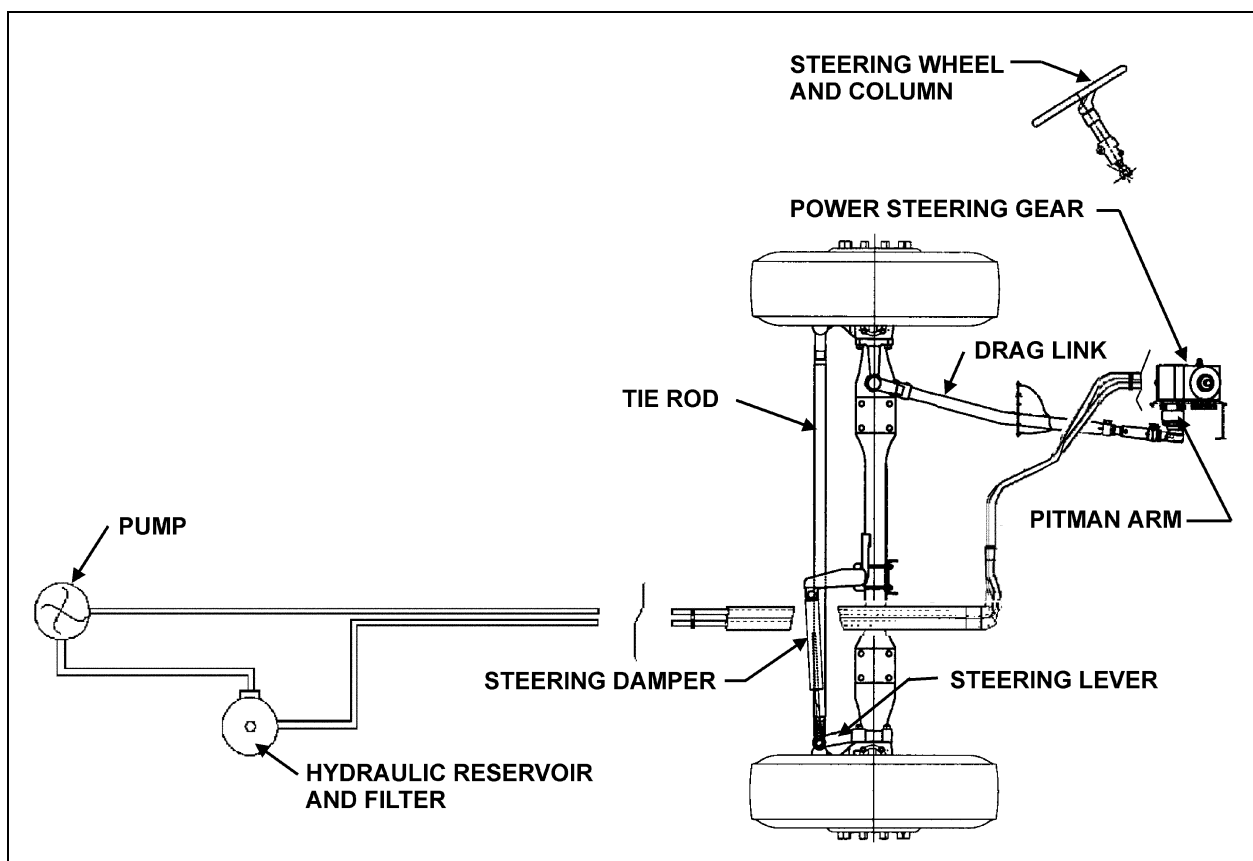


FIGURE 1: STEERING SYSTEM AXLE SETUP

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Section 14: STEERING

1.2 INDEPENDENT FRONT SUSPENSION 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 and linkage (Figure 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.

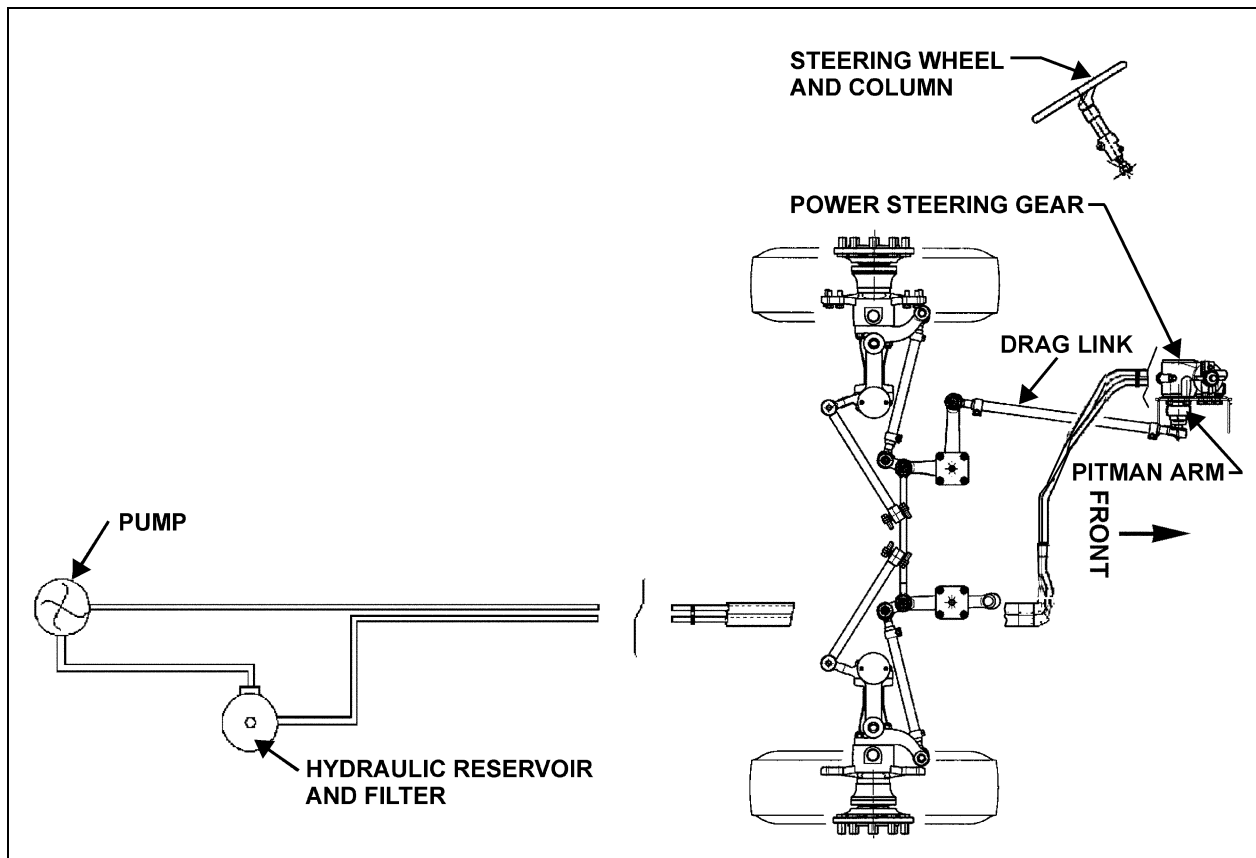


FIGURE 2: IFS STEERING SYSTEM SETUP

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2. POWER STEERING GEAR

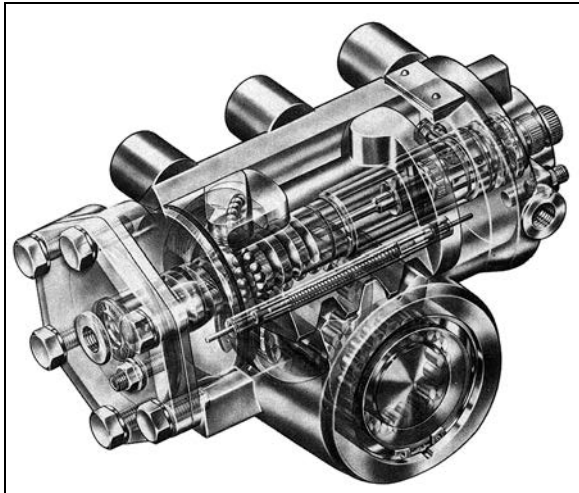


FIGURE 3: POWER STEERING GEAR

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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 engine-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.

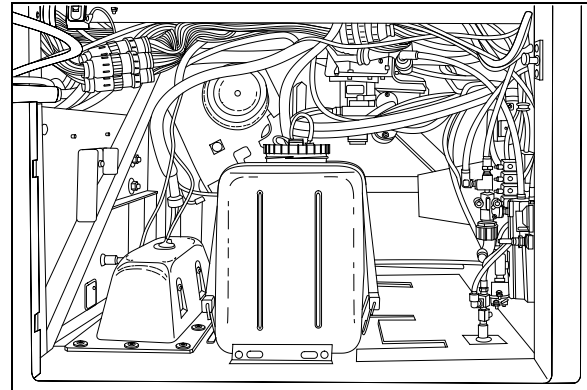


FIGURE 4: FRONT SERVICE COMPARTMENT

14050

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

1. Put a container into place, and then disconnect both the inlet and outlet hoses from the power steering gear. Cover fittings to prevent fluid contamination.
2. Mark both the steering shaft universal joint yoke and steering gear input shaft with a line, then disconnect universal joint.
3. Unscrew and remove the power steering gear.

	<p>WARNING</p>
<p>The steering gearbox weighs approximately 100 lbs. (45 kg) dry. Exercise caution when handling.</p>	

2.3 POWER STEERING GEAR INSTALLATION

Reverse "Power Steering Gear Removal" procedure paying particular attention to the following:

1. Tighten fasteners as prescribed.
2. Bleed air from the system as per step 3, next.

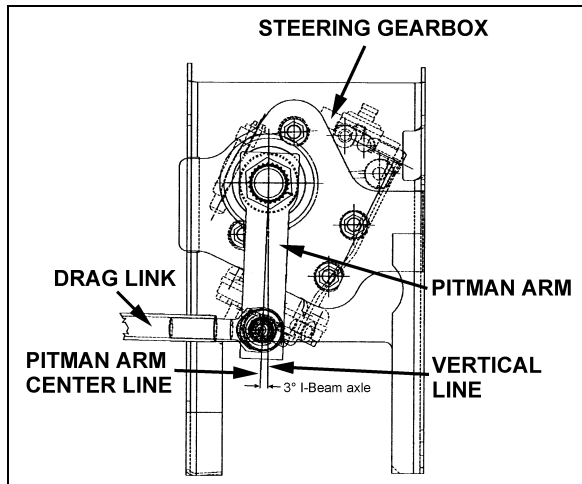


FIGURE 5: PITMAN ARM ADJUSTMENT 14052

2.4 TROUBLESHOOTING

Perform troubleshooting of the steering gear as outlined in the "ZF-SERVOCOM REPAIR MANUAL", the "ZF-SERVOCOM Operating, Servicing/Maintenance and Inspection Instructions".

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".

<p><i>NOTE</i></p>
<p><i>For vehicles equipped with ZF-SERVOCOMTRONIC unit, refer to the supplement to the repair manual ZF-SERVOCOM.</i></p>

5. POWER STEERING HYDRAULIC PUMP

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, at the flywheel end and is also used for driving the fuel pump.

5.1 REMOVAL AND INSTALLATION

The pump is accessible through the engine compartment R.H. access door.

To remove the pump, proceed as follows:

1. You must first remove the fuel feed pump.
2. Clean around the fuel pump and fuel lines. Position a container to catch any fuel that might drain from the pump or lines.
3. Remove the fuel pump.

<p><i>NOTE</i></p>
<p><i>Only unfasten the bolts marked with arrows.</i></p>

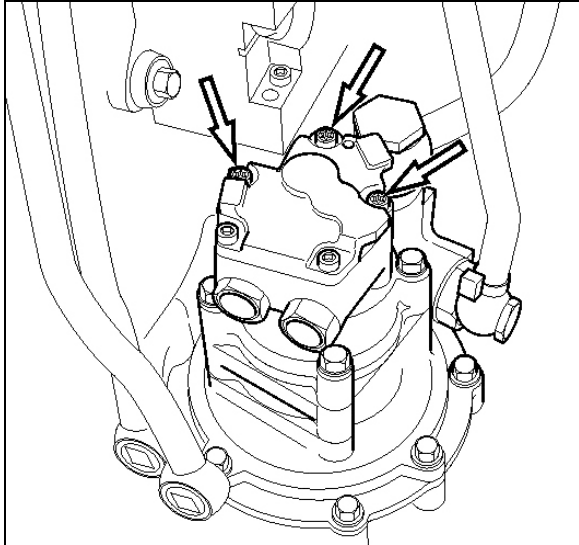


FIGURE 6: FUEL PUMP REMOVAL



CAUTION

Ensure to clean around the head of the bolts. Debris will prevent the tool from fitting properly and cause damage to the fasteners.

4. Check that the adapter and fuel pump drive axle are not damaged.

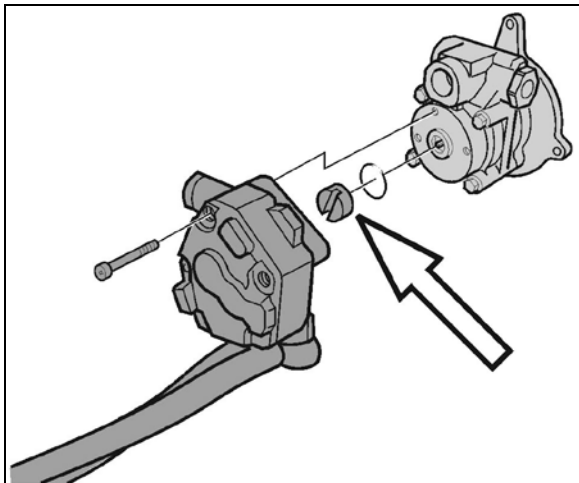


FIGURE 7: FUEL PUMP DRIVE AXLE

5. Set the fuel pump aside.
6. Clean around the power steering pump and loosen the steering lines. Position a container to catch any hydraulic fluid that might drain from the pump or lines.
7. Unfasten the power steering pump bolts.

NOTE

Only unfasten the bolts marked with arrows.

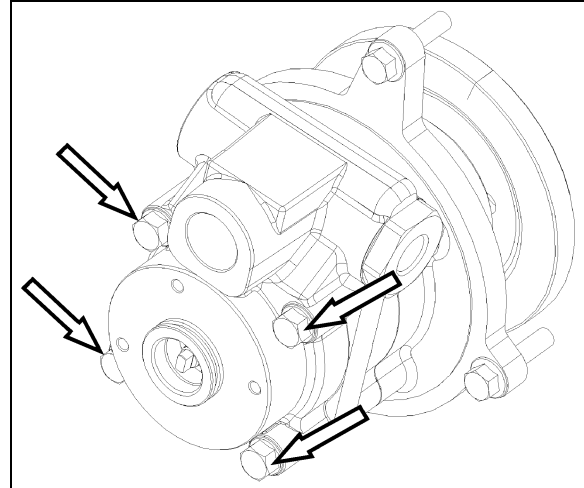


FIGURE 8: POWER STEERING PUMP REMOVAL

8. Install the new power steering pump. Torque-tighten bolts to specification.

NOTE

Use a new gasket.

9. Connect the hydraulic lines to the power steering pump.
10. Install the fuel pump. Torque-tighten bolts to specification.

NOTE

Use a new sealing ring. Check that the fuel pump drive axle sits correctly in the power steering pump.

11. Start the engine and let run for 5 minutes. Make sure that there are no leaks.

6. STEERING COLUMN

6.1 REMOVAL

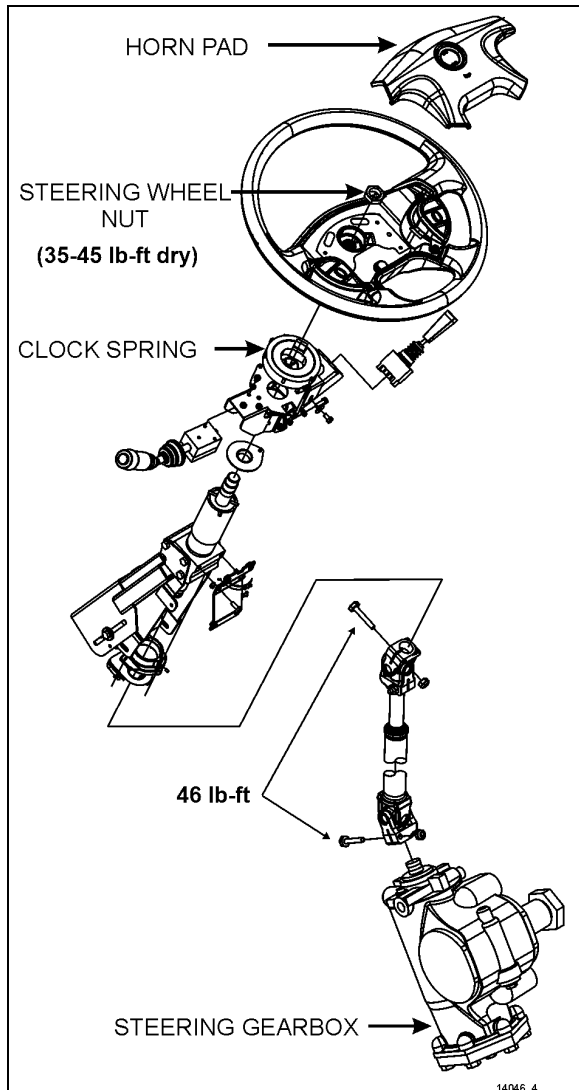


FIGURE 9: STEERING COLUMN

To disassemble the steering column from system, refer to figure 9 & 10. 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:

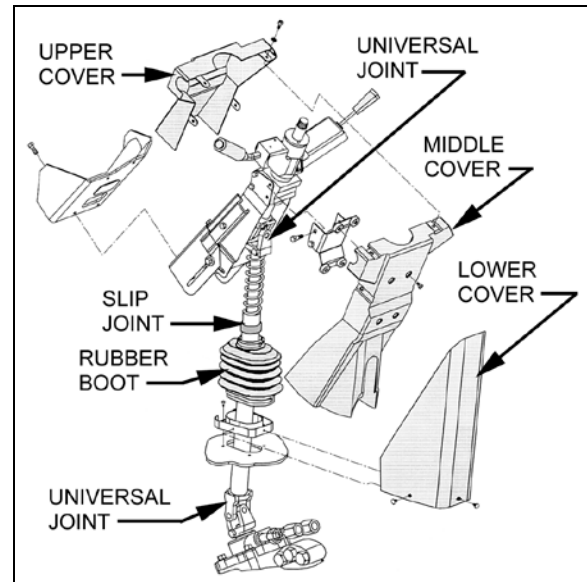


FIGURE 10: STEERING COLUMN COVERS

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1. From the front driver's compartment area, remove the three plastic fasteners on steering column lower cover. Remove the lower cover (Figure 10).
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.

7. STEERING WHEEL

7.1 REMOVAL

NOTE

Before undertaking the steering wheel removal, assure that the front wheels are pointing straight ahead, aligned with the vehicle.

1. Set the battery master switch located in the main power compartment to the "OFF" position.
2. Pull the horn pad straight up gently to detach it from the steering wheel (Figure 11).
3. Disconnect the horn wire (white) connected to the horn pad and the steering wheel harness 4-pin connector.

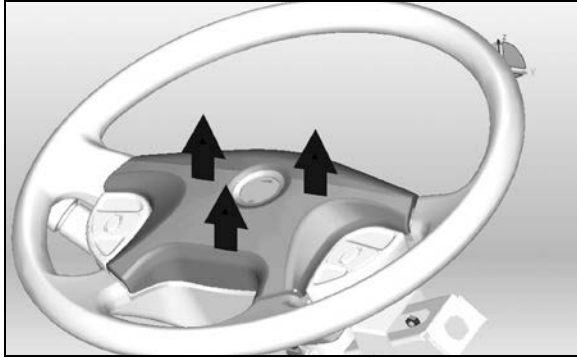


FIGURE 11: REMOVING THE HORN PAD

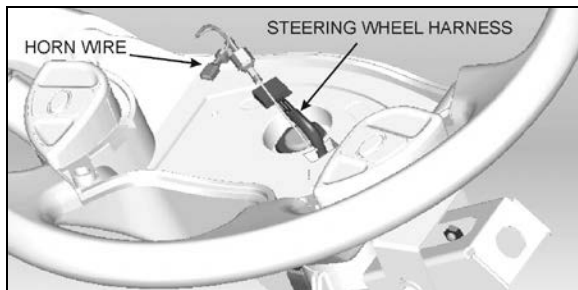


FIGURE 12: STEERING HARNESS & HORN WIRE

4. Unscrew the steering wheel nut. To simplify installation and ensure steering wheel alignment, mark the relationship of the spline shaft to the steering wheel hub (if marks don't already exist or don't line up).
5. Using an appropriate puller, separate the steering wheel from the spline shaft.
6. From behind the steering wheel, pull gently on the electrical wires passing through the rectangular opening in the steering wheel to finish removal of the steering wheel.

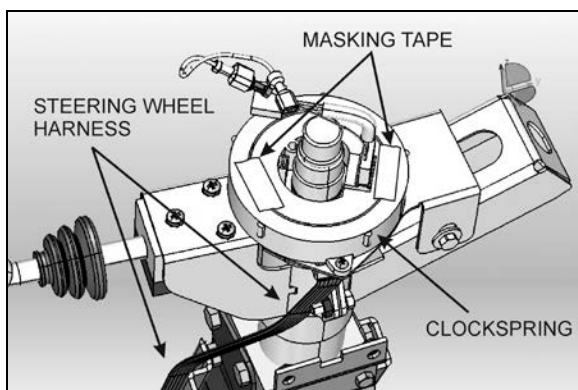


FIGURE 13: LOCKING THE CLOCKSPRING IN PLACE

7. Once the steering wheel is removed, it is important to block any rotating movement of the clockspring in order to prevent it from losing its neutral position. Use two pieces of masking tape to lock it in place (Figure 13).

NOTE

The clockspring mechanism permits a certain number of turns in each direction. At the moment of reinstalling the steering wheel, if the clockspring is not at its neutral position, the number of available turns will be reduced. This may damage the clockspring if the steering wheel is turned to its maximum amplitude.

7.2 INSTALLATION

1. Route the white horn wire and the 4-pin connector through the opening on the steering wheel.
2. Align the mark on the steering wheel hub with the mark on the spline shaft and slide the wheel onto the shaft.
3. Tighten wheel retaining nut to a torque of 35-45 lbf-ft.
4. Plug the 4-pin connector and connect the white horn wire to the center pad.
5. Reinstall the center pad and test for proper horn functioning.

7.3 CLOCKSPRING REPLACEMENT

1. Remove the steering wheel.
2. Remove the 2 clockspring mounting screws and then remove the clockspring. You will have to disconnect the clockspring harness connector located lower along the steering wheel column. If necessary, remove the steering column covers (Figure 10).
3. Route the new clockspring harness through the opening in the clockspring support (Figure 14). Plug the connector at the base of the steering wheel column and fix harness along the steering wheel column.
4. Mount the clockspring in place with 2 screws.

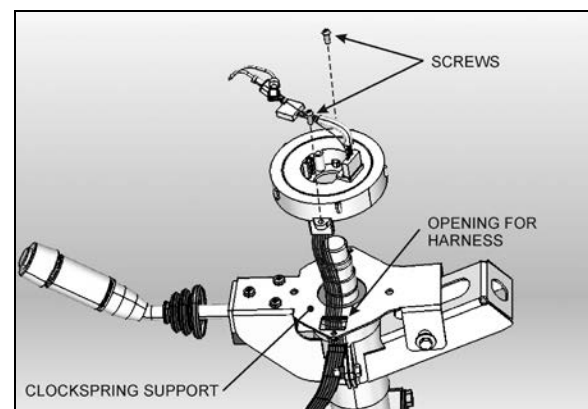


FIGURE 14: CLOCKSPRING INSTALLATION

- Break the paper seal and rotate the center part of the clockspring about 50° clockwise (Figure 15). This step is necessary for the installation of the steering wheel.

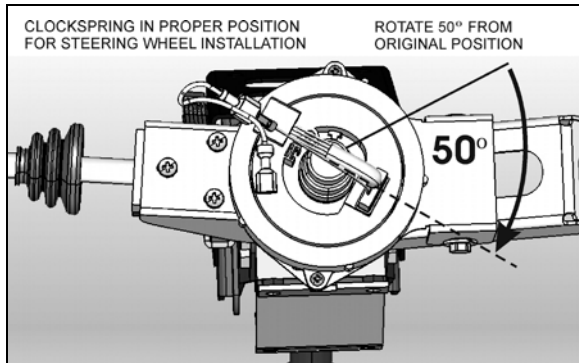



FIGURE 15: PROPER CLOCKSPRING POSITION


- Reinstall the steering wheel.


8. 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 ADJUSTMENT".

 CAUTION
<p>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)").</p>

Hydraulic Stop

 CAUTION
<p>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").</p>


 CAUTION
<p>Never maintain the relief pressure for more than 5 seconds, since damage to the power steering pump may occur.</p>

9. 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".


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
<p>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".</p>

10. PITMAN ARM

10.1 REMOVAL

- Remove cotter pin, nut and washers from drag link ball stud at pitman arm.
- Disconnect drag link from pitman arm, using jaw style pullers (pressure screw type).

 WARNING
<p>Always wear approved eye protection when operating pullers.</p>

 CAUTION
<p>Do not drive (hammer in) pitman arm on or off pitman shaft as this can damage the steering gear.</p>

 CAUTION
--

Heating of components to aid in disassembly is not allowed because it has a detrimental effect on axle components and steering linkages.

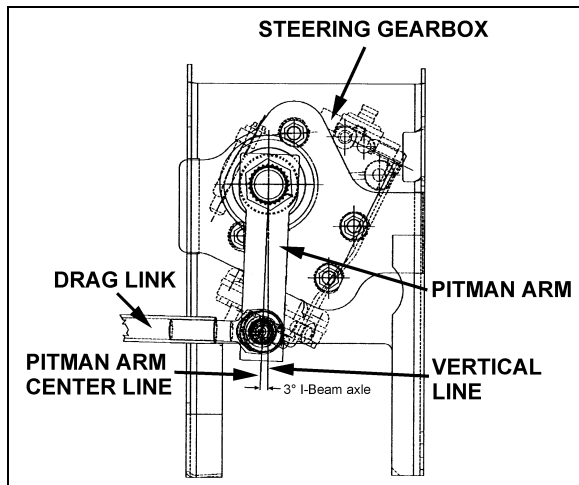


FIGURE 16: PITMAN ARM ADJUSTMENT 14052

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.

10.2 INSTALLATION

1. Position pitman arm on sector gear shaft with reference marks aligned.
2. Install fixing nut (Prevost #661050). Tighten as per "Torque Specifications" in this section.

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 17).



FIGURE 17: 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 as per "Torque Specifications" in this section. Afterwards, install a new cotter pin.



CAUTION

Input shaft marks must be aligned before adjusting pitman arm.

10.3 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 Figure 16 for details).
3. The pitman arm should be adjusted to an angle of 3° (I-Beam axle) or 2° (Independent Front Suspension) in relation with the vertical axis (towards rear 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 Tighten as per "Torque Specifications" in this section.

11. DRAG LINK (I-BEAM AXLE)

The draglink on your vehicle connects the steering gear pitman arm to the front axle's steering arm.

For additional details please refer to ZF assembly instructions LMN404-3 and Lemförder service information leaflet for the fine adjustment system.

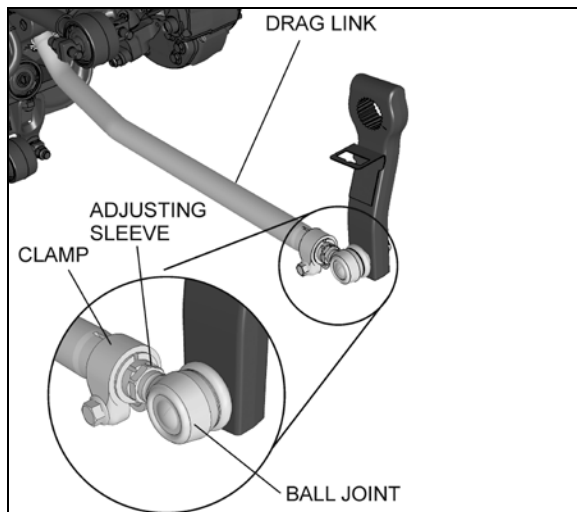
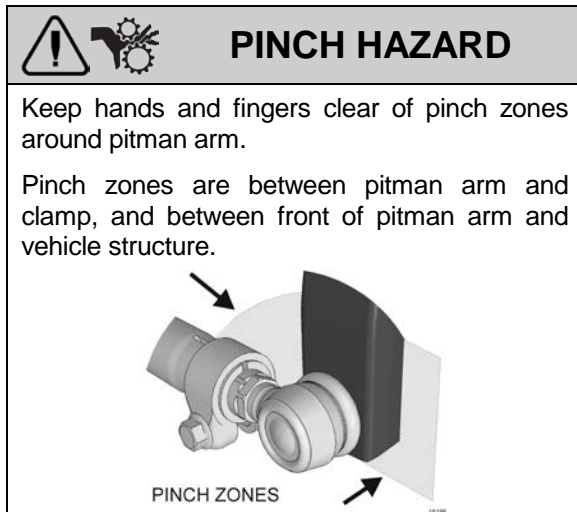


FIGURE 18: DRAG LINK

11.1 FINE ADJUSTMENT

The drag link fore end is provided with an adjusting sleeve which has internal and external left and right threads. Turning this sleeve allows fine adjustments to the length of the draglink.

Apply a small amount anti-seize compound on the threads for corrosion protection. Be sure to avoid smearing the ball joint boot.

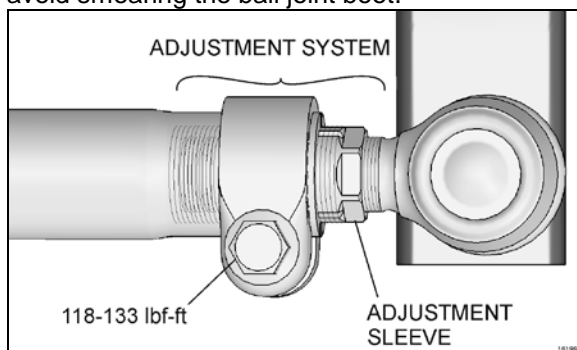
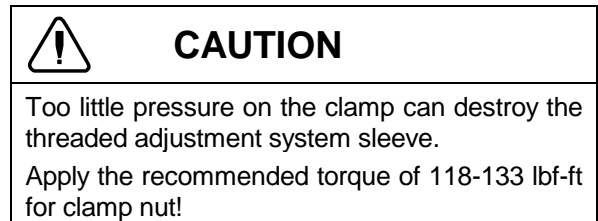


FIGURE 19: DRAG LINK ADJUSTMENT SYSTEM



Fine adjustment of the drag link length should be performed exclusively by turning the adjuster sleeve.

11.1.1 Adjustment System Thread Lengths

When assembling the adjuster sleeve or ball joint, be sure to assemble the parts within the following prescribed maximum thread lengths and values to preserve the integrity of the adjusting system.

Lengths V and W should be measured prior to removal to restore the steering system to its original state.

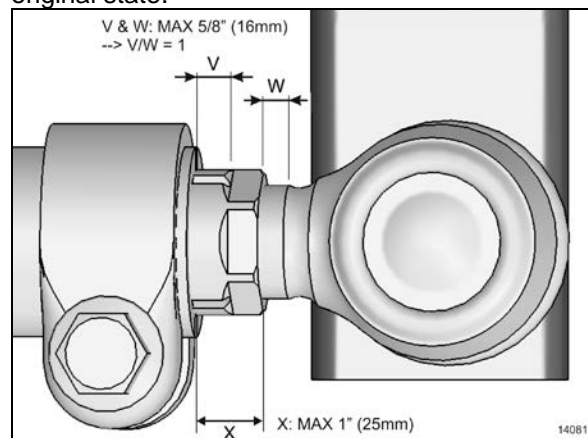


FIGURE 20: DRAG LINK ADJUSTMENT SYSTEM

- Dimension V and W should be equal: $V/W = 1$
- Max dimension V: $5/8"$ (16mm) ± 1 thread pitch
- Max dimension W: $5/8"$ (16mm) ± 1 thread pitch
- Max dimension X: $1"$ (25mm)

12. MAINTENANCE

The power steering system requires little maintenance. However, the system should be kept clean to ensure maximum operating performance and trouble-free service. Periodic inspections should also be made to check for leakage and all parts for damage or distortion.

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-II 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*".



CAUTION

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, on front wall and accessible through the engine compartment R.H. side door. (Figure 21).



MAINTENANCE

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.

Power steering fluid reservoir is equipped with a magnetic drain plug. Check for trapped metal particle when replacing filter cartridge element.

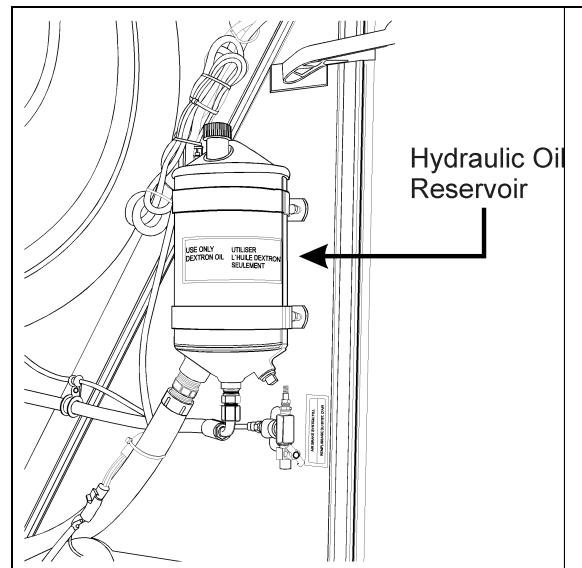


FIGURE 21: HYDRAULIC FLUID RESERVOIR LOCATION
14043

12.1.1 Oil Level Check Procedure

1. Stop engine. Open engine compartment R.H. side door.
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 (Figure 21).
4. Adjust level to "*FULL*" mark using proper dipstick side depending on fluid temperature, use "*Dexron-IIIE or Dexron-III*" automatic transmission oil.
5. Reinsert and tighten the dipstick.

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.

- Remove the retaining spring and finally the filter cartridge element.

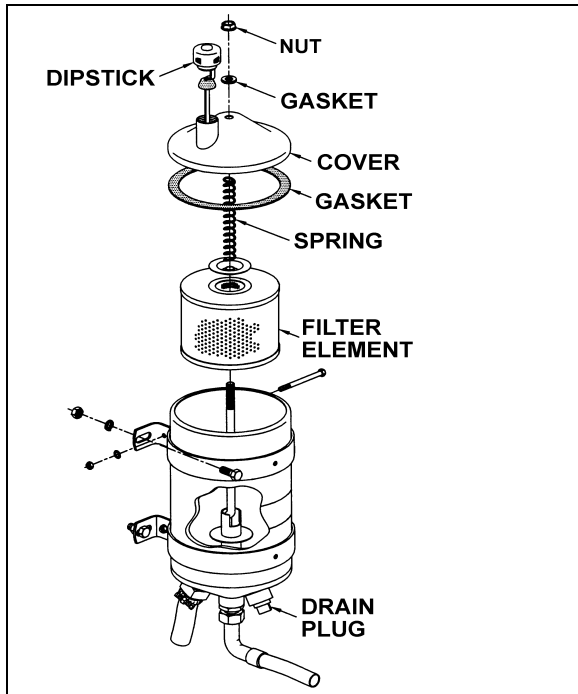



FIGURE 22: POWER STEERING FLUID RESERVOIR^{14018A}

12.2 STEERING STABILIZER CYLINDER (DAMPER)

The steering damper is located on R.H. side, aft of front axle (Figure 23).

The cylinder is non-adjustable and non-repairable. Disconnect the cylinder from axle, and then carefully attempt to extend and collapse it manually.

 <h2 style="margin: 0;">MAINTENANCE</h2>
<p>Steering damper ball joint (rod end) is provided with grease fitting for pressure lubrication. Under normal conditions, it should be serviced every 6,250 miles (10 000 km) or twice a year, whichever comes first.</p> <p>Check the ball joint for wear, and replace if necessary. Good quality lithium-base grease NLGI No. 2 like Shell Retinax LX is recommended.</p>

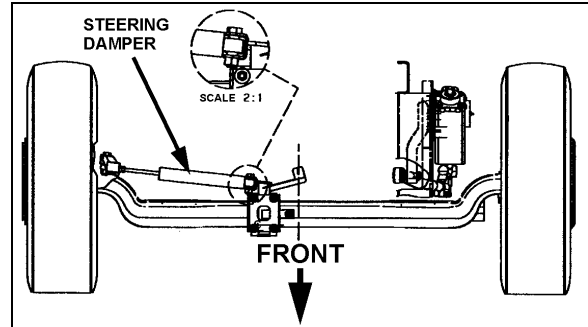



FIGURE 23: STEERING STABILIZER (DAMPER) ¹⁴⁰⁵³

12.3 DRAG LINK

Visually inspect drag link components for broken, corroded or deformed clamps, loose, bent or corroded nuts and gauges on tube from rubbing parts.

12.3.1 Independent Front Suspension

 <h2 style="margin: 0;">MAINTENANCE</h2>
<h3 style="margin: 0;">Drag Link (with Independent Front Suspension)</h3> <p>Drag link ends (ball joint) are provided with grease fittings for pressure lubrication. These grease fittings should be serviced every 6,250 miles (10 000 km) or every 6 months whichever comes first.</p> <p>To prevent corrosion from forming around the ball pin (particularly the drop type ball joint as it is exposed to dirt and water), remove the old grease bead and assure sufficient grease is applied to purge the old grease and fill the joint and dust seal. Good quality lithium-base mineral grease NLGI No.2 like Shell Retinax LX is recommended.</p>

12.3.2 Front I-beam Axle

On vehicles equipped with I-beam front axle, the drag link features **lubricated for life** ball joints and a compact fine adjustment system.

Visual inspection

Inspect the adjustment system to ensure the threads are firmly seated. Also, a visual inspection should be carried-out looking for damage or corrosion to the adjustment system components. Replace any part showing corrosion or damage.

Functional inspection

Clean the adjustment system with a brush and compressed air prior to inspection, if required.

With the engine running and the vehicle on the ground (with a load on the axle) turn the steering wheel left and right.

To verify that the threads are tight and do not present any play, use one of the following methods:

- Visual inspection
- Place a finger on the separation line from the adjuster sleeve to the threaded ball joint shaft.
Keep fingers clear of pinch zones.
- Use a dial gage clamped to the tube and feelers aligned on the ball joint to indicate any play

When play is discovered in the adjusting system, replace the complete drag link.

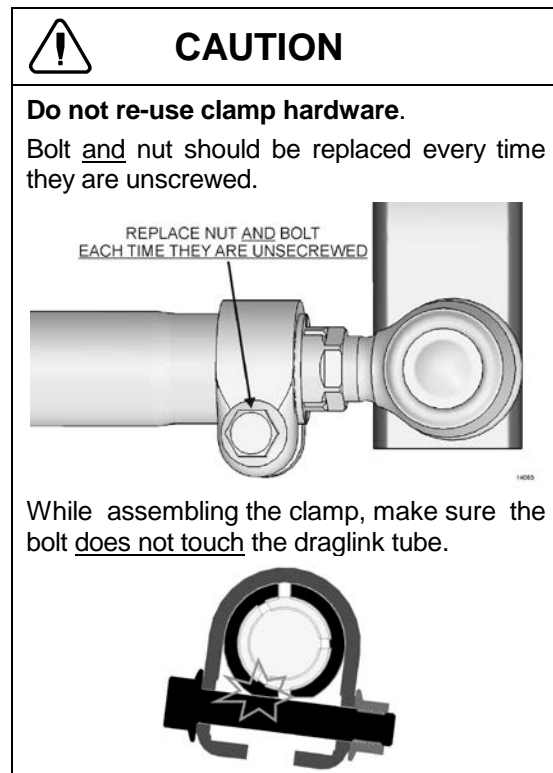


FIGURE 24: I-BEAM FRONT AXLE DRAG LINK

12.4 TIE ROD

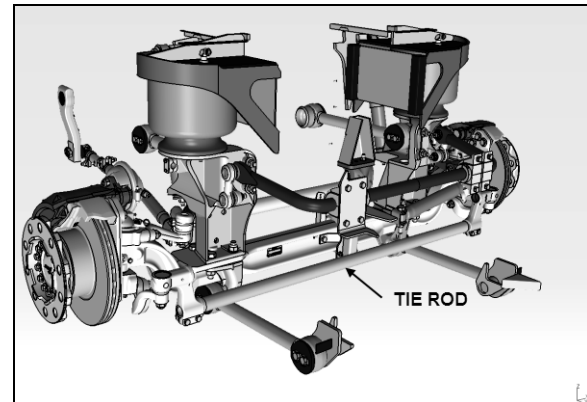



FIGURE 25: TIE ROD



MAINTENANCE


Tie rod ends (ball joint) are provided with grease fittings for pressure lubrication. These grease fittings should be serviced every 6,250 miles (10 000 km) or every 6 months whichever comes first.

To prevent corrosion from forming around the ball pin, remove the old grease bead and assure sufficient grease is applied to purge the old grease and fill the joint and dust seal.

Good quality lithium-base mineral grease NLGI No. 2 like Shell Retinax LX is recommended.

12.5 DRAG LINK AND TIE ROD BALL JOINTS INSPECTION FOR CORROSION

Inspection of ball joints is important. Damaged sealing boots, salt and climatic conditions can cause loss of the corrosion protection coating applied at time of manufacturing.



MAINTENANCE

Inspect drag link and tie rod ball joints for corrosion once a year.

1. Carefully clean the sealing boot or dirt seal contact area to ensure that no contaminants can get under the sealing boot or dirt seal during the following inspection procedure.
2. Use an appropriate inspection tool (e.g. spatula with cut out) to push up (sealing boot) or down (dirt seal) the seal (without damaging it) until ball pin surface is visible. Degrease the ball pin surface and inspect carefully.

Section 14: STEERING

3. If there is corrosion of the ball pin or the sealing boot has deteriorated through ageing or is damaged, replace the ball joint.
4. If there is corrosion of the steering arm or tie rod arm area which is in contact with the sealing boot or dirt seal, clean and eliminate all surface irregularities.
5. If there is no corrosion or damage to the sealing boot or dirt seal, smear the steering arm and tie rod arm with Lithium grease and push seal back into its properly seated position.

When dismantling tie rod or drag link, ensure that no damage is caused to the sealing boots, dirt seals or ball joint housings.

12.6 DROP TYPE BALL JOINT

12.6.1 Drop Type Ball Joint End Play

If end play (direction of the ball pin axis) exceeds 0.047" (1.2 mm), readjustment is necessary.

Remove protective cap, using a suitable tool i.e.: 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.

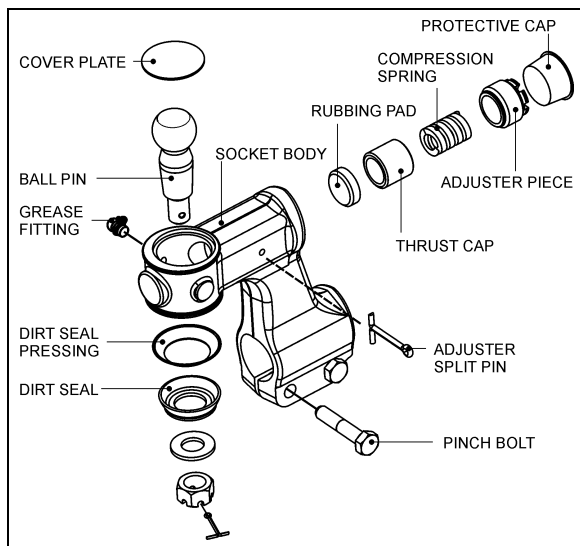


FIGURE 26: DROP TYPE BALL JOINT FOUND ON TIE ROD (2X)

10029

12.6.2 Dismantling Drop Type Ball Joint

1. Remove dirt seal and dirt seal pressing from ball pin.
2. Slacken pinch bolt nut then unscrew and remove ball joint assembly from tie rod having first marked ball joint body and tie rod to enable tracking on re-assembly.
3. Remove adjuster split pin from ball joint body.
4. Remove cap then using a suitable tool i.e.: a piece or 1"x1/8"x 9" flat bar, unscrew and remove adjuster piece. Waggle ball pin to free thrust cap.
5. Remove compression spring and thrust cap from ball joint body.
6. Relieve peening on socket body top then using a hide faced mallet, tap ball pin out of body. This operation will also remove cover plate from body.
7. The rubbing pad can now be removed from body.

Thoroughly clean all parts and check for wear, renewing where necessary.

12.6.3 Assembling Drop Type Ball Joint

1. Apply a bead of Loctite 638 sealant to mating corner of rubbing pad in socket body then knock rubbing pad into its recess in ball joint body.
2. Thoroughly grease rubbing pad and ball pin with Shell Retinax LX or equivalent.
3. Insert ball pin into body.
4. Insert thrust cap, compression spring and adjuster piece into body.
5. Tighten adjuster piece fully home (SOLID) locating thrust cup onto ball pin.
6. Still with tool located on adjuster piece, back off carefully (LEAST AMOUNT) until adjuster piece split pin is allowed to pass through body, and that ball pin shank can be moved by moved of hand, then remove tool.

NOTE: If ball pin does not rotate when re-adjusted in line with above instructions, this suggests that ball pin has local worn flats. In this instance ball pin, thrust cup and rubbing pad MUST be replaced, if not FAILURE could occur in service, i.e. ball pin not being able to move in assembly when turning from lock to lock.

7. Fit cover plate into top of ball joint body, re-peen using a cold chisel to secure.
8. Screw assembled ball joint onto tie rod. Lining up marks on both body and tie rod previously made, or retracking using manual instructions.
9. Fit pinch bolts and nuts then tighten nuts alternately and progressively to 65-75 lbf-ft (88-102 Nm.) thus securing ball joint to tie rod.
10. Fit dirt seal (pressing) and dirt seal (rubber) onto ball pin.
11. Locate ball joint and tie rod assembly with lever, carefully align and fit ball pin into hole in tie rod arm.

NOTE: Ball pin and ball pin tapers in bottom tie rod arms must be clean, dry and free from oil prior to assembly.

12. Fit pin washer onto ball pin.
13. Screw pin nut onto ball pin then tighten to 175 lbf-ft (237 Nm).
14. Using a 2lb hammer, tap tie rod arm to "shock" ball pin into taper hole.
15. Re-torque pin nut to 175 lbf-ft (23 7Nm).
16. Fit split pin, if slot/hole are not in line, adjust up to next slot.

Pin nut torque 175 lbf-ft, max pin nut torque 200 lbf-ft.

17. Re-charge ball joint with Shell "Retinax LX" or equivalent grease through grease fitting.

12.7 STRAIGHT BODY TYPE BALL JOINT

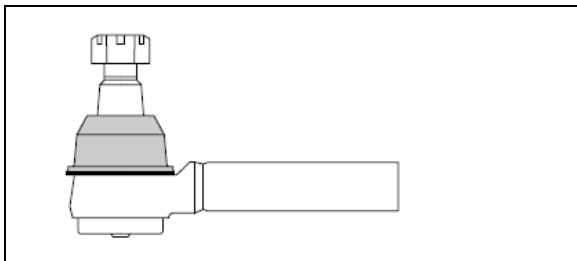


FIGURE 27: STRAIGHT BODY TYPE BALL JOINT

12.7.1 Visual Inspection

- Visually inspect for missing or damages grease fittings and replace if required.
- Damaged sealing boot or improper sealing requires seal replacement.

- Check ball joint connection for missing cotter pins.
- Check for looseness in the ball/socket assembly.

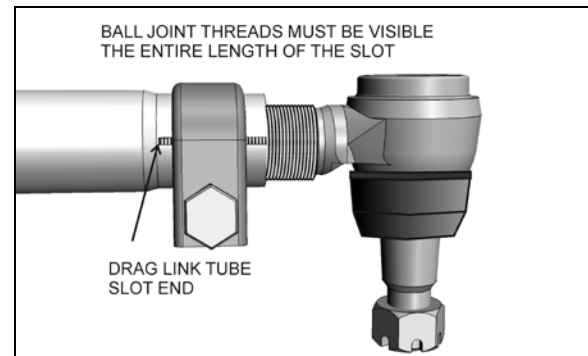


FIGURE 28: ADEQUATE CLAMPING CONDITION

For adequate clamping, the ball joint threads must be visible the entire length of the tube slot. If not, the drag link must be adjusted or replaced. It is either the wrong size, or improper adjustment was used to compensate for another problem (e.g. bent steering arm).

12.7.2 Straight Body Type Ball Joint End Play And Looseness

What creates movement in sockets?

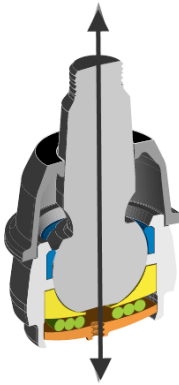
In each straight body type ball joints, the compressive force of the spring creates resistive torque by applying a constant load on the bearing and stud.

As wear occurs on the components, the spring creates less resistive torque. With less torque, you no longer have the precise joint needed for optimum steering, but you do still have a safe linkage. **When all compression is lost, it's time to replace the linkage.** This wear can be caused by impact, lack of lubrication and normal wear.

1. With vehicle engine on, lightly rock the steering wheel while checking for looseness in any threaded joint. Observe any looseness in the two mating tapers or any movement of the ball pin nut. Any looseness requires further inspection. If either of the mating tapered parts shows distortion or wear, both parts must be replaced.

2. With the engine off and wheels straight ahead and no force is being exerted on the linkage by the steering gear, push and pull the ball joint in and out by hand (approximately 100 lbs. force) in the direction of the ball pin. If no movement is detected, the ball joint is safe. **Any movement detected by hand requires replacement of the ball joint.**

Inspect for movement along vertical axis only.



CAUTION

Do not use a wrench or other object to apply leverage when inspecting ball joint. Applying leverage can give distorted results and damage components.

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. TROUBLESHOOTING

CONDITION	CAUSE	CORRECTION
Tires wear out quickly or have uneven tire tread wear.	<ol style="list-style-type: none"> 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. 	<ol style="list-style-type: none"> 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.	<ol style="list-style-type: none"> 1. Low pressure in the power steering system. 2. Steering gear not assembled correctly. 3. Steering linkage needs lubrication. 4. Kingpins binding. 5. Incorrect steering arm geometry. 6. Caster improperly adjusted. 7. Tie rod ends hard to move. 8. Worn thrust bearing. 	<ol style="list-style-type: none"> 1. Repair power steering system. 2. Assemble steering gear correctly. 3. Lubricate steering linkage. 4. Replace kingpins. 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.	<ol style="list-style-type: none"> 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. 	<ol style="list-style-type: none"> 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 pin.	<ol style="list-style-type: none"> 1. Drag link fasteners tightened past specified torque. 2. Lack of lubrication or incorrect lubricant. 3. Power steering stops improperly adjusted. 	<ol style="list-style-type: none"> 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 kingpins and knuckle bushings.	<ol style="list-style-type: none"> 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. 	<ol style="list-style-type: none"> 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.	<ol style="list-style-type: none"> 1. Caster not adjusted properly. 2. Wheels and/or tires out-of balance. 3. Worn steering stabilizer cylinder. 	<ol style="list-style-type: none"> 1. Adjust caster. 2. Balance or replace wheels and/or tires. 3. Replace steering stabilizer cylinder.

15. TORQUE SPECIFICATIONS

The torque specifications applicable to the front axle steering are grouped with information regarding the front suspension. Please refer to Section 16: SUSPENSION of this manual.

16. SPECIFICATIONS

Power Steering Gear

Make ZF-SERVOCOMTRONIC
Type.....Speed Sensitive
F.E.W.....16,600 lbs (7 545 kg)
Pressure rating2,175 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

MakeZF-SERVOCOM
F.E.W.....16,600 lbs (7 545 kg)
Pressure rating2,175 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 (with IFS)

MakeZF-SERVOCOM
Type.....8098
F.E.W.....19,000 lbs (8 618 kg)
Pressure rating2,320 psi (160 Bar)

Power Steering Reservoir

Oil capacity4 US qts (3.7 liters)
Prevost number660982
Make Nelson Muffler

Steering Stabilizer Cylinder (Damper)

Extended length..... 32.73±0.12"
Collapsed length..... 20.26±0.12"
Stroke..... 12.47±0.12"

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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. 1-6). 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 + Front High-Buoy;
- Front Kneeling + Full High-Buoy;
- Front Kneeling + Front High-Buoy and Low-Buoy Combination;
- Front Kneeling + Full High-Buoy and Low-Buoy Combination;

For a description of each of these systems, refer to the appropriate heading in this section

2 FRONT I-BEAM AXLE SUSPENSION

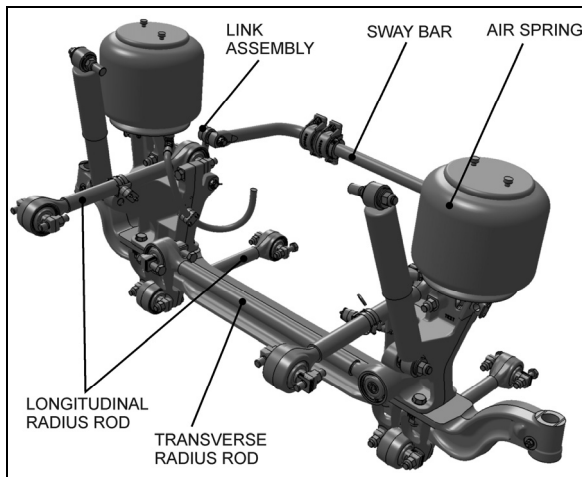


FIGURE 1: FRONT I-BEAM AXLE SUSPENSION 16105

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. Each of the three axles is provided with air springs that are attached to the subframe and to the axles.

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.

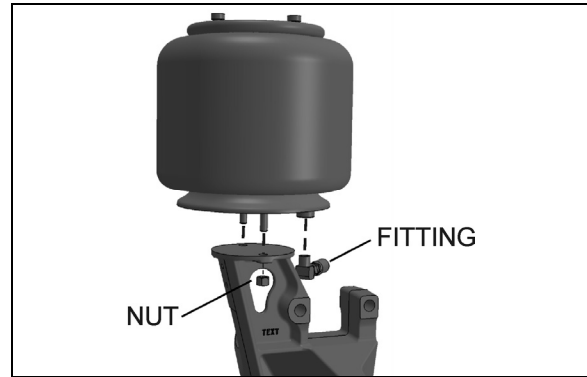


FIGURE 2: AIR SPRING

16052

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

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recommended jacking points. Make sure that the measurement between the air spring mounting plates is greater than the normal clearance (normal ride height).

- 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 and cover both the line end and fitting to prevent the entry of foreign matter.
5. Unscrew the two air spring lower mounting nuts.
6. Rotate the air spring counterclockwise to free the upper attachments from the mounting plate.
7. Remove the air springs.

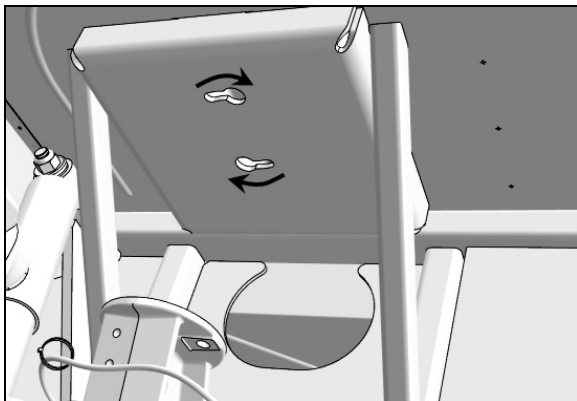


FIGURE 3: AIR SPRING UPPER MOUNTING PLATE

2.1.3 Installation

1. Compress air spring as necessary and position air spring between both the lower and upper mounting plates.
2. Align the upper attachments with holes in the mounting plate. Rotate air spring clockwise.
3. Thread the lower nuts 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 air spring and keeps it compressed, thus enabling to place the air spring in between the mounting plates and greatly easing installation.

4. Tighten and torque the lower stud nuts according to Torque Table under heading Torque Specifications.
5. Install fitting (if applicable), then connect air line.
6. Connect the height control valve link.
7. 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 and tag axles are each provided with two shock absorbers while the drive axle is provided with four of them.

Shock absorbers are non-adjustable and non-repairable. Maintenance requirements involve replacement of the rubber mounting bushings, and tightening of all shock absorber pins according to Torque Table under heading Torque Specifications 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 (Refer to the SACHS document "Guideline to Evaluate Warranty Claims" annexed at the end of this section before replacing a shock). 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 5 for details.
2. Remove the shock absorber assembly from pins.
3. Remove the two inner bushings from the shock absorber and discard them.

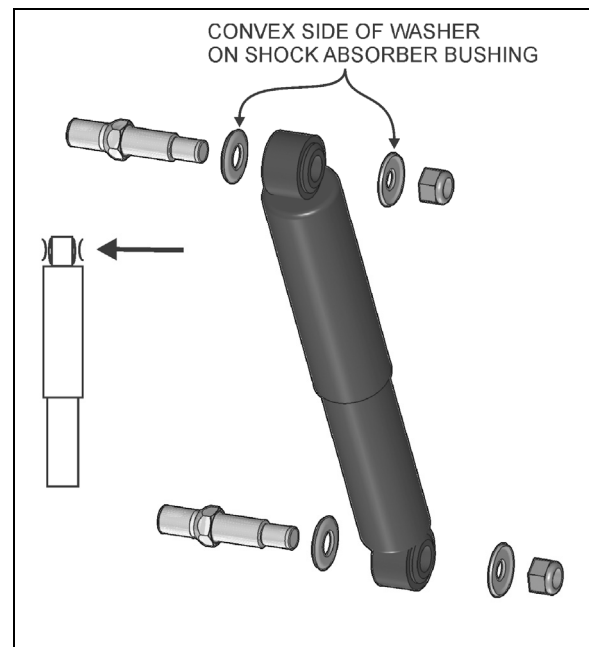


FIGURE 4: SHOCK ABSORBER 16008

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.
4. Install the shock absorber eyes over the mounting pins, then the outer washers (with washer convex side facing the shock).

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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).

5. Place the lower and upper mounting pin stud nuts and torque according to paragraph 13 Torque Specifications.

2.3 RADIUS RODS

Radius rods are used to secure the axles in the proper transversal and longitudinal positions. Five radius rods are provided on the front I-beam axle suspension (four longitudinal and one transversal). Refer to figures 1 and 5 for details. These rods transmit both braking and driving forces from the axles to the vehicle body.

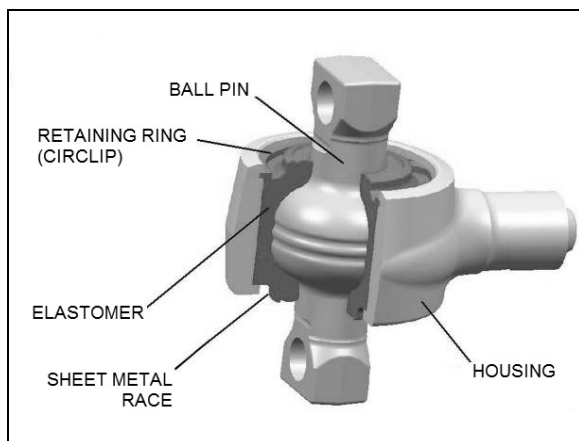


FIGURE 5: BALL PIN JOINT CONSTRUCTION 16186

2.3.1 Inspection

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.

Take off the load from the ball joint by lifting 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 sheet metal race is permissible up to a third of the circumference.

When the following characteristics are noted, the joint is to be changed:

- Free play between ball pin and housing;
- Radial cracking of the external sheet-metal race (fig. 6)
- Any crack or fracture of a metal part
- Plastic deformation of the sheet metal race
- Loosened bolt
- Broken bolt
- Loss of bolt
- Circlip (retaining ring) detached from groove
- Broken Circlip
- Loss of Circlip
- Incipient crack

If damage to the inner housing contour or the Circlip groove is found during replacement of the molecular bearing, the entire radius rod must be replaced.

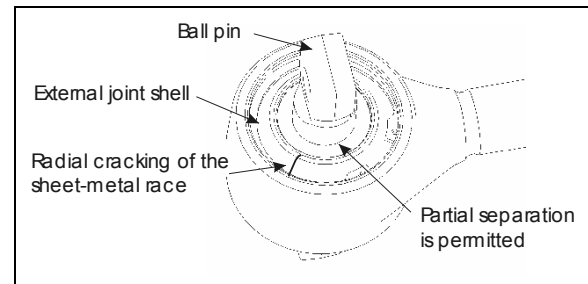


FIGURE 6: BALL PIN BUSHING

2.3.2 Radius Rod Removal

1. Unscrew the nuts (or bolts) at each extremity of the radius rod.
2. Remove the radius rod.

2.3.3 Stripping Down

Strip down the defective joint by removing the Circlip, and ball pin/bushing assembly.

Clean out housing bore and Circlip groove.

2.3.4 Radius Rod Assembly

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.

Execute assembly of the new joint parts in the following sequence:

1. Complete moistening of the contact surface between housing bore and ball pin elastomer through application of grease.

NOTE

Apply the supplied grease, only if you are using a repair kit.

2. Insert ball pin/bushing, assembly. 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 Circlip in the housing using axial load with the aid of assembly stamp.
4. Opening of the Circlip is located at 45° to the housing shaft axis. Make sure that the Circlip is perfectly engaged in the housing.

2.3.5 Radius Rod Installation

1. Snug up the nuts (or bolts) and repeat at the other end.
2. Refer to heading "Suspension Height Adjustment" later in this section, and set the vehicle to normal ride height.
3. With the vehicle at normal ride height, tighten all radius rod anchor pin nuts or bolts as prescribed.



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 vehicle (Fig. 7).

2.4.1 Removal

1. Disconnect the two links from sway bar.

2. Safely support the sway bar. Unbolt the four bushing brackets from subframe.
3. Remove sway bar.

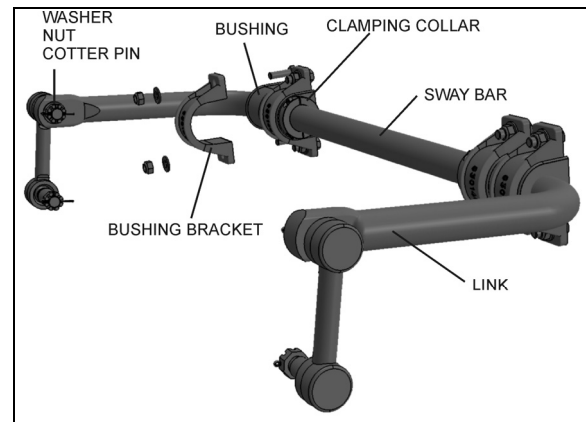


FIGURE 7: SWAY BAR

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NOTE

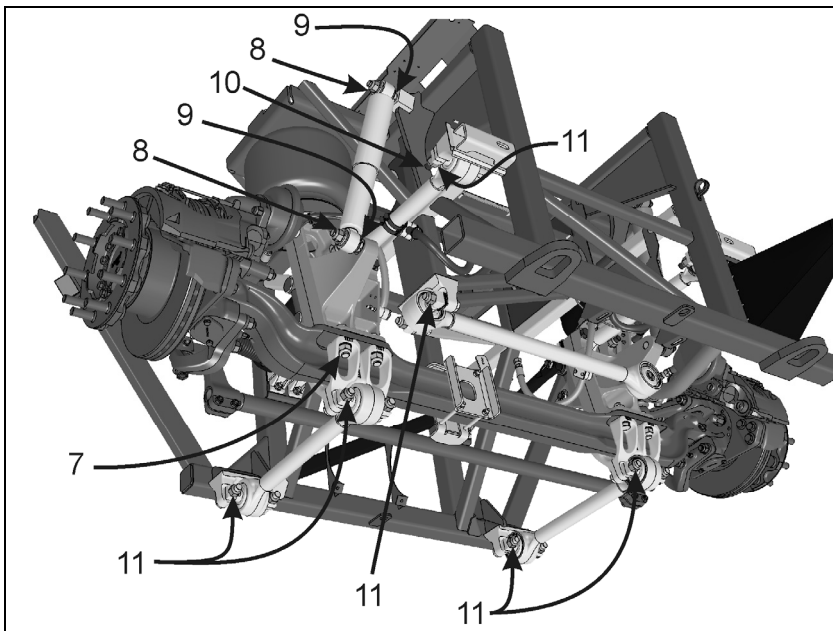
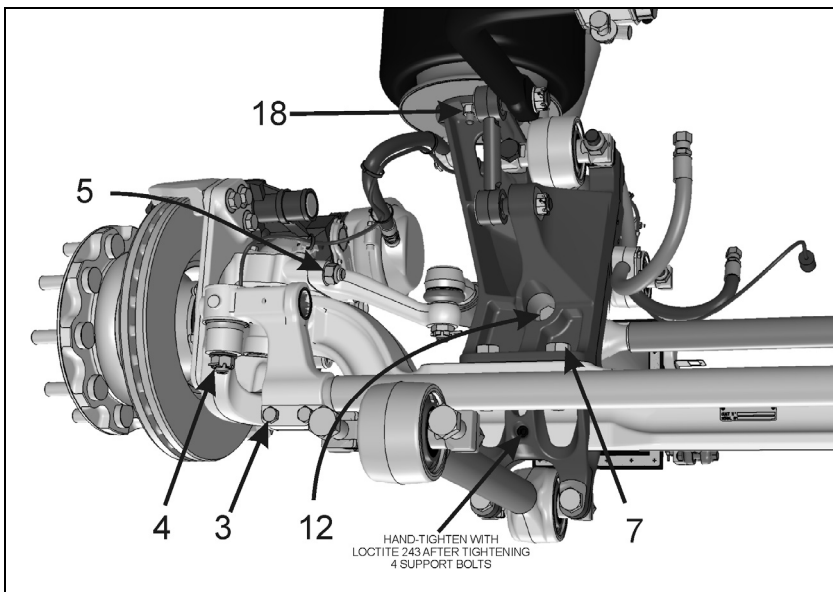
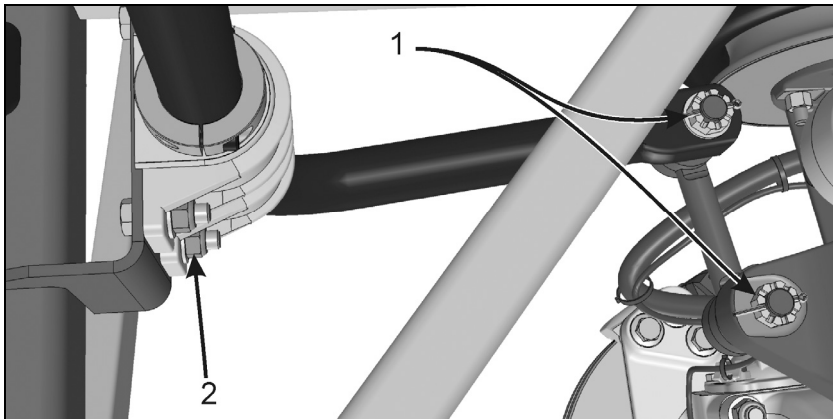
Sway bar bushings are slit to ease their removal.

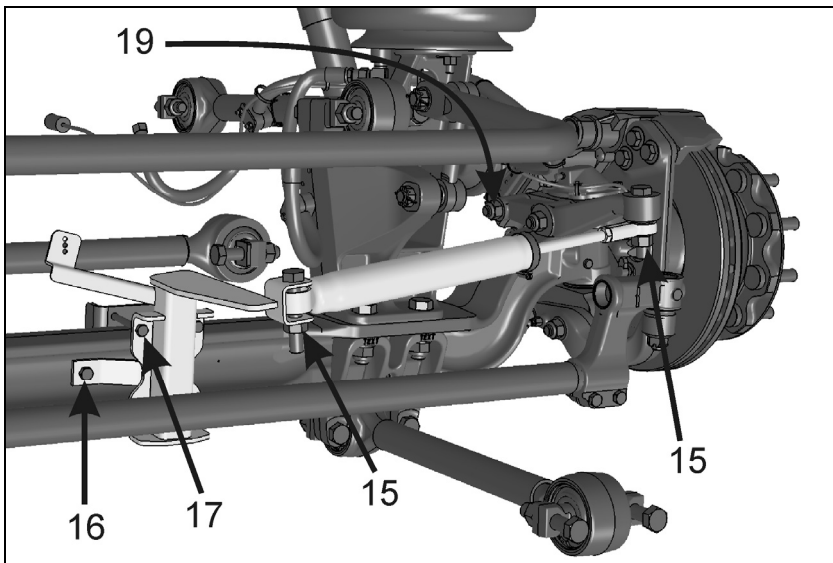
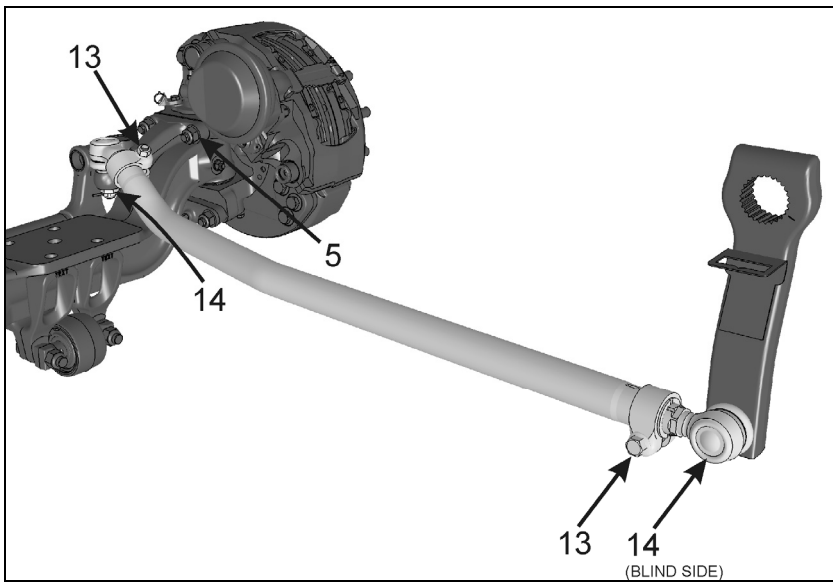
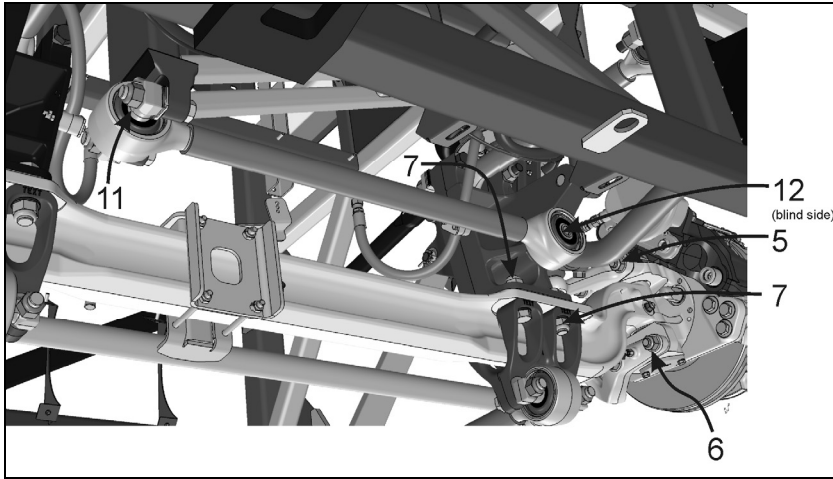
2.4.2 Installation

1. Loosely install the sway bar.
2. Tighten the eight bushing brackets nuts according to Torque Table 1 under heading Torque Specifications.
3. Tighten sway bar link upper nuts and lower nuts according to Torque Table 1 under heading Torque Specifications.

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2.5 TORQUE SPECIFICATIONS - FRONT I-BEAM AXLE SUSPENSION AND STEERING





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The following table lists the tightening torques which do require a specific torque value. When no torque specifications are indicated, use the Standard Torque Specifications table found in Section 00: General Information of the Maintenance Manual.

SPECIFIC TORQUE TABLE 1 – FRONT I-BEAM AXLE SUSPENSION & STEERING				
REFERENCE	DESCRIPTION	QTY	TORQUE DRY (lbf-ft / Nm) <i>threads must be free of oil or other lubricant</i>	
1	SWAY BAR LINK, UPPER AND LOWER NUTS	4	165-200	224-271
2	SWAY BAR BUSHING BRACKET	8	80-100	108-136
3	TIE ROD END CLAMP BOLTS	4	65-75	88-102
4	TIE ROD END BALL PIN NUTS	2	150-200	203-271
5	STEERING ARM STUD NUTS	2	285-315	386-427
6	TIE ROD ARM STUD NUTS	4	285-315	386-427
7	I-BEAM AXLE MOUNT NUTS	8	230-280	311-378
8	SHOCK ABSORBER UPPER & LOWER MOUNTING NUTS	2	99-121	134-164
9	SHOCK ABSORBER PINS, UPPER & LOWER	2	350-400	475-545
10	RADIUS ROD RETAINING STUDS	4	90-100	122-136
11	RADIUS ROD RETAINING NUTS	18	225-255	305-346
12	TRANSVERSE RADIUS ROD TAPER PIN NUT	1	171-209	232-283
13	DRAG LINK CLAMP BOLTS	2	118-133	160-180
14	DRAG LINK BALL JOINT STUD NUT	2	150-200	203-271
15	STEERING DAMPER NUTS	2	100-120	135-160
16	STEERING DAMPER BRACKET BOLT	1	39-45	53-61
17	STEERING DAMPER BRACKET NUTS	4	29-34	39-46
18	AIR SPRING NUT	4	31-38	42-52
19	STEERING DAMPER ARM NUTS	2	285-315	386-427

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

3 INDEPENDENT FRONT SUSPENSION (IFS)

This section contains information and specifications unique to the independent front suspension (IFS), including suspension and steering.

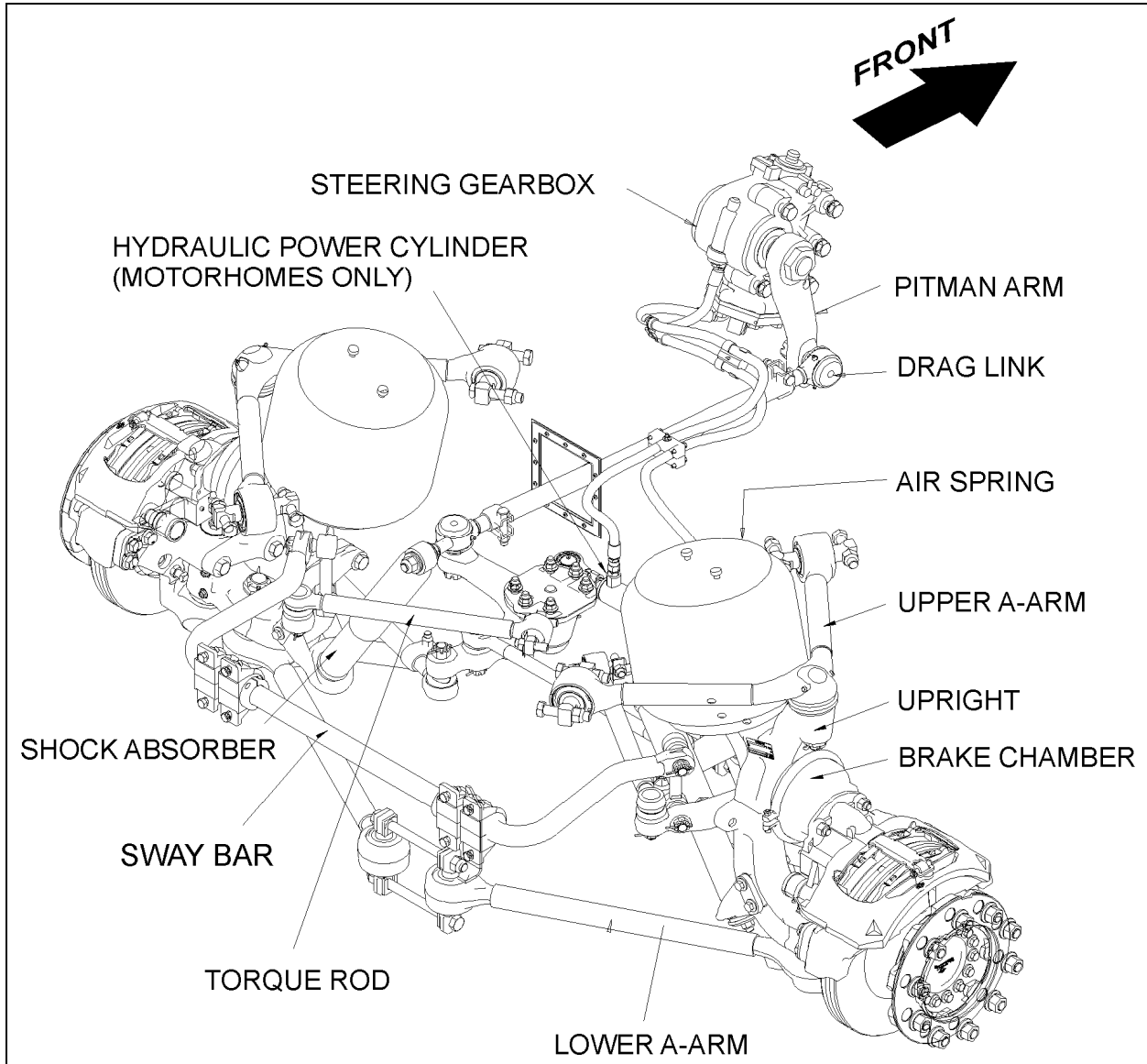


FIGURE 8: INDEPENDENT FRONT SUSPENSION

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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. On VIP series, a hydraulic power cylinder provides an added source of assistance and being connected to the R.H. wheel, makes it

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such that the total steering forces are produced with minimal stress on mechanical linkages (Fig. 10).

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.

Turning Angle

The maximum turning angle is set mechanically through the two steering stop screws installed on the swivel assembly. The turning angle 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.

Turning angles are as follows:

Exterior: $49.5^{\circ} \pm 0.5^{\circ}$

Interior: $58^{\circ} \pm 0.5^{\circ}$

Before checking the turning angle, be sure the front end is properly aligned as described under paragraph FRONT END ALIGNMENT in this section.

To check steering maximum turning angle, proceed with the following method:

1. Lift the vehicle using the axles lifting points. Suspension must be at normal ride height.
2. Check if front tires rub against the frame or if the steering gear has been serviced.
3. While performing a full left and right turn, check for proper position of the tie rod end clamp bolt and nut and drag link end clamps in order to avoid clamps interfering with close parts. Refer to figure 11 for location and positioning of

clamp bolts and nuts. Reposition if required.



CAUTION

Clamp bolts are either in a vertical or horizontal position. Reinstall clamp bolts exactly as they were before removal as they might interfere with other components.

NOTE

Prior to hydraulic steering limiter adjustment, verify vehicle wheel alignment, and ensure that oil level is adequate and that air bleeding is done.

4. If necessary readjust hydraulic steering limiter. Refer to these manuals annexed to the Maintenance Manual, Section 14: STEERING:
 - ZF-SERVOCOM Types 8090-8099 Single and Dual-Circuit Versions Repair Manual.
 - ZF-SERVOCOM Types 8090, 8095, 8097 and 8098 Design, Operation' Maintenance, Inspection.

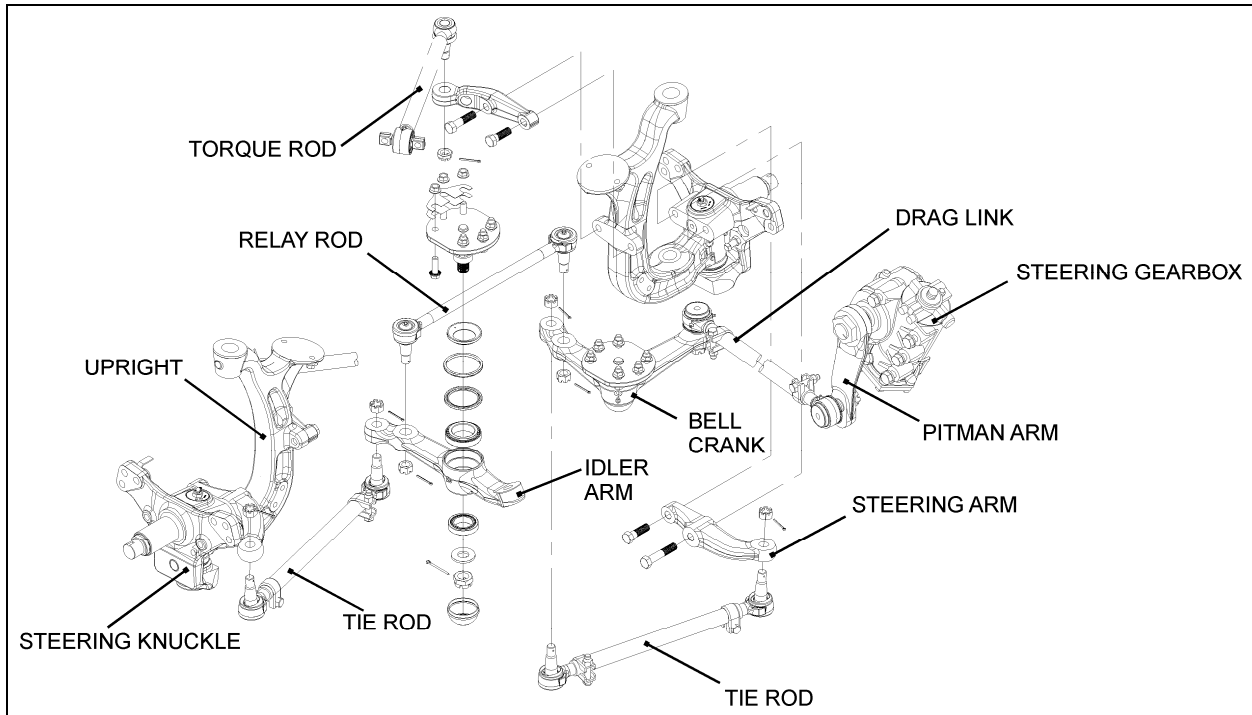


FIGURE 9: IFS STEERING LINKAGE OVERVIEW

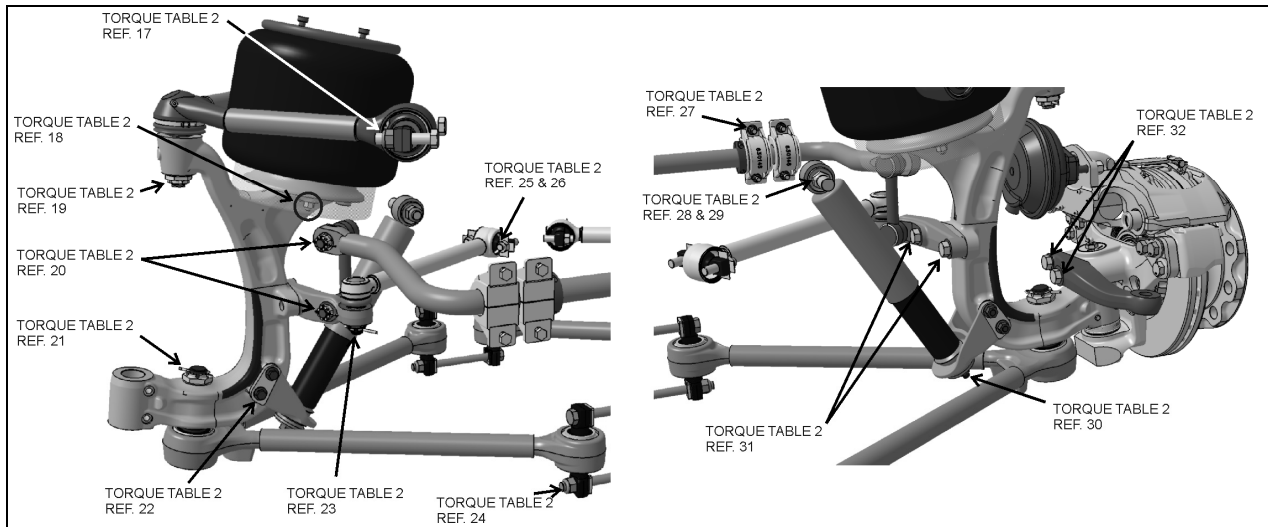


FIGURE 10: IFS - SUSPENSION COMPONENTS

Section 16: SUSPENSION

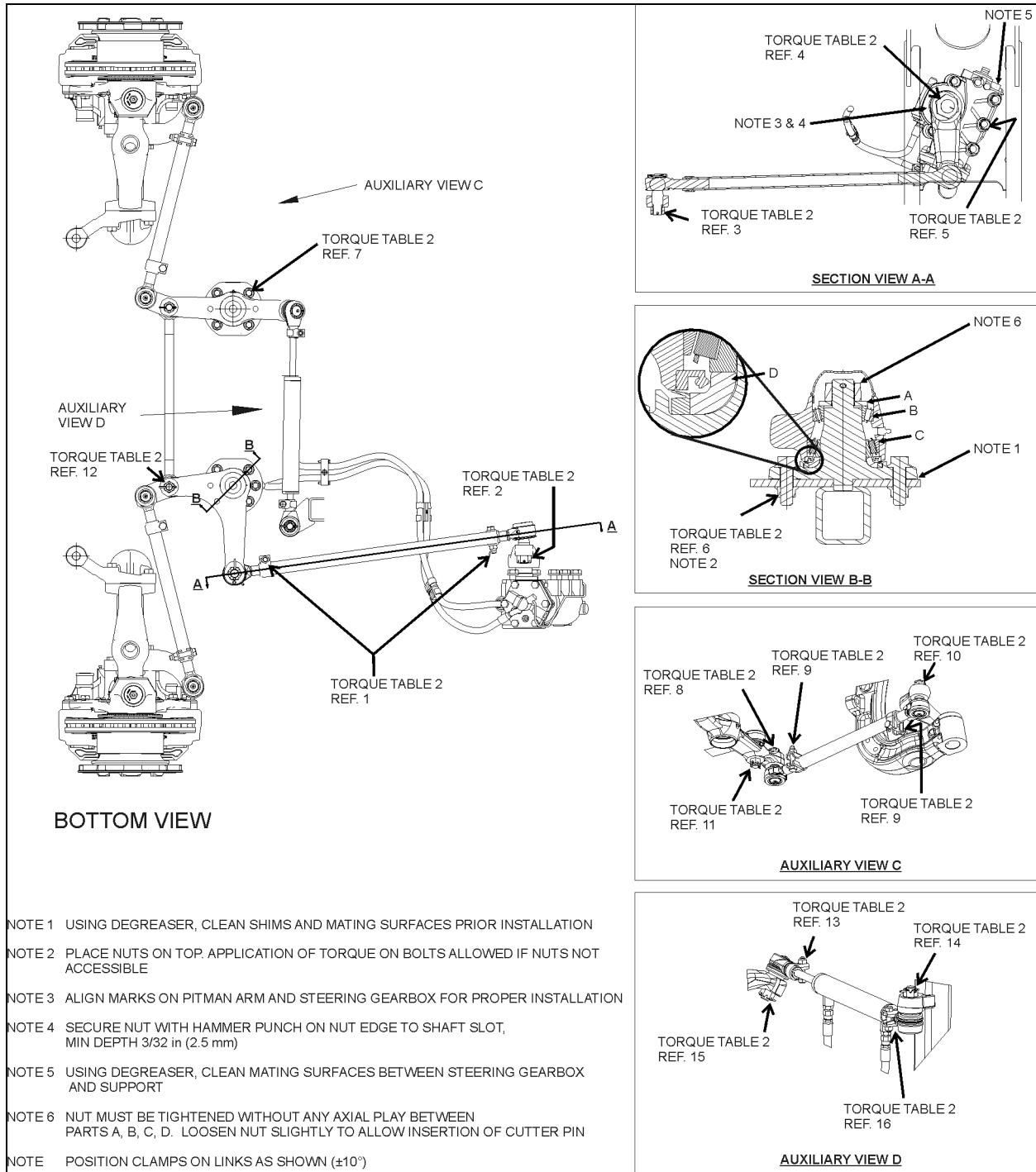


FIGURE 11: IFS STEERING LINKAGE

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The following table lists the tightening torques which do require a specific torque value. When no torque specifications are indicated, use the Standard Torque Specifications table found in Section 00: General Information of the Maintenance Manual.

SPECIFIC TORQUE TABLE 2 – INDEPENDENT FRONT SUSPENSION				
DESCRIPTION	QTY	REFERENCE	TORQUE DRY	
			<i>threads must be free of oil or other lubricant</i>	
			<i>lbf-ft</i>	<i>Nm</i>
<i>Drag link socket end clamp pinch bolt</i>	2	1	50-60	68-81
<i>Drag link ball stud nut to pitman arm</i>	1	2	245-270	332-366
<i>Drag link ball stud nut to bell crank</i>	1	3	245-270	332-366
<i>Pitman arm to steering gear fixing nut</i>	1	4	470-570	637-772
<i>Steering gearbox to mounting bracket bolt</i>	5	5	365-405	495-549
<i>Bell crank spindle mounting nut</i>	6	6	208-254	282-344
<i>Idler arm spindle mounting nut</i>	6	7	208-254	282-344
<i>Tie rod end ball stud nut to idler arm or bell crank</i>	2	8	150-200	203-271
<i>Tie rod end clamp pinch bolt</i>	4	9	50-60	68-81
<i>Tie rod end ball stud nut to steering arm stud *</i>	2	10	150-200	203-271
<i>Relay rod stud nut to idler arm *</i>	1	11	150-200	203-271
<i>Relay rod stud nut to bell crank *</i>	1	12	150-200	203-271
<i>Hydraulic power cylinder end clamp pinch bolt</i>	1	13	50-60	68-81
<i>Hydraulic power cylinder to bracket stud nut*</i>	1	14	150-200	203-271
<i>Hydraulic power cylinder to idler arm stud nut*</i>	1	15	150-200	203-271
<i>Hydraulic power cylinder end clamp pinch bolt</i>	1	16	50-60	68-81
<i>Upper a-arm ball joint</i>	4	17	230-255	312- 346
<i>Air spring lower stud nut (6 air springs)</i>	2	18	31-38	42- 51
<i>Upper a-arm central ball joint (castellated hex nut)*</i>	1	19	210-250	284-339
<i>Sway bar link, upper and lower ball stud nuts (front suspension)*</i>	2	20	165-200	224-271
<i>Lower a-arm central ball joint (castellated nut)*</i>	1	21	490-540	664- 732
<i>Shock absorber support</i>	4	22	145-165	196-224
<i>Torque Rod ball stud nut*</i>	1	23	150-200	203-271
<i>Lower a-arm ball joint</i>	4	24	270-300	366-407
<i>Torque rod, nut</i>	2	25	140-155	190-210
<i>Torque rod, stud</i>	2	26	90-110	122-150
<i>Sway bar bushing collar (front suspension)</i>	8	27	80-100	108-136
<i>Shock absorber mounting stud nut</i>	1	28	99-121	134-164
<i>Shock absorber mounting stud</i>	1	29	350-400	475-545
<i>Shock absorber lower mounting pin nut</i>	1	30	60-75	81-102
<i>Torque rod lever bolt (M20-2.5)</i>	2	31	520-575	705-780
<i>Steering arm bolt (M22-2.5)</i>	2	32	642-708	870-960

* Tighten nut to specified torque, then advance to next aligning cotter pin slot and install a new cotter pin.

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3.2 STEERING LINKAGE INSTALLATION SEQUENCE

NOTE

Whenever a steering linkage component has been removed and replaced, check steering geometry and front end alignment as directed in this Section. Check to insure that all stud nuts and mounting bolts and nuts have been tightened to prescribed torque.

1. Position front wheels in straight ahead position.
2. Align the steering gearbox input shaft marks.
3. Afterwards, the pitman arm should be adjusted with output shaft and pitman arm reference marks aligned (for proper tightening torque, refer to Torque Table 2).

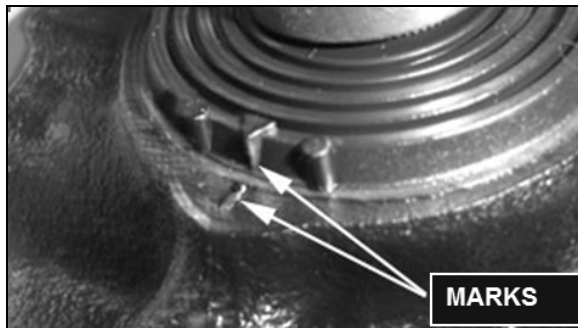


FIGURE 12: STEERING GEARBOX INPUT SHAFT MARKS

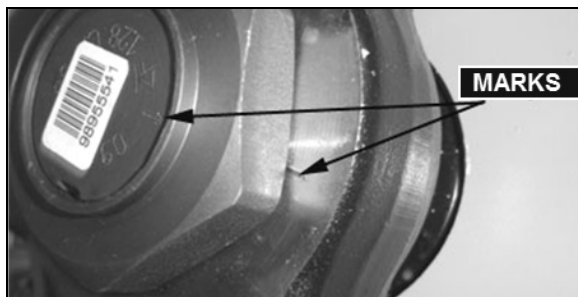


FIGURE 13: STEERING GEARBOX OUTPUT SHAFT AND PITMAN ARM MARKS ALIGNED

4. 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.
5. Install drag link to pitman arm and adjust opposite end of drag link to fit ball stud hole in bell crank.
6. Install tie rods then adjust toe-in as described in "Front End Alignment" in this section (for proper tightening torque, refer to Torque Table 2).

3.3 PITMAN ARM

3.3.1 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 sector gear 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 linkage.

3. Remove pitman arm fixing nut.
4. Check the radial position of the pitman arm in relation to the sector shaft prior removal of pitman arm.
5. Locate the reference marks to the arm and shaft to ensure correct alignment at reassembly.
6. Use a puller to remove pitman arm.

3.3.2 Installation

1. Position pitman arm on sector gear shaft with reference marks aligned.
2. Install fixing nut. Tighten nut (dry) as per Torque Table 2.

NOTE

Use a new nut if the previously removed nut was punched.



CAUTION

Lock nut with sector shaft using a punch mark into the groove, minimum depth 3/32 inch (2.5mm) (see figure 16).

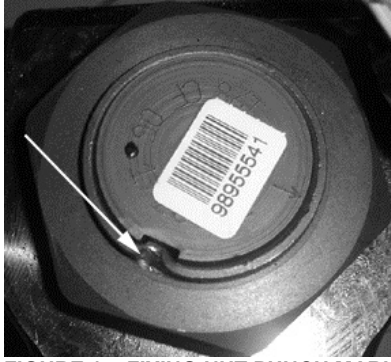


FIGURE 14: FIXING NUT PUNCH MARK

16098

3. Connect drag link to pitman arm. Ball stud and taper bore must be clean and free of grease. Install washers. Tighten nut (dry) as per Torque Table 2. Advance nut to next alignment cotter pin slot and install a new cotter pin.

3.4 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.

NOTE

The drag link nominal length is 41 17/32 inch (1055 mm) measured from the center of one ball socket to the other. Nominal length is given only for preliminary adjustment.

3.4.1 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 "Steering Linkage Installation Sequence".
3. Remove cotter pin, nut 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 with nut and torque to proper torque. Ball stud and taper bore must be clean and free of grease. Align nut with cotter pin slot (tighten) and install a new cotter pin.
5. Torque mounting clamp bolt nut to prescribed torque, then test the adjustment. Front wheels should turn from full right to full left end of stroke without noticeable binding at drag link ends.



CAUTION

Clamp bolts are either in a vertical or horizontal position. Reinstall clamp bolts exactly as they were before removal as they might interfere with other components.

3.5 BELL CRANK AND IDLER ARM

Bell crank and idler arm are equipped with one lubrication fitting and should be lubricated as directed in "Lubrication Fittings" in this section.

3.5.1 Bell Crank or Idler Arm Removal

NOTE

Use a piece of wire to support 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 and nuts from ball studs. Separate socket assemblies from the bell crank.

Idler arm: Remove cotter pins and nuts from ball studs connecting relay rod, tie rod and hydraulic power cylinder to idler arm. Separate socket assemblies from idler arm.

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Remove nuts from bolts attaching bell crank or idler arm mounting spindle to vehicle subframe. Remove bell crank or idler arm mounting spindle.

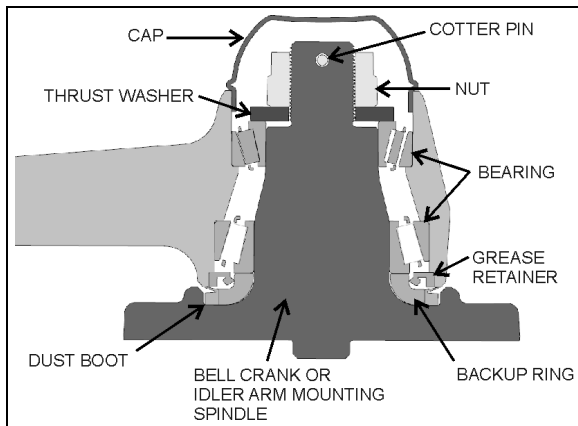


FIGURE 15: BELL CRANK OR IDLER ARM HUB

3.5.2 Bell crank or Idler Arm Hub Disassembly

1. Remove adjacent link assemblies from bell crank or idler arm as previously described.
2. Remove the cap (fig. 17).
3. Remove the cotter pin, nut and thrust washer. Remove bearings, grease retainer, backup ring and the bell crank or idler arm from its mounting spindle (fig. 17).

3.5.3 Bell Crank or Idler Arm Hub Reassembly

NOTE

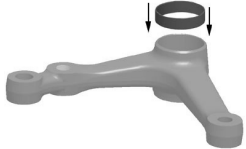
For bearing installation use tool Prevost # 110684.

NOTE




Install grease retainer according to figure 17. Grease must be able to exit the bell crank or idler arm mechanism. For grease retainer installation use tool Prevost # 110683.

NOTE

Apply grease on bearings before installation.

1. Clean parts thoroughly with degreaser.
2. Insert the small bearing outer race into appropriate bore (done on a press). 
3. Insert the large bearing outer race into

appropriate bore (done on a press).

4. Insert the large bearing into outer race and then, add grease retainer. 
5. Apply good quality lithium grease (#680752) on backup ring and dust boot. 
6. Install backup ring and dust boot on bell crank or idler arm spindle.
7. Apply a thin layer of grease on spindle shaft.
8. Install bell crank or idler arm onto its mounting spindle, while holding the bell crank or idler arm, slide on the small bearing assembly, thrust washer and secure using nut. 
9. Tighten nut to 130 lbf-ft.
10. Rotate assembly 3 turns in each direction.

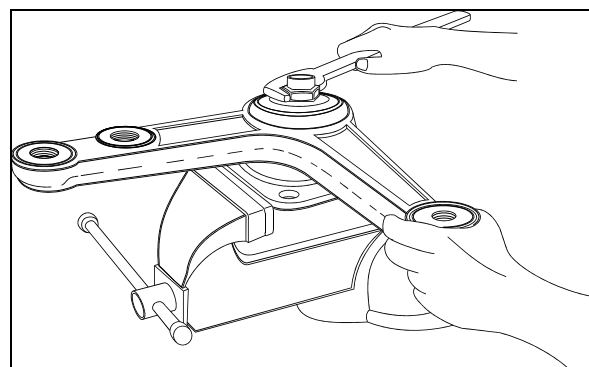


FIGURE 16: BELL CRANK

16044

11. Unscrew nut until bell crank or idler arm starts to turn with the application of 1 to 3 lbs force load as shown on figure 19.
12. Check for loose bearings by applying an up and down load on bell crank or idler lever. The lever is not supposed to move in the vertical axis direction.

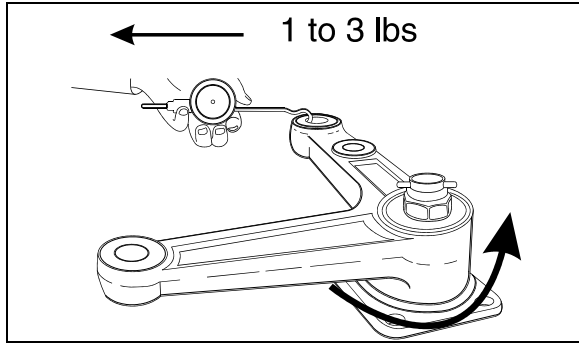


FIGURE 17: BELL CRANK 16045

- Align nut with cotter pin slot (tighten) and install a new cotter pin.

NOTE

Bend cotter pin around the nut. Do not bend the cotter pin in the direction of the cap as it may interfere with the cap.

- Install the cap.
- Bell crank:** Install drag link, tie rod and relay rod as directed herein under each specific subject.
- Idler arm:** Install hydraulic power cylinder, tie rod and relay rod as directed herein under each specific subject.
- Adjust turning angle as previously directed under paragraph "**Turning Angle**" and check front end alignment as specified under heading "Front End Alignment".

3.6 RELAY ROD

Relay rod ends are equipped with lubrication fittings and should be lubricated as directed in "Lubrication Fittings" in this section.

NOTE

The relay rod is crimped in place and it is not possible to remove and replace the ball joint socket end assemblies.

3.6.1 Replacement

- Remove cotter pins from bell crank and idler arm end of relay rod. Loosen nuts flush with end of studs.
- 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.
- Remove stud nuts then remove relay rod.

- Position new relay rod studs into bell crank and idler arm then tap stud ends with a brass hammer to seat tapered surfaces. Ball stud and taper bore must be clean and free of grease.
- Install stud nuts. Tighten nuts to prescribed torque (refer to Torque Table 2). Align cotter pin slot (tighten) and install a new cotter pin.

3.7 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 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.

- Periodically check bolt nut for tightness.
- Inspect tie rod for bent condition and inspect tube for damaged threads. If tie rod is bent or threads are damaged, replace the assembly.
- Lubricate tie rod end fittings as directed in "Lubrication Fittings" in this section.

3.7.1 Removal

- 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.
- Remove tie rod ball stud by tapping on steering arm and bell crank or idler arm with brass hammer, while using a sledge hammer to absorb shocks.

NOTE

If tie rod end assemblies are damaged in any way, they must be replaced

3.7.2 Installation

- Install socket end assemblies on tie rod. Be sure both ends are threaded an equal distance into the tube.

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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. Ball stud and taper bore must be clean and free of grease. Install a ball stud nut on each stud and tighten firmly.
4. Torque stud nuts to prescribed torque (refer to Torque Table 2). Align cotter pin slot (tighten) and install a new cotter pin.

NOTE

Adjust toe-in as directed under heading "Toe-In Adjustment" in this section.

5. Make sure tie rod ends are properly aligned with ball studs, and then torque tie rod end clamp bolts to prescribed torque (refer to Torque Table 2).



CAUTION

Clamp bolts are either in a vertical or horizontal position. Reinstall clamp bolts exactly as they were before removal as they might interfere with other components.

NOTE

If tie rod is not properly aligned with stud, binding will result.

2. Torque steering arm to steering knuckle fixing bolts. Torque bolt to prescribed torque (refer to Torque Table 2).
3. Position tie rod ball stud in steering arm and tap with a brass hammer to seat ball stud in steering arm. Ball stud and taper bore must be clean and free of grease. Install nut on stud. Torque nut to prescribed torque (refer to Torque Table 2). 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 "Installation" of the maintenance manual.

3.8 STEERING ARMS

The left and right wheel steering arms are secured to a steering knuckle at one end and to a tie rod at the other end.

3.8.1 Removal

1. Remove wheel as directed in Section 13, "Wheel, Hubs and Tires" of the maintenance manual.
2. Remove cotter pin 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 bolts securing steering arm to steering knuckle assembly. Remove steering arm from steering knuckle.

3.8.2 Installation

1. Install steering arm onto steering knuckle.

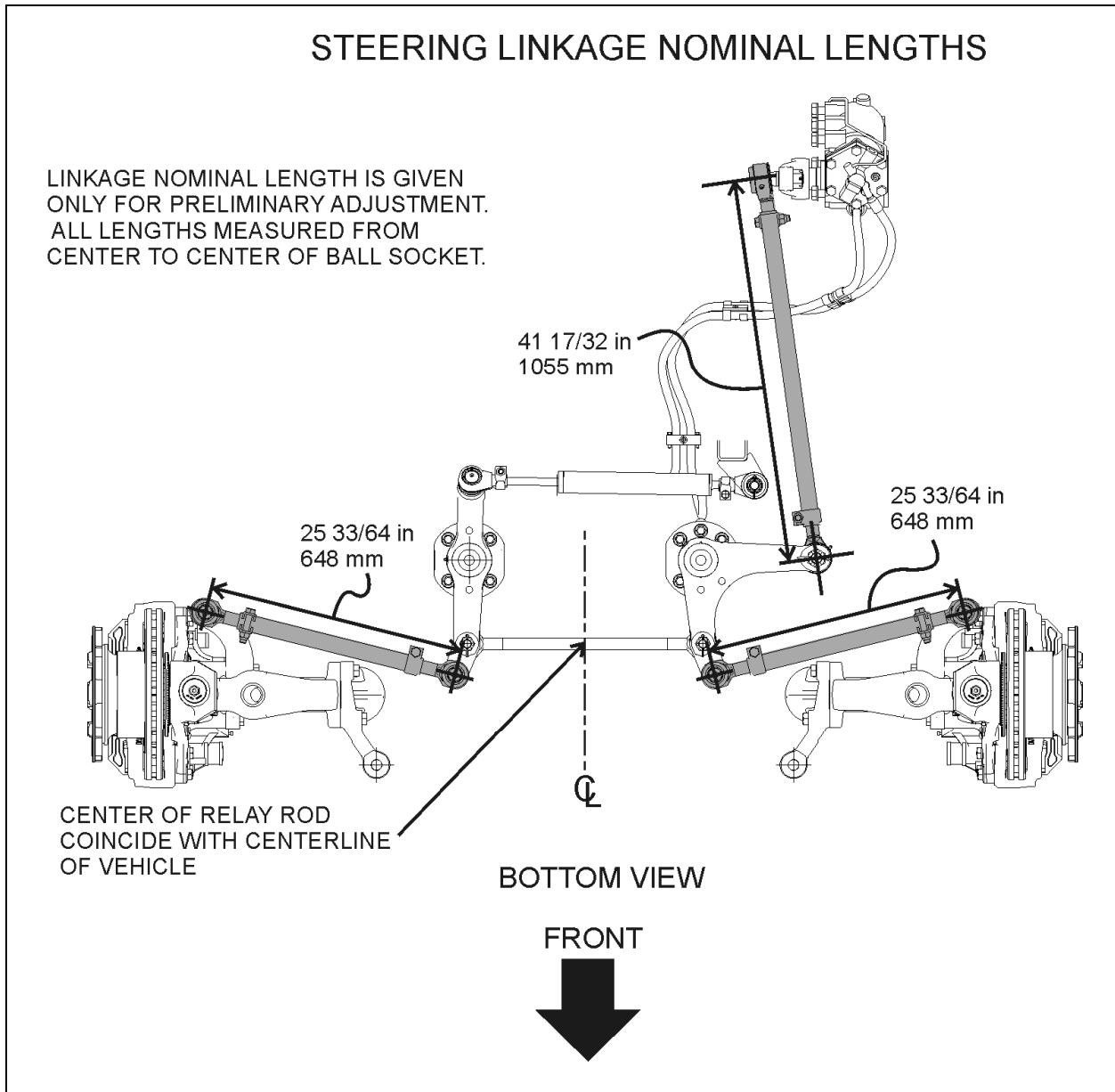


FIGURE 18: STEERING LINKAGE NOMINAL LENGTHS

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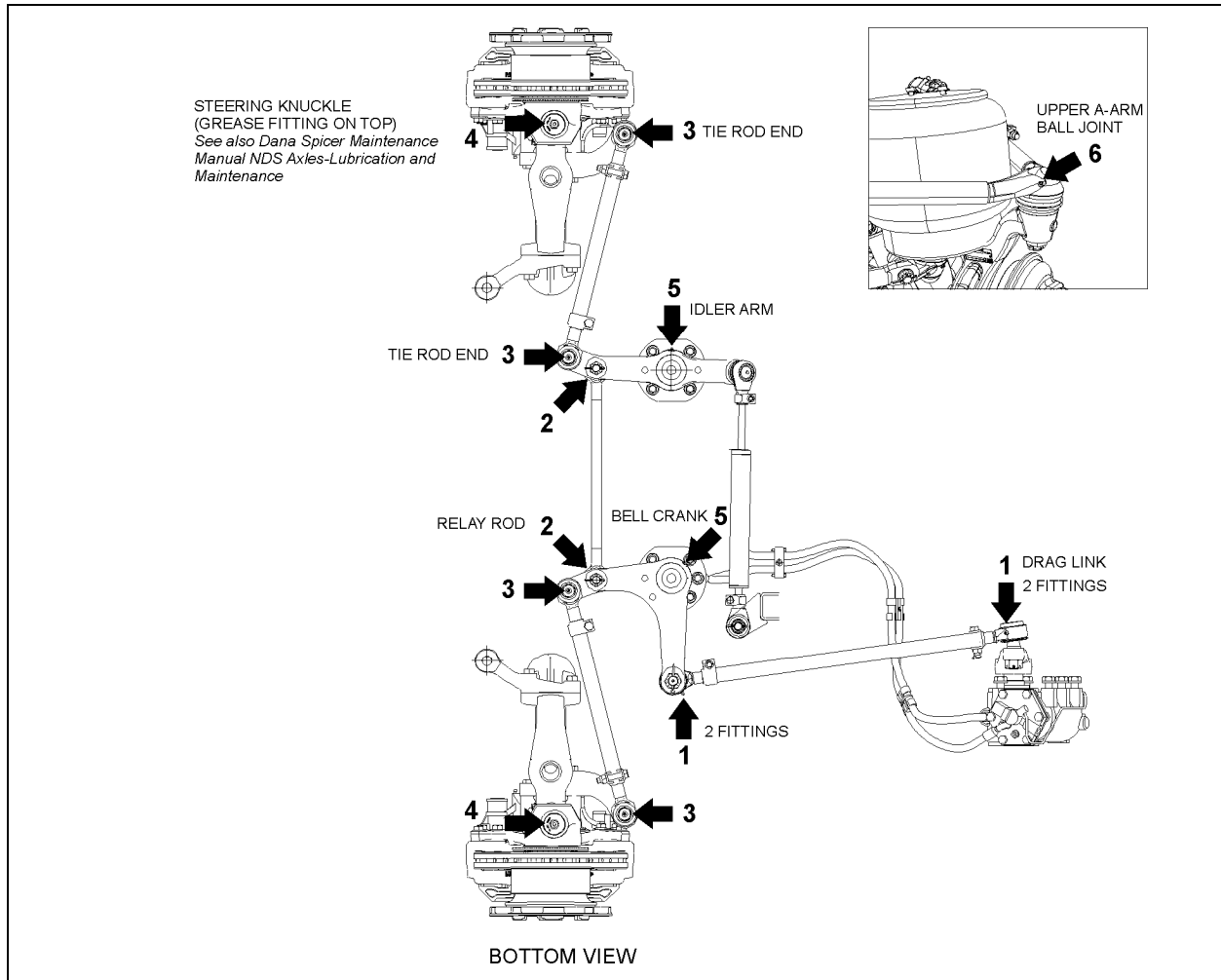


FIGURE 19: LUBRICATION FITTINGS LOCATION


3.9 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 become broken or damaged.

Re-charge ball joint until grease can be seen escaping from socket. On ball joints fitted with a rubber boot, do not add too much grease as the rubber boot might expand and rupture.

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. Figure 21 shows

approximate location of steering lubrication fittings.

 MAINTENANCE
(1) Drag Link Ends: Lubricate at four fittings, two 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) **Steering Knuckle (swivel assembly):** Refer to DANA SPICER MAINTENANCE MANUAL NDS AXLES Lubrication and Maintenance" annexed at the end of section 10.
- (5) **Idler Arm and Bell Crank:** 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 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).

3.10 BALL JOINTS – GENERAL RECOMMENDATIONS

Visual Inspection

- Visually inspect for missing or damages grease fittings and replace if required.
- Check ball joint connection for missing cotter pins.
- Check for looseness in the ball/socket assembly.

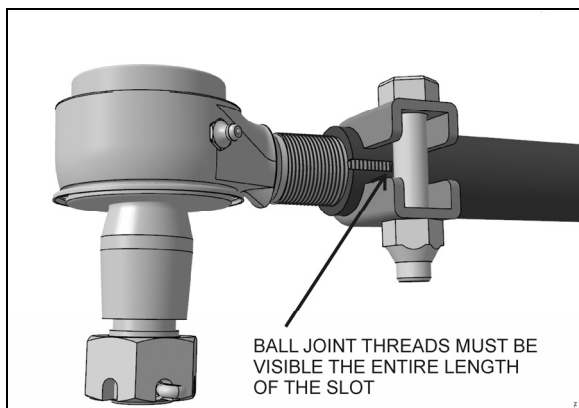


FIGURE 20: ADEQUATE CLAMPING CONDITION

For adequate clamping, the ball joint threads must be visible the entire length of the tube slot. If not, the drag link must be adjusted or replaced. It is either the wrong size, or improper adjustment was used to compensate for another problem (e.g. bent steering arm).

Damaged sealing boots, salt and climatic conditions can cause loss of the corrosion protection coating applied at time of manufacturing. To prevent corrosion from forming around the ball pin, remove the old grease bead and assure sufficient grease is applied to purge the old grease and fill the joint and dust seal (if applicable).

Good quality lithium-base mineral grease NLGI No. 2 like Shell Retinax LX is recommended.

3.11 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 at the IFS lower A-arms. 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 Torque Table 2.
- Installing a longer bolt if less than 2 threads are remaining after the nut.
- Using a torque seal, leave a mark on the nut for future visual inspection.

3.11.1 Alignment Terminology

Wheel Camber: Camber is the number of degrees the top of the wheel is tilted inward or outward from a true vertical (fig. 27).

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Wheel Toe-In: a slight forward convergence given to the wheels of motor vehicles to improve steering and equalize tire wear (D minus E, fig. 27).

Kingpin Inclination: The inclination of the kingpin from vertical toward the center of the vehicle at the top and outward at the bottom (B, fig. 27).

Front Axle Caster: The inclination of the kingpin from vertical in the fore and aft direction (C, fig. 27).

3.11.2 Front End Inspection

Before checking front end alignment, make the following inspection:

1. Check that the vehicle is at normal ride height (see paragraph "8. 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 kingpins for looseness.
7. Check if the length of the torque rod is 21 17/64" (540 mm) (Fig. 11). Check if the length of the relay rod is 23 19/64" (592 mm).

3.11.3 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 A-arm may be improperly shimmed.

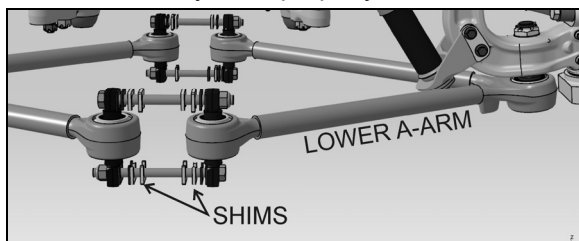


FIGURE 21: SHIMS AT THE LOWER AARMS

Check kingpin inclination. If kingpin inclination is incorrect, readjust the camber and check kingpin inclination again.

NOTE

Camber is more important than kingpin inclination, so adjust camber and verify kingpin inclination.

Shim the lower A-arm to adjust camber (figure 23 & 26). If the kingpin inclination is incorrect, the wheel kingpin 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-locking 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.

3.11.4 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 $3/32 \pm 1/32$ 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" (figure 26).
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 24.

NOTE
Use only tie rods to adjust toe-in.

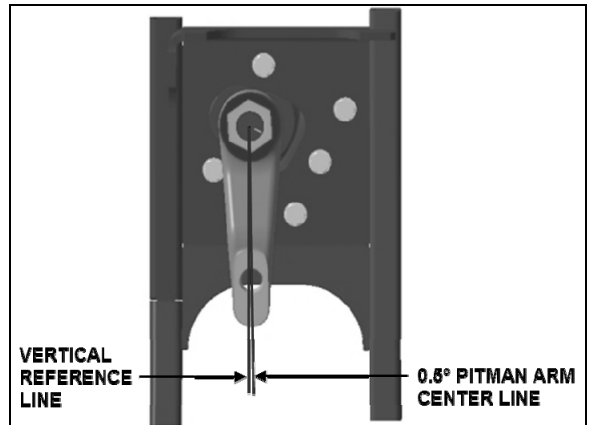


FIGURE 22: IFS PITMAN ARM ALIGNMENT 14056

3.11.5 Front Wheel Caster

Positive caster is the inclination of the top of the kingpins toward the rear of the vehicle. Negative or reverse caster is the inclination of the kingpins 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 A-arm, lower suspension A-arm, or kingpin housing. Caster should be adjusted with shims. Precision instruments should be used to measure caster. Shim bell crank and idler arm to adjust caster (figure 26).

Variations from the specified caster will affect steering stability, cause wandering, wheel shimmy, and reduce steer re-centering when pulling out of curves.

NOTE
On Independent Front Suspension, caster on right wheel must be equal or greater than caster on left wheel, without exceeding 0.3°.

3.11.6 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 "Front End Alignment".

3.11.7 Alignment Specifications

See figure 26 & 27.

NOTE
On Independent Front Suspension, caster on right wheel must be equal or greater than caster on left wheel, with a maximum difference of 0.3°.

Use static wheel alignment systems which work with angle measurements only, such as Josam or Hunter systems.

H3-45 VIP INDEPENDENT FRONT SUSPENSION						
Load	Minimum value		Nominal value		Maximum value	
	Non-converted	Converted	Non-converted	Converted	Non-converted	Converted
Right camber	0.20°	-0.20°	0.30°	0°	0.50°	0.20°
Left camber	0.20°	-0.20°	0.30°	0°	0.50°	0.20°
Right caster	2.55°		2.8°		3.05°	
Left caster	2.55°		2.8°		3.05°	

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Total toe	0.02°	0.04°	0.04°	0.06°	0.06°	0.08°
------------------	-------	-------	-------	-------	-------	-------

H3-45 Coaches WITH INDEPENDENT FRONT SUSPENSION			
	Minimum value	Nominal value	Maximum value
Right camber	0.0°	0.150°	0.30°
Left camber	0.0°	0.150°	0.30°
Right caster	2.35°	2.6°	2.85°
Left caster	2.35°	2.6°	2.85°
Total toe-in	0.04°	0.06°	0.08°

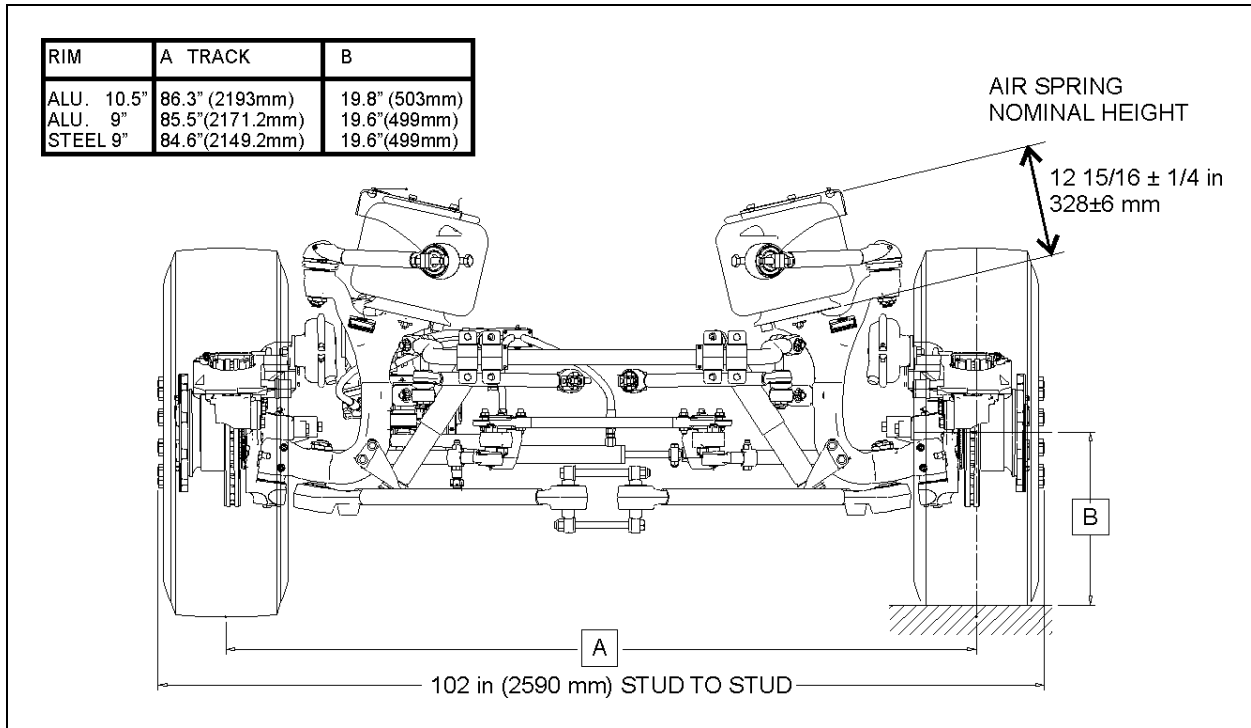


FIGURE 23: IFS NOMINAL DIMENSIONS

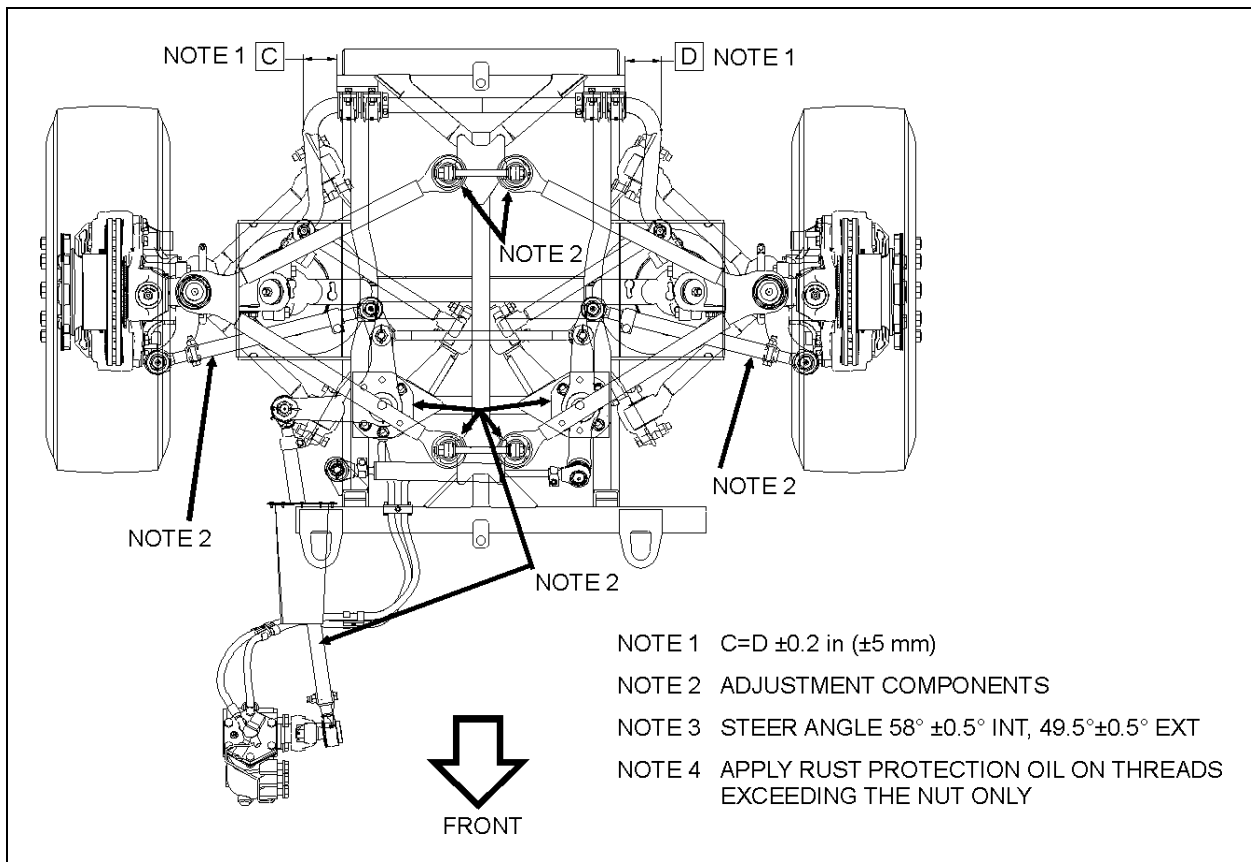


FIGURE 24: NOTE 2 INDICATES WHERE ADJUSTMENT MAY BE PERFORMED IF NEEDED WHEN PROCEEDING TO IFS ALIGNMENT

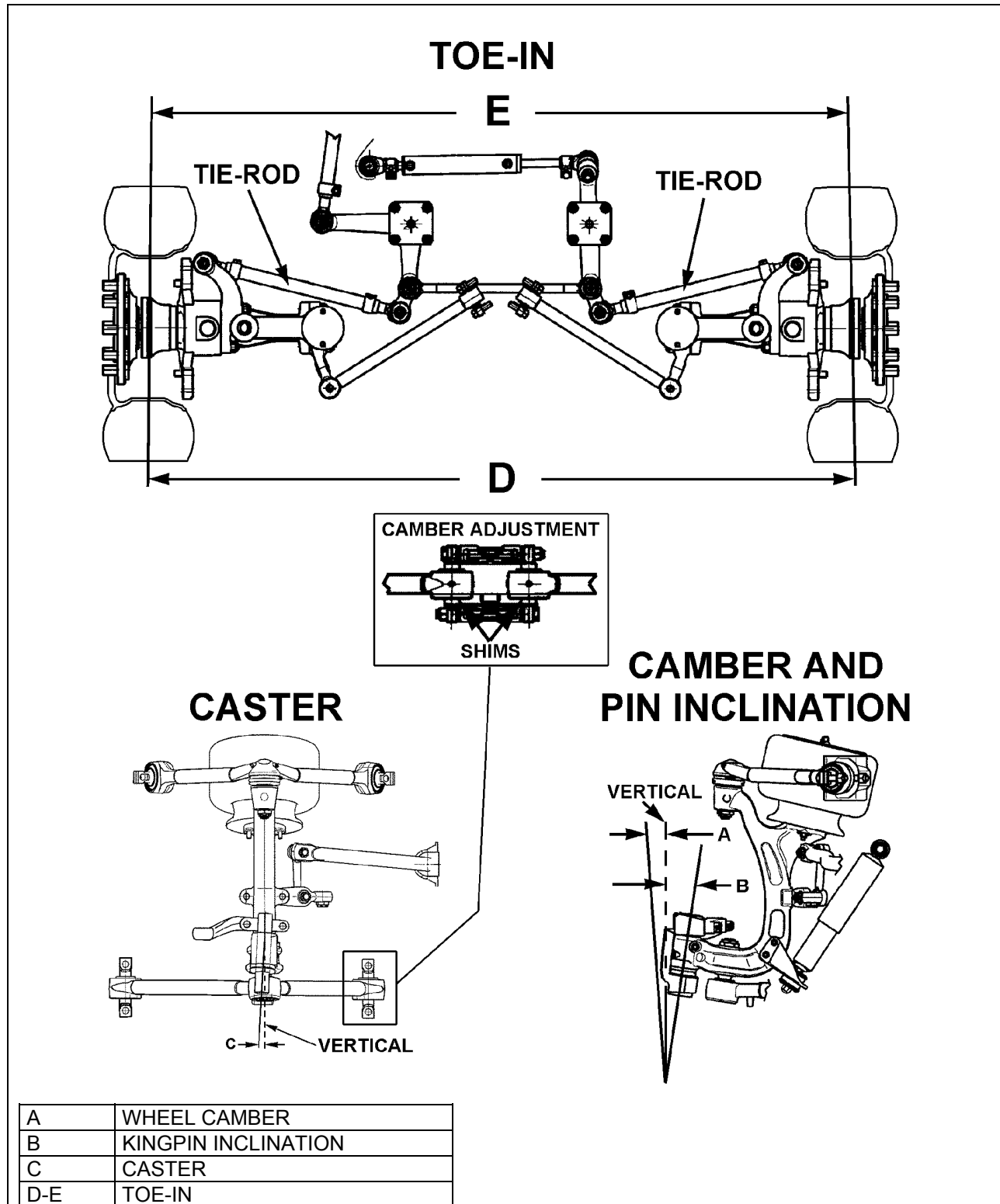


FIGURE 25: FRONT END ALIGNMENT DIAGRAM

16051

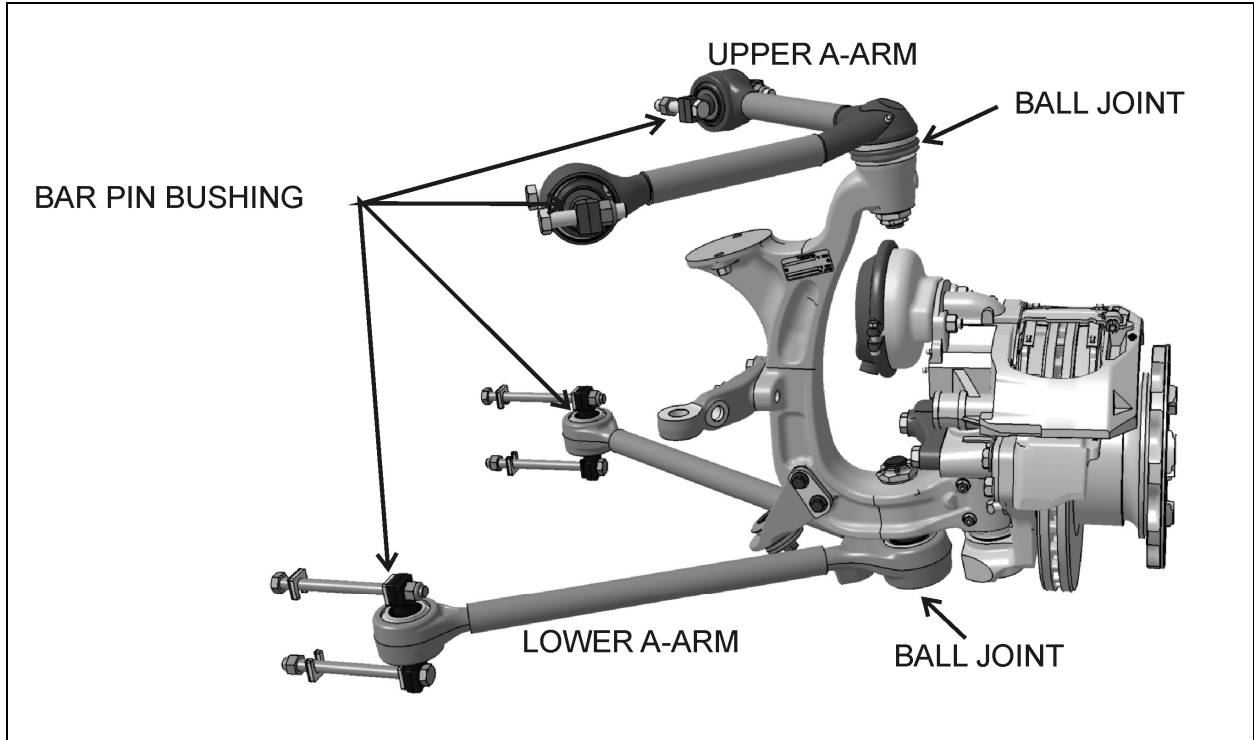


FIGURE 26: A-ARM JOINT IDENTIFICATION

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3.12 LOWER AND UPPER A-ARM BALL PIN BUSHING REPAIR

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.

3.12.1 Inspection

Take off the load from the 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.

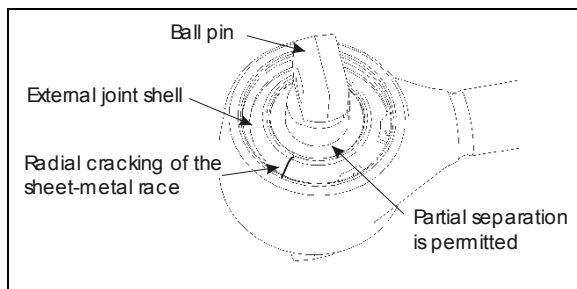


FIGURE 27: BALL PIN BUSHING

3.12.2 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.

3.12.3 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 bushing through application of the grease.

NOTE

Apply grease, only in the case of repair kit (Prevost # 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.

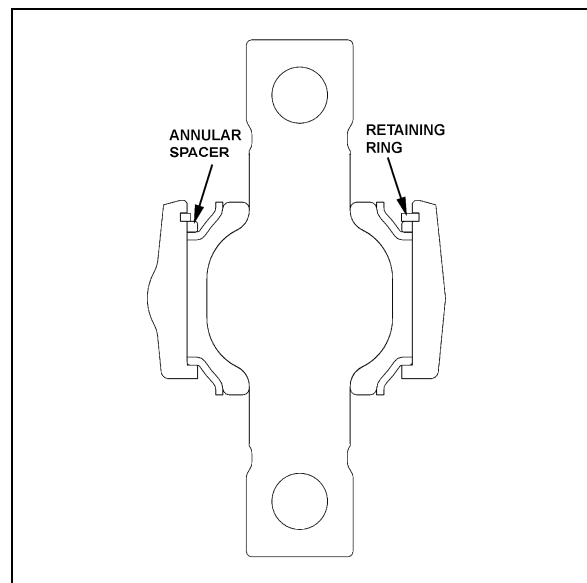


FIGURE 28: LOWER A-ARM BALL PIN BUSHING 16047

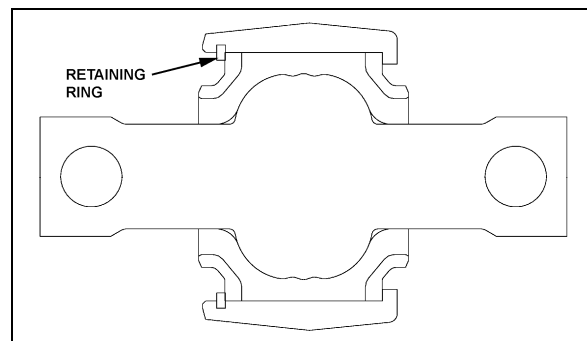


FIGURE 29: UPPER A-ARM BALL PIN BUSHING

3.13 LOWER A-ARM BALL JOINT REPAIR

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.

3.13.1 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

3.13.2 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.

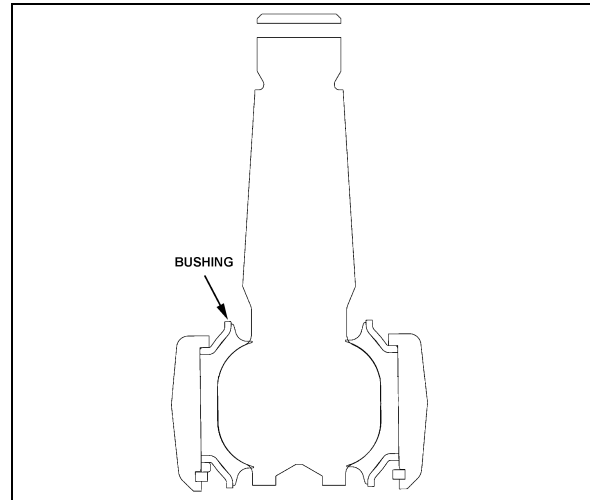


FIGURE 30: LOWER A-ARM BALL JOINT

3.14 UPPER A-ARM BALL JOINT

3.14.1 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.

3.14.2 Play Measurement

1. Raise the vehicle and support through axle jacking points.
2. Using a caliper, measure dimension "A" on figure 33.
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. Measure dimension A again. If the difference between the two dimensions is greater than 0.060" (1.5mm), then the ball joint should be replaced.

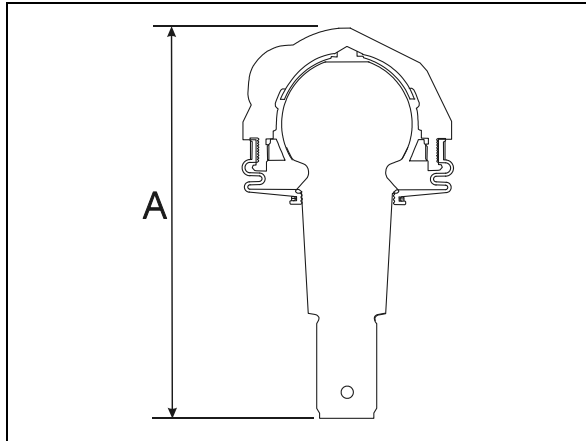


FIGURE 31: UPPER A-ARM BALL JOINT 16116

3.15 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.

3.15.1 Inspection

1. Check operation of air springs.
2. Visually inspect bellows for evidence of cracks, punctures, deterioration, or chafing. Replace the air spring 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 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 leakage is detected, replace air spring.



WARNING

To prevent personal injury, do not apply more than 10 psi (69 kPa) air pressure to the dismounted air spring.

3.15.2 Removal

NOTE

Front air springs can be removed without removing the entire suspension assembly.

1. Jack up the vehicle using the axles jacking points.
2. Safely support the front of the vehicle at the recommended body jacking points.
3. 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.



CAUTION

Always adequately support the IFS assembly when lifting up the vehicle to avoid maximum extension of shock absorber.

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.
6. Lower the IFS slightly while maintaining the vehicle body at the same level.

NOTE

While performing this step, do not change the height control valve overtravel lever adjustment.

7. 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.
8. Unscrew the two air spring lower nuts (2 nuts). Rotate the air spring to disengage the upper mounting and remove the air spring.

3.15.3 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.

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 a few turns.
2. Tighten and torque the lower stud nuts as prescribed in Torque Table 2.
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 air springs 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.

3.16 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. (Refer to the SACHS document "Guideline To Evaluate Warranty Claims" annexed at the end of this section before replacing a shock).

3.16.1 Shock Absorber Removal

1. Remove the nut, washer and rubber joint from shock absorber mounting stud. Discard the rubber joints.

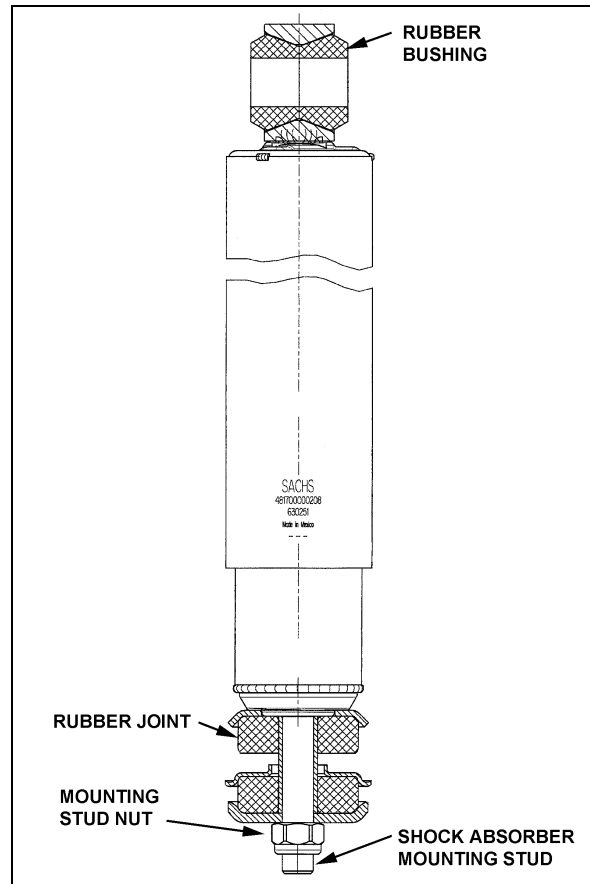


FIGURE 32: SHOCK ABSORBER

161124

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.
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.

3.16.2 Shock Absorber Installation

1. Check that the shock absorber mounting stud is tightened as prescribed in Torque Table 2. Ensure that the stud is clean and not stripped (upper end).
2. Install new rubber (mounting) bushing on shock absorber (upper end).
3. Place the inner washer on shock absorber stud.
4. Install washer and rubber joint on shock absorber mounting stud (lower end).
5. Install the shock absorber as shown in figure 36 with the mounting stud protruding through the hole in the mounting bracket

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and the shock absorber eyes over the mounting pins. Install the outer washer.

- Place a rubber joint and washer on the shock absorber mounting stud. Place the lower shock absorber mounting stud nut and torque as prescribed in Torque Table 2.
- Place the upper mounting pin stud nut and torque as prescribed in Torque Table 2.

3.17 SWAY BAR

A sway bar is provided on the IFS and rear suspension to increase vehicle stability. It controls lateral motion (swaying movement) of vehicle.

3.17.1 Removal

- Disconnect the two links from sway bar.
- Safely support the sway bar. Unbolt bushing collars from subframe.
- Remove sway bar.

NOTE

Sway bar bushings are slit to ease their removal.

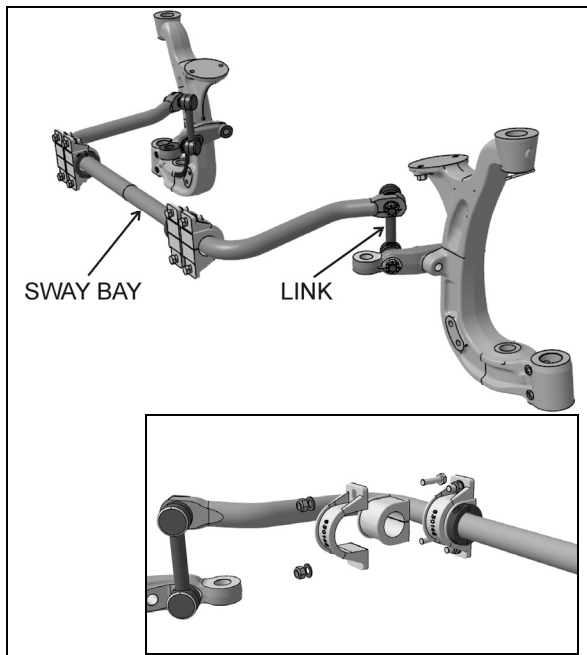


FIGURE 33: SWAY BAR (INDEPENDENT FRONT SUSPENSION) 16138_C

3.17.2 Installation

- Loosely install the sway bar.
- Torque bushing collar nuts as prescribed per Torque Table 2.

- Torque sway bar link nuts as prescribed per Torque Table 2.

3.18 INDEPENDENT FRONT SUSPENSION HEIGHT ADJUSTMENT

VIP coach shells are equipped with "LEVEL-LOW" leveling system. The purpose of the "LEVEL-LOW" is to adjust suspension in three separate points; front, rear right and rear left air springs in order to level vehicle body. Three height control valves, automatically control air pressure in the three separate points (air springs) and maintains a constant vehicle height regardless of load, or load distribution. The control solenoid valve supplies air to the five way three-position air control valve, which bypasses the height control valve, and opens a passage to allow the air control and exhaust valve to release/supply air from air springs. To improve road comfort, an expansion air tank is installed in series with each air spring.

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 (fig. 37). 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.

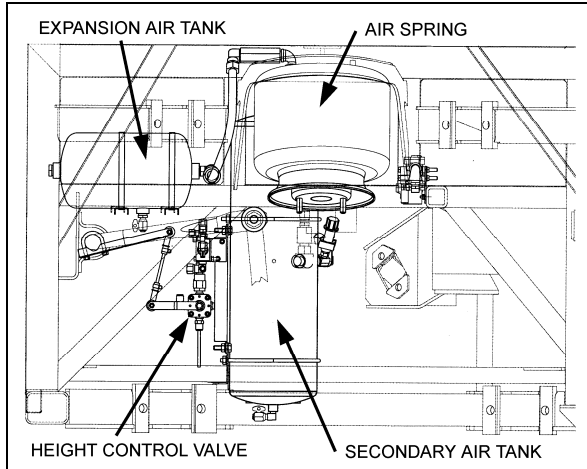


FIGURE 34: HEIGHT CONTROL VALVE LOCATION 16057

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 $12 \frac{15}{16} \pm \frac{1}{4}$ in (328 ± 6 mm). Refer to figure 38 to identify the correct area to take measurement. The rear air springs clearance should be $11 \frac{1}{2} \pm \frac{1}{4}$ " (292 ± 6 mm) (refer to paragraph "6.0 Suspension Height Adjustment" for rear height control valves' adjustment). 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.

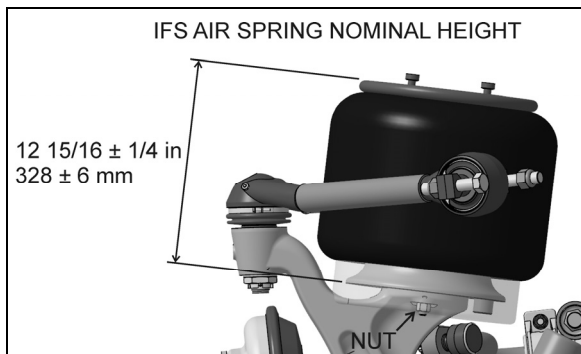


FIGURE 35: TYPICAL AIR SPRING CLEARANCE 16058

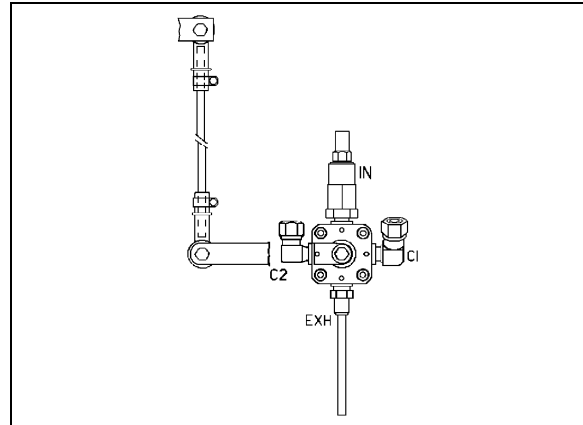


FIGURE 36: FRONT HEIGHT CONTROL VALVE 16100

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 $12 \frac{15}{16} \pm \frac{1}{4}$ in (328 ± 6 mm).

NOTE

The measurement should be taken from underneath the upper air spring support on subframe to top of air spring mounting surface on the upright. 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. 39).

NOTE

Allow suspension to stabilize before taking reading.

When the desired height is obtained, tighten clamp.

Rear air springs clearance

Refer to «Suspension Height Adjustment».

4 REAR SUSPENSION

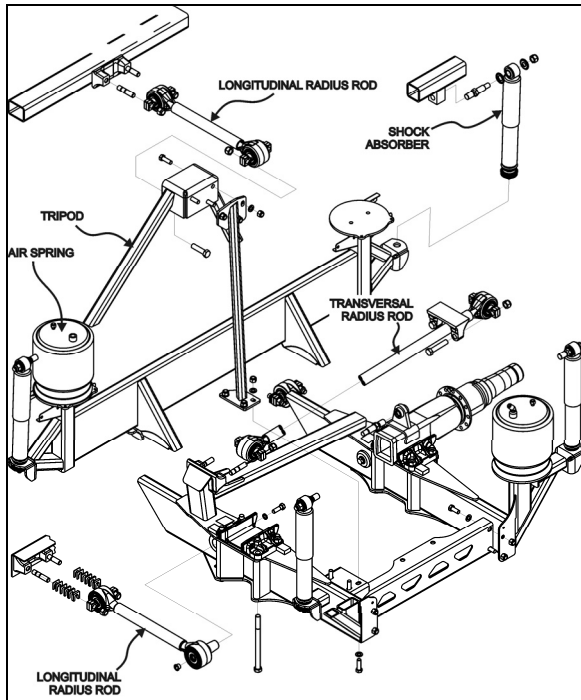


FIGURE 37: DRIVE AXLE TAILS OF REAR SUSPENSION
16106

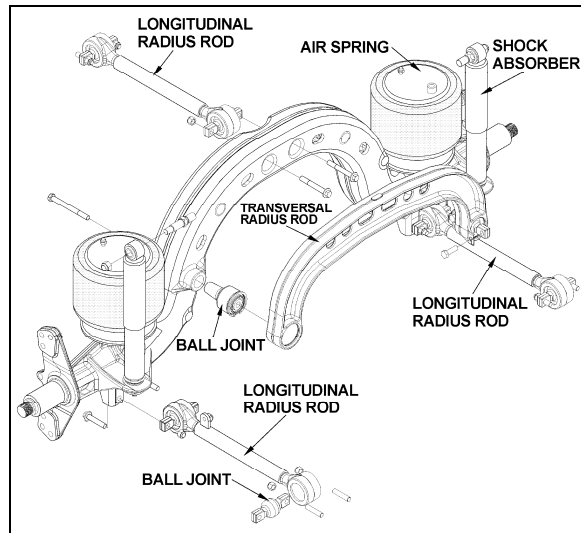


FIGURE 38: TAG AXLE SUSPENSION

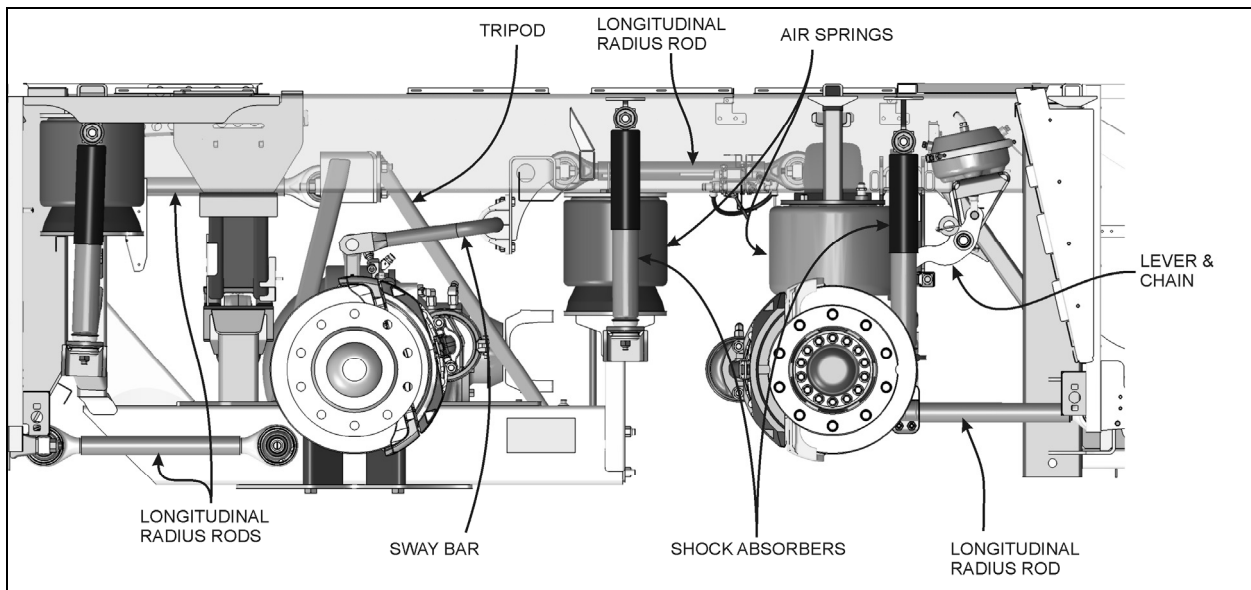


FIGURE 39: REAR SUSPENSION COMPONENTS

16003

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.

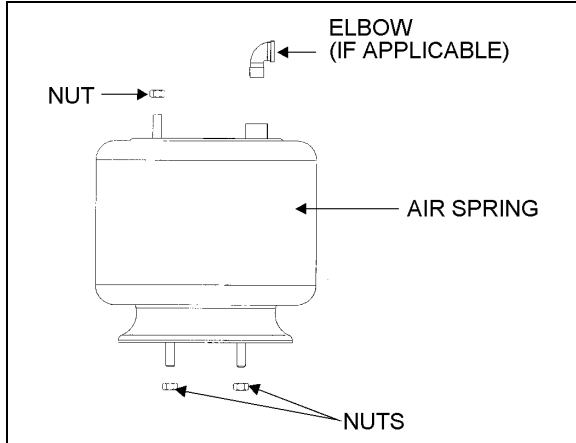


FIGURE 40: AIR SPRING 16052

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

Section 16: SUSPENSION

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 as prescribed in Torque Table 3.
3. Thread the remaining upper nut (large nut) and tighten as prescribed in Torque Table 3.
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. The tag axle is provided with two shock absorbers while the drive axle is provided with four of them (Fig. 41).

Shock absorbers are non-adjustable and non-repairable. Maintenance requirements involve replacement of the rubber mounting bushings, and tightening of all shock absorber mounting pins at the proper torque (refer to Torque Table 3) 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 mounting pin and lower mounting bracket, taking care to identify the inner and outer washers to ease reinstallation. Refer to figure 41 for details.
2. Remove the shock absorber assembly from pins.

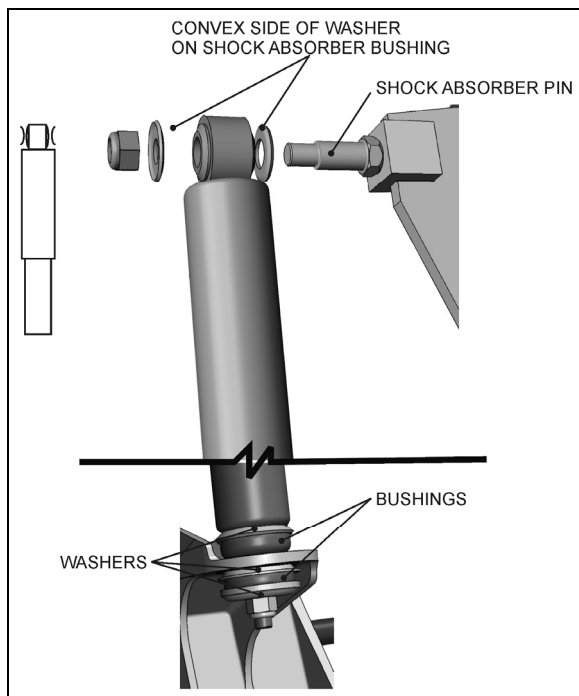


FIGURE 41: TYPICAL SHOCK ABSORBER SETUP 16009

4.2.3 Installation

1. Ensure that the shock absorber mounting pin is tight and that the threads are not stripped.
2. Install new rubber mounting bushings on shock absorbers (upper and lower).
3. At the upper mounting pin, place the inner washer with washer convex side facing the shock absorber rubber bushing.
4. Install the shock absorber eyes over the mounting pin, then the outer washers (with washer convex side facing the shock absorber rubber bushing).

NOTE

If shock absorber pins are removed, they must be reinstalled using "Loctite" (see "Parts Specifications" in this section).

5. Place the lower and upper mounting pin stud nuts and torque as prescribed in Torque Table 3.

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. These rods transmit both braking and driving forces from the axles to the vehicle body.

Refer to section 2.3 for more information regarding radius rods.

5 SUSPENSION AIR SYSTEM

The suspension air system has its own air reservoir (accessory tank) which is located in the reclining bumper compartment. Pressurized air from the main tank (wet tank) flows through a pressure protection valve (PR-4), to the accessory air tank and through an air filter which is located in front service compartment.

The pressure protection valve (PR-4) is mounted to the supply port of the tank. This valve controls the pressure at which compressed air is delivered to the accessory air tank. The valve remains closed until a preset pressure is reached (approximately 70 psi (485 kPa)). It then opens and passes air out the delivery port.

The main use for this valve is to protect the main air system by ensuring at all times a sufficient air pressure in the main system (i.e. air delivered to the accessories will be shut off in case of a decrease in pressure). Maintenance and repair information on the pressure protection valve is supplied in the applicable booklet, annexed to Section 12, "Brakes and Air System" under reference number SD-03-2010.



WARNING

Depressurize parts prior to removal.

5.1 INSPECTION

The following inspection should be performed at established service inspection periods.

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Performing these procedures will allow substandard performance to be discovered before the condition becomes bad enough to cause operator complaints and failure on a run.

1. Visually inspect the suspension air lines for evidence of chafing on metal parts or other damage.
2. Visually inspect the air springs for cracks, abrasion or other damage.
3. Replace any parts found to be damaged.

5.2 AIR LINE TEST

With the main air system at normal operating pressure, coat all suspension air line connections and air spring mountings with a solution of soap and water. Air leakage will produce soap bubbles. Any leak found must be corrected as no air leakage is permissible.

6 SUSPENSION HEIGHT ADJUSTMENT

The flow of pressurized air from the accessory air tank to the air springs is controlled by three height control valves. These valves are mounted to the subframe and connected to the axles through an arm and link connection. This connection allows 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 axle, and regulates air to front axle 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 wheelhouse.

The appropriate vehicle body height is obtained by measuring the clearance of all the air springs installed on the front and drive axles. The clearance should be:

Front I-beam axle: $12 \pm \frac{1}{4}$ " (305 \pm 6 mm);

Independent Front Suspension: $12 \frac{15}{16} \pm \frac{1}{4}$ " (328 \pm 6 mm);

Drive axle, tag axle: $11\frac{1}{2} \pm \frac{1}{4}$ " (292 \pm 6 mm);

Refer to figure 42 and 44 to identify the correct location where the measure has to be taken. 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 the height of vehicle and

down to lower it. Check that main air pressure is at normal operating pressure and raise the vehicle to the specified height.

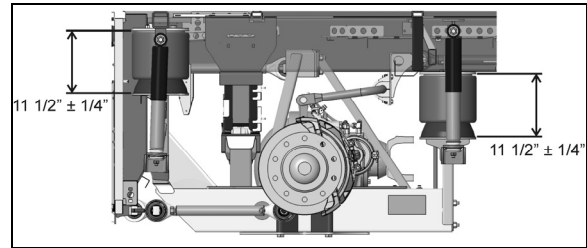


FIGURE 42: DRIVE AXLE AIR SPRING CLEARANCE 16195

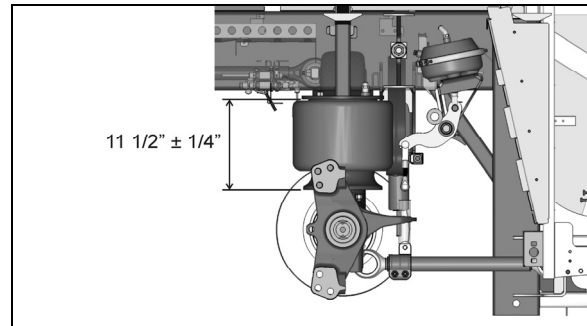


FIGURE 43: TAG AXLE AIR SPRING CLEARANCE 16195

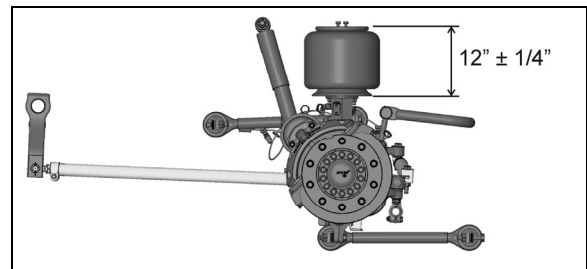


FIGURE 44: FRONT I-BEAM AXLE AIR SPRING CLEARANCE 16197



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.

To adjust suspension height, proceed as follows:

1. With the vehicle at normal operating air pressure, check the air spring clearance as illustrated in figure 42 to 44.

NOTE

The measure should be taken from under the upper air spring support on subframe to top of the lower air spring support on axle (refer to figure 42 to 44 for more details). If adjustment is required, begin with the drive axle.

2. Loosen the adjusting nuts on the connecting rod of height control valve to raise or lower the overtravel lever until the desired clearance is reached.
3. If there is not enough play on adjusting nuts, it is possible to make further adjustments by loosening the clamp on the rubber coupling and bringing it up or down.

NOTE

Allow suspension to stabilize before taking reading.

4. When the desired height is obtained, tighten adjusting nuts and clamp.

7 HEIGHT CONTROL VALVES

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.

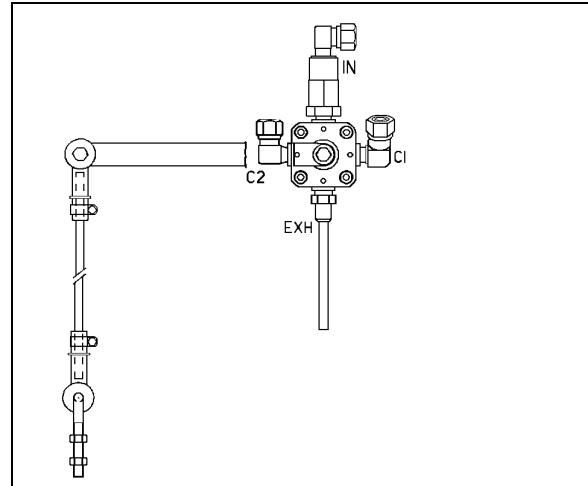


FIGURE 45: HEIGHT CONTROL VALVE

16093

7.1 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 point. Inspect the valve for loose joints, air leaks and worn bushings.

7.1.1 Removal and installation

Before disconnecting any height control valve air lines, securely support the vehicle by its jacking points on the body, and place safety support underneath body. Refer to "VEHICLE JACKING POINTS" in Section 18, "Body".

1. Exhaust air from air system by opening the drain cock on accessory air reservoir. 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 ends of the lines 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.

7.1.2 Air leakage test

NOTE

The following procedure applies when valve assembly has been removed from vehicle.

Section 16: SUSPENSION

1. Clean the exterior of valve assembly.
2. Connect air pressure line to air inlet port, then allow air pressure build-up (70- 100 psi (480 - 690 kPa)).
3. Dip the valve assembly in a container of water, and watch for air bubbles when the overtravel lever is in the center position. No air should escape from any point of the valve assembly.
4. If bubbles appear from the air spring port, this is an indication that the air inlet valve assembly is defective and must be replaced.
5. Remove air pressure line from air inlet fitting and connect it to the air spring port. If bubbles appear at the air inlet check valve port, this is an indication that the check valve unit is defective and must be replaced.
6. If bubbles appear at the exhaust port, this is an indication that the exhaust valve assembly is defective and must be replaced.
7. If bubbles appear around edge of valve cover plate, the cover plate gasket must be replaced.
8. If no leaks are found, remove valve assembly from water, then with air pressure still connected to the air spring port, actuate overtravel lever to remove any excess water which may have entered exhaust valve chamber. Remove air line, connect it to the air inlet port, and repeat operation to remove water from the air inlet valve chamber.

8 "LEVEL-LOW" LEVELING SYSTEM – VIP SERIES OPTION ONLY

The purpose of the *Level-Low* leveling system is to adjust suspension in three separate points (front, rear right and rear left) in order to level vehicle body. This system can be put into service when the ignition key is turned to the "ON" position, and must be used only when the parking brake is applied. The *Level-Low* warning light on the dashboard indicates that the selector switch is not in the "OFF" position. Level low system controls are located on L.H. side control panel.

8.1 PRINCIPLES OF OPERATION

Down

The (front/rear right/rear left) control solenoid valve supplies air to the (front/rear right/rear left) five-way three-position air control valve, which bypasses the (front/rear right/rear left) height

control valve, and opens a passage to allow the air control and exhaust valve to release air from (front/rear right/rear left) air springs.

Up

The (front/rear right/rear left) control solenoid valve supplies air to the (front/rear right/rear left) five-way three-position air control valve, which bypasses the (front/rear right/rear left) height control valve, and opens a passage to allow the air control and exhaust valve to supply air to (front/rear right/rear left) air springs.

Drive

When the ignition key is turned to the "ON" position with selector knob in the "DRIVE" position, the drive control solenoid valve supplies air to all five-way three-position air control valves, each one opening a passage to allow height control valves to accomplish their function.

When the ignition key is turned to the "OFF" position and selector knob to the "DRIVE" position, the air is entrapped between air springs and five-way three-position air control valves to ensure the adjusted level will be kept.



WARNING

Never move vehicle with selector knob in any other position than the "DRIVE" position.

8.2 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 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 the kneeling 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. On I-beam axle, a second kneeling air tank is available as an option. This second kneeling air tank is standard on coaches with Independent Front Suspension (IFS).

The system is provided with two safety features; first, a speed switch will enable the kneeling system to work only below 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 front axle 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 air spring control and air spring 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 air spring 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 air spring 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 AIR SPRING CONTROL SOLENOID VALVES

9.3.1 Removal and installation

1. On the rear side of steering compartment, locate both the air spring control and air spring 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.

	<p>CAUTION</p>
<p>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.</p>	

10 HIGH-BUOY SYSTEM

The purpose of the full 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.

UP:

The air coming from the control valve flows through double shuttle valves, to supply air springs. The double shuttle valves prevent

Section 16: SUSPENSION

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."

10.3 HIGH-BUOY – PRESSURE REGULATOR

The pressure regulator is located on ceiling of the spare wheel and tire compartment and is accessible through the reclining bumper. 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. 46) then turn regulator adjustment handle counterclockwise until the load is removed from the regulating spring.
2. Turn on system pressure.
3. Turn regulator adjustment handle 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. 46) 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 handle (1, Fig. 46) 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.

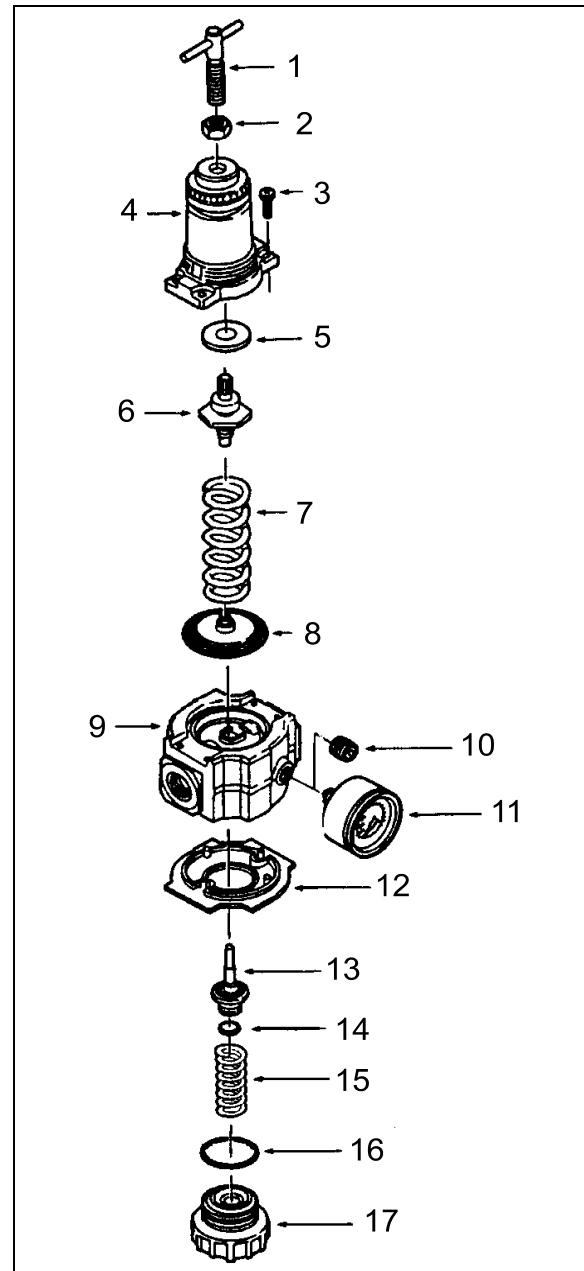


FIGURE 46: AIR PRESSURE REGULATOR

16035

Torque Table	
Item	Torque in lbf-in (Nm)
3 (Screw)	25-35 (2.8-3.9)
17 (Bottom plug)	20-25 (2.3-2.8)

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.

10.3.4 Reassembly

1. Lubricate O-ring (14 and 16, Fig. 46), valve stem (13), tip of adjusting screw (1), and the outer circumference and both sides of the thrust washer (8) with a light coat of good quality O-ring grease.
2. Assemble the regulator as shown on the exploded view.

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.

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 H3-41 and H3-45 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".

12 AIR SYSTEM

The basic air system consists of an air compressor, tanks, valves, filters and

Section 16: SUSPENSION

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. 47).

In addition, an expansion air tank is installed in series with each air spring.

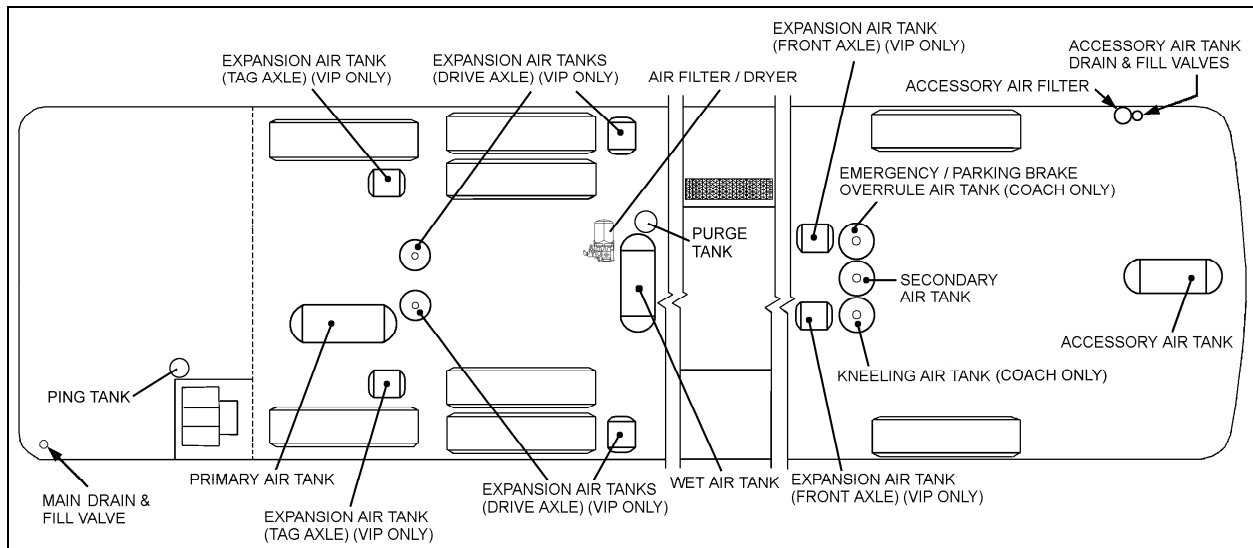


FIGURE 47: LOCATION OF AIR TANKS

12195


12.1 AIR TANK MAINTENANCE

Ensure that the accessory 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. 49).

Moreover, purge all tanks by their bottom drain valves at specified intervals.

12.1.1 Wet Air Tank

This tank is installed in front of and above drive axle in the rear wheelhousing and is provided with a bottom drain valve.


	MAINTENANCE
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 **purge daily** (Fig. 48).

12.1.2 Primary Air Tank

The primary air tank is located above tag axle.

This tank is also provided with a bottom drain valve.

	MAINTENANCE
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.	

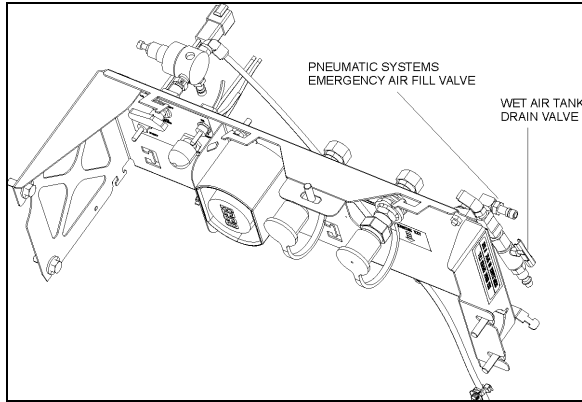



FIGURE 48: REAR VALVE LOCATION 12162


12.1.3 Secondary Air Tank

This tank is located in front wheelhousing. The tank is installed vertically and is provided with a bottom drain valve.

 <h2 style="margin: 0;">MAINTENANCE</h2>
<p>It is recommended to purge the secondary air tank by its bottom drain valve every 12,500 miles (20 000 km), or once a year, whichever comes first.</p>

12.1.4 Accessory Air Tank

The accessory air tank is installed at the ceiling of spare wheel compartment. The tank is provided with a bottom drain valve.

 <h2 style="margin: 0;">MAINTENANCE</h2>
<p>It is recommended to purge the accessory air tank by its bottom drain valve every 12,500 miles (20 000 km), or once a year, whichever comes first.</p>

A remote drain valve is located in front service compartment (Fig. 49) underneath the accessory air filter. Refer to Section 12, paragraph "4. Accessory Air Filter" of the maintenance manual for daily purge procedure.

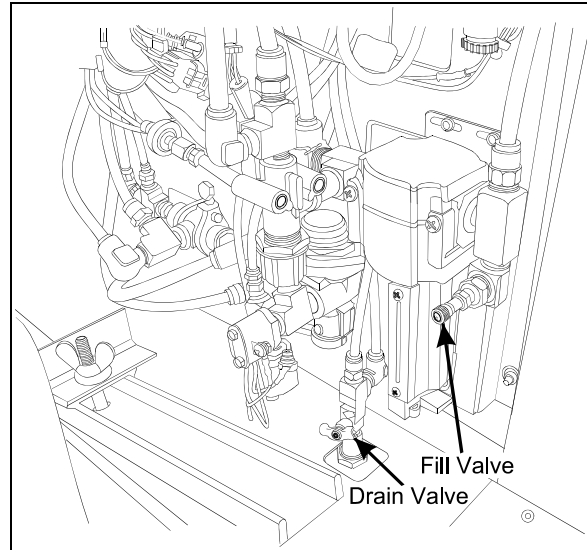



FIGURE 49: FRONT VALVE LOCATION 12144

12.1.5 Expansion Air Tank


Two expansion tanks are located in front wheelhousing. These air tanks are located behind secondary air tank. Also, six expansion tanks are located near rear air springs (Fig. 47). 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.

 <h2 style="margin: 0;">MAINTENANCE</h2>
<p>It is recommended to purge the expansion air tanks every 12,500 miles (20 000 km), or once a year, whichever comes first.</p>

12.2 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. 48).

 <h2 style="margin: 0;">CAUTION</h2>
<p>No other point should be used to supply air system. The maximum allowable air pressure is 125 psi (860 kPa).</p>

The front valve is located in the front service compartment close to accessory air filter (Fig. 49).

Section 16: SUSPENSION

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 Prevost. Do not fill air through any other points.

13 REAR SUSPENSION TORQUE SPECIFICATIONS

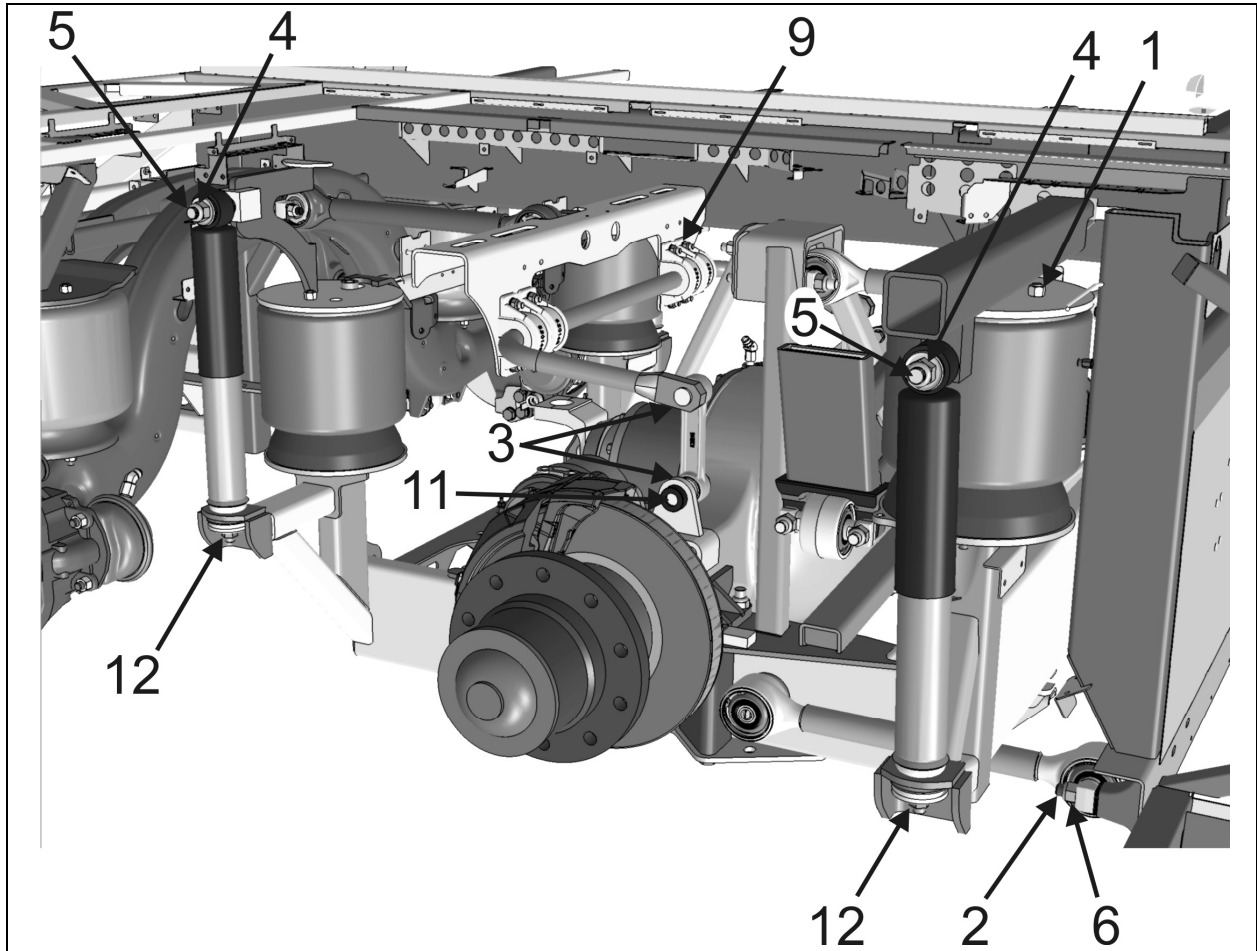


FIGURE 50: TORQUE SPECIFICATIONS – DRIVE AXLE

16158_A

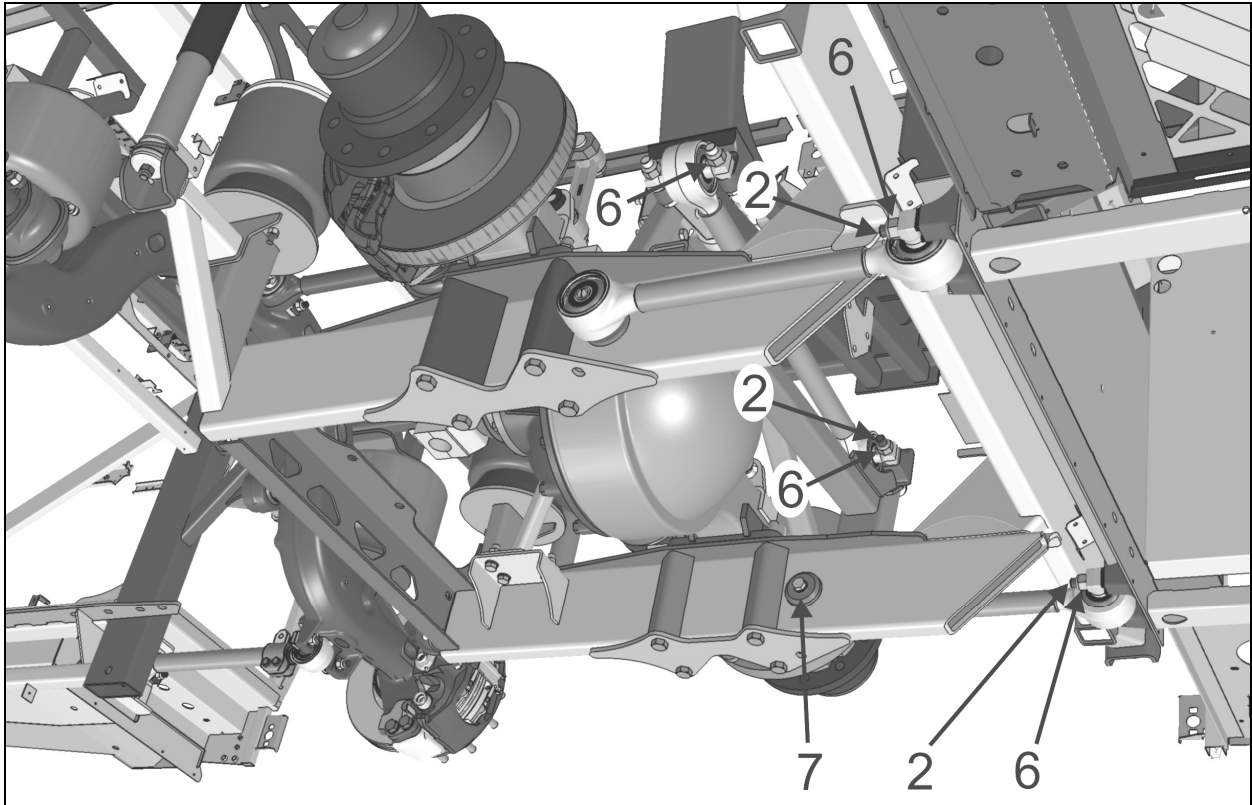


FIGURE 51: TORQUE SPECIFICATIONS – DRIVE AXLE

16159

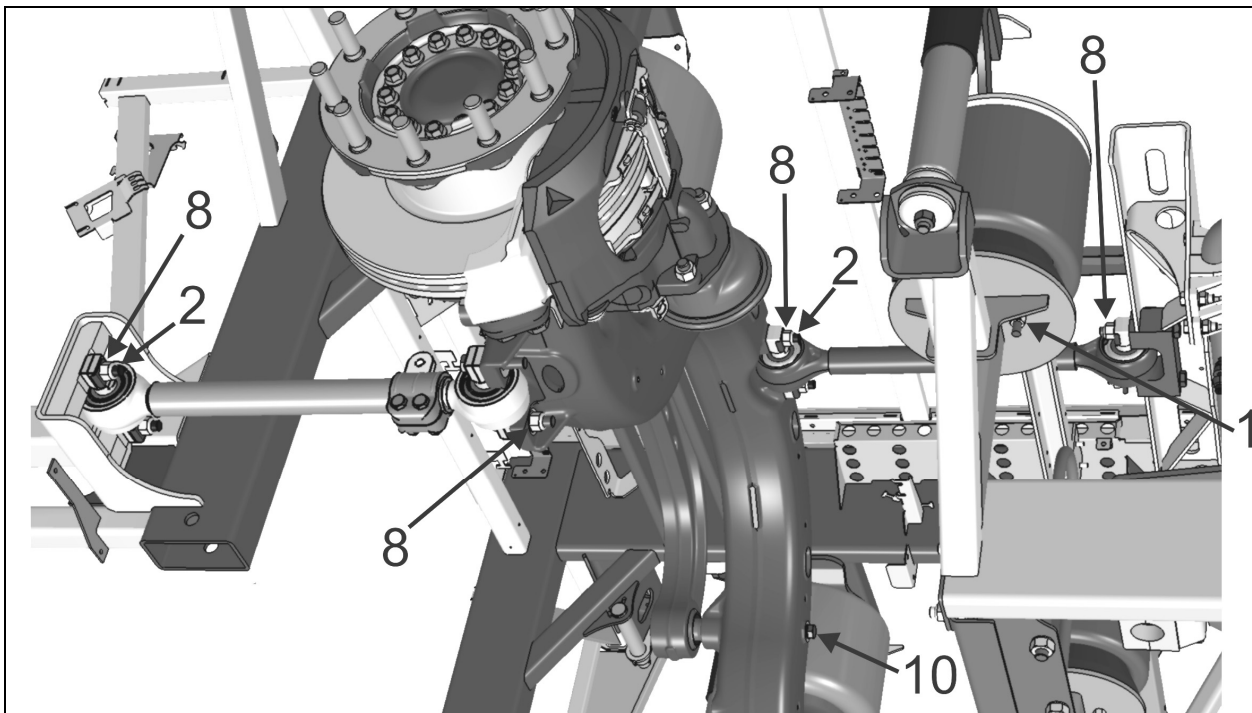


FIGURE 52: TORQUE SPECIFICATIONS – TAG AXLE

16160

Section 16: SUSPENSION

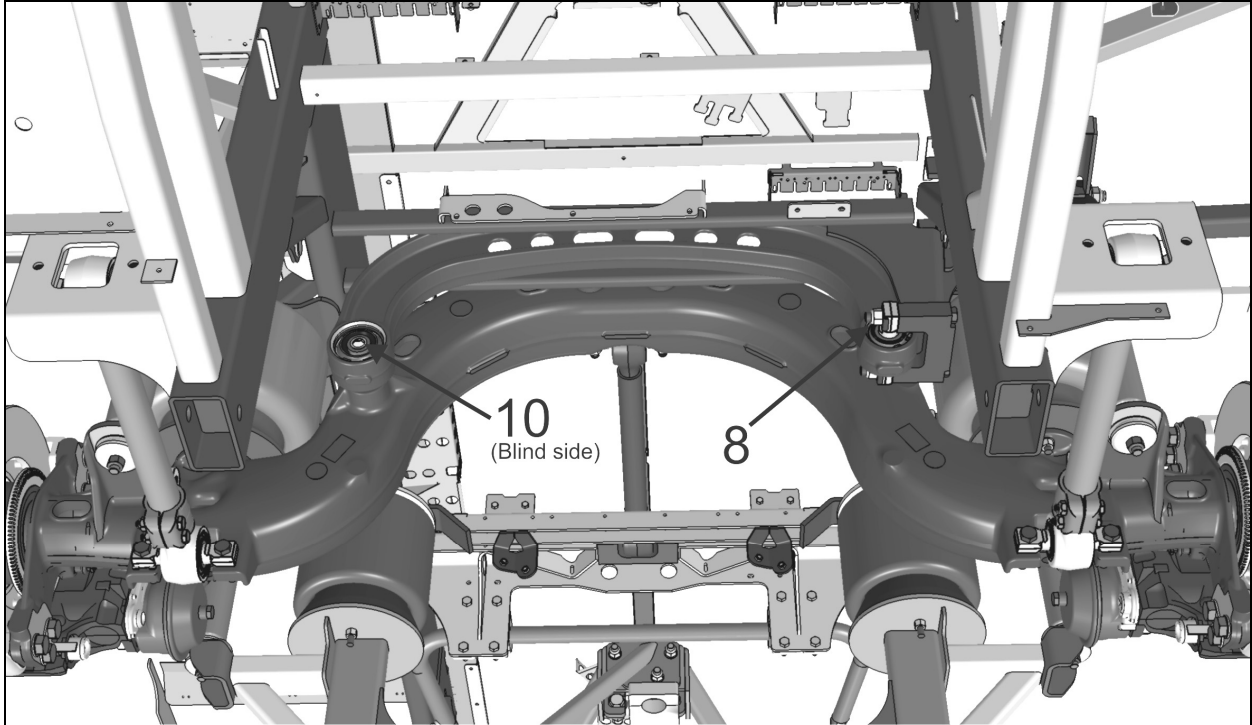


FIGURE 53: TORQUE SPECIFICATIONS – TAG AXLE

16161

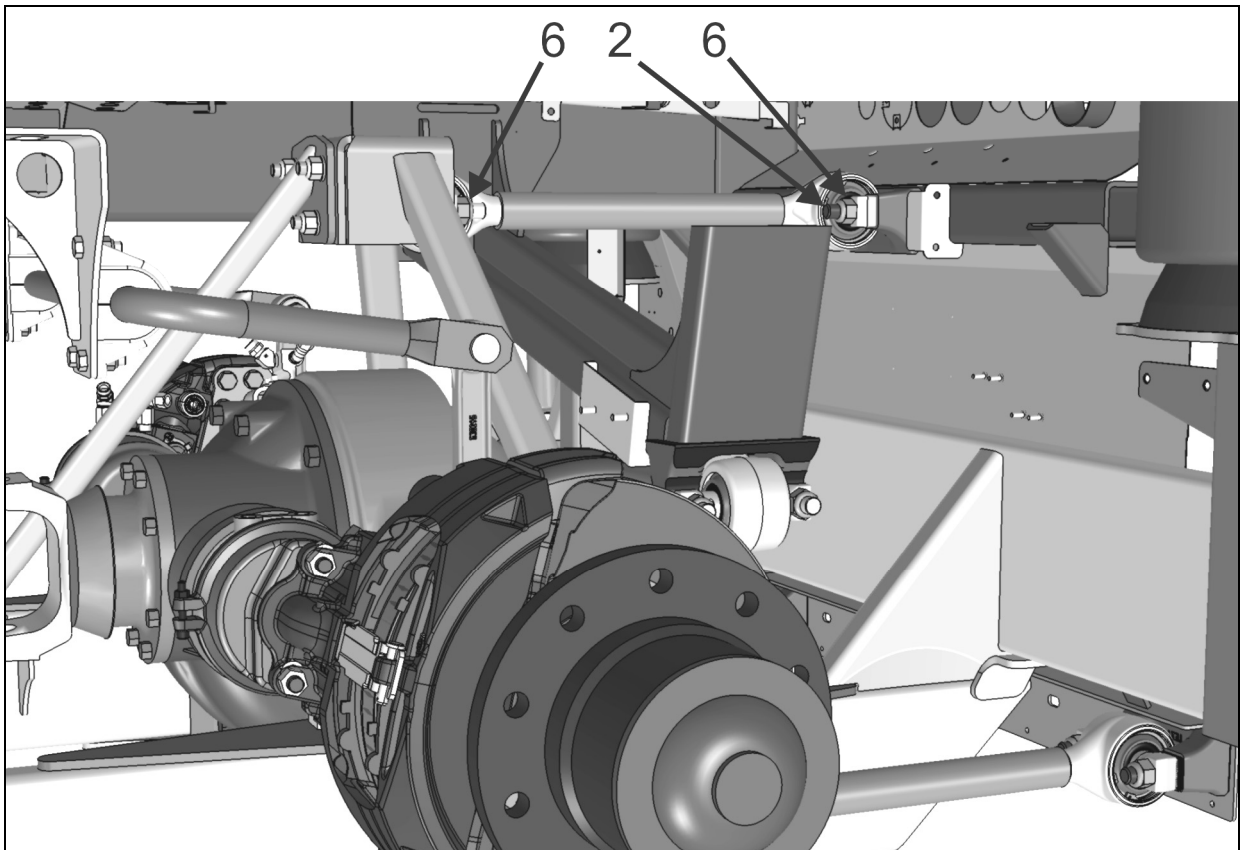


FIGURE 54: TORQUE SPECIFICATIONS – DRIVE AXLE, TOP

16162

The following table lists the tightening torques of bolts and nuts requiring a specific torque value. When no torque specifications are indicated, use the Standard Torque Specifications table found in Section 00: General Information of the Maintenance Manual.

SPECIFIC TORQUE TABLE 3 – REAR SUSPENSION			
REFERENCE	DESCRIPTION	TORQUE DRY (lbf-ft / Nm)	
1	Air Spring Upper & Lower Stud Nut (6 air springs)	31-38	42-52
2	Drive & Tag Axle Radius Rod threaded stud (12 supports)	90-110	122-149
3	Sway Bar Link Upper & Lower Nut	99-121	134-164
4	Shock Absorber Pin Nut (6 shock absorbers)	99-121	134-164
5	Shock Absorber Pin (6 shock absorbers) ¹	350-400	475-545
6	Drive axle Radius Rod Nut/bolt (6 supports)	225-255	305-346
7	Drive Axle Radius Rod Retaining Bolts (2 longitudinal radius rods)	228-232	309-314
8	Tag Axle Radius Rods Nut (6 supports)	228-252	309-341
9	Sway Bar Bushing Collar Bolt	80-100	108-136
10	Tag Axle Transversal Radius Rod (Casting) Retaining Bolt	188-192	255-260
11	Sway Bar Link Pin Stud	350-400	475-545
12	Shock Absorber Lower Nut (6 shock absorbers)	60-75	81-101

* Tighten nut to specified torque, then advance to next aligning cotter pin slot and install a new cotter pin.

NOTE

Apply corrosion-protective compound on exposed threads.

14 TROUBLESHOOTING

Condition	Cause	Correction
Air springs deflate over time	<ol style="list-style-type: none"> Defective check valve assembly. Defective exhaust valve assembly. Leak in air line and/or air springs. Defective valve cover, rubber O-rings or gasket. 	<ol style="list-style-type: none"> Replace check valve assembly. Replace exhaust valve assembly. Replace air line or air springs. Replace valve cover, O-rings or gasket.
Air springs raise to full height and fail to exhaust air pressure	<ol style="list-style-type: none"> A clogged exhaust screen in height control valve assembly. A combination clogged exhaust screen and defective air inlet valve assembly. 	<ol style="list-style-type: none"> Remove and clean screen. Clean exhaust screen and replace air inlet valve assembly.
Erratic valve action	<ol style="list-style-type: none"> Dirt or foreign matter in the air valve lever chamber. Defectives valves. 	<ol style="list-style-type: none"> Remove valve cover and blow out dirt. Install cover using new gasket. Overhaul height control valve assembly
Vehicle body fails to level to satisfactory ride height	<ol style="list-style-type: none"> Improper height control valve overtravel lever adjustment 	<ol style="list-style-type: none"> Adjust lever as directed.

15 SPECIFICATIONS

Independent Front Suspension Air Springs

Make.....Goodyear Tire and Rubber
Diameter..... 14 inches
Air Inlet..... 1/2"-14 NPTF AIR INLET
Prevost number..... Refer to Parts Manual

Front I-Beam axle air springs and tag axle air springs

Make.....Goodyear Tire and Rubber
Type.....Mae West
Nominal diameter..... 12" (304 mm)
Prevost number.....Refer to Parts Manual

Drive axle air springs

Make.....Goodyear Tire and Rubber
Type..... Double Flare
Nominal diameter..... 11" (279 mm)
Prevost number.....Refer to Parts Manual

Independent Front Suspension - Shock Absorbers

Prevost number..... Refer to Parts Manual

Shim (Camber Adjustment)

Thickness.....3.175 mm
Prevost number..... Refer to Parts Manual
Thickness.....6.35 mm
Prevost number..... Refer to Parts Manual
Thickness.....4.76 mm
Prevost number.....661094
Thickness.....1.52 mm
Prevost number..... Refer to Parts Manual

Front I-Beam axle shock absorbers

Make..... Sachs
Color..... Black
Ext. Diam..... 75 mm
Collapsed length..... 15.51" (394 mm)
Extended length..... 24.37" (619 mm)
Prevost number.....Refer to Parts Manual

Drive and tag axle shock absorbers

Make..... Sachs
Color..... Black
Ext. Diam..... 75 mm
Collapsed length..... 15.51" (394 mm)
Extended length..... 24.37" (619 mm)
Prevost number.....Refer to Parts Manual

Height control valve (IFS)

Quantity used..... 1
Prevost number.....Refer to Parts Manual

Height control valve (coach, all axles & VIP, rear only)

Quantity 2 or 3

Prevost number Refer to Parts Manual

Bellows control and exhaust solenoid valve assembly

Make Norgren

Solenoid valve manifold

Prevost number Refer to Parts Manual

Coil

Voltage 24 V DC

Current draw 29 amperes

Prevost number Refer to Parts Manual

Valve (3-way, 2 positions)

Type N/C

Prevost number Refer to Parts Manual

Type N/O

Prevost number Refer to Parts Manual

Radius rod bushing

Make Prevost

Prevost number Refer to Parts Manual

Sway bar bushing (Independent Front Suspension)

Make Prevost

Prevost number Refer to Parts Manual

Sway bar bushing (Front Axle)

Make Prevost

Prevost number Refer to Parts Manual

Sway bar bushing (Drive Axle)

Make Prevost

Prevost number Refer to Parts Manual

Sway bar link bushings

Prevost number Refer to Parts Manual

Shock absorber bushings

Prevost number Refer to Parts Manual

Section 16: SUSPENSION

High-Buoy Pressure regulator

Recommended pressure setting 90 psi (621 kPa)

Prevost number Refer to Parts Manual

Guideline to Evaluate Warranty Claims Heavy-duty Shock Absorbers

Index:

- 1) Inspection
- 2) Misting
- 3) Leakage
- 4) Noise – Rubber Bushings
- 5) Noise – Scratching Metal Dust Cover
- 6) Damping Performance

1) Inspection

It is recommended to inspect Sachs shocks visually during regular maintenance schedules, however at least:

- linehaul applications: every 100,000 miles
- vocational applications: every 50,000 miles

The visual inspection should include

- the shock itself (leakage, any irregularities)
- shock bushings
- tires (tire cupping)

The most common failures and their possible causes are compiled in this document. By understanding the cause you may be able to correct the problem, avoid future failures and ensure ride safety.

For further assistance please contact:

Sachs Automotive of America

(859) 647 – 84 47 Ivan Botello
or (248) 458 – 36 88 Jim C. King

Guideline to Evaluate Warranty Claims Heavy-duty Shock Absorbers

2) “Misting“

Appearance might be deceptive. A certain degree of vapor is normal and actually necessary for lubrication of the rod seal.

The inspection must not be conducted after drive in wet weather or a vehicle wash. Shock needs to be free from water.



“Misting“

OBSERVATION:

A precipitation of oil mist on the outside of the shock is visible.

Carefully touch shocks with dry finger. (Use caution: shocks may be hot!) If the finger remains dry, the shock is not leaking.

If in doubt, wipe shock clean and check again after a few days of operation.



CAUSE:

Oil vapor is necessary to lubricate the rod seal. At high operating temperatures this results in oil mist and precipitation.

EFFECT:

none

ACTION:

none

Guideline to Evaluate Warranty Claims Heavy-duty Shock Absorbers

3) „Leaker“

OBSERVATION

A shock is considered a „leaker“, if

- the reservoir tube (smaller diameter) is largely covered with oil
- finger gets wet, when touching shock (see „Misting“)



- after above finger test, shock exhibits a glossy film of oil and/or dirt, or an oil droplet forms on reservoir tube

- a film of oil is also visible in the upper area of the reservoir tube, after extension of the shock. If oil is only visible around the bottom, it likely stems from an outside source

CAUSE:

- worn, damaged or overheated seal



EFFECT:

- loss of oil
- loss of damping function
- loss of ride control and safety

ACTION:

replace leaking shock

Guideline to Evaluate Warranty Claims Heavy-duty Shock Absorbers

4) Noise - Rubber Bushings

Noise emitted during operation is not necessarily caused by defective shocks.

Therefore in case of noise issues:

Check all relevant suspension and axle components, e.g. rubber mounts, springs, jounce stops, bushings, steering.



Rubber bushing „worn“ or „deformed“

OBSERVATION:

- rubber bushing is visibly deformed or damaged
- eye (or „loop“) is eccentrically deformed
- sleeve is not centered within bushing

CAUSE:

- extensive use of rebound stop, incorrect ride height, shock may be too short for application
- extremely high conical angles, not suitable for this design

EFFECT:

noise, increased wear of shock and suspension

ACTION:

- verify ride height
- verify that shock is suitable for this application
- replace defective shock absorber



Guideline to Evaluate Warranty Claims Heavy-duty Shock Absorbers

5) Noise - Scratching Metal Dust Cover

Noise emitted during operation is not necessarily caused by defective shocks.

Therefore in case of noise issues:

Check all relevant suspension and axle components, e.g. rubber mounts, springs, jounce stops, bushings, steering.



„Metal dust cover scratches reservoir tube“

OBSERVATION:

- Paint scratched off reservoir tube

CAUSE:

- suspension is misaligned, shock is under unintended lateral or longitudinal preload

EFFECT:

- noise
- corrosion of reservoir tube
- subsequently wear of rod seal, leakage and loss of function

ACTION:

- check suspension, while vehicle is at design height
- replace shock only, if significant amount of paint is already scratched off or loss of oil is visible



Guideline to Evaluate Warranty Claims Heavy-duty Shock Absorbers

6) Degradation of Damping Performance

It is impossible to verify the correct damping characteristic of a shock absorber without a dynamometer. In the field, the following, more practical test can help to identify a shock, which is suspected to have failed:

- 1) Conduct test few minutes after operating the vehicle
- 2) Touch a metal element of the chassis to determine a reference temperature
- 3) Carefully touch the shock reservoir tube (lower tube, smaller diameter) on either side of the same axle to measure temperature of shock absorbers
- 4) Both shocks should be
 - warmer than the original reference point
 - similar in temperature
- 5) A cool or significantly colder shock absorber likely is a failure and needs to be replaced
- 6) After removal from the vehicle, the following may hint to the cause of failure:
 - Manually stroke shock several times in vertical position: no or delayed resistance would indicate a loss of damping force.
 - Shake shock upside down: rattling would indicate a broken internal component
- 7) A final determination can only be made by the manufacturer, using a dynamometer

Other indicators of damping force degradation include:

- a) ride deterioration
- b) deteriorated rubber attachments
- c) uneven tire wear („tire cupping“)
- d) excessive vibrations and premature wear on other vehicle components

EFFECT: Reduced ride control, comfort and safety

ACTION: Replace shock absorber

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1. VEHICLE EXTERIOR

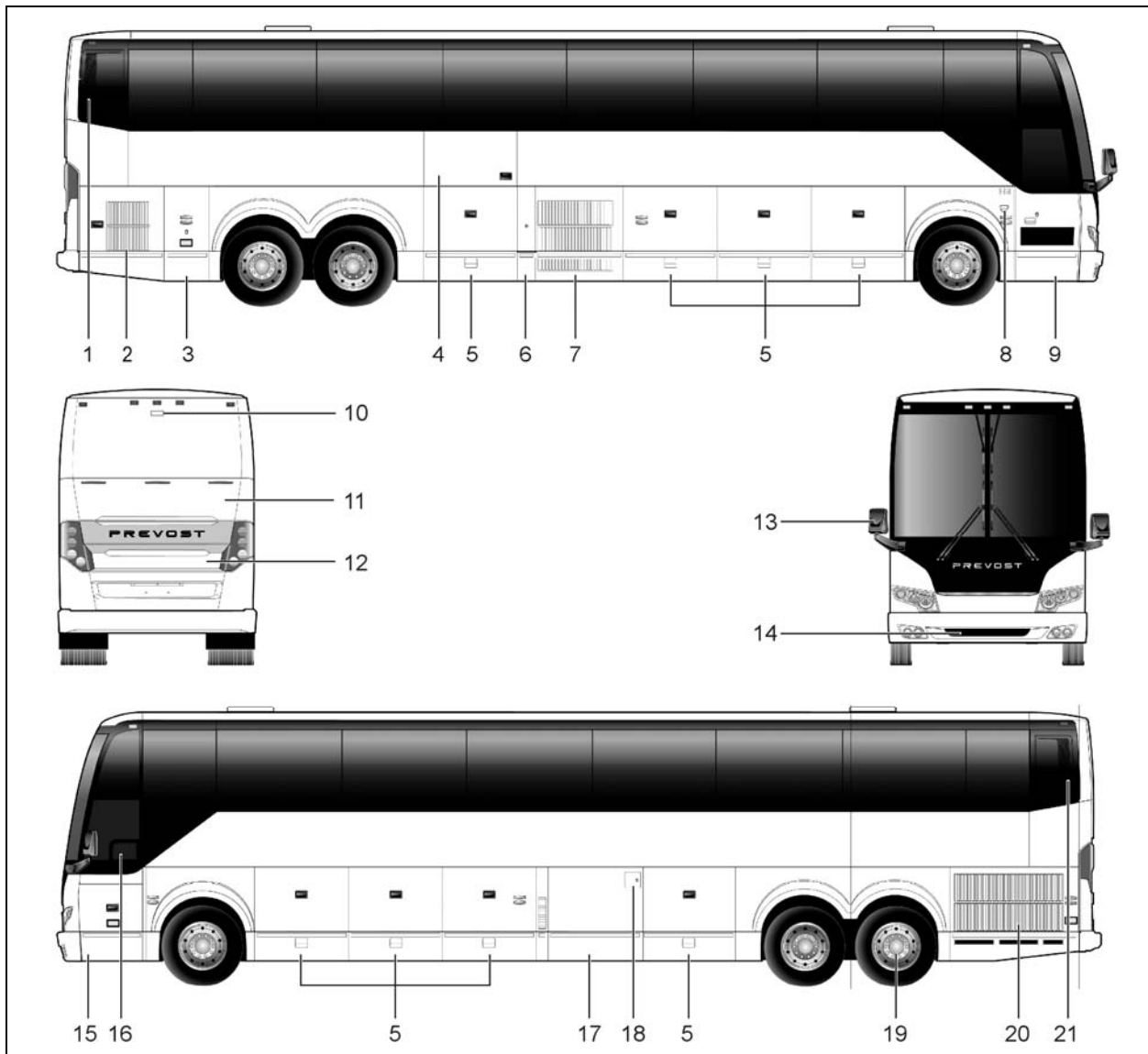


FIGURE 1: H3-45 (TYPICAL)

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- | | |
|--|---|
| <ol style="list-style-type: none"> 1. Engine air intake 2. Engine compartment curb-side door 3. Main power compartment (battery compartment) 4. Wheelchair access door (optional Ricon lift) 5. Baggage compartment 6. Fuel filler neck and diesel exhaust fluid (DEF) filler neck access door 7. Condenser compartment 8. Entrance door control switch 9. Entrance door 10. Back up camera (optional) | <ol style="list-style-type: none"> 11. Diesel Particulate Filter (DPF) access door 12. Engine compartment rear door 13. Rear-view mirror 14. Spare wheel compartment 15. Front electrical and service compartment 16. Driver's power window 17. Evaporator compartment 18. Fuel filler neck access door 19. Tag axle 20. Radiator door 21. SCR catalytic converter access door |
|--|---|

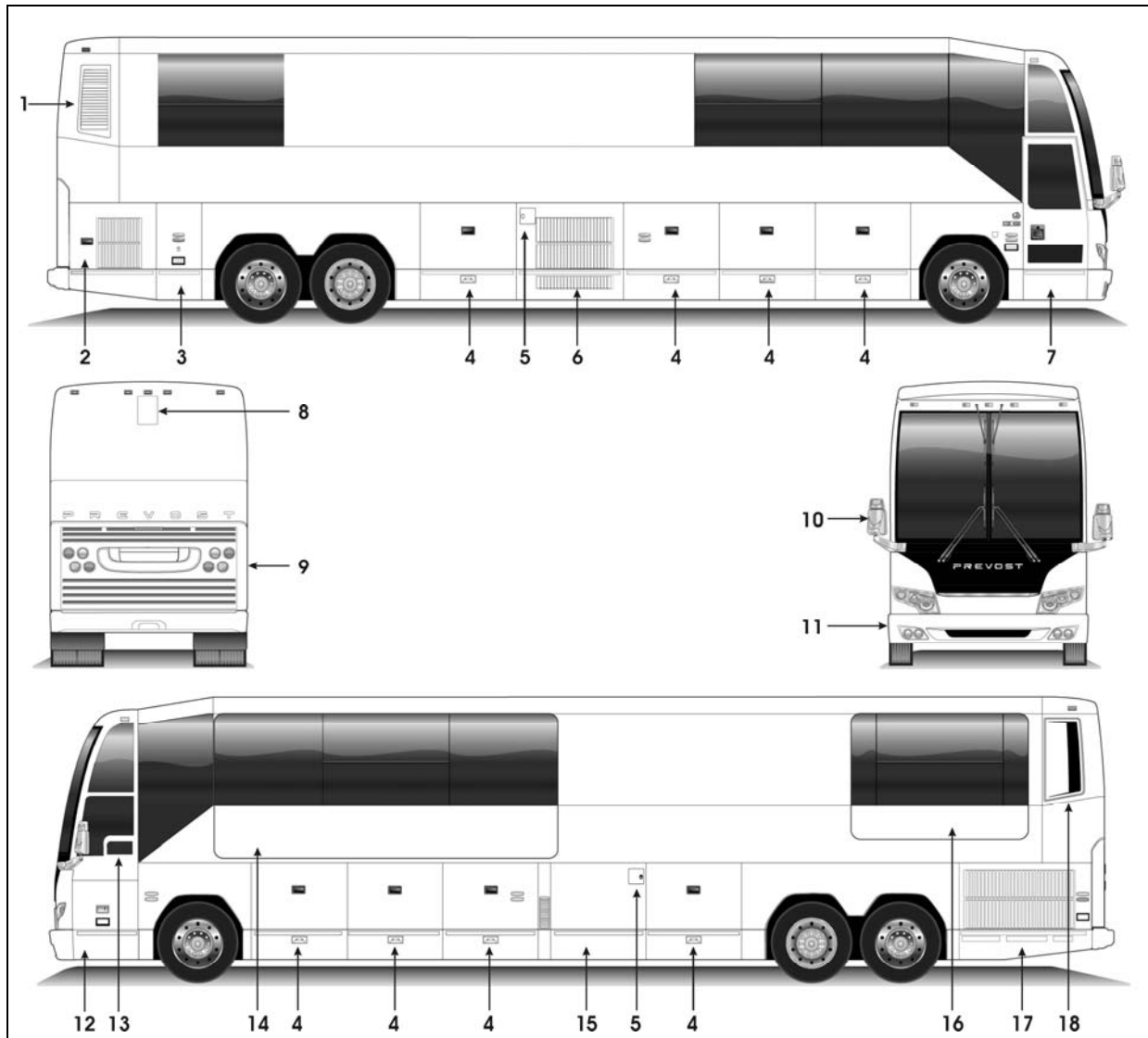


FIGURE 2: H3-45 VIP EXTERIOR VIEW

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- | | |
|---|---|
| 1. Engine air intake | 13. Driver's power window |
| 2. Engine R.H. side access door | 14. Front Slide-out |
| 3. Main power compartment | 15. Heating, ventilating and air conditioning compartment (HVAC) or baggage compartment |
| 4. Baggage compartment | 16. Rear Slide-out |
| 5. Fuel filler door | 17. Engine radiator door |
| 6. A/C condenser compartment or baggage compartment | 18. Diesel Particulate Filter (DPF) compartment access door |
| 7. Entrance door | |
| 8. Retractable back up camera (optional) | |
| 9. Engine compartment rear door | |
| 10. Rear-view mirrors | |
| 11. Reclining bumper compartment | |
| 12. Front electrical and service compartment | |

2. STRUCTURE

The body of the H3-41, H3-45 and VIP vehicles is an integral structure made of 14, 16 and 18 gauge welded and braced high tensile steel and stainless steel members. The roof arches are made with cold rolled, electrically welded (CREW) steel tubes, 1 ½" x 2" x 14 gauge. The inside is filled with urethane foam and the exterior is primed. The front subframe is made of open sections of high-strength steel alloy. These open sections permit a better application of primer and undercoating, and does not trap moisture. The rear subframe is made of closed sections of high tensile steel sealed at both ends.

2.1 WELDING

Since welding is a procedure that may be carried out either as specific instructions from Prevost 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.

Weld in clean and well ventilated area, and always have an appropriate fire extinguisher within your reach

3. EXTERIOR MAINTENANCE

Regular washing to remove dust and dirt is recommended. See "Operator's Manual" or "Owner'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 underbody 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 understructure, 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 UNDERSTRUCTURE AND VISUALLY INSPECT FOR CALCIUM DEPOSIT, CORROSION OR ANY DIRT ACCUMULATED ONTO EXPOSED SURFACES. VISUALLY INSPECT SEALING BEADS CONDITION. VISUALLY INSPECT IF UNDERFLOOR IS PEELING. VISUALLY INSPECT WHEELHOUSING COATING. MAKE SURE DISCHARGE TUBES ARE FREE FROM OBSTRUCTIONS	APPLY UNDERCOATING LOCALLY AS NECESSARY. APPLY UNDERCOATING LOCALLY AS NECESSARY 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



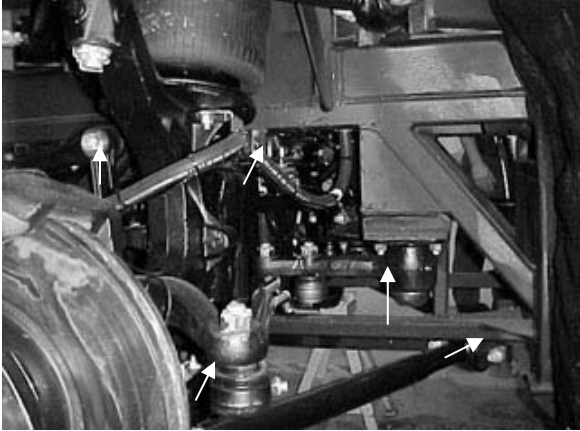
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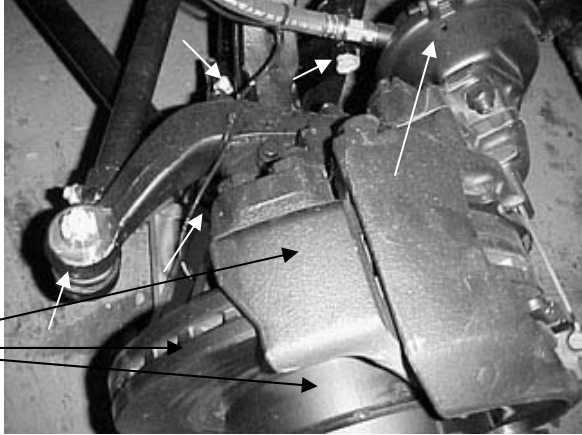
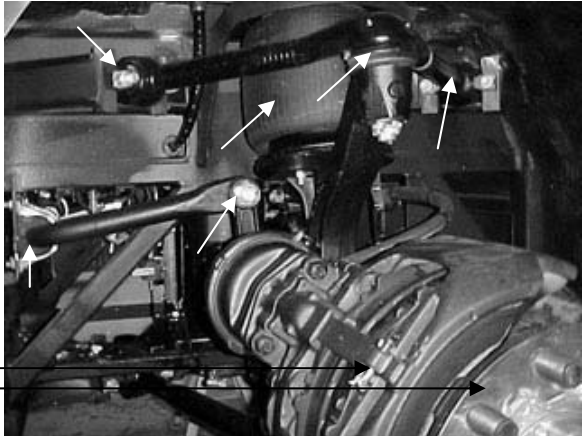
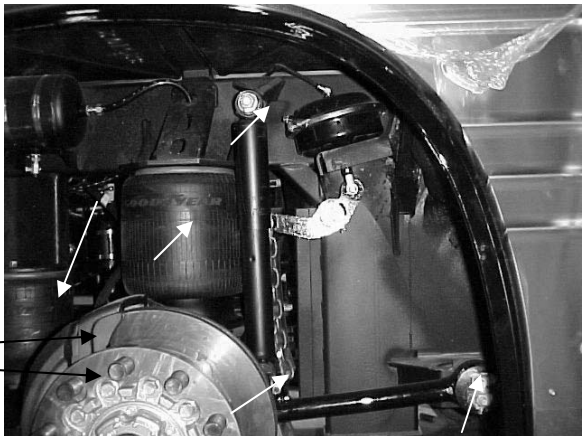
Safety Rules: Use safety glasses

Supplied air hood

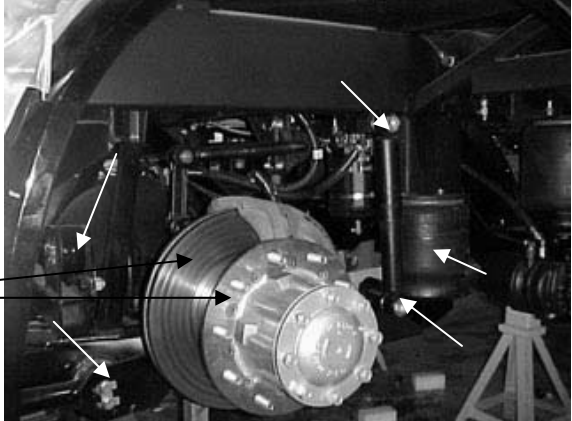
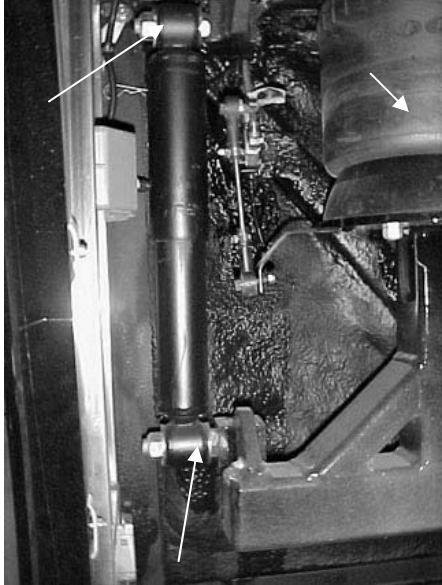
Solvent-resistant rubber gloves

Section 18: BODY

<p>1.0 Wash both wheelhousing mechanical parts before masking.</p>	<p>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.</p>
<p>2.0 Dry all water sprayed parts. Surface temperature and dew point must be respected before applying rust inhibitor.</p>	<p>Air pressure system may be used, refer to annex 1 for surface temperature and dew point.</p>
<p>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.</p>	
<p>3.1 Front wheelhousing Front view</p>	
<p>3.2 Front wheelhousing</p>	

<p>3.3 Front wheelhousing</p> <p>(Entire braking system)</p>	 <p>A black and white photograph showing the front wheelhousing assembly. Several white arrows point to various components, including the brake master cylinder, brake lines, and suspension parts. A black arrow from the text '(Entire braking system)' points to the main brake assembly area.</p>
<p>4.0 Rear wheelhousing</p> <p>a) Mask all rubber joints. Braking system must also be protected (refer to arrows). Commercial aluminum foil may be used for masking</p> <p>(Entire braking system)</p>	 <p>A black and white photograph showing the rear wheelhousing assembly. Several white arrows point to various components, including the brake master cylinder, brake lines, and suspension parts. A black arrow from the text '(Entire braking system)' points to the main brake assembly area.</p>
<p>4.1 Rear wheelhousing</p> <p>(Entire braking system)</p>	 <p>A black and white photograph showing the rear wheelhousing assembly. Several white arrows point to various components, including the brake master cylinder, brake lines, and suspension parts. A black arrow from the text '(Entire braking system)' points to the main brake assembly area.</p>

Section 18: BODY

<p>4.2 Rear wheelhousing</p> <p>(Entire braking system)</p>	
<p>4.3 Rear wheelhousing</p>	
<p>5.0 Close off wheelhousing using masking paper.</p>	<p>Prevent rust inhibitor from coming in contact with paint. To close off wheelhousing, a polythene sheet may be used.</p>
<p>6.0 Apply TECTYL 185 GW black rust inhibitor onto wheelhousing mechanical parts.</p>	<p>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.</p>
<p>7.0 Remove all masking material 30 minutes after application.</p>	

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

<p>NOTE</p> <p>Use the following table to determine dew point.</p>


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. FIBERGLASS REPAIR

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
<i>Roughening the surface improves adhesion of resin.</i>

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 with 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 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. 4).

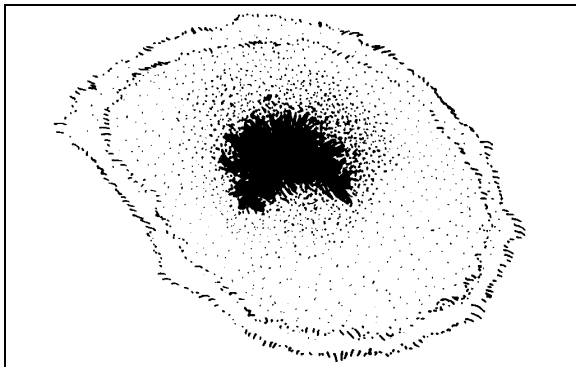


FIGURE 3: FIBERGLASS REPAIR

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. 5).

NOTE

Remove all air between surfaces being joined. Allow area to harden and sand surface to remove any wax.

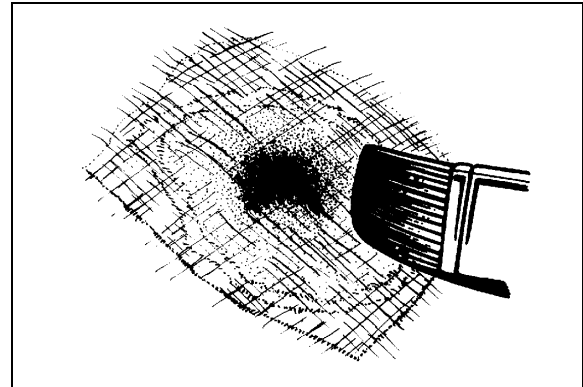


FIGURE 4: FIBERGLASS REPAIR

18090

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. 6).

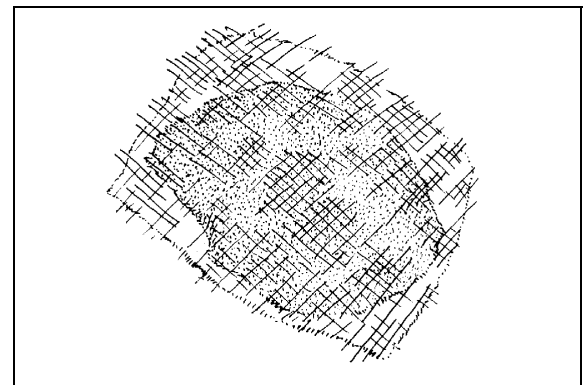


FIGURE 5: FIBERGLASS REPAIR

18091

Allow area to harden and contour the area with coarse sandpaper #100 (Fig. 7).

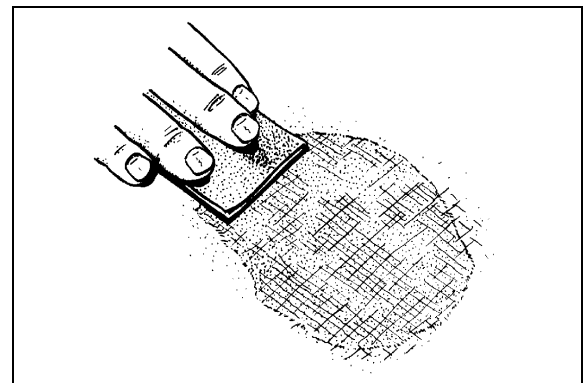


FIGURE 6: FIBERGLASS REPAIR

18092

Cover the area with a layer of resin putty and allow drying for approximately 15 to 20 minutes (Fig. 8).

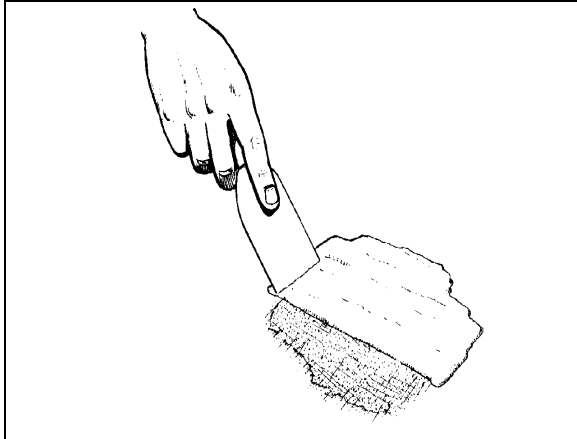


FIGURE 7: FIBERGLASS REPAIR

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. PAINTING

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.

Prevost 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 packagings, 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

5.4 FRONT AND REAR BUMPERS

5.4.1 Paint touchup and surface preparation for vehicles equipped with urethane bumpers

	COMMENTS	VIP	COACHES
Cleaning	Clean using red wool and Standoflex 11100 (ST-11425) thinner	YES	YES
	Clean again twice using Standoflex 11100 (ST-11425) thinner	YES	YES
Priming	Apply Non-Stop primer (ST-13320) with flexible agent dilution 2:1 10% in 2 or 3 coats, 15 min. flash/off between coats	YES	YES
Sanding	Sand Non-Stop primer using P-320 grit sandpaper	YES	YES
	Use a tack cloth	YES	YES
Basecoat	Apply basecoat. Wait 30 minutes.	YES	YES
Varnish dilution	Dilution without flexible agent	YES	YES
Varnishing	Apply varnish	YES	YES

If assistance or technical information on STANDOX products is needed, please dial: 1 (800) 551-9296

6. FRONT AND REAR BUMPERS

6.1 FRONT BUMPER REMOVAL AND INSTALLATION

The front bumper is hinged to give access to the spare wheel compartment. Bumper must first be tilted down before its removal. Two people are required to remove and install the front bumper.



WARNING

Front bumper weighs approximately 180 lbs. (80 kg). Use proper lifting equipment to support the bumper during the removal and installation operations to avoid personal injury.

Pull on the release handle located in the front electrical and service compartment. The bumper assembly will lower gradually.

6.1.1 Front Bumper Removal

Loosen 12 attaching bolts from inside the bumper, 6 over and 6 under the bumper beam (Fig. 9). Let the bumper rest face down on the lifting equipment platform.

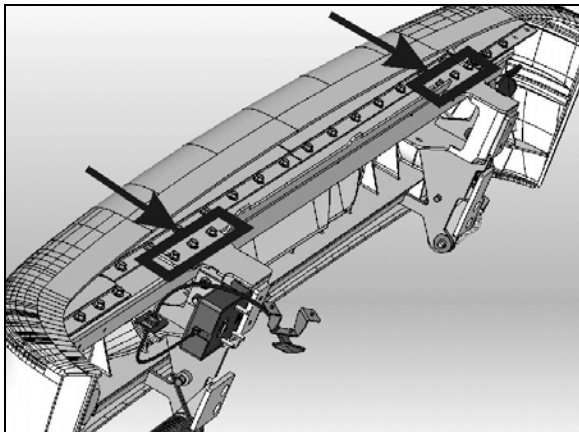


FIGURE 8: BUMPER ATTACHING BOLTS 18498

To reinstall the front bumper, reverse the procedure.

6.1.2 Front Bumper Skin Removal

The bumper skin is pinched to the bumper beam by the use of aluminum extrusions bolted over and under the beam. First, remove the front bumper as per "Front Bumper Removal". Let the bumper rest face down on the lifting equipment platform. Loosen the aluminum extrusion bolts as required and then detach the skin from the beam (Fig. 10).

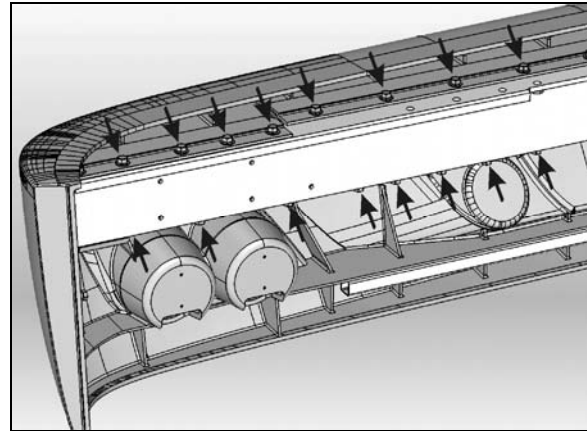


FIGURE 9: ALUMINUM EXTRUSIONS - BUMPER SKIN REMOVAL

6.1.3 Front Bumper Assembly Removal including spare wheel compartment door.

1. Ask assistant to relieve spring tension with assistant proper tool, and relieve spring tension on one locking pin and remove it. Slowly release spring tension and remove the second locking pin. The spring is free. Repeat procedure for the other spring.

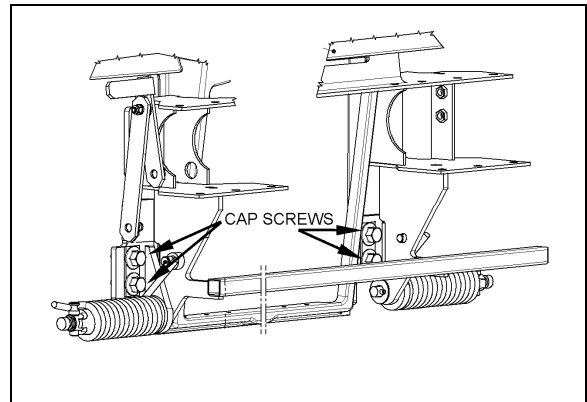


FIGURE 10: FRONT BUMPER ASSEMBLY

NOTE

A special tool kit is available from Prevost: Kit # 410671 including tool #410708.

2. Remove 4 cap screws holding bumper to vehicle and remove bumper (Fig. 11).
3. To install bumper, reverse the removal procedure.

6.2 FRONT BUMPER LICENSE PLATE SUPPORT INSTALLATION

License plate supports are stored in the first baggage compartment. Install supports as per figure 12.

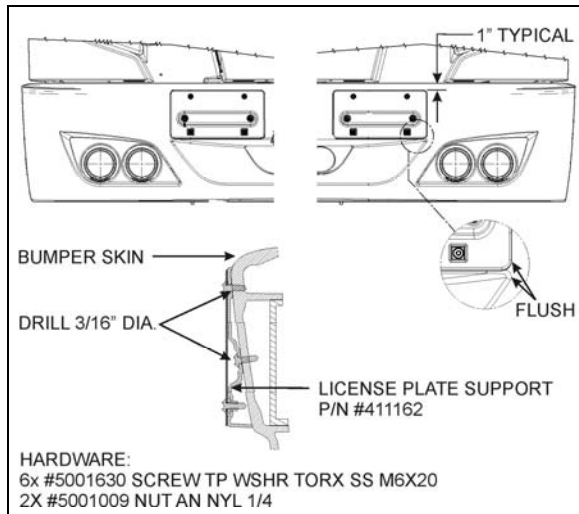


FIGURE 11: LICENSE PLATE SUPPORTS 18500A

6.3 REAR BUMPER REMOVAL AND INSTALLATION



WARNING

Rear bumper weighs approximately 180 lbs. (80 kg). Use proper lifting equipment to support the bumper during the removal and installation operations to avoid personal injury.

1. Remove 6 nuts (3 on each side) holding bumper assembly to vehicle and remove bumper (Fig. 13).
2. Let the bumper rest face down on the lifting equipment platform.
3. To install bumper, reverse the procedure.

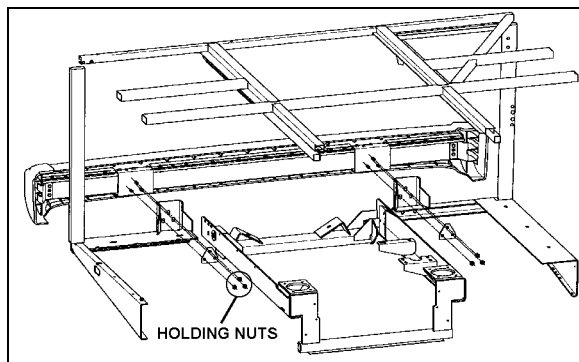


FIGURE 12: REAR BUMPER ASSEMBLY 18501

7. COACH 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 (Fig. 16). Door activation is controlled by a relay panel, located near the defroster and wiper motors. The accessory air reservoir supplies air to this system.

The door is held in the closed position during coach operation by 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 valves, which open 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.

7.1 OPERATION

The air-operated door is controlled from inside the coach by two push-button switches located on the R.H. dashboard.

Opening and closing of the door from outside the coach is accomplished by a momentary toggle switch located behind the coach model nameplate (Fig. 14).

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.

Section 18: BODY

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.

If the door has been locked with the key, a lever on the door can be moved to unlock.

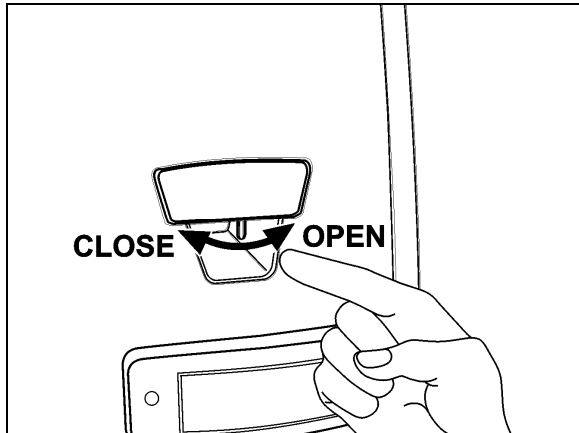


FIGURE 13: DOOR OPERATING SWITCH 18316

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 cylinders. From the exterior, an emergency exit valve located in the front service compartment, also releases the air from the lock cylinders.

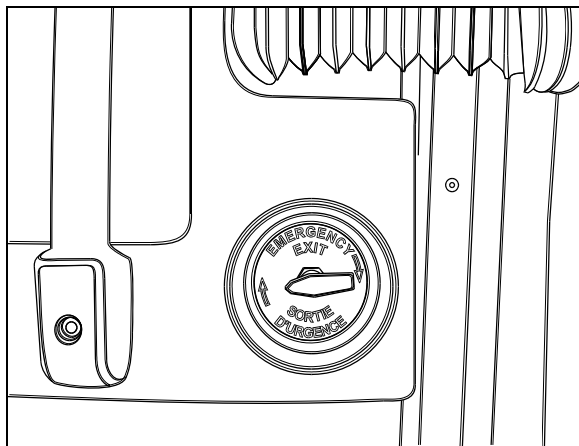


FIGURE 14: EMERGENCY EXIT VALVE 18321

7.2.1 Without Air and/or Without Electricity

If the air pressure drops while 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.

7.2.2 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.

7.3 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.

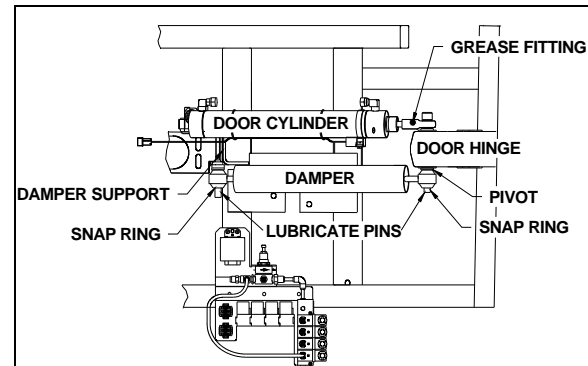


FIGURE 15: DOOR CYLINDER AND DAMPER 18161



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. 16):

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. 18).

NOTE

In figure 18, 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.

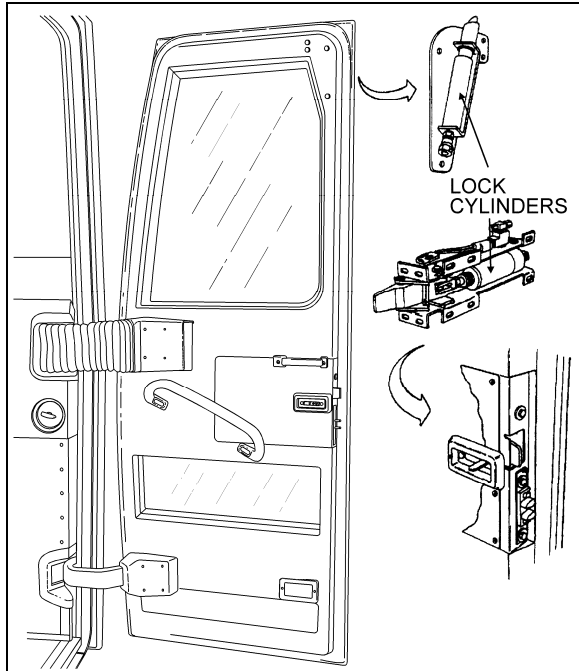


FIGURE 16: COACH ENTRANCE DOOR

18439

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.
5. 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.

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. 18)

6. The damper can now be refitted in the vehicle.
7. Reinstall panels and entrance door hinge cover.

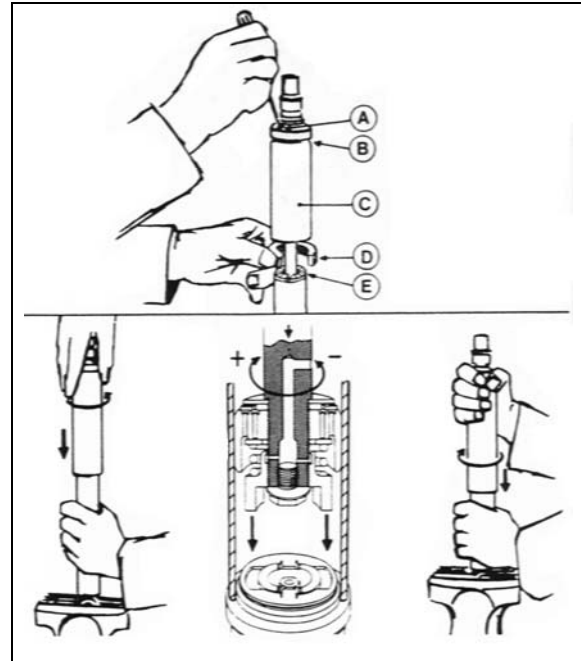


FIGURE 17: DAMPER

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 19.
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 entrance door does not interfere with the exterior panel.

Section 18: BODY

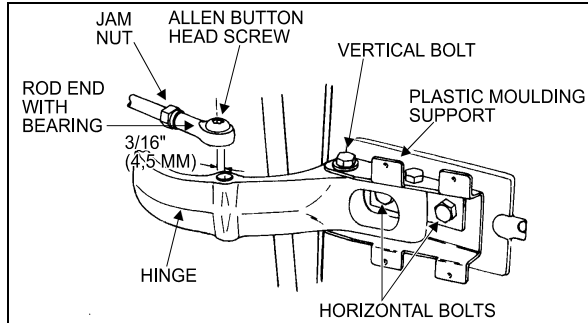


FIGURE 18: UPPER DOOR HINGE (COACH) 18058

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.

7.5 DEPTH ADJUSTMENT

1. Turn the emergency exit valve to the "UNLOCK" position.
2. Remove the screws and the plastic molding covering each of the hinges.

NOTE

Ask an assistant to help you to perform the following adjustments.

3. Remove the Allen button head screw and the washer retaining the ball and socket rod to the upper hinge. See figure 19.
4. Loosen the vertical bolts on the hinges for the front section, and for the rear section, move the central door catch on the door frame.
5. To adjust the male dovetail on L.H. side of the door, remove the two screws and loosen the two bolts. Slide the male dovetail toward the interior and loosely tighten the two bolts. Close the door slowly but firmly, then slowly open it and tighten the two bolts. Attach dovetail to the door with screws. See figure 20.

NOTE

The frame dovetail is not adjustable.

6. Pull and fasten the rod end to the hinge with the washer and the button screw.
7. Using the screws, attach the plastic moldings covering the hinges.
8. Reset the emergency exit valve to the normal position.

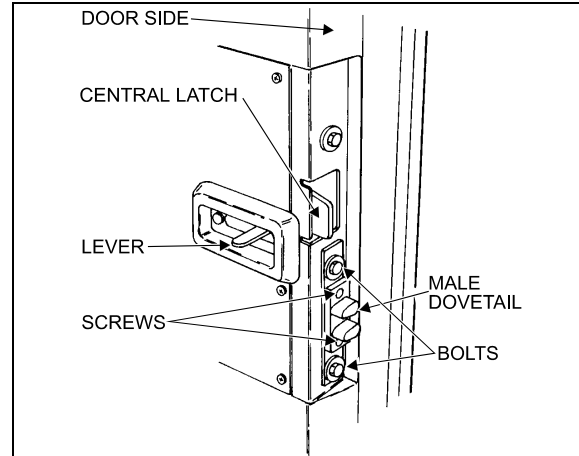


FIGURE 19: DOOR LATCH (COACH) 18059

7.6 ROD END ADJUSTMENT

1. Turn the emergency exit valve to the "UNLOCK" position.
2. Remove the screws and the plastic moldings covering the upper and lower hinges.
3. Remove the Allen button head screw and the washer retaining the rod end with bearing to upper hinge. See figure 19.
4. Loosen the jam nut locking the door cylinder rod end. Close the door firmly, adjust the rod end center hole in order to be 3/16" (4,5 mm) eccentric toward the left with the hinge hole center. Tighten the jam nut.
5. Pull and fasten the rod end to the hinge with the washer and the button screw.
6. Using the screws, attach the plastic moldings covering the hinges.
7. Reset the emergency exit valve to the normal position.

7.7 LUBRICATION

Part	Lubricant	Frequency
Latches Upper door catch Door cylinder rod end with bearing grease fitting (Fig. 16)	Low temperature grease	Every six months
Door locking mechanism	White grease	Every six months
Key hole Damper pins (Fig. 16) Hinges	Low viscosity oil	Every six months

7.8 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.
	The upper lock blocks the door	Adjust lower 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.
	Solenoid lock does 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.
DOOR 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.

8. ENTRANCE DOOR (V.I.P)

There are three ways of unlocking the entrance door from the inside of vehicle. The two first consist in actuating the rocker switch on the dashboard, but this last operation will also unlock the baggage compartments. Finally, you can unlock the door by sliding its lock lever to the left. If the orange tab on the door lock lever is visible, the door is unlocked.

You may lock/unlock the entrance door from the outside with the lock key provided with the vehicle. Turn key CCW to lock and CW to unlock the entrance door.

8.1 KEYLESS ENTRY SYSTEM

With this system, you can lock or unlock the entrance door as well as the baggage and service compartment doors. The keyboard is located below the entrance door handle. The module is pre-programmed by the manufacturer and this code can not be deleted. Moreover, you can program your own entry code. Refer to the "VIP Owner's Manual" for instructions on how to program your own entry code.

When you use the keyless entry system, the keyboard and stepwell lights illuminate. Do not push the buttons with a key, pencil or any other hard object as it could damage the buttons.

Although each button is provided with two digits separated by a vertical line, there is only one contact per button. Always press the center of the button (between the two digits, on the vertical line).

If you let more than five seconds pass between each button press, the system shuts down, and you have to enter your code again. If the keyless entry system does not work properly, use the key to lock or unlock entrance or compartment doors. To know more about the keyless system, refer to the "VIP Owner's Manual".

NOTE

You must unlock the entrance door before you unlock with the appropriate key any baggage or service compartment doors.

8.2 DOOR ADJUSTMENT

Check around the perimeter of the door for binding. If any binding is found, adjust as follows:

8.2.1 Horizontal and Vertical Adjustments

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.

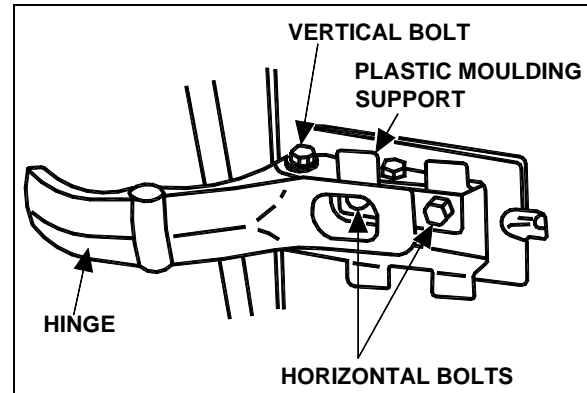


FIGURE 20: ENTRANCE DOOR (VIP)

18058VIP

2. Support the door with a wooden block and a hydraulic jack.
3. 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 Ft-lbs (40-50 Nm). Remove the jack and the wooden block.
4. Check door fit.
5. Using the screws, fasten the plastic trim to cover the hinges.

8.3 DEPTH ADJUSTMENT

To adjust door depth on the hinged side:

1. Remove the screws and the trim covering each of the hinges.

NOTE

Ask an assistant to help you to perform the following adjustments.

2. Slightly loosen, but not completely the vertical bolts on both door hinges.
3. Ask your assistant to press the door from the exterior, until it will adjust with the vehicle structure. Then, tighten the vertical bolts.
4. Repeat step 3 until depth is corrected to satisfaction.
5. Using the screws, install the trim hiding the hinges.

To adjust door depth on lock side:

Depth adjustment is done by moving the two door strikers.

1. Slightly loosen the door strikers.
2. Ask your assistant to press the door from the exterior, until it will adjust with the vehicle structure. Then tighten the striker pin.
3. Repeat until the door depth is corrected to satisfaction.

8.4 DOOR LOWER SECTION

When a plastic door lower section replacement is needed, proceed the following way:

1. Remove the reflective stripe at the top edge of the door's lower section. Unscrew the retaining screws located under the reflective stripe.
2. Remove the lower section.
3. With a sharp edge knife, scrape as much tape as possible and compound left on the fiberglass door surface. Note where adhesive tape and sealing compound was applied.
4. Sand the surface of the door where new adhesive tape will be applied with 240 grit sandpaper.

NOTE

Tape adheres best to smooth surfaces such as glass or gelcoat finishes. Be careful surface is as smooth as possible before applying tape.

5. Clean contact surfaces with alcohol.
6. Clean the fiberglass door and the new plastic lower section with a "tack cloth". Make only one pass on the surface and never come back on a previously cleaned surface.

**WARNING**

Wear rubber gloves and do not smoke when cleaning.

7. Prepare the door lower section with Sika #205 and a clean rag. Make only one pass on the surface and never come back on a previously cleaned surface.

NOTE

Never use Sika #205 directly from the container to avoid contamination of the product.

8. Wait at least 5 minutes before proceeding the next step to allow complete evaporation of the product.
9. Put new adhesive tape where it was previously applied. Pass a 1" (25mm) roller on it to get a good adhesion on the fiberglass.
10. Apply Sika #252 (Prevost #682462) compound where it was previously applied.
11. Remove protective paper from the adhesive tape and install the door lower section. Apply pressure with a roller where the lower door section touches the fiberglass door.
12. Replace the retaining screws.

8.5 REFLECTOR STRIPE INSTALLATION

1. Clean contact surfaces with alcohol.
2. Prepare surface of reflector stripe and door lower section with Sika #205.
3. Put two rows of adhesive tape on the lower door section.
4. Apply Sika #252 (Prevost #682462) compound between parallel tape stripes.
5. Remove protective paper from the adhesive tape and press the reflective stripe in place.

8.6 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.

**WARNING**

Wear rubber gloves and do not smoke when cleaning.

5. Peel of protective paper from the seal. Position the seal in order to leave ¼" (6 mm) from the upper molded edge of the door and

Section 18: BODY

3/16" (4,5 mm) from the sides and lower molded 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.

8.7 DOOR LUBRICATION

Part	Lubricant	Frequency
Latches Upper door catch	Low temperature grease	Every six months
Door locking mechanism	White grease	Every six months
Key hole Hinges	Low viscosity oil	Every six months

8.8 DOOR LATCH MECHANISM

Generally, when the latch mechanism malfunctions, a number of causes may be responsible for this situation. No single procedure will correct this situation. It is best to remove the protective cover and to look for binding, used or bent parts. Operate the latch mechanism and try to find where any binding occurs. Replacing a part or slightly bending a rod should be enough. Remember, having a global understanding of the mechanical activity will generally lead you to the cause of the problem, and ultimately to an easy repair.

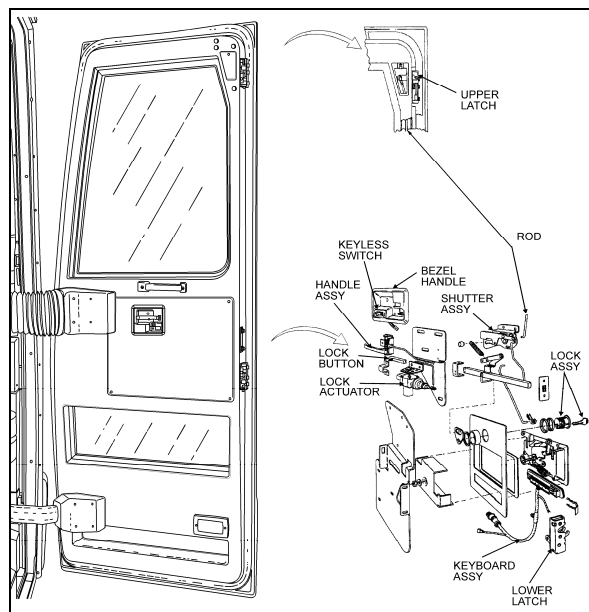


FIGURE 21: ENTRANCE DOOR (VIP, TYPICAL)

18440

9. DRIVER'S POWER WINDOW

To replace window or motor, the whole assembly must be removed. The following instructions refer to figure 23.

9.1 POWER WINDOW REMOVAL

1. Raise the driver's power window.
2. Set the battery master switch to the OFF position.
3. The window must be held in upper position. To do so, use duct tape to hold it in place.
4. Gain access to the power window mechanism. Dismount the driver's area lateral control panel and left interior trim. It may be required to remove the driver's seat and dashboard panel.
5. Unfasten bolts (item 1) fixing the window to the lifting mechanism (actuator).
6. Remove the three bolts (item 2) holding the motor support and actuator assembly in place.
7. Detach the plastic water protection shield and remove the assembly by slipping it under the vehicle structural members.
8. Dismount the window support and lower the window completely to release it from its guides.
9. Detach the motor and actuator guide from the support and plastic shield. Replace parts as required.

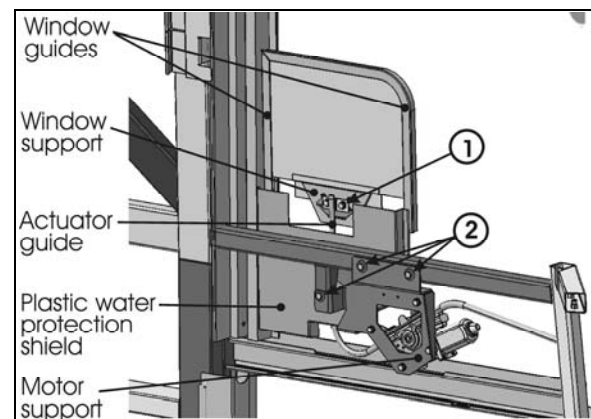


FIGURE 22: DRIVER'S WINDOW

23358


9.2 POWER WINDOW INSTALLATION

1. Energize the motor and position the actuator to its full extended position.

2. Using alcohol, a sharp knife or 240-grit sandpaper, clean off the butyl strip from the shield and frame. Install new butyl strip on plastic shield.
3. Install new window in opening. Use duct tape to hold it in upper position. Fix the window support using bolts recovered from disassembly. Use Loctite on threads.
4. Fasten window support to actuator using the recovered bolts (item 1). Use Loctite on threads.
5. Expose the other sticky side of the butyl strip. Install motor support and actuator assembly using recovered bolts (item 2). Stick plastic shield in place.


10. 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 section 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.

10.1 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 figures 24 and 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.

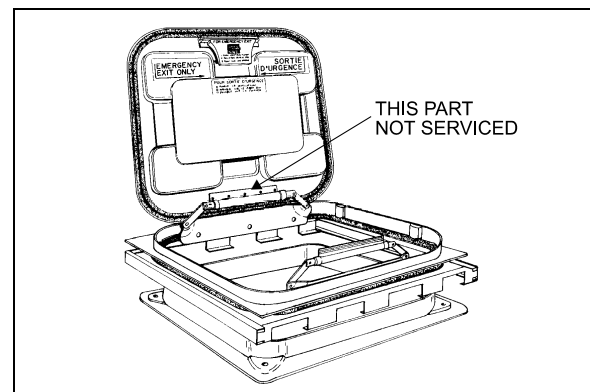



FIGURE 23: ESCAPE HATCH

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10.2 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.

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3. Apply rubber adhesive CA-40 (Prevost # 681285) in the gap between the seal ends.
4. Apply Sikaflex 221 sealant (Prevost # 680532) along the outline of the escape hatch on the roof of vehicle.

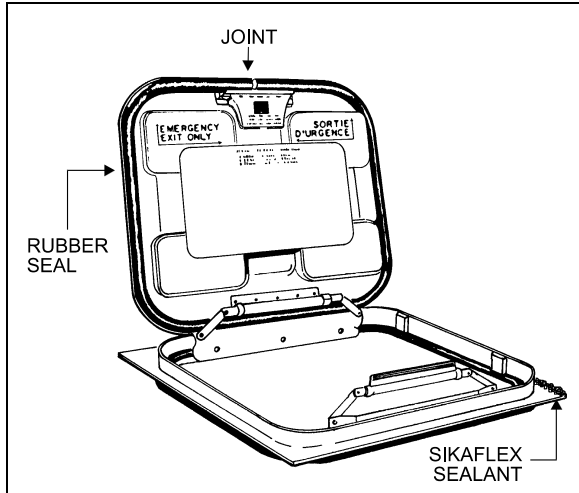


FIGURE 24: ESCAPE HATCH

18105

10.3 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.

10.4 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.

11. REPAIR OR REPLACEMENT OF “TARABUS” FLOOR COVERING

“Tarabus” covering installed in H3 coaches may be replaced or repaired. 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

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 27).

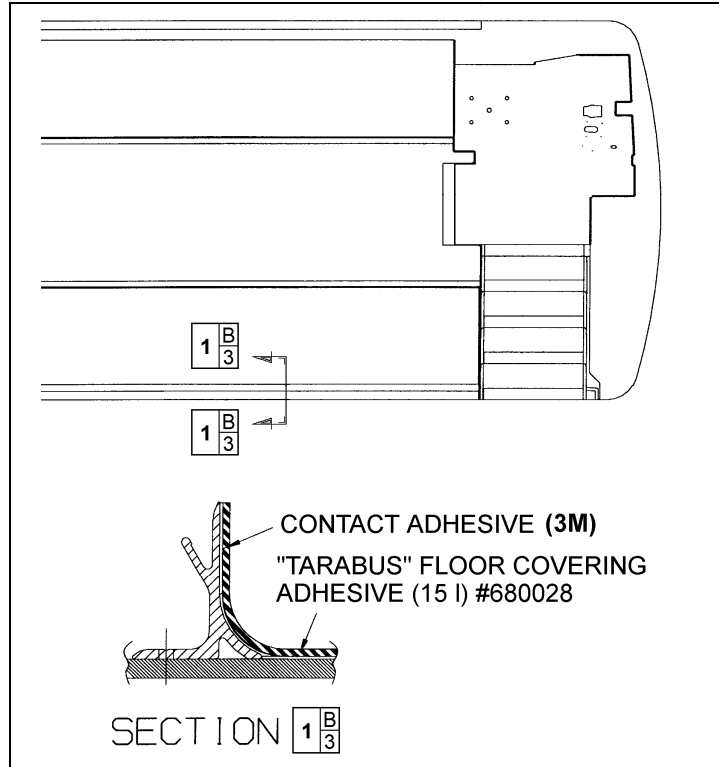


FIGURE 25: TARABUS FLOOR COVERING ADHESIVE APPLICATION

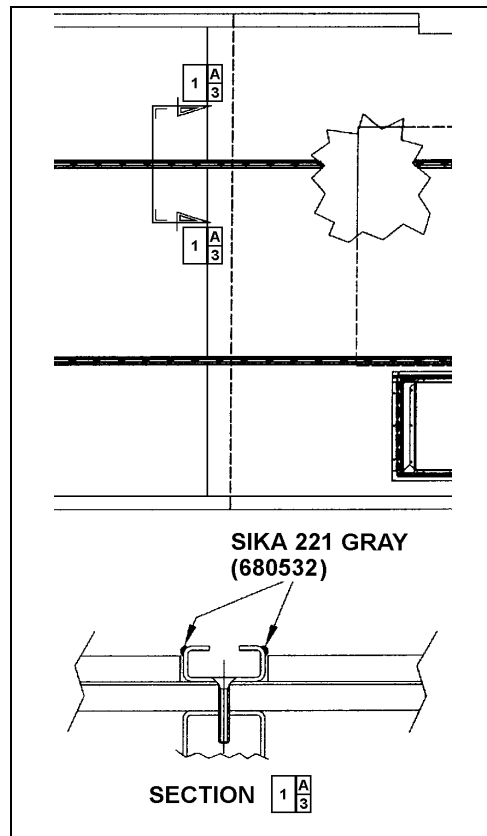


FIGURE 26: APPLICATION OF SIKA 221 GRAY

11.1 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
684654	Adhesive, Contact (3M)	3.8L
684655	Adhesive, Contact (3M)	18.9L
684517	Sealant, gray	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	
	<p>1. Apply</p> <p>CHIX cloth</p>
	<p>2. Dry immediately</p> <p>Blue cloth</p>
3. Allow drying	
Mandatory	<p>Minimum time : Wait for product to evaporate</p> <p>After 2 hours: Start cleaning operation again</p>
Before applying any other product	<p>If surface seems dusty, greasy or with finger marks, start cleaning operation again.</p>

3. Apply Sika Primer 215 (refer to Section D).

Section D Sika Primer 215		
	<p>1. Shake bottle to mix product</p> <p>2. Apply a thin layer</p>	<p>CHIX cloth</p>
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.

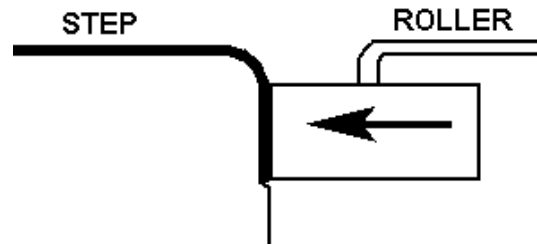
PREPARATION OF FIBERGLASS

1. Clean using anti-silicone (refer to Section A).
2. Apply Sika 205 (refer to Section B).

Section B Sika 205			
	<p>1. Apply</p>	<p>CHIX cloth</p>	
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.	

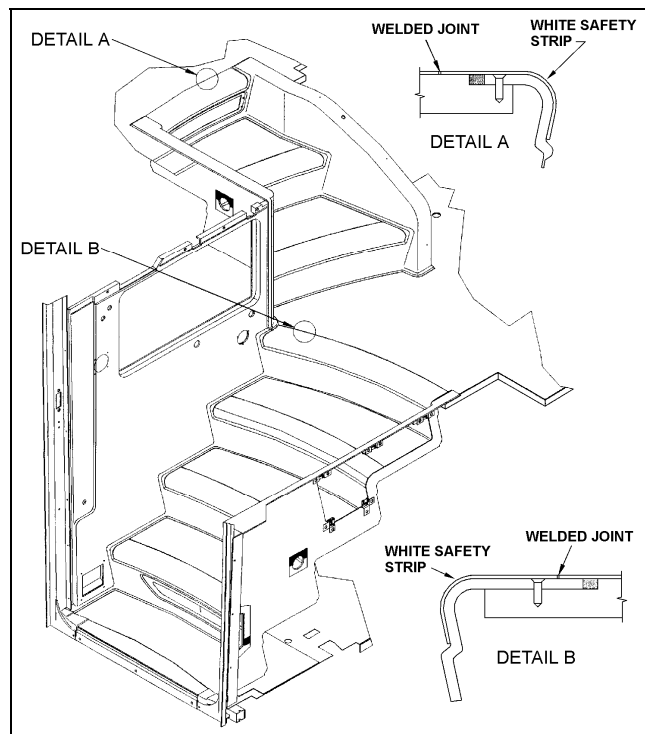
H3 VEHICLE FRONT STEPS GLUING

1. Remove adhesive tape from underneath step.
2. Apply a thin and even layer of contact adhesive (3M) (684655 or 684654) onto fiberglass and step surfaces. Allow drying for 3 to 5 minutes.
3. Install step beginning with the back and finishing with step nosing. Compress step covering using a roller paying particular attention to corners, edges and front of step.
4. Apply a bead of sealant (684517) around the perimeter of steps. Smooth out the joints.



GLUING OF WHITE SAFETY STRIP BETWEEN STEP AND “TARABUS” FLOOR COVERING

1. Sand fiberglass using “Scotchbrite”.
2. Clean using tack cloth.
3. Clean twice using anti-silicone (refer to Section A).
4. Protect surfaces around the step with masking tape.

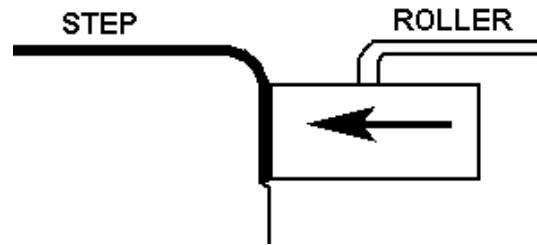


5. Apply contact adhesive (3M) (684655 or 684654) onto both surfaces to glue (fiberglass and back of white safety strip). Drying time: 4 to 5 minutes.

NOTE

There should be no floor covering adhesive (680028) onto plywood before applying contact adhesive, otherwise the two surfaces won't stick.

6. Position white safety strip with reference to “Tarabus” step covering finishing with step nosing. Compress step covering using a roller paying particular attention to corners, edges and front of step.



NOTE

Keep a gap of 1 to 1.5 mm between "Tarabus" covering and white safety strip.

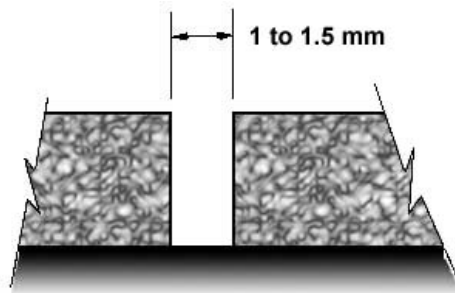
7. Remove masking tape.

11.2 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.

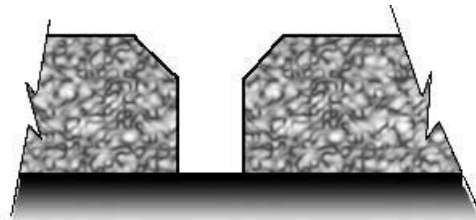
2. Before welding, visually ensure that a 1 to 1.5 mm gap exists between white safety strip and "Tarabus" floor covering. Use a knife if this is not the case.



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.

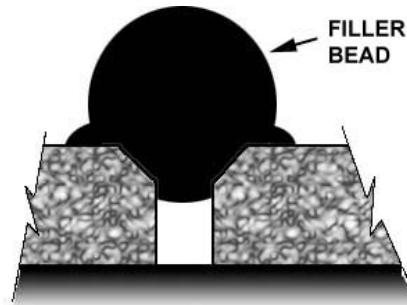


8. The heel of the fast nozzle must not lean against "Tarabus" covering (always parallel to the surface).



9. Allow cooling down of filler bead (about 5 minutes).

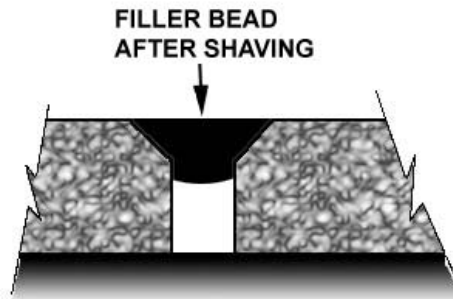
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10. Shave filler bead to make it level to the floor. Use supplied knife designed for that purpose.

NOTE

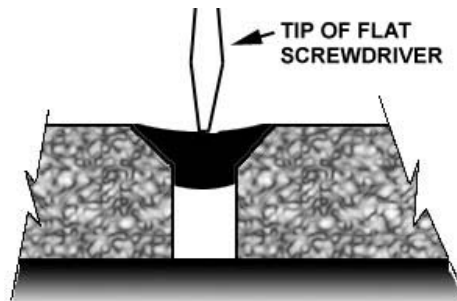
To facilitate the cut, you can spray some soapy water onto the joint.



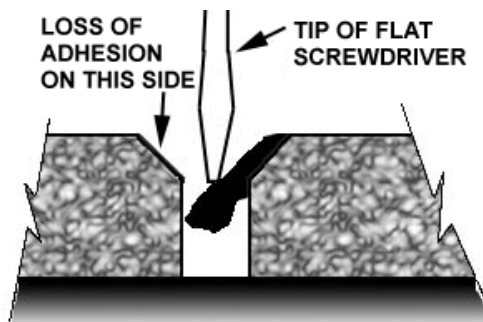
CAUTION

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 be a loss of adhesion on one side. If this is the case, repair the joint.



11.3 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 3, 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.

12. PASSENGER SEATS

H3-41 and H3-45 coaches can be equipped with any of 2 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. Standard seating capacity is 48 in H3-41 and 56 in H3-45.
2. 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 cushion frame for cleaning or replacement. To remove the fabric, simply unclip from the frame. The "Tourismo 2" seats have 3 armrests. The aisle and center armrests can be folded up and down manually, while the window armrest is fixed.

12.1 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.

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12.2 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 figures 28 and 29.

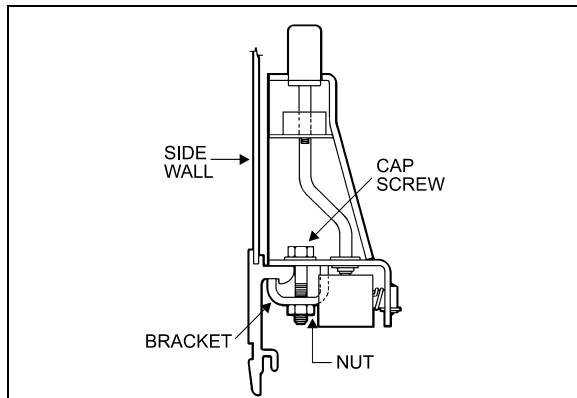


FIGURE 27: ARMREST

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5. Remove 2 nuts and washers holding seat frame to pedestal rods.

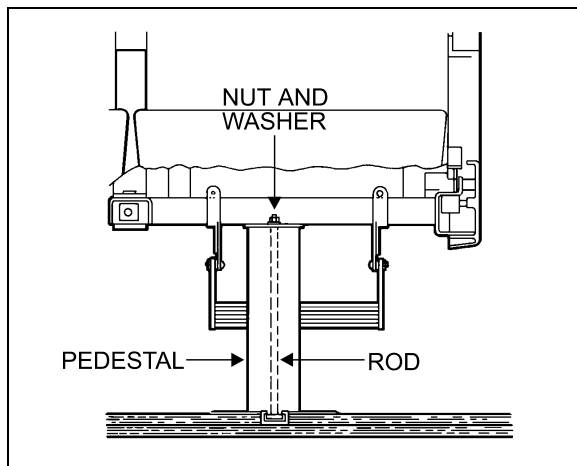


FIGURE 28: SEAT PEDESTAL ASSEMBLY

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NOTE

Bottom end of rod is coated with Loctite 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.

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.

12.3 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.

12.3.1 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 become excessively dirty, particles of grit will cause gradual wear, reducing the life span of the fabric.

12.3.2 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.

12.3.3 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.

13. COACH SIDE WINDOWS

Seven passenger side windows are provided on each side on H3-41, while the H3-45 has eight. 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.

The two trapezoidal windows are also mounted on an aluminum extrusion (except for H3-45 VIP, where they're mounted with adhesives. Refer to "Adhesive Mounted Windows" in this section, for more information on this type of installation). The trapezoidal windows are made

of fixed, double glazed, heat absorbing AS-3 tempered safety glass inside and tempered glass outside.

13.1 EMERGENCY EXIT WINDOWS

Three of the windows on each side serve as emergency exits on the H3-41, while there are three of them on curb side of the H3-45, and four on driver's side. See figures 30 and 31.

Except for the window upper edge, the three other glass edges 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.

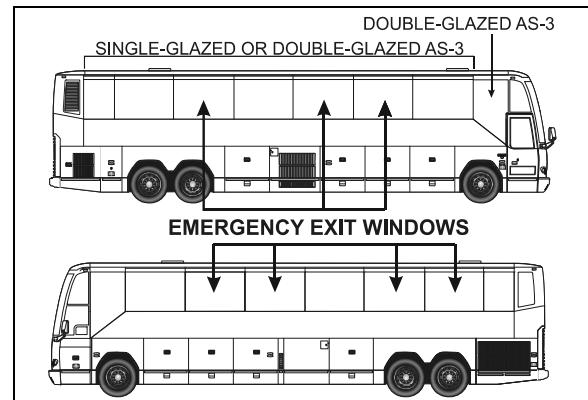


FIGURE 29: H3-45 COACH

18519

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.

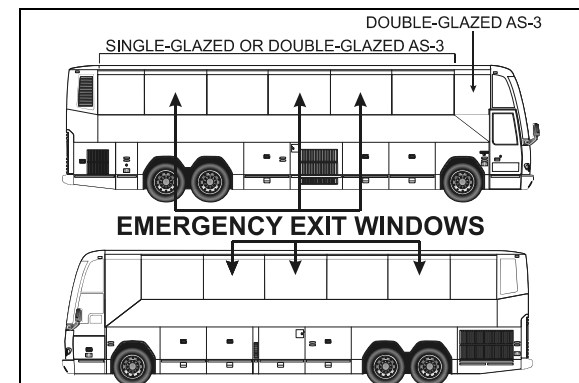


FIGURE 30: H3-41 COACH

18520

Section 18: BODY

13.2 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. To install a new release bar, reverse the procedure.

NOTE

Check the legal twenty pound maximum resistance to be sure to comply with regulations.

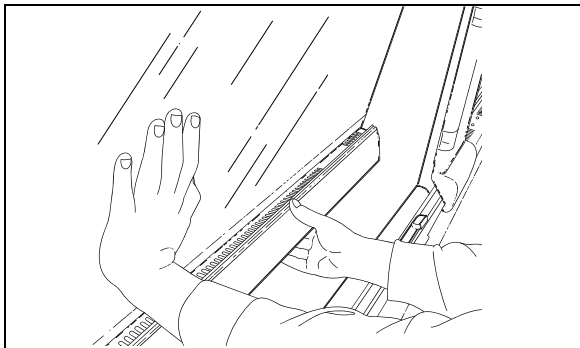


FIGURE 31: EMERGENCY EXIT WINDOW 18391

13.2.1 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.

13.3 FIXED WINDOW REPLACEMENT

When it becomes necessary to replace the glass of a fixed-type window, follow this procedure:

1. Unscrew the decorative plate and the bottom window bar in order to get access to the window retaining devices.
2. Remove the window bottom retaining bolts.
3. Push the glass window out ninety degrees (90°).



WARNING

The window may fall out.

4. The window is free and can be unhooked.
5. Reverse procedure to install a new one.

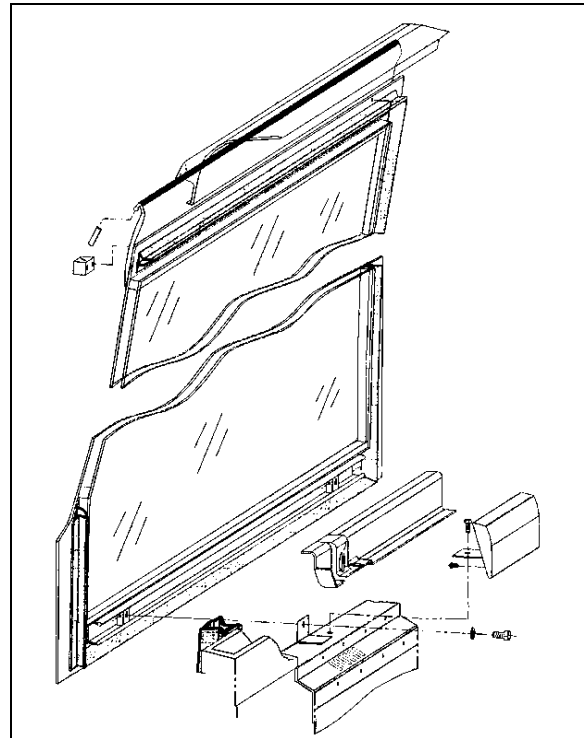


FIGURE 32: FIXED WINDOW 18434

NOTE

For all window replacement, it is extremely important to center the top side between the window dividing posts with great precision in order to be able to attach the bottom of window and the structural posts.

13.4 EMERGENCY EXIT WINDOW REPLACEMENT

1. Lift the bar release system and follow the same procedure mentioned above for fixed windows.

2. Remove the stop blocks from the top exterior of the window.
3. Reverse the procedure to install a new emergency exit window.

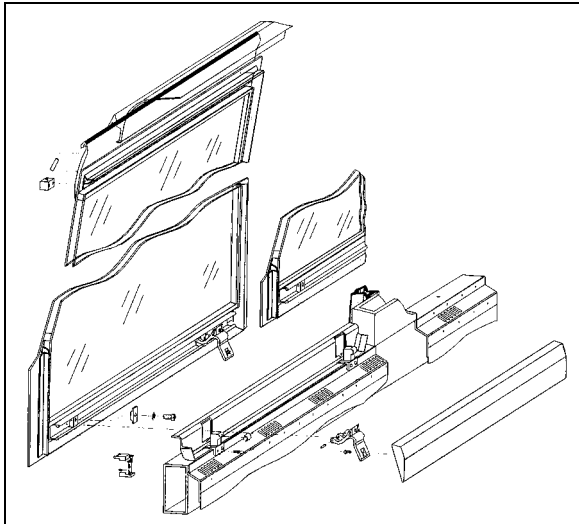


FIGURE 33: EMERGENCY WINDOW

18435

13.5 TRAPEZOIDAL WINDOW REPLACEMENT

Apply procedure for fixed window replacement described in this section but with these variations:

- The angle at which the window will detach is considerably smaller (about 45°);
- These windows are also glued to the structure at certain areas on their perimeter. Note where adhesives are used and apply gluing techniques at these areas to complete replacement of these windows.

13.6 SMALL REAR WINDOWS REPLACEMENT

These small windows are located at the vehicle's rear end, just forward of the lavatory.

Apply procedure for fixed window replacement described in this section but with these variations:

- The angle at which the window will detach is considerably smaller (about 45°);
- These windows are also glued to the structure at certain areas on their perimeter. Note where adhesives are used and apply gluing techniques at these areas to complete replacement of these windows.

Both the trapezoidal windows and the small rear window are fixed in place with adhesives. They are not serviceable, in the event that they may need replacement.

13.7 ADHESIVE-MOUNTED WINDOWS

These windows are located in the vehicle's front and rear caps (Fig. 35).

The adhesive-mounted windows are fixed, double-glazed, heat absorbing AS-2 or AS-3 glass mounted in their opening with polyurethane windshield adhesive. The double-glazed windows are tempered safety glass outside and inside.

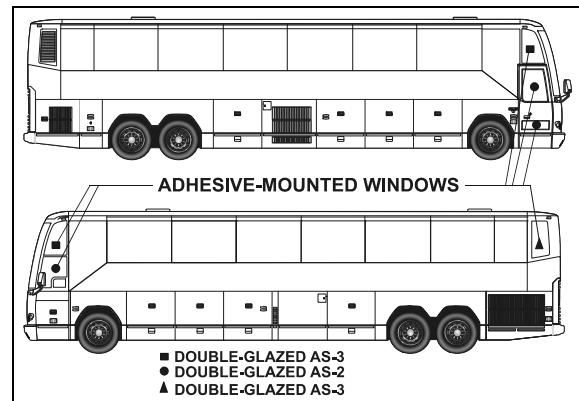


FIGURE 34: ADHESIVE-MOUNTED WINDOWS

18494

13.7.1 Glass Window Replacement

Items Needed:

- Scraper with new blade;
- Masking tape;
- Tremshield tape (Prevost #681089);
- Chix cloths (Prevost #682384);
- Isopropyl alcohol or enamel reducer or NAPA 6383 surface cleaner;
- Sika 205 cleaner;
- Sika 255 F.C. adhesive;
- Disposable vinyl gloves;



WARNING

Wear disposable vinyl gloves during this procedure. Do not smoke. Dispose of unused toxic material properly. Heed all warnings on product containers.

1. Remove old window glass and scrape off remaining material up to 1/16" to 1/8" (2 to 3 mm) thick.

NOTE

Hardened adhesive will not remove easily. A new blade works best to remove all adhesive residue using care not to damage the fiber structure.

Section 18: BODY

- Place the new window glass in the opening and center it to leave an even gap top and bottom, and from side to side.

NOTE

Use small shims to raise the glass in proper position. Shims can be cut from the tremshield tape (Fig. 36).

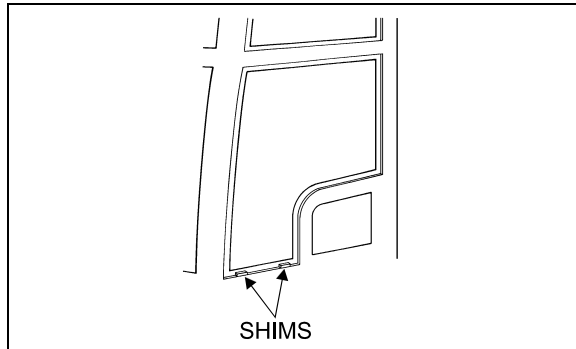


FIGURE 35: ADHESIVE-MOUNTED WINDOW 18079

- Hold the window glass centered and have an assistant mark the inside contour of the opening on the glass with a china pencil. Remove glass and place it on a table with the pencil mark facing up.
- Place masking tape on the inside surface of the glass to just cover the china pencil mark, leaving the outer surface exposed for the adhesive. This will make cleanup much easier. For ease of removal, do not overlap the tape at corners.

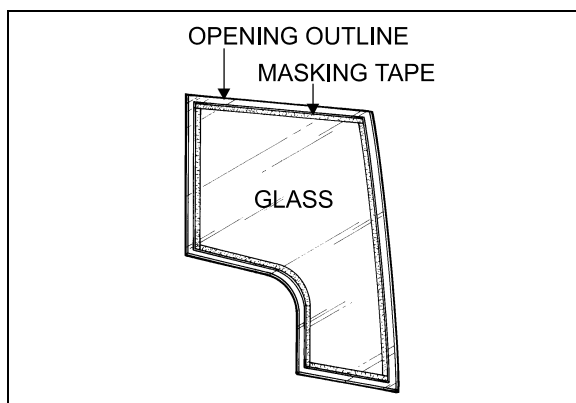


FIGURE 36: ADHESIVE-MOUNTED WINDOW 18080

- Clean all around the window opening and the window glass edge with Sikaflex 205 (shake well before applying). Let dry 5-6 minutes minimum but no more than 8 hours.



CAUTION

There must be absolutely no silicone on glass or channel or Sikaflex 255 FC will not stick.

- Put masking tape on the inner and outer contour of the window opening on the structure, approximately 1/16" (1,5 mm) from the edges of the contour.
- Install Tremshield tape around the sealing surface of the window opening.

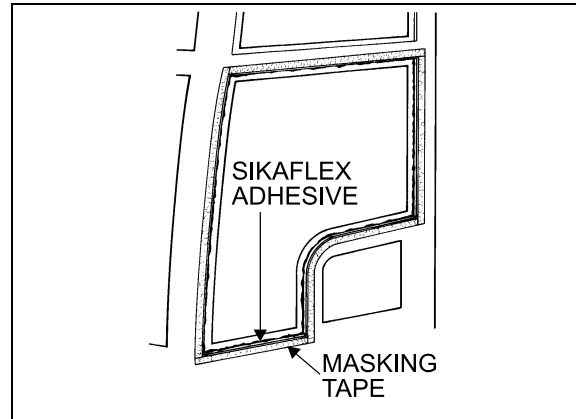


FIGURE 37: ADHESIVE-MOUNTED WINDOW 18081

- Apply a generous bead of Sikaflex-255 FC polyurethane adhesive on the sealing surface around the window opening from outside the vehicle.

NOTE

To ease applying of Sikaflex 255 FC, it may be heated to 86° F (30°C).

NOTE

Bead should touch the side surface of the window opening.

- Place shims correctly, and position window glass in the opening. Press firmly and evenly. Excess adhesive should flow out from behind glass.

NOTE

Add adhesive in areas where overflow is minimal or if air bubbles are present.

- Smooth the adhesive joint using your finger (wear vinyl gloves). Remove excess material around both sides of the window as soon as possible before adhesive dries.

NOTE

Remove most of the adhesive from the scraper or trowel with a rag, and then dip tool in heavy hydrotreated naphtha (vanishing oil) after each use for cleaning.

**CAUTION**

Never use solvents to clean excess adhesive.

11. Remove masking tape at once, clamp window glass suitably and let dry overnight or at least 8 hours.
12. Spraying pure water on the joint will accelerate the drying process.

14. ELECTRIC AWNING WINDOW

The electric awning windows are connected directly on the batteries 24 V DC terminal block. As a result, they can be operated regardless of the state open or close of the master switch. However, the circuit is protected with fuse F41 (10A) located in the front service compartment.

14.1 OPERATION

Opening sequence: switch is set to the OPEN position. Window latch solenoid SOL1-A and SOL1-B are turned on along with M1 window motor. Once the latch is open, proximity switch PROX1 is de-activated, turning sol1-A and SOL1-B off.

Closing sequence: switch is set to the CLOSE position, turning on relay R1 which turns on M1 in reverse polarity, closing the window. Once the window is closed, PROX1 is activated, turning on SOL1-A and SOL1-B in reverse polarity latching the window closed.

14.2 WINDOW REMOVAL

Replacement awning window does not include a new motor. If in working order, transfer the motor of the replaced window to the replacement window. If not, the motor can be bought separately. When replacing the window, keep the components in working order as spare parts.

1. Push the vertical latch handle downwards to release the track and then open the window using the horizontal latch handle.
2. Take out the screw at the lower end of the track to let free the swiveling arm roller.
3. Unplug connector C7 & C9. Dismount the gas spring from the window.
4. Loosen the set screws #5 (figure 40)(rotate the arm to get to the second set screw) and disengage the swiveling arm from the motor shaft extension.
5. Push the glass window out ninety degrees (90°).

**WARNING**

The window may fall out.

6. The window is free and can be unhooked.
7. Reverse procedure to install a new one.

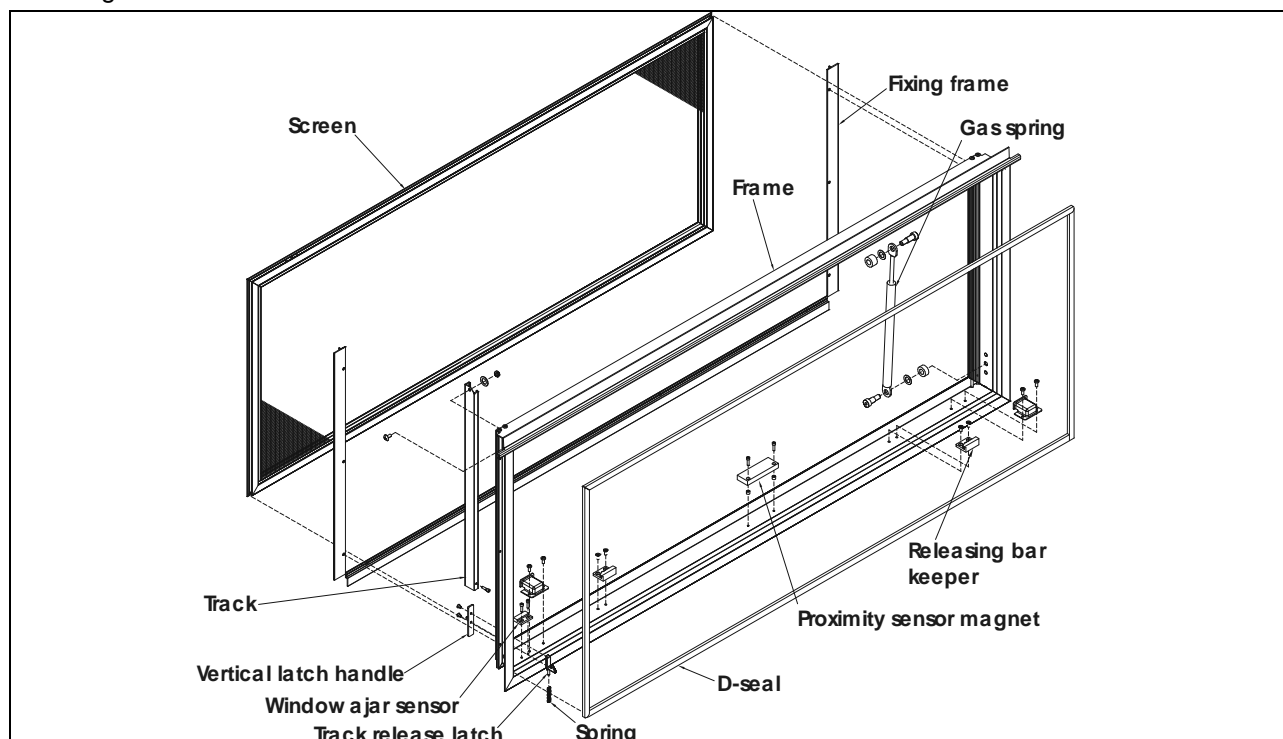


FIGURE 38: ELECTRIC AWNING WINDOW EXPLODED VIEW (FRAME)

18586

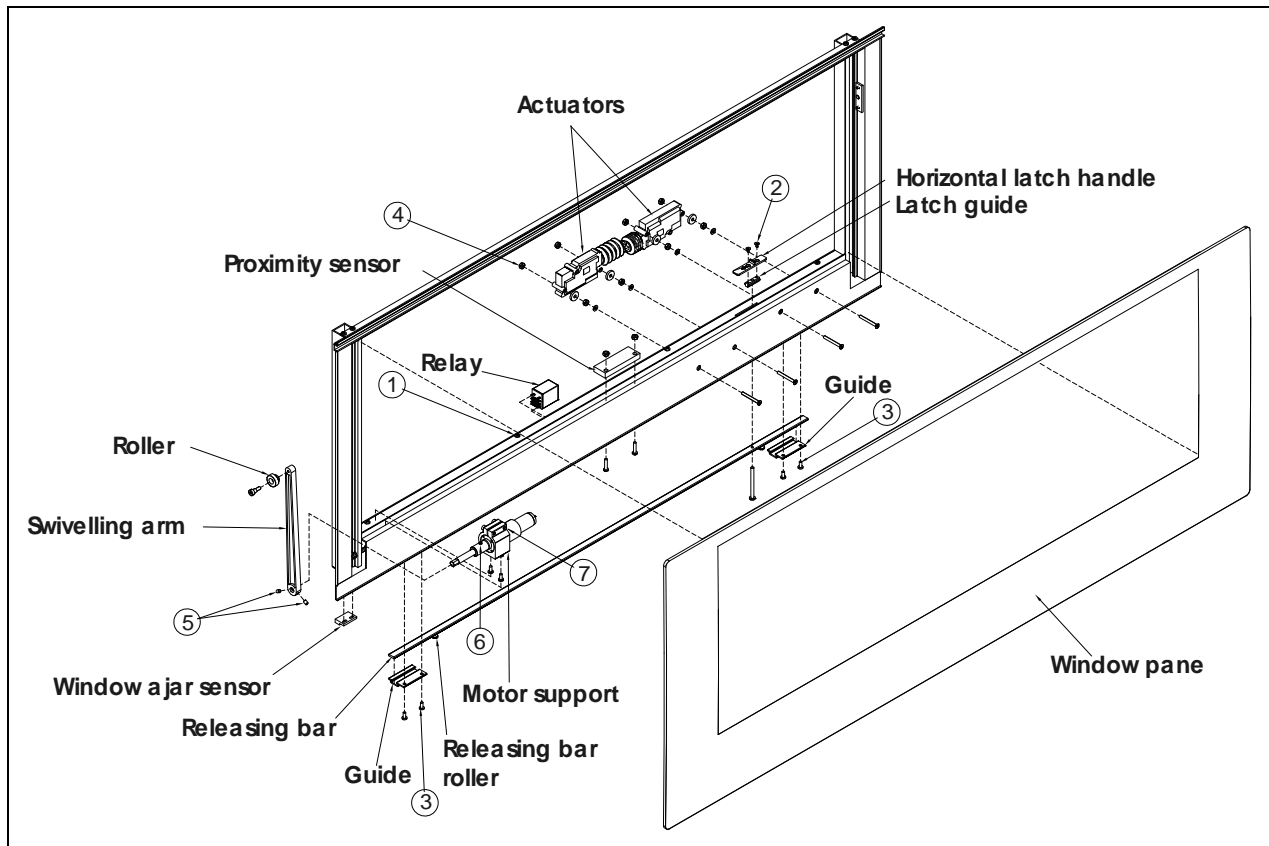


FIGURE 39: ELECTRIC AWNING WINDOW EXPLODED VIEW (SASH)

18583

14.3 ACTUATOR REPLACEMENT

1. Push the vertical latch handle downwards to release the track and then unlatch the window using the horizontal latch handle.
2. Remove actuator access cover by taking out screws #1 (8x).
3. Take out screws #2 (2x) and remove horizontal latch handle and guide.
4. Take out the guide screws #3 (4x) and remove releasing bar.
5. Unplug connector C3 or C4 from problem actuator, unscrew nuts #4 (2x) and remove the actuator.
6. Reverse operations for reinstallation.

3. Remove actuator access cover by taking out screws #1 (8x).
4. Loosen the set screws #5 (rotate the arm to get to the second set screw) and disengage the swiveling arm from the motor shaft extension.
5. Unplug motor connector C2 and dismount motor and support assembly.
6. The shaft extension is glued to the motor shaft. It has to be heated to break the binding to permit removal. Loosen set screw #6 and remove the shaft extension. Also loosen screw #7 and remove motor from the support.
7. Reverse operations for reinstallation.

14.4 MOTOR REPLACEMENT

1. Push the vertical latch handle downwards to release the track and then unlatch the window using the horizontal latch handle
2. Take out the screw at the lower end of the track to let free the swiveling arm roller.

ELECTRIC AWNING WINDOW – CONVERTER CHECKLIST	
<p>Check the electrical circuit & proximity sensor</p>	<p>A: The latching system will not operate without power.</p> <p>Is there electrical power to the latching circuit? The horizontal latch handle, on the sill sash will be seen to move if there is power on this circuit, or it can be checked with an electrical tester. If there is no power to this circuit when the window is closed and either rocker switch are switched "ON", there is a problem with the electrical system.</p> <p>B: The Proximity Sensor on the sash may not be switching power to the latching circuit if the magnet is not getting close enough to the switch OR the Proximity Sensor may be broken (or stuck in one position).</p> <p>Is the proximity sensor switching when the window is closed?</p>
<p>Check the release force required to operate the horizontal latch handle</p>	<p>A: If the pull force required to move the latch is more than 20lbs the window will not latch properly. Average pull force during testing by manufacturer is 12lbs -15lbs.</p> <p>What is the force required to release the handle? Check using a force gauge (same test done by manufacturer).</p>
<p>Check Installation</p>	<p>A: If the window is too tightly installed OR if the sequence for tightening the clamping frame screws is incorrect the window may not close properly.</p> <p>Was the window installed correctly?</p> <p>Was the correct sequence (see below) used when tightening the clamping frame screws?</p> <div style="text-align: center;"> </div> <p>B: Removing the shipping blocks before the window is installed can create major problems.</p> <p>Were the shipping blocks in place during installation?</p> <p>C: Failure to remove the shipping blocks after installation can create interference between sash and frame.</p> <p>Have the shipping blocks been removed after installation?</p> <p>D: The window is misaligned or not installed squarely.</p> <p>Is there interference with any coach parts?</p> <p>Is there proper clearance between the bottom of the outer glass and the belt-line trim / seal?</p>
<p>Check for missing parts or misaligned parts</p>	<p>A: The frame and sash are misaligned.</p> <p>Is there any interference between the sash and frame?</p> <p>Is there clearance between the sash and the rocker switch covers?</p> <p>B: Releasing bar guides are missing.</p> <p>Check that the releasing bar guides are installed. There should be 4 installed on H windows, and 3 installed on XL2 windows.</p>

15. ELECTRIC SLIDING WINDOW

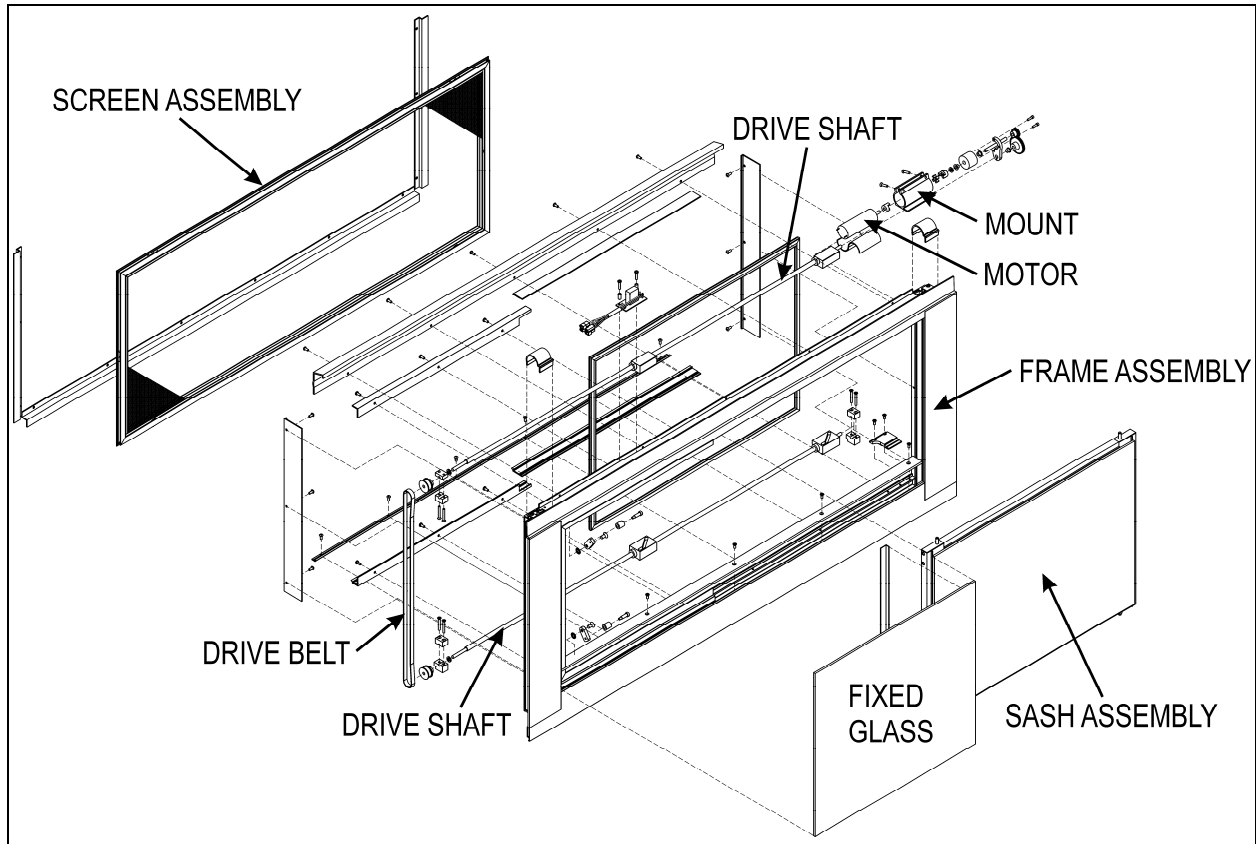


FIGURE 40: ELECTRIC SLIDING WINDOW EXPLODED VIEW

Sash Removal

1. Remove the Screen Assembly
2. Pull down on both release latches simultaneously and rotate the sash inwards approximately 10 degrees.(Figure 43)



FIGURE 41: REMOVING THE SASH

3. Lift the sash up and out to disengage the bottom of the sash from the window frame. (Figure 42)



FIGURE 42: DISENGAGING THE BOTTOM OF THE SASH

Installation

1. Align the leading edge of the slot on the lower cam follower block with the sash stop. Use the power toggle switch to obtain the correct alignment. (Figure 44)

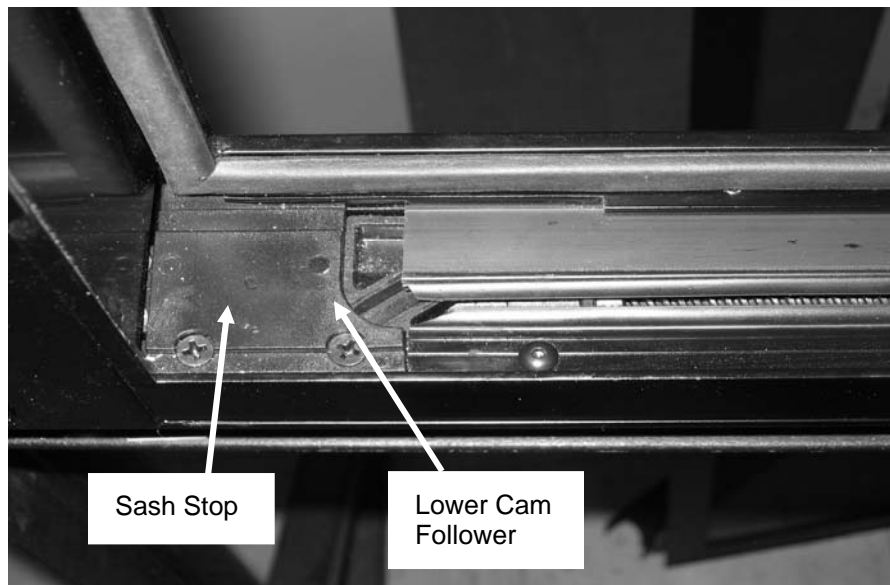


FIGURE 43: PROPER ALIGNMENT

2. Position the left hand lower corner of the sash over the front cam follower block (Figure 45)

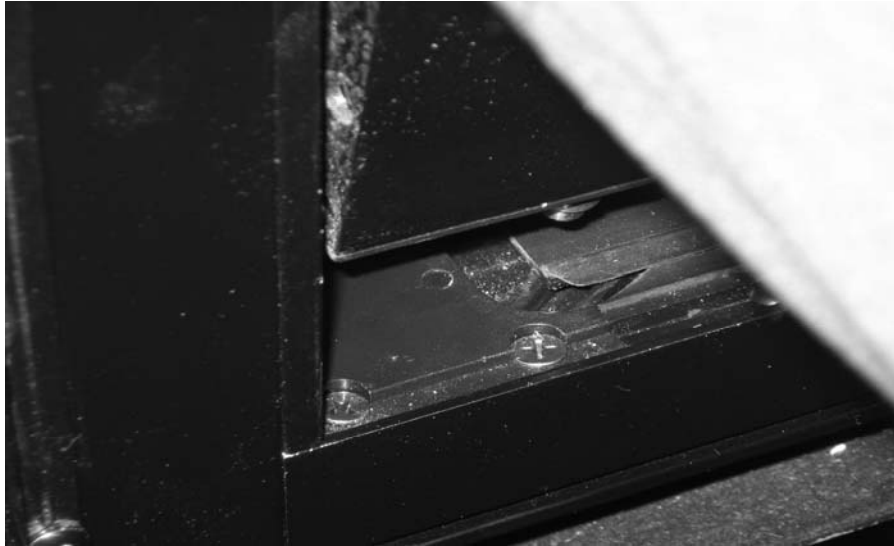


FIGURE 44: POSITIONING THE LOWER LEFT CORNER OF THE SASH

3. Engage the sash pin with the leading edge of the slot of the cam follower block. Do the same at the rear of the sash.
4. Pull down on the release latches and rotate the sash inwards until it is parallel with the window frame.
5. Release the latches to engage the latch pins with the upper cam follower blocks.
6. Confirm that both latches are in the closed (latched) position. The upper edge of the latch opening must be aligned with upper edge of the sash opening (Figure 46)

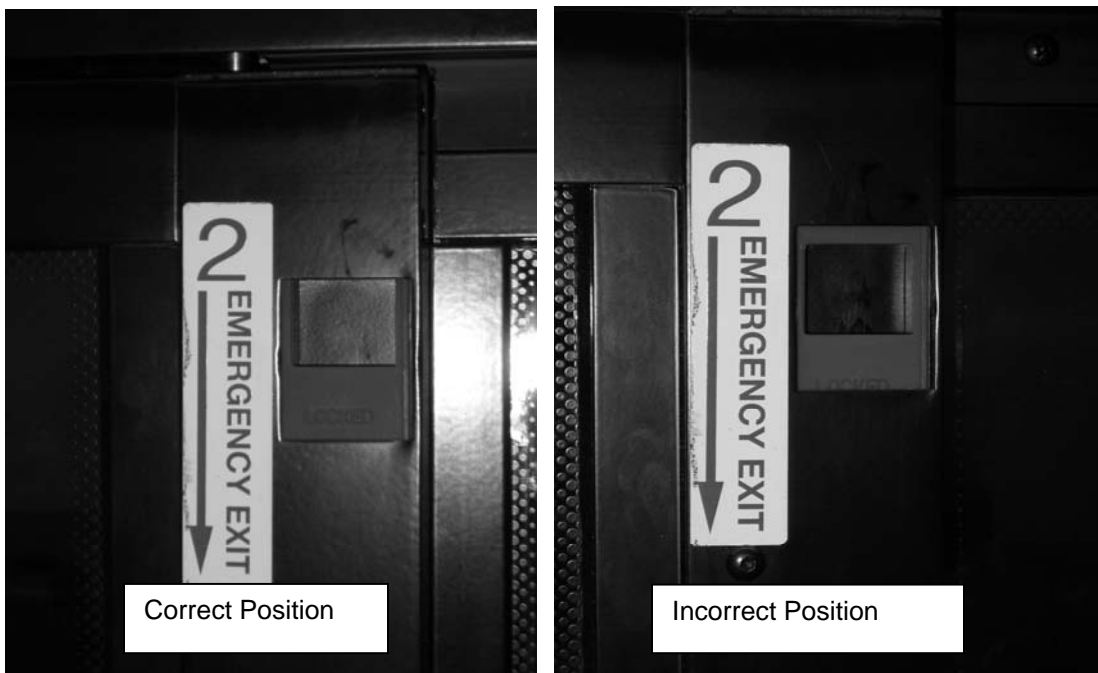


FIGURE 45: RELEASE LATCH PROPER POSITION

7. * Failure to confirm this step may lead to the sash becoming disengaged with the frame and could result in personal injury.
8. Operate the window to confirm that it opens and closes properly.

Install the screen assembly.

16. WINDSHIELD

The windshield is single-glazed AS-1 laminated safety glass. Each windshield side is laced to a flange around an opening in the front structure by means of a one-piece black rubber extrusion and locked with two filler strips. Proper installation of the windshield is necessary to ensure watertightness. Since glass varies in fit depending on the supplier, we recommend installing a replacement windshield obtained from Prevest Parts to ensure proper fit. Windshields obtained from other sources should be checked for proper size and curvature.

NOTE

For more information on windshield removal or installation, a video is available from Prevest Parts Inc.

16.1 REMOVAL



WARNING

Windshield removal and installation must be performed by more than one person. To avoid personal injury, wear protective gloves when handling the windshield glass.

1. Remove the wiper arms of the affected windshield.
2. To ease damaged windshield removal, remove the two top rubber filler strips from the rubber extrusion, then the two rubber filler strips on each side. Finally, remove the rubber filler strip located on top of rubber extrusion bottom section. Leave the bottom filler strip in place.

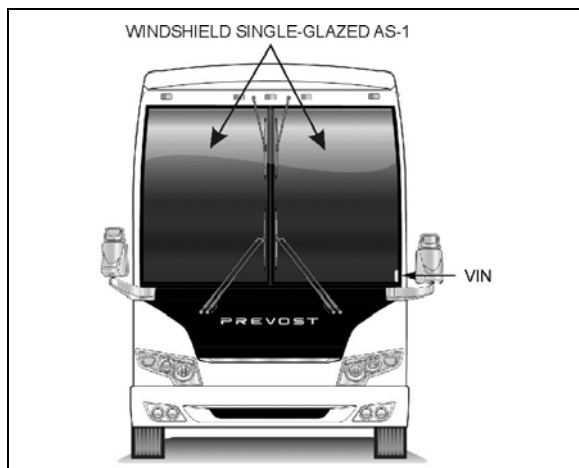


FIGURE 46: WINDSHIELD

18495A

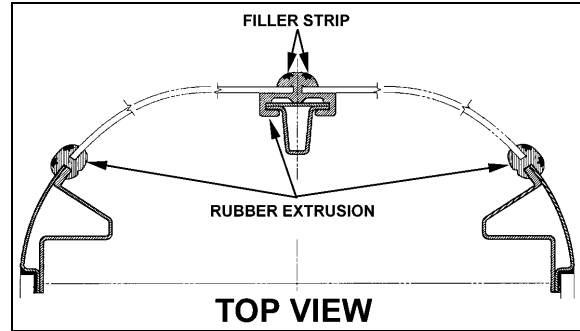


FIGURE 47: WINDSHIELD INSTALLATION TOP VIEW¹⁸⁰⁹⁸

3. 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.

4. At the same time, another person gradually lifts the rubber lip from the vehicle exterior using a plastic spatula from top to bottom.
5. Remove the entire damaged windshield and broken glass if applicable.
6. Clean the rubber extrusion channel with Sika 205. Refer to heading "Windshield Installation Only" in this section for instructions on how to reinstall windshield.

NOTE

If the rubber extrusion is damaged, remove and discard it, then clean the windshield opening with Sika 205. Refer to heading "Installation of Rubber Extrusion and Windshield" in this section for complete instructions.

16.2 WINDSHIELD INSTALLATION ONLY

1. Spray rubber extrusion with soapy water to ease windshield insertion.
2. Insert rope into rubber extrusion leaving enough length at each corner to make a loop. Spray soapy water onto rope and rubber extrusion (Fig. 48).
3. Slide windshield into rubber extrusion groove starting with the bottom curved side edge. Using a plastic spatula, move the rubber extrusion lip aside to gradually insert the windshield into the groove.

Section 18: BODY

NOTE

Spray lubricant on a regular basis to ease windshield insertion.

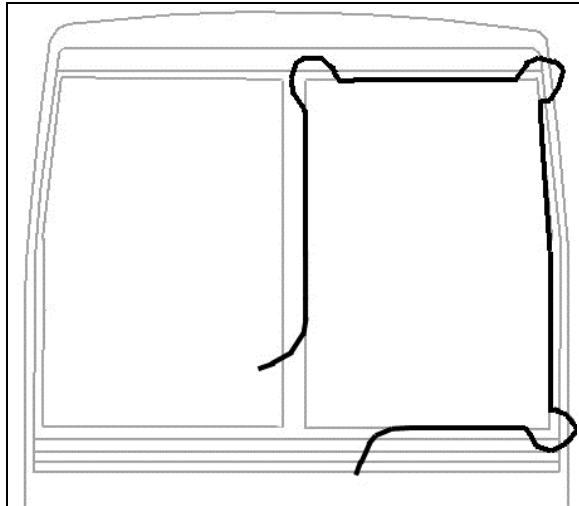


FIGURE 48: WINDSHIELD INSTALLATION USING ROPE

- Using the same type of plastic spatula, repeat the same operation from inside of vehicle, gradually inserting the windshield into the groove.

NOTE

Make sure windshield bottom edge is well inserted into the rubber extrusion groove before proceeding with the sides.

- Then, working from both sides of windshield bottom to top, gradually move the rubber extrusion lip aside to insert the windshield into the groove. Use also lubricant on the inside of vehicle to insert the windshield into the rubber extrusion groove.

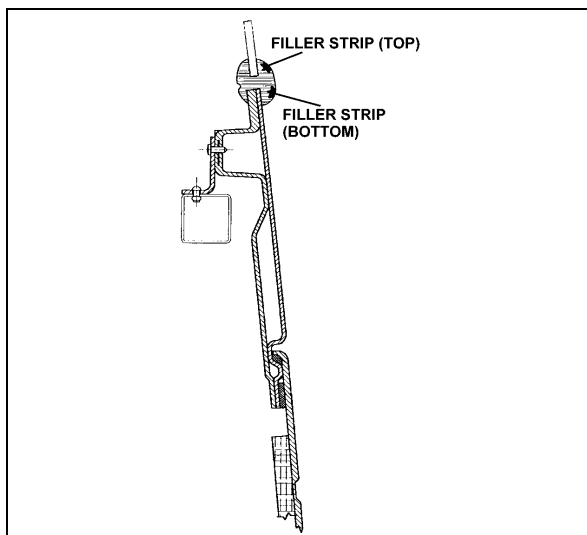


FIGURE 49: WINDSHIELD INSTALLATION SIDE VIEW 8099

- 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. 51).

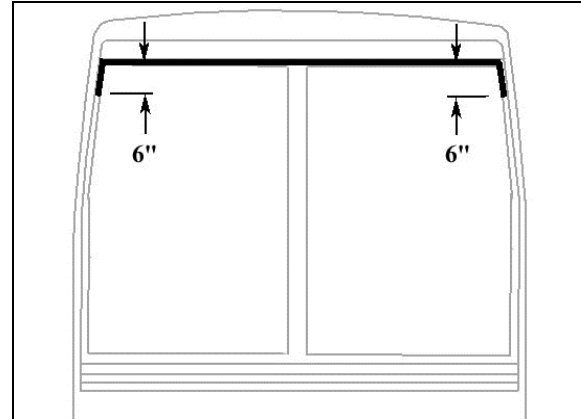


FIGURE 50: APPLICATION OF SIKA 221 BLACK

- Apply Sika 221 black between fiberglass and rubber extrusion.
- Spray filler strip and rubber extrusion groove generously with lubricant.

NOTE

Filler strips retract with time. Install ends of filler strips as tight as possible in the V-channel.

- Using the special filler insertion tool, insert the filler into the bottom rubber extrusion groove. Gradually insert filler 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 at a 45° angle leaving ¼" of excess length to thwart filler contraction over time then insert filler into groove.
- Continue with side filler strips and finish with top ones.
- Reinstall windshield wiper and destination sign if applicable.

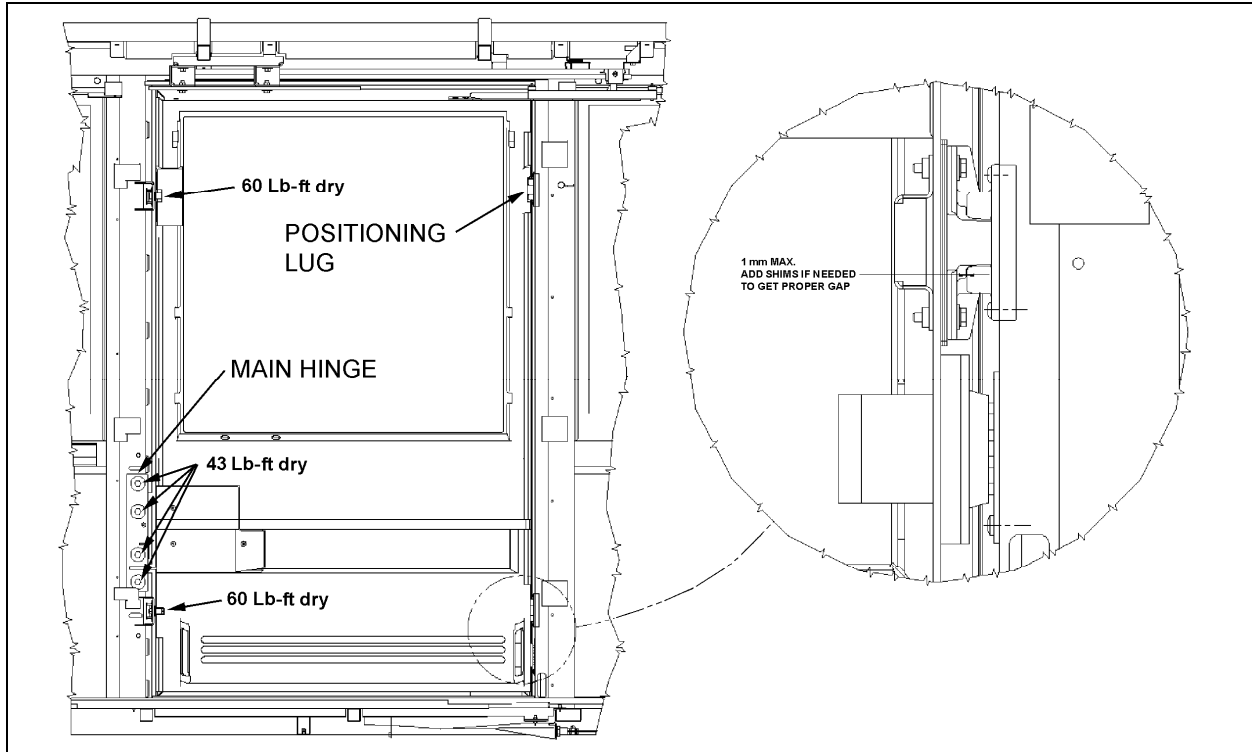


FIGURE 52: WCL SLIDING DOOR INSTALLATION

18.2 ADJUSTMENT

1. Adjust sliding door height with reference to the side panels and windows.
2. Slide the top rail into the upper arm then bolt the rail to the structure. Do not fully tighten (Refer to fig. 54).

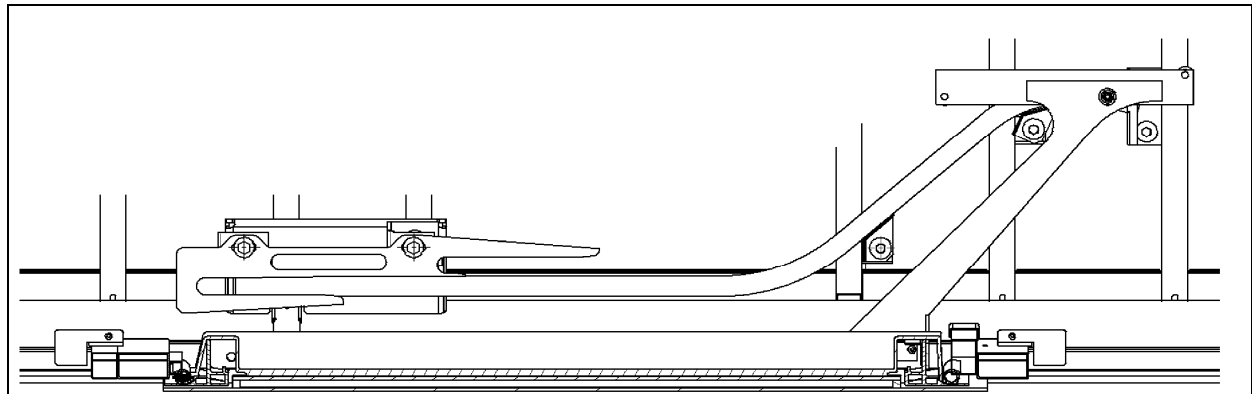


FIGURE 53: WCL UPPER ARM AND RAIL

3. Pull the door in or push from the outside to adjust the door with reference to the vehicle outside surface.
4.
 - Unfasten the upper arm bolt located on the door side.
 - Position the top rail at 3mm from the ceiling bracket.
 - Force the upper arm down then tighten the upper arm fixing bolt.
 - Pull the upper rail towards the inside in order to remove the play between the roller and the upper rail then tighten the rail fixing bolt at the back.
 - Push the lower rail towards the outside in order to remove the play between the roller and the lower rail then tighten the rail fixing bolt at the back.

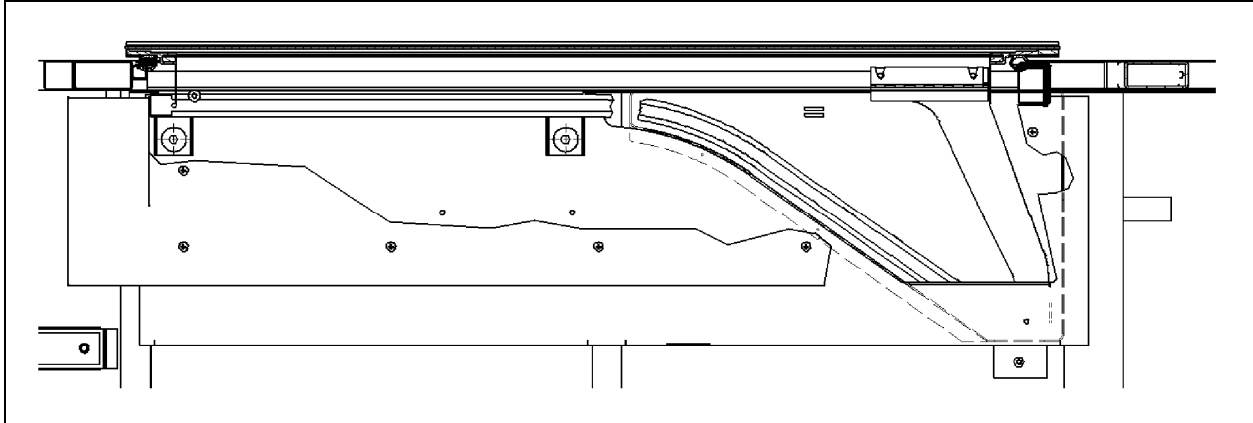


FIGURE 54: WCL LOWER RAIL INSTALLATION

5. Adjust the gap between the positioning lugs and their housing, required gap: 0.5 – 1.5mm. Add shims underneath the lugs to get the proper adjustment.
6. Take away the plays from the upper arm assembly by lifting the main hinge using a crowbar. Tighten the main hinge bolts to 43 Lb-ft.

NOTE

Do not exert too much force to lift the door.

7. Open WCL sliding door completely.
8. - Pull the upper rail towards the inside in order to remove the play between the roller and rail then bolt the rail at front and center. Add some shims if necessary between the rail and the structure before tightening the bolts.
 - Push the lower rail towards the outside of the vehicle in order to remove the play between the roller and rail then bolt the rail at front and center. Make sure the rollers stay in contact with the support when starting to close the door.
9. Adjust the distance between the bottom of the guide and the roller when the door is completely open. Required distance: 2 – 3mm. Make sure the roller stay in contact with the guide.
10. Install and adjust strikers. Torque to 60 Lb-ft (Refer to figure 53).

NOTE

Make sure that a 2mm gap exists between the door structure and the striker.

11. Adjust latches releasing, the two latches must open simultaneously.

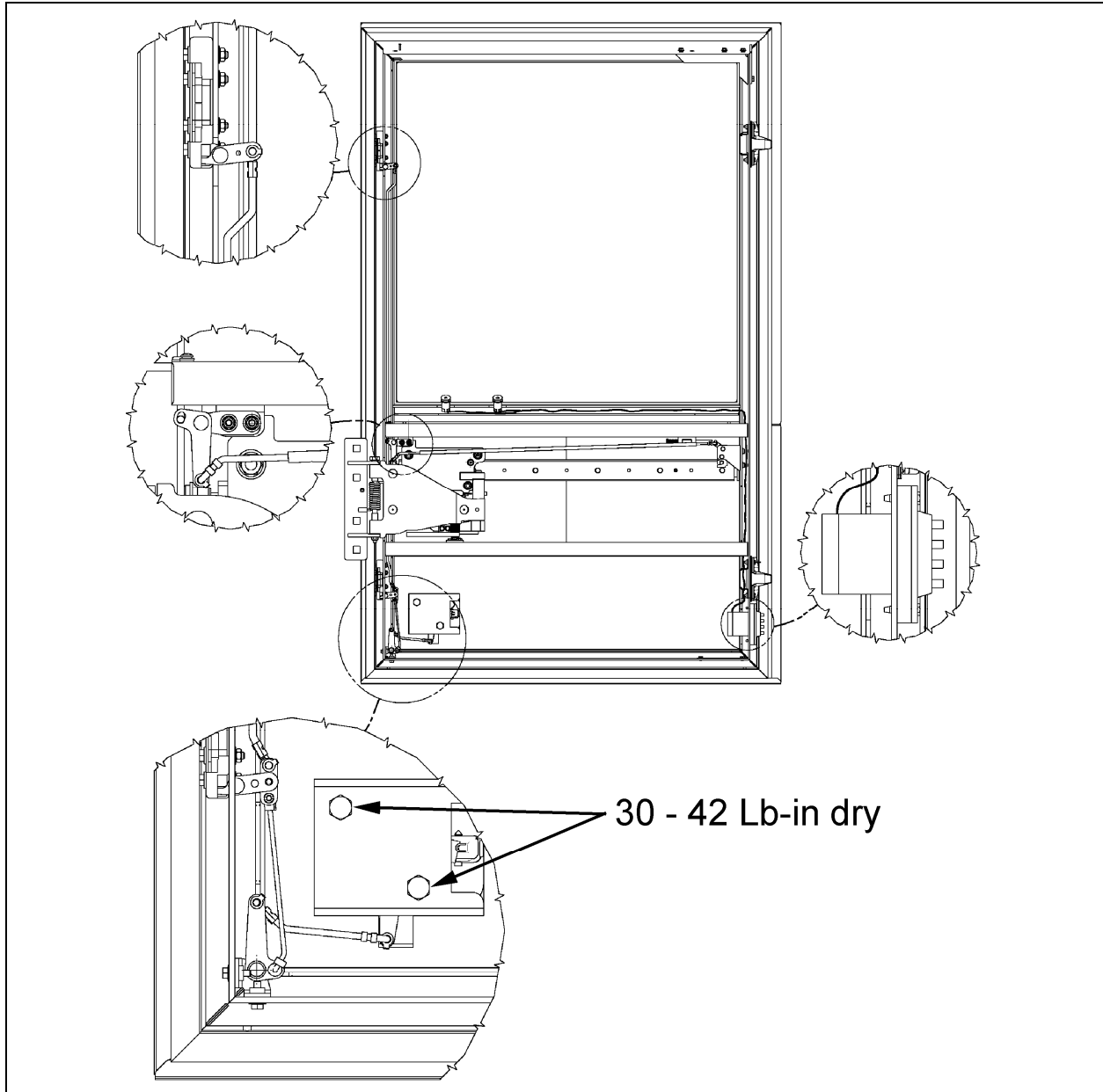


FIGURE 55: WCL SLIDING DOOR OPENING MECHANISM

19. BAGGAGE COMPARTMENT DOORS

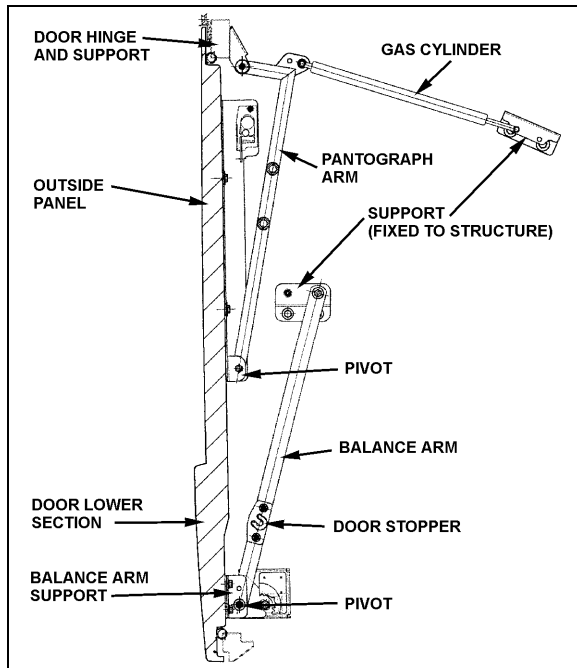


FIGURE 56: BAGGAGE COMPARTMENT DOOR 18061

There are 6 pantograph doors serving as baggage compartment doors on the H3-41, while there are 8 on the H3-45 and the V.I.P (depending on options, VIP model may have even more pantograph doors). Each of these doors is of identical design. A centrally mounted, key-lockable door handle unlatches the door which can then be pulled out and raised up in a path parallel to the side of the vehicle. The door is held in open position by two fully extended gas-charged cylinders, giving clear access to the opening of the baggage compartment.

From its fully open position, the door can be closed by pulling down on the door panel, and letting go when you sense the door will close on its own. The door will easily hinge its way back in the contour of the compartment opening and will be held closed by two latches. Each door can be opened by lifting the centrally mounted handle to unlatch the door and lifting it all the way up. If the door does not remain in the fully open position, one or both gas cylinders on that door is (are) defective. To test the cylinders, first support the door in the fully open position with proper equipment. Disconnect the rod end of one cylinder and try to retract the rod. If strong resistance is felt, the gas cylinder is in good condition and can be reinstalled. If the rod retracts with little effort, the cylinder is defective and should be replaced at once. Test the other cylinder on that door the same way.

NOTE

In case of malfunctioning or in specific situations, use door stoppers to secure the door in the open position.

19.1 PANTOGRAPH ADJUSTMENT

**WARNING**

Park vehicle safely, apply parking brake, stop engine and set batteries master switches to the "OFF" position prior to working on the vehicle.

For more information concerning baggage compartment door adjustment, refer to the following procedures. You will find these procedures at the end of this section.

- SAV00589
- SAV00590

NOTE

Refer, if needed, to figure 57 for identification of door components.

If the door bends when opening or if pantograph does not function properly, it is probably because the pantograph arms are misadjusted.

Measure distance between a pantograph arm end and a straight edge resting on structure. Repeat procedure for the other arm. The distance on each side should be equal. If not, bend appropriate arm until desired measure is obtained. (Fig. 59 and 60).

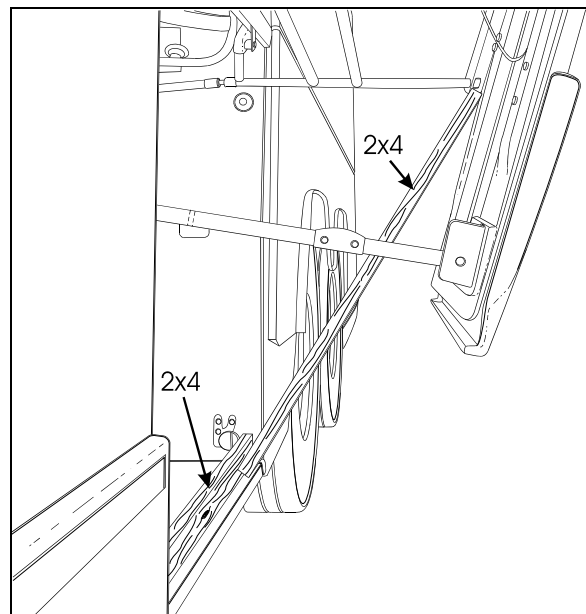


FIGURE 57: PANTOGRAPH ADJUSTMENT 18319

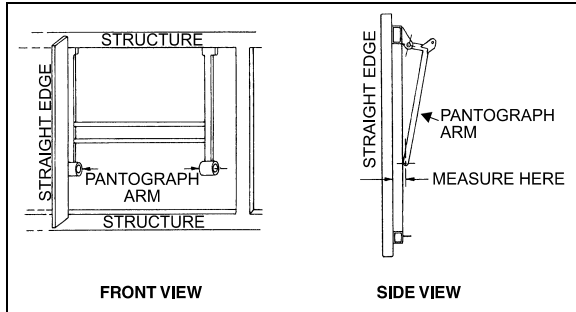


FIGURE 58: PANTOGRAPH DOOR ADJUSTMENT 18062

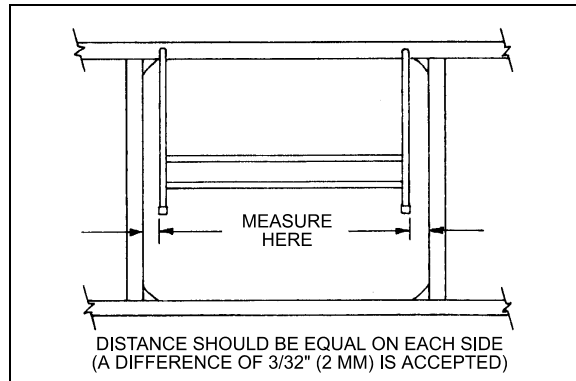


FIGURE 59: PANTOGRAPH DOOR ADJUSTMENT 18063

Doors can be adjusted by bending the arms as follows:

1. Open the door halfway up.
2. Install a piece of wood (a 2x4 will do) along the bottom of the baggage compartment. Arrange so it rests against the striker pins and is prevented from sliding further in the compartment.
3. Install another piece of 2x4 between the first piece and the bottom of the pivot of the lowest (or shortest) pantograph arm, (Fig. 58).
4. Pull down on the opposite side of the door to bend the door around the pantograph arm pivot (prevented from moving by the 2x4).
5. When the door is straight, remove the 2x4's and check door operation and fit. A difference of 3/32" (2mm) between both sides is accepted (Fig. 60).
6. Repeat as necessary.

20. DOOR HANDLES

Compartment door handles are non serviceable. When a door handle has to be removed, proceed as follows:

1. Unscrew the four (4) retaining screws;

2. Remove the two (2) wires connecting the handle to the door latch locking mechanisms.
3. To install a new handle, reverse the procedure.

21. ENGINE COMPARTMENT DOOR

The engine compartment rear door (Fig. 61) rises in the same way as the baggage compartment doors and is held open by three gas-charged cylinders (Prevost # 980024). The engine compartment opens by lifting a handle accessed from the R.H. side of the engine compartment.

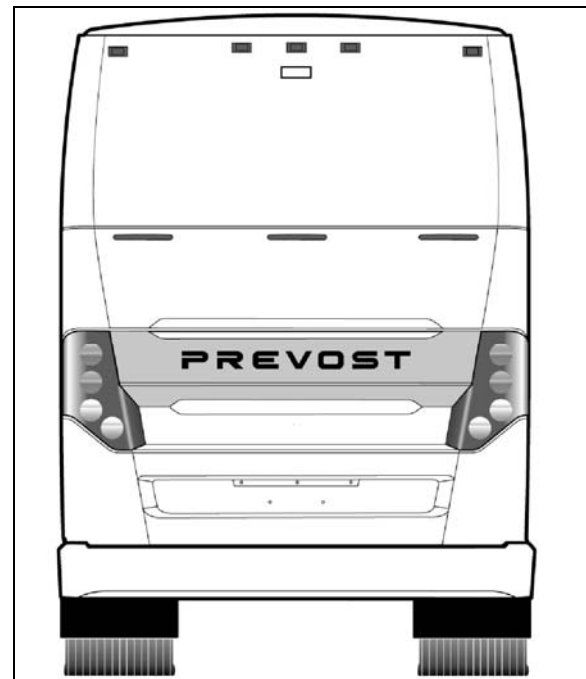


FIGURE 60: ENGINE COMPARTMENT DOOR 18497

When pushed up, the handle pulls on two steel wires, each steel wire connected to its respective door latch locking the rear door. Both steel wires are looped at the release handle and can be adjusted to proper length to ensure positive release of both catches when the handle is raised.

21.1 ENGINE DOOR ADJUSTMENT

As indicated above, the engine door mechanism is similar to the baggage door mechanism using a pantograph and 3 gas cylinders to move the door up and down.

For a minor horizontal or vertical adjustment:

1. Open the door mid-height;
2. With the help of an assistant, pull down one side of door while holding up the other side

to bend the pantograph arms in the desired position;

3. Close the door and check the top edge parallelism between the door and the vehicle end cap structure. The space may be somewhere between 10 and 15 mm;
4. Repeat until satisfied.

21.2 MINOR TOP EDGE DEPTH ADJUSTMENT

Two rubber spring loaded stops may be adjusted. They are located near the top edge on each side of the rear door.

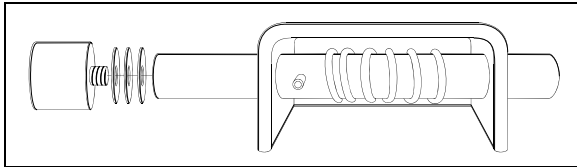


FIGURE 61: DOOR STOP

18324

To adjust:

1. Open door.
2. Unscrew rubber stop.
3. Add or remove washers as needed.
4. Firmly screw back rubber stop.

21.3 MINOR LOWER EDGE DEPTH ADJUSTMENT:

1. Open door.
2. Slightly loosen the striker pins on each side of door.
3. Using a hammer, strike striker pin gently in the desired direction (in or out).
4. Close the door slowly and check fit.
5. Repeat 3 and 4 to adjust the other striker pin.
6. When door depth is completed on the four corners, both vertical door sides should be parallel to the vehicle body structure.
7. Firmly tighten the striker pins (2) to lock them in position.

22. ENGINE AIR INTAKE GRILL

When needed, the engine air intake grill can be changed:

1. Cut the seal around the grill with a sharp edged knife.
2. Remove the grill from the vehicle.

3. On the vehicle grill opening, using the knife, remove as much adhesive as possible.
4. Sand the new grill backing edge to remove the glossy surface.
5. Clean with alcohol, wipe dry.
6. Apply SIKA 205 primer to the grill opening and the grill edges. Allow to dry at least 2 minutes for chemical evaporation.
7. Apply SIKA 255 FC adhesive on the grill edge.
8. Install the grill on the vehicle, adjust and fasten with masking tape. Allow 8 hours setting period.

23. RADIATOR DOOR ADJUSTMENT

23.1 DOOR HEIGHT ADJUSTMENT

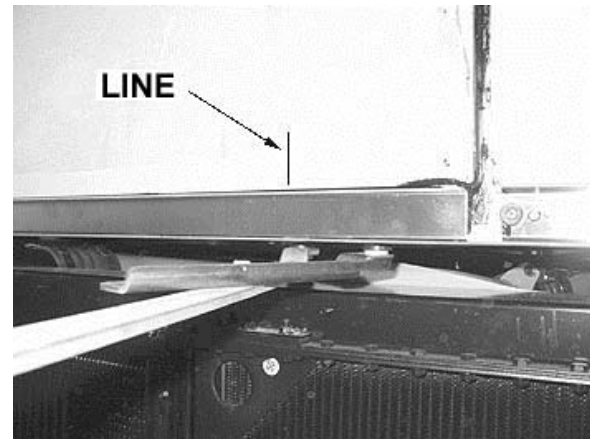


FIGURE 62: REFERENCE LINE

1. Using a pencil, draw a line onto the lateral panel in line with the balance arm.
2. Using a rubber mallet, adjust the lower part of pantograph arm in order to get 4 ± 1 mm between lateral panel and engine door (Refer to figures 64 and 66).



FIGURE 63: PANTOGRAPH ARM ADJUSTMENT

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3. Tighten the bolt.

23.2 DOOR LATERAL ADJUSTMENT



FIGURE 64: DOOR LATERAL ADJUSTMENT

1. Using a rubber mallet, adjust radiator door positioning with reference to pantograph arm so that the door is parallel to the lateral panel and to the engine door.
2. Tighten the two bolts.

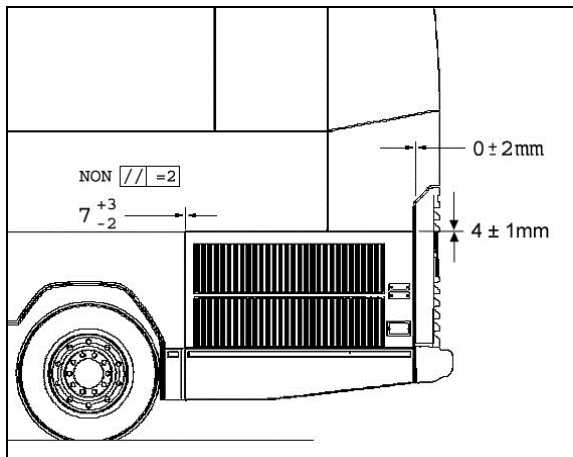


FIGURE 65: PROPER DOOR POSITIONING

23.3 DOOR DEPTH ADJUSTMENT

1. Close radiator door.
2. Check parallelism between radiator door and rear fender (max. 0 ± 2 mm).
3. If the door is too far inside, adjust using a rubber mallet (Refer to figure 68).
4. Tighten the bolt.
5. Close the radiator door in order to verify that latches adjustment is proper. If the gap is too small or too big, adjust latch positioning.

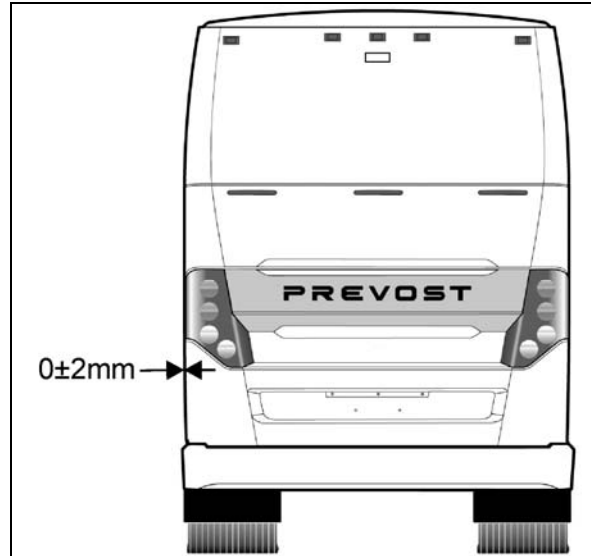


FIGURE 66: DOOR DEPTH ADJUSTMENT

6. Make sure that latch striker pin engages behind the strike plate at least 10 mm. Add or remove spacers if needed. Check door fit and operation. Tighten the latches bolts.



FIGURE 67: DEPTH ADJUSTMENT

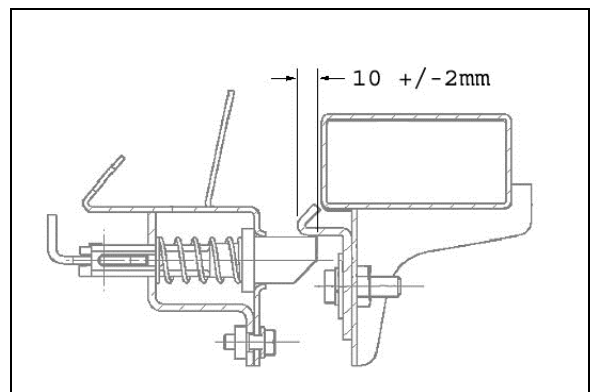


FIGURE 68: DOOR LATCHES ADJUSTMENT

24. CONDENSER DOOR ADJUSTMENT

1. Open the condenser door.
2. Loosen the nuts (1, Fig. 70) holding the hinge (3, Fig. 70) to hinge attachment (4, Fig. 77). Loosening nuts (1, Fig. 70) allows the condenser assembly to be shifted "LEFT or RIGHT" and "UP or DOWN".
3. Adjust condenser assembly position at the hinge.
4. Tighten the nuts.
5. Loosen bracket nuts holding the panel to condenser. Panel (6, Fig. 70) may be shifted "IN or OUT", "LEFT or RIGHT" and "UP or DOWN".
6. Adjust condenser panel at brackets (2, Fig. 70) and (5, Fig. 70).
7. Tighten the nuts.
8. Respect the required gap between exterior finishing panels (Fig. 52).
9. Check that the door swings freely and closes properly. It may be necessary to adjust the door latch to get proper fit and operation.

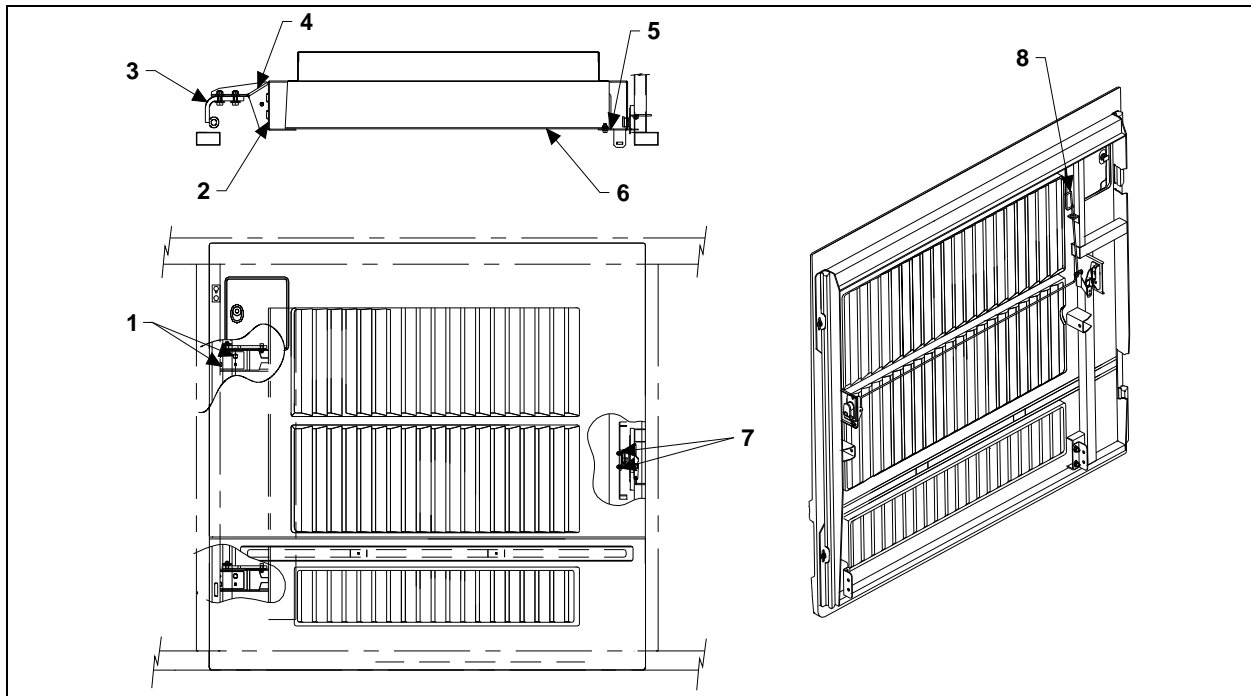


FIGURE 69: CONDENSER DOOR

D280201

25. FUEL FILLER DOOR

1. Open the fuel filler door (1, Fig. 71).

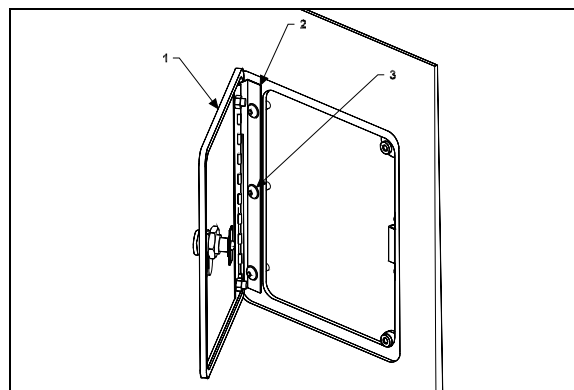


FIGURE 70: FUEL FILLER DOOR

1875003D

2. Loosen the screws (3, Fig. 71) holding the panel to hinge (2, Fig. 71) assembly.
3. Adjust the fuel filler door position according to distance required between exterior finishing parts (Fig. 52).
4. Tighten the nuts.
5. Check that the door swings freely and closes properly.

26. FRONT SERVICE COMPARTMENT

Adjustment of the front service compartment door can be done by following these steps:

1. Open the door.
2. Loosen nut (2, Fig. 72).

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3. Move part (1, Fig. 72), as close as possible to exterior of coach, so as to have enough clearance for proper door opening.
4. Tighten nut (2, Fig. 72).
5. Loosen nut (3, Fig. 72). Hinge allows the door to be shifted "IN or OUT".
6. Adjust door panel to have the same gap space as neighboring panels or refer to figure 52 for specified gap space. Only if necessary, use the adjustment allowed by moving part 1, Fig. 72.

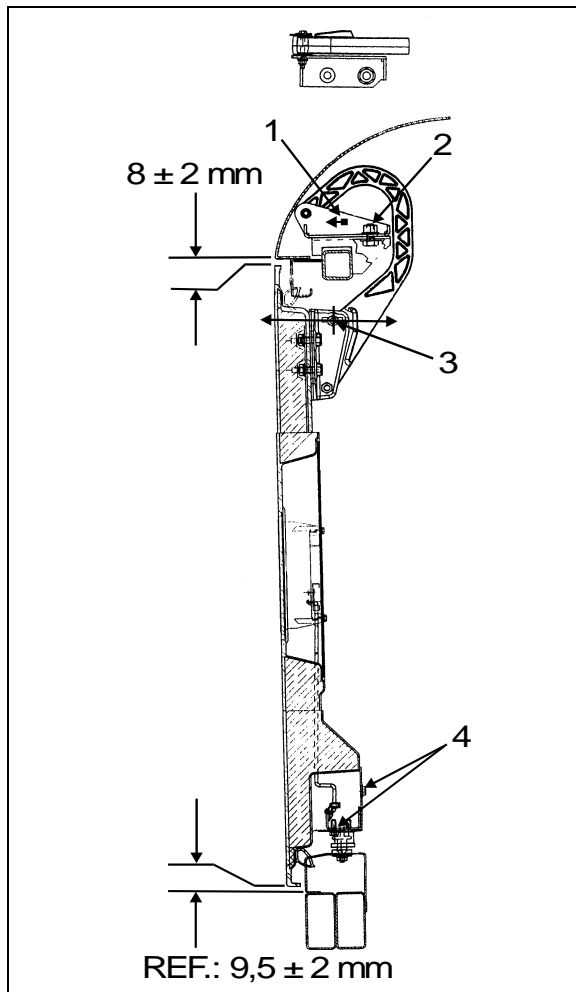


FIGURE 71: DOOR HINGE

18194

7. Loosen screws (5, Fig. 73) to allow the door to be shifted "UP or DOWN".
8. Adjust the door position.
9. Tighten the screws.
10. Check that the door swings freely and closes properly. It may be necessary to adjust the door latch to get proper fit and operation.

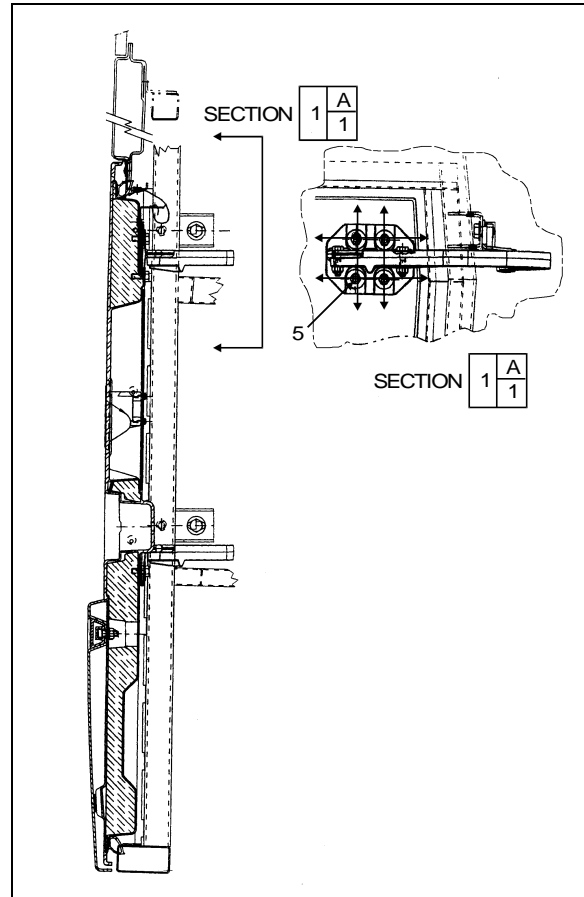


FIGURE 72: FRONT SERVICE DOOR

18195

26.1 LATCH MECHANISM ADJUSTMENT

To adjust the latch mechanism and the striker pin, open the door to access the striker pin. Slightly loosen the striker pin. Using a hammer, adjust the striker pin to center it in the door latch mechanism. Tighten the striker pin. Check door fit and operation.

27. ENGINE COMPARTMENT R.H. SIDE DOOR

The engine compartment R.H side door can be adjusted by following these steps:

1. Open the door.
2. Loosen nut (1, Fig. 74).
3. Move part (3, Fig. 74) as shown in figure for "LEFT or RIGHT" adjustment.
4. Tighten nut (1, Fig. 74).
5. Loosen nut (2, Fig. 74).
6. Hinge allows the door to be shifted "IN or OUT".

7. Adjust the door in accordance with the required distance between exterior finishing parts (Fig. 52).
8. Loosen screws (4, Fig. 75).
9. Screws allow the door to be shifted "UP or DOWN".
10. Adjust the door position according to the distance required between exterior finishing parts (Fig. 52).
11. Tighten the screws.

Check that the door swings freely and closes properly. It may be necessary to adjust the door latch to get proper fit and operation.

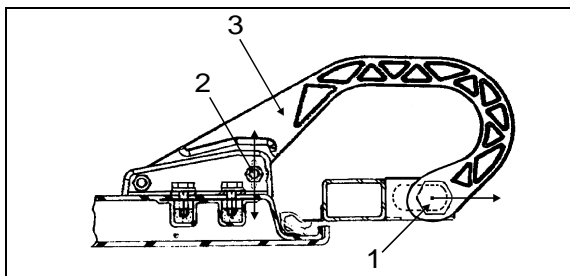


FIGURE 73: DOOR HINGE

18196

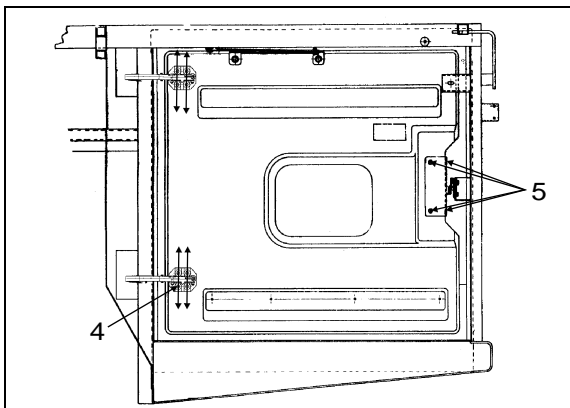


FIGURE 74: ENGINE COMPARTMENT R.H. DOOR

18197

28. EVAPORATOR DOOR ADJUSTMENT

1. Open the door.
2. Loosen nut (1, Fig. 76).
3. Move part as shown in figure for "LEFT or RIGHT" adjustment.
4. Tighten nut (1, Fig. 76).
5. Loosen nut (2, Fig. 76). Hinge allows the door to be shifted "IN or OUT".
6. Adjust the door in accordance with the required distance between exterior finishing parts (Fig. 75).
7. Loosen screws (3, Fig. 74). Screws allow the door to be shifted "UP or DOWN".
8. Adjust the door position according to the distance required between exterior finishing parts (Fig. 75).
9. Tighten the screws.

Check that the door swings freely and closes properly. It may be necessary to adjust the door latch to get proper fit and operation.

28.1 LATCH MECHANISM ADJUSTMENT

1. To adjust the latch mechanism and the striker pin:
2. Open the door to access the striker pin.
3. Loosen slightly the striker pin.
4. Using a hammer, adjust the striker pin to center it in the door latch mechanism.
5. Tighten the striker pin. Check door fit and operation.

27.1 LATCH MECHANISM ADJUSTMENT

To adjust the latch mechanism and the striker pin, open the door to access the striker pin. Slightly loosen the striker pin. Using a hammer, adjust the striker pin to center it in the door latch mechanism. Tighten the striker pin. Check door fit and operation.

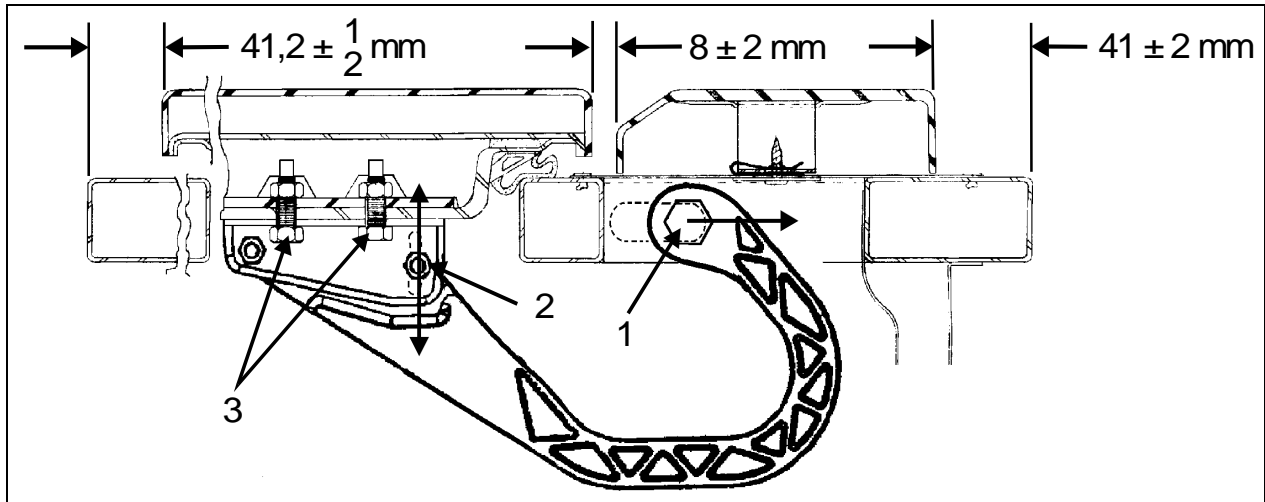


FIGURE 75: EVAPORATOR DOOR

18198

29. MAIN POWER COMPARTMENT

To adjust the main power compartment door:

1. Loosen nut (1, Fig. 77).

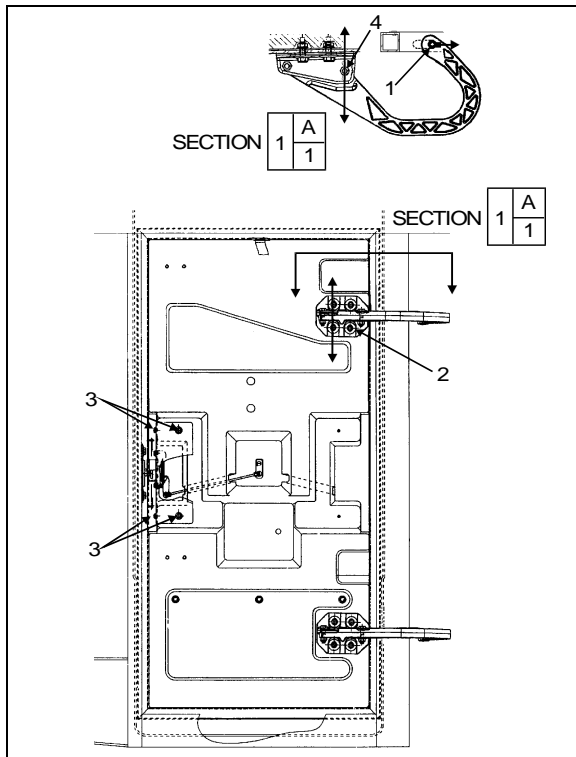


FIGURE 76: MAIN POWER COMP. DOOR

18199

2. Move part as shown in figure for "LEFT or RIGHT" adjustment.
3. Tighten nut (1, Fig. 77).
4. Loosen nut (4, Fig. 77).
5. Hinge allows the door to be shifted "IN or OUT".

6. Adjust door panel to have the same gap space as neighboring panels or refer to figure 45 for specified gap space
7. Loosen screws (2, Fig. 77). Screws allow the door to be shifted "UP or DOWN".

8. Adjust the door position.

Tighten the screws.

Check that the door swings freely and closes properly. It may be necessary to adjust the door latch to get proper fit and operation.

29.1 LATCH MECHANISM ADJUSTMENT

To adjust the latch mechanism and the striker pin:

1. Open the door to access the striker pin.
2. Loosen slightly the striker pin.
3. Using a hammer, adjust the striker pin to center it in the door latch mechanism.

4. Tighten the striker pin.

Check door fit and operation.

30. FENDERS

On the "H" series vehicle, all fenders are easily removable for maintenance on brakes and suspension. Each rear fender has three mechanical spring-loaded holding devices fixing it to the vehicle's structure.

30.1 REAR FENDER REMOVAL

1. Push the spring type rod sideways so that the lock disengages.

2. Support or have somebody hold the fender up.
3. As in 1, repeat to release both remaining holding devices.
4. Holding the fender firmly, pull it down until the top edge disengages from the holding plates.

To reinstall, reverse the procedure.

30.2 FRONT FENDER REMOVAL

1. At the bottom of fender, remove the retaining screws on one side of the fender.
2. Support or have someone hold the fender up.
3. Remove the screw on the other side of the fender.
4. Pull the fender down until the top edge disengages from the holding plates.

To reinstall, reverse the procedure.

31. REAR CAP

The fiberglass rear cap does not need any maintenance except painting as needed. For minor damages, refer to section 4 "Fiberglass Repair" and section 5 "Painting". If the rear cap ever has to be replaced:

1. Remove all accessories.
2. Drill out the retaining pop rivets.
3. With a sharp edge blade, cut the seal joint and remove the rear cap.
4. With the sharp edge blade, remove as much of the remaining seal pieces as possible.
5. Sand with #120 or #150 sandpaper.
6. Wipe clean with alcohol
7. Prepare surface with SIKA #205 and let dry for a minimum of 2 minutes.
8. Install a new seal using LOCTITE 414 glue.
9. Install the rear cap and fasten with pop rivets.



CAUTION

Do not attempt this procedure unless you are qualified and equipped to handle this job.

32. FRONT CAP

The front cap windshield frame does not need any maintenance. It is held in place with bolts and nuts. If it ever has to be replaced, make an appointment at a Prevost service center near you.

Section 18: BODY

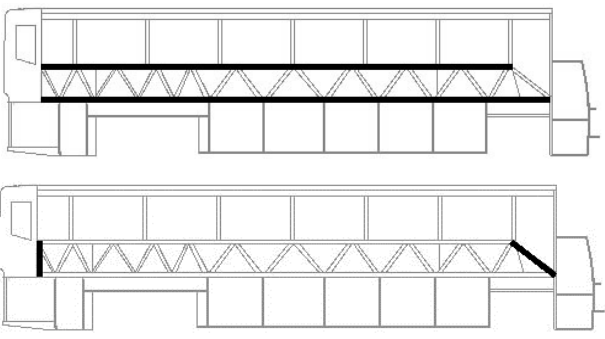
33. SIDE PANEL INSTALLATION PROCEDURE FOR COACHES AND VIP


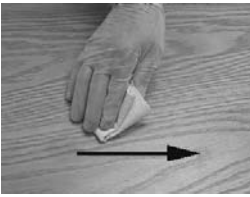
Material:


Anti-silicone (682989)	√	Blue cloth (682383)	√	Sika 206 G+P 1 liter (683446)	√
Tack cloth	√	Pure water	√	Sika 252 black	√
CHIX cloth (682384)	√	Scotchbrite gray (680226)	√	Masking tape	√

Equipment:

Glue gun	√	
Compression roller	√	

SECTION #1 SIDE PANEL INSTALLATION		
1.00	SS Body structure preparation	<div style="display: flex; align-items: flex-start;"> <div style="flex: 1; padding: 5px;"> <p>A) Clean using anti-silicone. See SAV000001 section A. Use Scotchbrite to sand structure. Use 1 side of Scotchbrite for 1 side of vehicle.</p> </div> <div style="flex: 2;">  </div> </div>

SAV000001 Section A Alcohol or Anti-silicone	
<div style="display: flex; align-items: center;">  <div style="margin-left: 10px;"> <p>1. Apply</p> <div style="border: 1px dashed black; padding: 2px; display: inline-block;">CHIX cloth</div> </div> </div>	<div style="display: flex; align-items: center;">  <div style="margin-left: 10px;"> <p>2. Dry immediately</p> <div style="background-color: #cccccc; border: 1px dashed black; padding: 2px; display: inline-block;">Blue cloth</div> </div> </div>
3. Allow to dry	
Mandatory	<p>Minimum time : Wait for product to evaporate</p> <p>After 2 hours: Start cleaning operation again</p>
Before applying any other product	If surface seems dusty, greasy or with finger marks, start cleaning operation again.

1.05	Fiberglass panel preparation (fiber side)	<div style="display: flex; align-items: center;"> <div style="flex: 1; padding: 5px;"> <p>A) Clean using tack cloth. Repeat if surface seems dusty.</p> </div> <div style="flex: 2;">  </div> </div>
------	--	--

B)	Clean using anti-silicone See SAV000001 section A.
C)	Apply primer 206 G+P. See SAV000001 section D.

PR000001 Section D Sika Primer 206 G+P



3. Shake bottle to mix product

4. Apply a thin layer

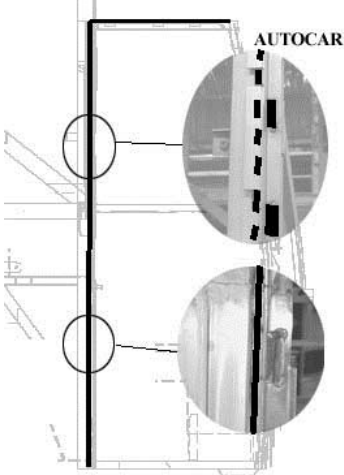

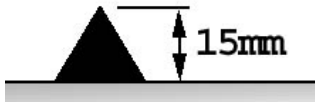

CHIX cloth

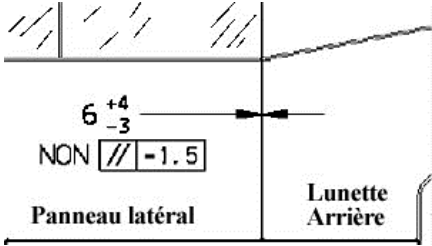
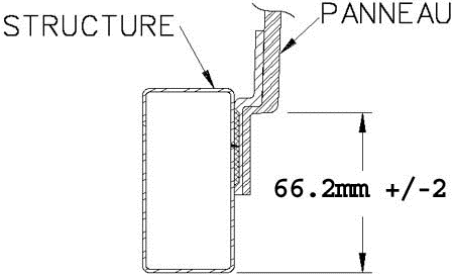

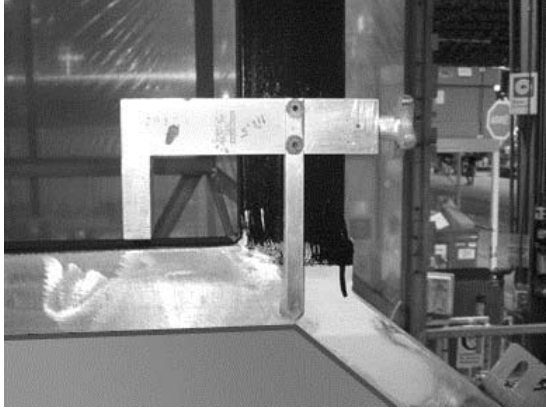

3. Allow to dry

Mandatory	206 G+P	Minimum time : 10 minutes
		After 2 hours: Remove dust using damp cloth (pure water)
		After 8 days : Reactivate with Aktivator as per section "C"
Before applying any other product		If surface seems dusty, dust using damp cloth.
		If surface seems greasy or with finger marks, reactivate with Aktivator.


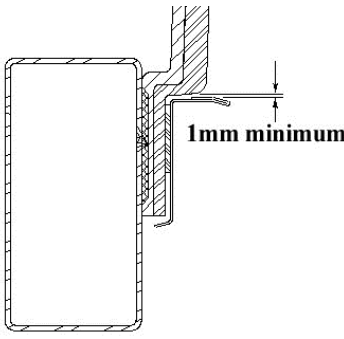
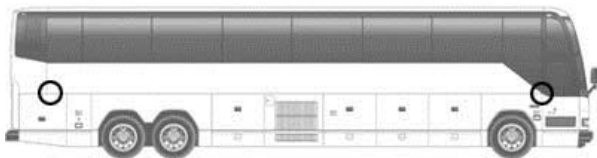
1.10	SS Body structure preparation		
	A)	Clean using anti-silicone. Clean structure at least twice. Repeat is necessary until cloth comes clean. See SAV000001 section A.	
	B)	Apply 1 ¼" protective tape along bottom structural tubing.	
C)	Apply 206 G+P onto structure. See SAV000001 section D.		

Section 18: BODY

1.15	<p>Seal entrance door perimeter using Sika 252 black, Smooth down the excess.</p>	 <p>A technical drawing of an autocar door frame. Two circular callouts provide close-up views of the sealant application process along the door's perimeter. The word 'AUTOCAR' is written at the top right of the diagram.</p>
1.20	<p>Install lateral panel supports onto bottom structural tubing. Install lateral panel onto supports to verify proper positioning.</p>	
1.25	<p style="text-align: center;">Glue application</p> <p>A) Set (timer) or record time.  No more than 45 minutes should elapse between beginning of glue application and panel installation.</p> <p>B) Apply Sika 252 black onto structure</p> 	
1.30 *	<p>A) Install lateral panel onto supports and clamp panel in place using "C" clamps and square tubing to even out the pressure. Note: A maximum of clamps should be used (every 6 inches) to ensure proper bonding. Do not tighten too much.</p>	
	<p>B) At the rear, adjust panel height so that it is level with rear cap</p>	 <p>A photograph showing a person's hands adjusting the height of a panel. The panel is being pushed against a rear cap. In the background, there are some markings: '37' and '37&'. The word 'AUTOCAR' is visible on the panel above the hands.</p>

	<p>C) Gap between lateral panel and rear cap must be 6mm +4/-3 and panels must be aligned within 1.5mm.</p>	
	<p>D) Using a ruler, adjust front of lateral panel.</p>	
	<p>E)  Verify if panel upper corner is in the middle of window post.</p>	
<p>1.55</p>	<p>Remove excess of glue using a spatula. Apply a bead of Sika 252 at the top of panel Spray pure water onto all the joints to speed up drying process</p>	
<p>1.60</p>	<p>Remove protective tape (installed at step 1.10b).</p>	
<p>1.70</p>	<p>Do not move the vehicle for 48 hours Make sure room temperature is superior to 20°C (68°F) before gluing Perform a visual inspection before installing side windows</p>	

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SECTION #2 DRIP MOLDING INSTALLATION		
2.00 *	A) Clean using Anti-silicone See SAV000001 section A.	
	B) Apply Sika 206 G+P See SAV000001 section D.	
2.05	Remove blue paper from drip molding. Remove protective tape from double-face self adhesive tape	
2.10	Glue drip molding. Allow a gap of 1mm minimum between top of drip molding and panel.	
2.15	Compress drip molding using the compression roller to increase adherence.	
2.20	Round off rear and front drip molding corners.	

SECTION #3 REPAIR		
4.00	Remove fiberglass from structure using a screwdriver. Use wedges if necessary to hold down panel during the work.	
4.05	Remove as much glue as possible. If primer is removed, apply primer 206 G+P locally. If primer is OK, reactivate as per SAV000001 section D.	
4.10	Apply Ultrafast 2 glue (heated).	
4.15	Compress panel using clamps and a metal flat bar (for an even compression). Only use screws as a last resort to compress.	
4.20	Vehicle must not move for the next 12 hours.	

34. 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.

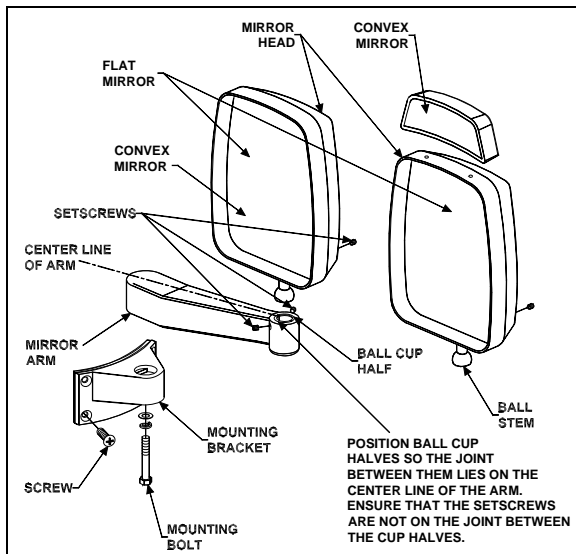


FIGURE 77: REAR-VIEW MIRROR (RAMCO)

18201

34.1 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.

34.2 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.

34.3 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.

34.4 REPLACEMENT OF MIRROR GLASS

Remove the broken glass.

Position new glass in mirror head and press to lock the Velcro in place.

34.5 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.

34.5.1 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

Section 18: BODY

button's (4) sides to adjust the selected mirror viewing angle.

34.5.2 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.

34.5.3 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

34.5.4 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.

35. VEHICLE JACKING POINTS

The vehicle can be lifted by applying pressure under body jacking points or front and drive axle jacking points (from fig. 79 up to 86). 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).



WARNING

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 79 up to 86.



WARNING

Extra lift capacity may be required if luggage or any other type of load (e.g. conversion equipment) are onboard the vehicle.



CAUTION

The suspension of the vehicle must be in the normal ride position before jacking. The "Level Low" system on a motorcoach must be in the "DRIVE" position prior to turning the ignition key "OFF".

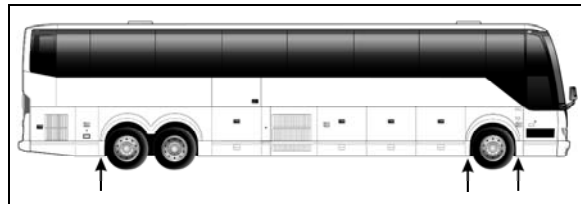


FIGURE 78: JACKING POINTS ON STRUCTURE 18480

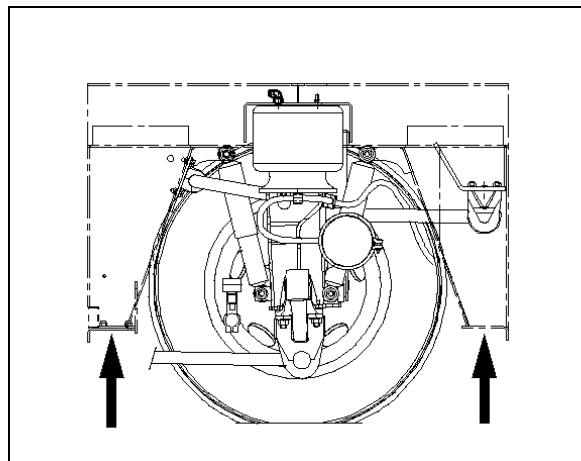


FIGURE 79: JACKING POINTS ON FRONT UNDERFRAME – I BEAM AXLE 16183

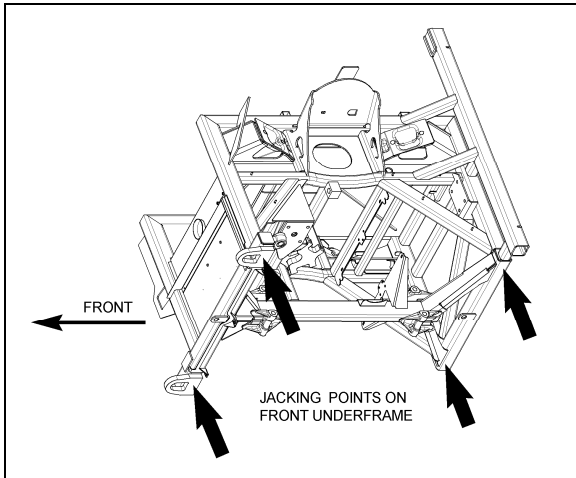


FIGURE 80: JACKING POINTS ON FRONT UNDERFRAME – IFS

18530

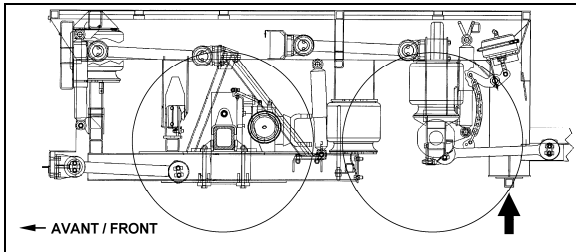


FIGURE 81: JACKING POINTS ON REAR FRAME

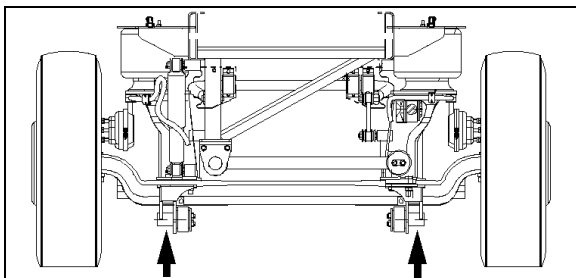


FIGURE 82: JACKING POINTS ON FRONT AXLE – I BEAM AXLE

10000

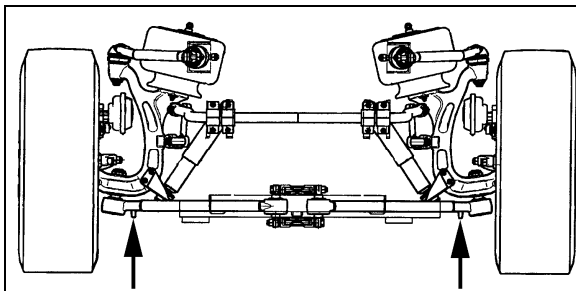


FIGURE 83: JACKING POINTS ON IND. SUSPENSION

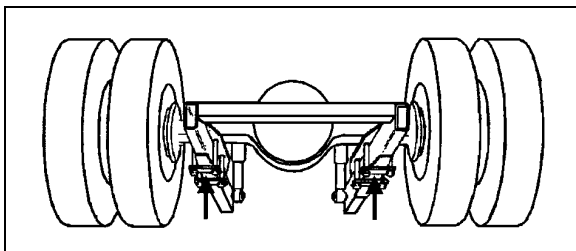


FIGURE 84: JACKING POINTS ON DRIVE AXLE

18085

CAUTION

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 85: JACKING POINTS ON TAG AXLE

WARNING

The jacking points on the tag axle must be used for raising the tag axle only.

36. 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.

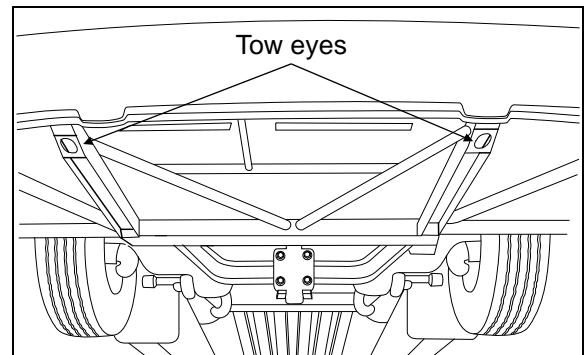


FIGURE 86: TOW EYES UNDER VEHICLE

18401

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.

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- 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.

36.1 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 Rockwell's "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 either 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 a minimum of 75 psi (520 kPa), 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. Lift the vehicle from under the front axle, and adequately secure the underside of the tow vehicle lifting attachment with chains.
4. Observe safety precautions when towing.

36.2 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 Rockwell's "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 a minimum of 75 psi (520 kPa), 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.

37. SPECIFICATIONS**Door cylinder**

Manufacturer Bimba
 Type Pneumatic
 I.D. 1½" (mm)
 Stroke..... 8" (mm)
 Prevost number..... 780595

Damper

Manufacturer Koni
 Prevost 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)
 Prevost number..... 641392

Lock cylinder (central)

Manufacturer Bimba
 Type Air, single action, ¼ NPT
 I.D. 1¾" (45 mm)
 Stroke..... 1" (25 mm)
 Prevost 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)
 Prevost 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
 Prevost number..... 641412

Pressure switch assembly

Prevost number..... 452831

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1. HEATING AND AIR CONDITIONING

The coach's interior is pressurized by its Heating, Ventilation, and Air Conditioning (HVAC) system. Air flow and controls divide the vehicle in two areas: driver's area and passenger's (cabin) 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 WITH CENTRAL HVAC SYSTEM

2.1 DRIVER'S AREA

Fresh air is taken from behind the R.H. side headlights assembly and enters the mixing box through an ON/OFF damper. Return air is taken through the right console 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 his air flow to the dashboard, from which he can direct vent to his upper body with adjustable HVAC register and to his feet with the appropriate button (see figure 1 and Operator's manual or Owner's manual).

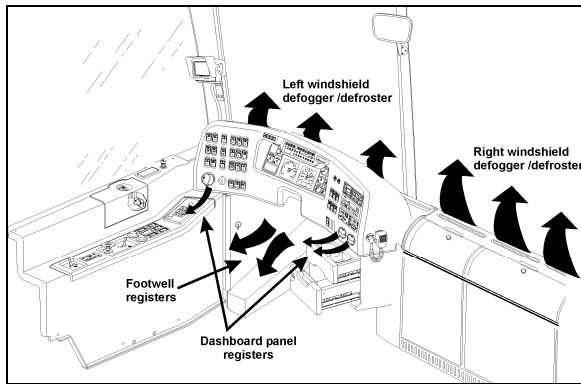


FIGURE 1: DRIVER'S UNIT AIR CIRCULATION 22291

2.1.1 Coaches only

Two additional air outlets are located in the front area but supplied by the passenger's (cabin) unit ducting system. One is located in the stepwell for step de-icing (Figure 2). The air flow outlet comes from the left side and is drawn from the first step riser. The other air outlet is located behind the driver, on his L.H. side. The air outlets can be rotated to direct Air flow.

Optionally, the coach may be equipped with a defogger/defroster system in the windshield upper-section, refer to paragraph: "Central Heating System" for more information.

2.1.2 VIP only

VIP vehicles equipped with the Central HVAC System have two additional registers called Navigator's registers located near the entrance door, at bottom of first lateral window.

2.2 PASSENGER'S (CABIN) AREA

Fresh air is taken from the left side of vehicle through a two-position damper located at the left of the evaporator compartment. The thermal control damper can be fully opened for normal operation or partially closed for extreme weather or highly polluted areas. The recirculation REC button is located on the HVAC control unit. Press down the button to partially close the fresh air damper.

NOTE
Opening the entrance door also partially closes the fresh air damper.

Return air is drawn through the first entrance step riser (coaches only), last entrance step riser and from the lower section of the floor ducts in two locations: one in the rear section of vehicle and the other in the front section of vehicle on the L.H. side (figure 2).

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 (upper section) along the walls, and finally exhausts it at the bottom of the windows.

On coaches, the Central HVAC system includes an overhead compartment ventilation system equipped with adjustable registers in the passenger's overhead console to control air flow for the passenger seats. Direct air flow by pointing or rotating register. Open or close register to adjust air flow (figure 3). Also on coaches, the lavatory ventilator acts as the main exhaust for the whole vehicle, eliminates odors, and finally heats or cools the lavatory with the vehicle's ambient air.

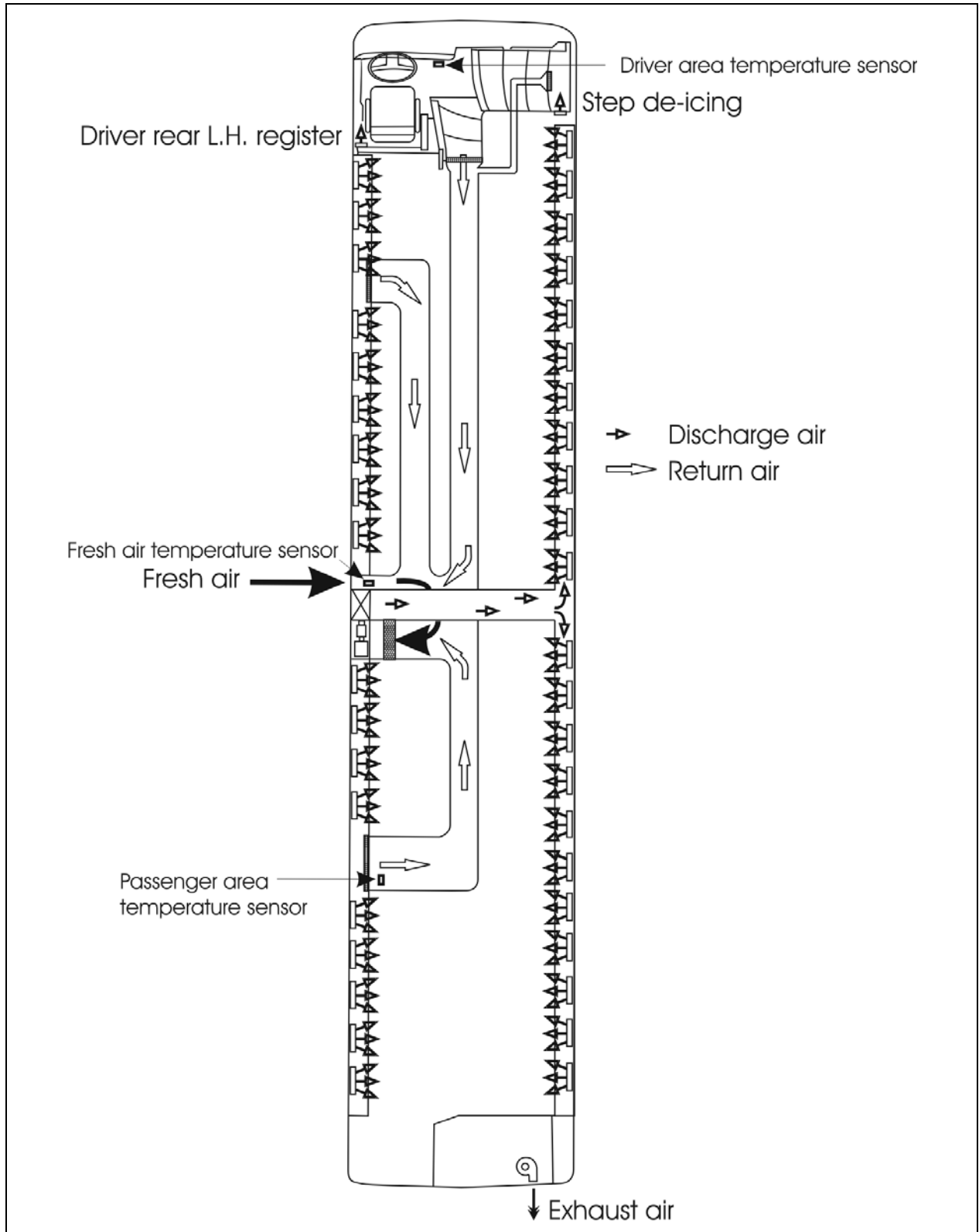


FIGURE 2: CENTRAL HVAC SYSTEM – PASSENGER'S UNIT AIR CIRCULATION (COACH)

22264

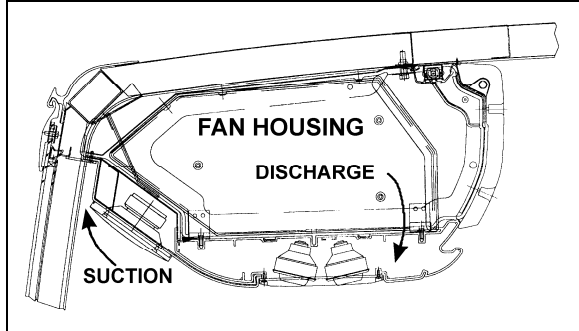


FIGURE 3: OVERHEAD COMPARTMENT VENTILATION SYSTEM 22211

3. AIR CIRCULATION WITH SMALL HVAC SYSTEM

Fresh air is taken from behind from behind the R.H. side headlights assembly and enters the mixing box through an adjustable damper. Returning air is taken through the right console into the mixing box. The recirculation REC button is located on the HVAC control unit (figure 4). Mixed air goes through cooling and heating coils, fans and discharge ducts.

Both right and left discharge ducts defrost/defog one half of the windshield. The driver can divert his air flow to the dashboard, from which he can direct vent to his upper body with adjustable HVAC register and to his feet with the appropriate button (see figure 1 and Owner's manual).

3.1 AUXILIARY UNIT

VIP vehicles with small HVAC system are equipped with an auxiliary system that provides five additional registers. Three are located behind the driver's seat and the other two are located near the entrance door, at bottom of first lateral window. The auxiliary unit comes with cooling and heating coils, fan and discharge ducts.

4. SMALL HVAC SYSTEM OPERATION

4.1 DRIVER'S UNIT OPERATION

The temperature control in the driver's area is provided directly by the HVAC control unit mounted on the dashboard R.H. side.

Using the Up/Down type switch sets the fan speed and the speed chosen is displayed on the HVAC control unit.

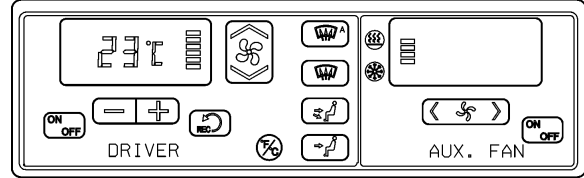


FIGURE 4: CONTROL UNIT - SMALL HVAC SYST. 22286

4.2 AUXILIARY UNIT OPERATION

The temperature control is provided by the small system HVAC control unit. The R.H. portion of the HVAC control unit enables to actuate the Auxiliary Unit and to regulate the fan speed. Using the < > type switch sets the fan speed and the speed chosen is illustrated on the window display.

5. 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.

5.1 DRIVER'S UNIT

The temperature control in the driver's area is provided directly by the L.H. portion of the HVAC control unit.

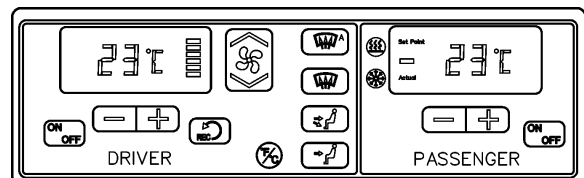


FIGURE 5: CONTROL UNIT - CENTRAL HVAC SYST 22276

The driver's unit piping is paralleled with the passenger's unit piping. Both units use the same refrigerant and coolant, and are linked to the same condenser and compressor, even if they are individually controlled. It requires the passenger's unit to engage the A/C compressor magnetic clutch; consequently, the driver's unit cannot be operated alone in the air conditioning mode.

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:

Section 22: HEATING AND AIR CONDITIONING

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.

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.

NOTE

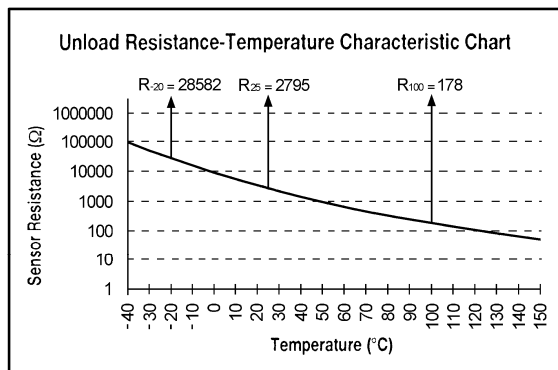
VIP vehicles equipped with Small HVAC System have two air temperature sensors; the driver's area temperature sensor (same place as coaches) and the exterior temperature sensor located behind the reclining bumper.

The following table can be used for troubleshooting the following temperature sensors:

- 1) Driver area temperature sensor (SE21);
- 2) Passenger area temperature sensor (SE25);
- 3) Outside air temperature sensor (SE20).

The table values are for unloaded, disconnected temperature sensor (thermistor) probed at the temperature sensor connector pins.

If the temperature sensor resistance value is measured at the multiplex module inputs, the measured value includes a parallel 33 kohms resistor.



TEMPERATURE SENSOR		
Temp °C	Temp °F	Resistance Ohms (temperature sensor disconnected)
-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

Using the Up/Down type switch sets the fan speed and the speed chosen is illustrated on the window display.

5.2 PASSENGER'S UNIT

The passenger section of the HVAC control unit enables the selection of the temperature in the passenger's section (Refer to the VIP Owner's manual or H3 Operator's Manual for details).

Temperature control is provided in conjunction with a thermistor sensor located inside return duct, on L.H. side of vehicle (figure 2).

The flow of water to the passenger's unit heater core is controlled by a pneumatic water valve which varies the cycling rate depending on selected temperature. A red LED indicator, located on the HVAC control unit, illuminates

when the heating mode is one. A green LED indicator illuminates when compressor clutch is in operation.

The evaporator motor is located in the evaporator compartment on the L.H. side of vehicle is protected by a 90 amp, with manual-reset (CB3) circuit breaker mounted in the main power compartment (refer to Section 06, "Electrical System" in this manual for details).

The condenser coil mounted on the opposite side of the evaporator is ventilated by four brushless axial fans. The fan motors are protected by a manual-reset 70 amp circuit breaker (CB 7) mounted in the main power compartment on rear R.H. side of vehicle (figure 6). Furthermore, the following relays, diodes and multiplex modules are located in the evaporator compartment (figure 7). They are mounted on the HVAC components panel located on the R.H. side wall when facing the compartment.

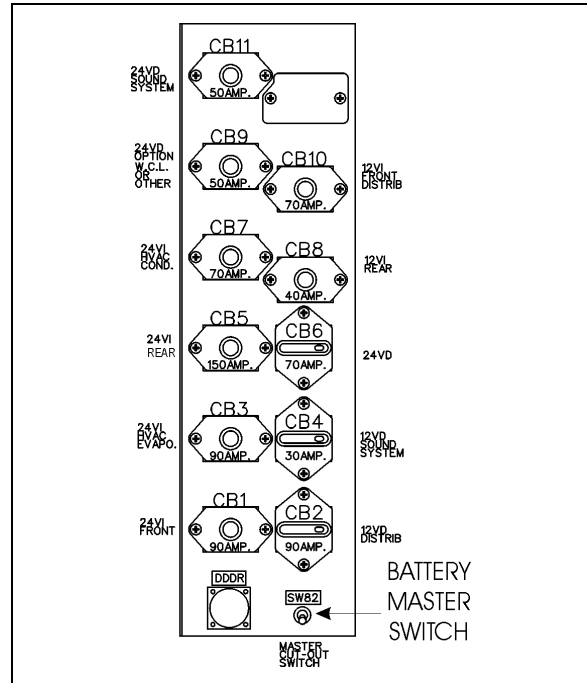


FIGURE 6: MAIN BREAKERS – SEATED COACH 06582A

Multiplex Module (evaporator compartment)	
A54	I/O-B
Relays (evaporator compartment)	
R10	24V Condenser fans
R12	24V Evaporator fan
R20	Water pump
R26	Pre-heating
Diodes (evaporator compartment)	
D9	Pre-heating
D10	Pre-heating
D16	Baggage compartment -3
D17	Baggage compartment -5
D19	Baggage compartment -2
D20	Baggage compartment -1
DXX	Not used

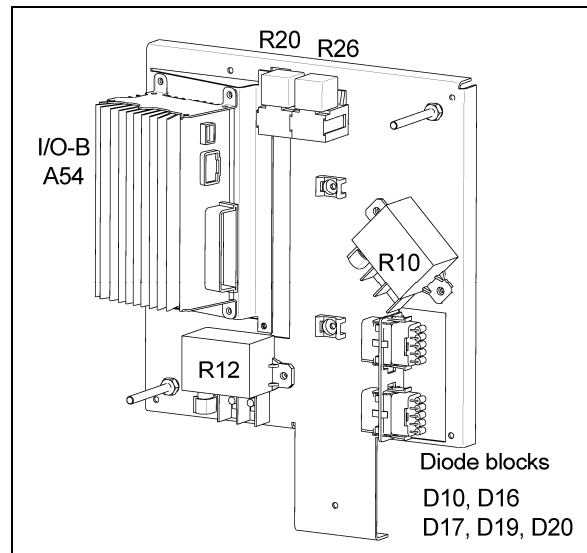


FIGURE 7: HVAC CONTROL PANEL 06596

5.3 OVERHEAD COMPARTMENT UNIT (H3 COACHES)

Optional evaporator coils may be added to both overhead compartment air systems. This air conditioning unit permits a wider temperature range in the passenger's area.

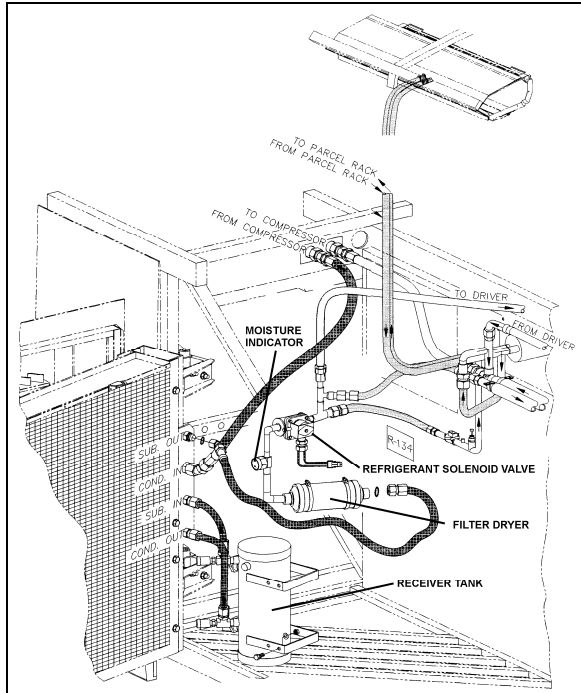


FIGURE 8: PASSENGER'S OVERHEAD COMPARTMENT UNIT 22221

6. HVAC UNIT MAINTENANCE

No special maintenance is required on the passenger's and driver's units, with the exception of cleaning their respective coil air filters.

NOTE

Squeeze rubber hose located under the concerned compartment, to eliminate water and dirt when you make routine maintenance.

6.1 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 evaporator coil from inside (figure 14).

For the optional windshield upper section defogger/defroster, remove the bottom access panel, remove the six bolts fixing the blower motor assembly. Use low air pressure to clean the coil.



MAINTENANCE

For the passenger's unit evaporator coil, back flush the coil (figure 9) every 12,500 miles (20 000 km) or once a year whichever comes first and for the condenser, back flush the coil (figure 11) every 6,250 miles (10 000 km) or twice a year, whichever comes first.

Use a water jet or water mixed with low air pressure to clean the coil.

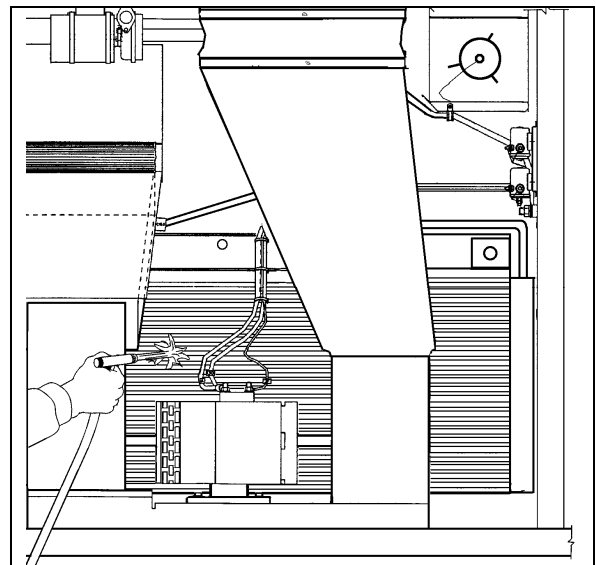


FIGURE 9: PASSENGER'S UNIT EVAPORATOR COIL 22226

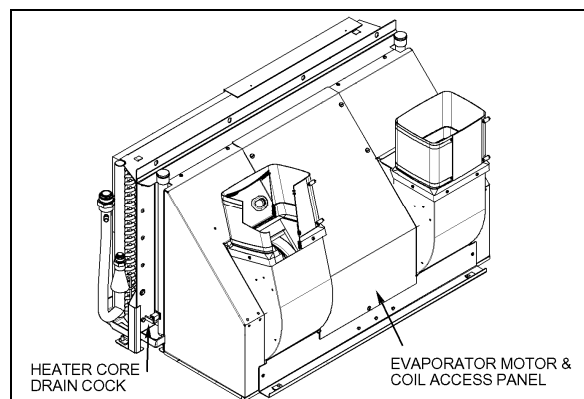


FIGURE 10: PASSENGER'S UNIT EVAPORATOR COIL (VIP WITH CENTRAL HVAC SYSTEM ONLY) 22332

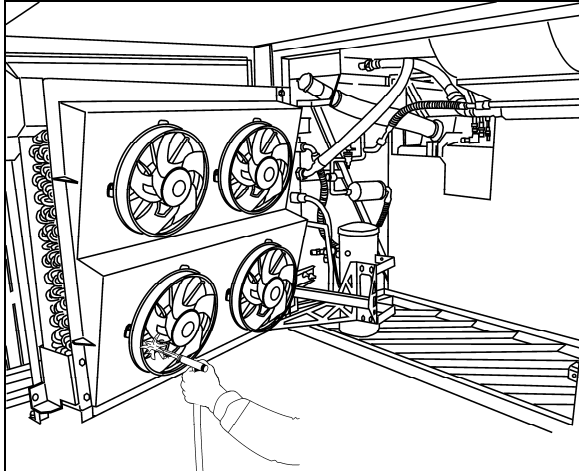


FIGURE 11: PASSENGER'S UNIT CONDENSER COIL 22362



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.

6.2 DRIVER'S UNIT AIR FILTERS

The driver's unit is located behind the R.H. console panel. To gain access to the air filters, unscrew the R.H. console's grill located in the entrance stepwell. Slide out the recirculating air filter.



MAINTENANCE

To clean filter back flush with water, then dry with air, every 12,500 miles (20 000 km) or once a year, whichever comes first.

The fresh air intake is located behind the R.H. side headlights assembly. Clean the steel wire screen as required.

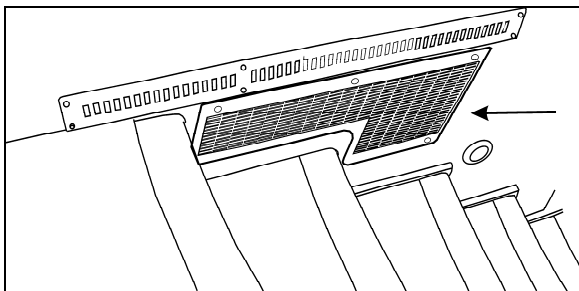


FIGURE 12: R.H CONSOLE AIR FILTER ACCESS GRILL (COACHES) 18505

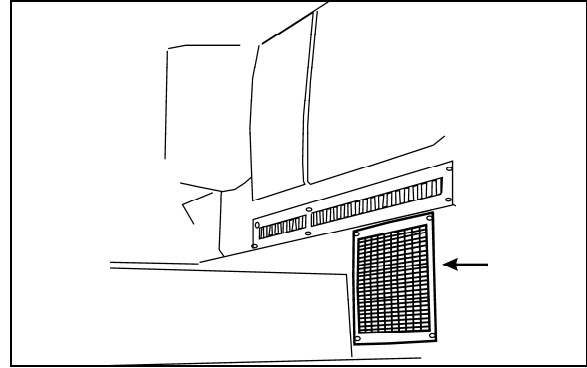


FIGURE 13: R.H. CONSOLE AIR FILTER ACCESS GRILL (VIP) 22232

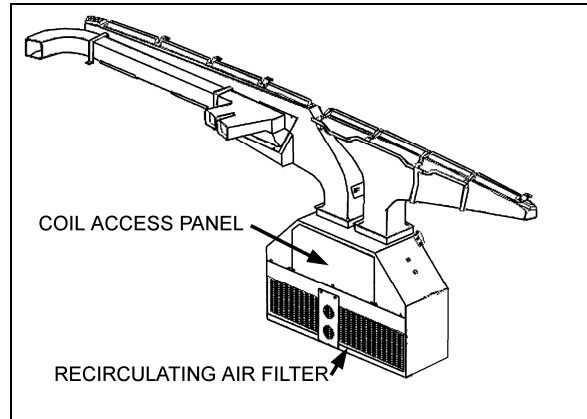


FIGURE 14: DRIVER'S UNIT AIR FILTERS 22171

6.3 PASSENGER'S UNIT AIR FILTER

The passenger's unit 2-part air filter is located in the evaporator compartment (figure 15). To access the filter, locate the access panel in the baggage compartment at the left of the evaporator compartment. Open panels by turning the three screws of either panel ¼ of a turn, unsnap both fasteners on top of filter, and slide out filter.



MAINTENANCE

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.



CAUTION

Do not use high pressure water jet to avoid damaging filter.

 **CAUTION**
Be sure not to reverse filter upon installation.

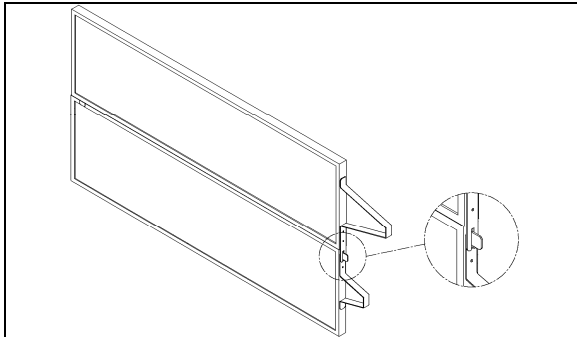


FIGURE 15: PASSENGER'S UNIT 2-PART AIR FILTER

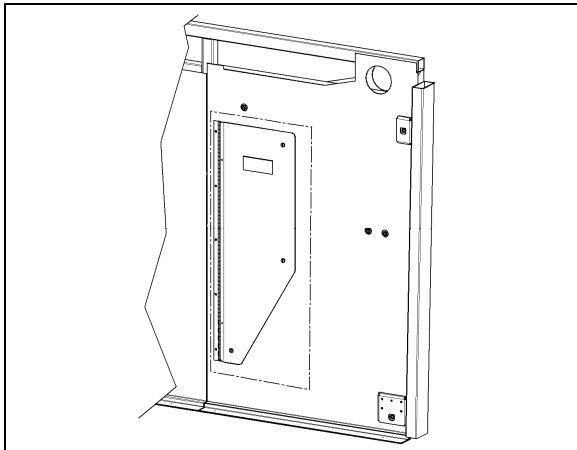



FIGURE 16: PASSENGER'S UNIT 2-PART AIR FILTER ACCESS PANEL

6.4 OVERHEAD COMPARTMENTS FAN AIR FILTER

Air conditioning 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 (figure 17).

 **MAINTENANCE**
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 comes first.

For air conditioning unit, ball valves are added on supply and return lines in the condenser compartment. They have service port to evacuate the A/C parcel rack 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.

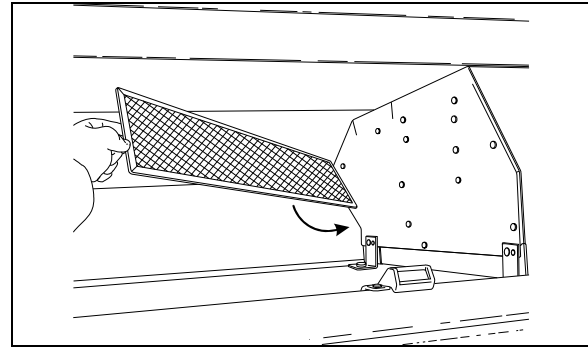


FIGURE 17: PARCEL RACK FAN AIR FILTER 22201

7. 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.

7.1 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.

pump, hot water solenoid valve and overhead compartment air register fans.

7.2 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

7.3 PARTICULARITIES

<p>Conditions for engaging the 2nd speed on the evaporator motor (cooling demand).</p>	<p>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.</p>
<p>Conditions for hot water recirculating pump activation (heating demand).</p>	<p>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 SWITCHES AND SENSORS.</p>
<p>The compressor unloaders are working based on pressure and also on the difference between the passenger's area temperature and the set point.</p>	<p>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.</p>
<p>The A/C deactivation pressure is 320 psi.</p>	<p>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.</p>

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7.4 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 passenger's area return air duct or the sensor wiring	1. 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 Bad wiring	1. Check / reset circuit breaker CB7
HVAC condenser fans not functioning in speed 1	Circuit breaker CB7 was manually tripped and not reset Module A53 is faulty	1. Check the SYSTEM DIAGNOSTIC menu of the message center display (MCD). Select FAULT DIAGNOSTIC and ELECTRICAL SYSTEM. The message "Voltage Module A53, Value too Low, Active" confirms a power problem on the module 2. Check / reset circuit breaker CB7
HVAC condenser fans not functioning in speed 2	Circuit breaker CB7 was manually tripped and not reset Module A53 is not powered or is faulty Seized bearing Bad wiring	1. Check the SYSTEM DIAGNOSTIC menu of the message center display (MCD). Select FAULT DIAGNOSTIC and ELECTRICAL SYSTEM. The message "Voltage Module A53, Value too Low, Active" confirms a power problem on the module 2. Check / reset circuit breaker CB7
Defroster fan is functioning but no heat or cooling available in the driver 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 2. Check / reset circuit breaker CB1 3. Check / replace fuse F12

Problem/Symptom	Probable Causes	Actions
The A/C compressor clutch does not engage	Module A52 is not powered or is faulty	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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

8. CENTRAL HVAC SYSTEM - AIR CONDITIONING

The central system is equipped with 4-cylinder 4NFCY Bitzer compressor with an air conditioning capacity of 7½ tons. The receiver tank and filter dryer are mounted inside the condenser compartment.

8.1 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 18.

The air conditioning system used in the H3 series vehicle is the "Closed" type using R134a refrigerant.

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 back to the condenser sub-

cooler. It leaves the condenser and 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 passenger's and driver's unit evaporator coils which absorb 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 in² (5162 mm²) 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.

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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 depending on operating conditions.

8.2 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.

8.2.1 Procurement

Refrigerant is shipped and stored in metal cylinders. It is serviced in 30 and 100 pound (13,6 and 45 kg) cylinders. Approximately 25 pounds (11, 4 kg) are used in the central system.

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.

8.2.2 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.

8.2.3 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.

8.2.4 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 reduce the refrigeration capacity of the entire system.

2. The flexible hose lines should never be allowed to come within a distance of 2-1/2" (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.

	<p>WARNING</p>
<p>Always wear safety goggles when opening refrigerant lines.</p>	

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.

8.3 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 cleanout procedures mentioned.

8.3.1 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.

8.3.2 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.


8.3.3 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 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.

8.4 PUMPING DOWN

This procedure is intended to reduce refrigerant loss 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.

 **WARNING**
When air conditioning system must be opened, refer to previous paragraph "Precautions In Handling Refrigerant" to prevent any injury.

NOTE
To ease purging and refilling of refrigerant, it is possible to open the passenger's and overhead compartment system liquid solenoid valves. To do so, connect both male and female connector housing of C24 together for the passenger's area (located in evaporator compartment). During normal use, both male and female housings of connector C24 are kept unplugged. They are connected only for refrigerant refilling and pumping down procedure.

Procedure

1. Open the solenoid valves by connecting both male and female connector housing of C24 together.
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).
4. Start the engine, press the HVAC control unit Passenger ON/OFF switch then the A/C switch, and adjust A/C temperature set point to coldest to increase cooling load.

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.

5. Stop engine, and close compressor outlet valve by turning it clockwise until valve is properly seated.
6. Close compressor suction valve by turning it clockwise until it is properly seated.
7. 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.
8. Connect the "Low Pressure Switch" connector and disconnect C24.

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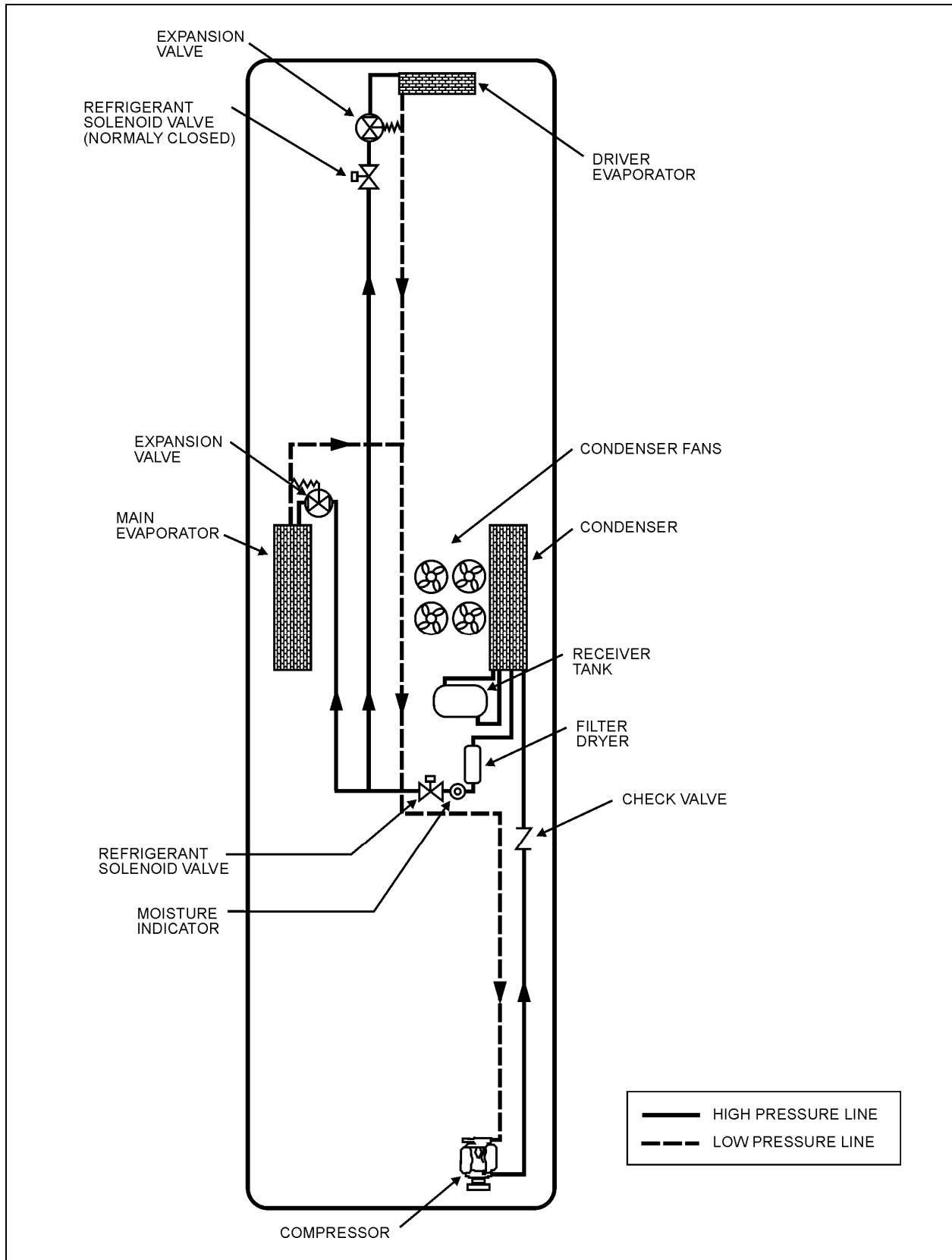


FIGURE 18: CENTRAL HVAC SYSTEM – AIR CONDITIONING

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8.5 ADDING REFRIGERANT (VAPOR STATE)

Addition of vapor state refrigerant is carried-out to compensate for hose permeation and shaft seal losses over a long period.

A typical sign of refrigerant low charge would be A/C lower performance experienced by the user.

Perform the usual leak inspection and correct any leaks before adding refrigerant.

8.5.1 Verification

Perform the following verifications:

- 1- A vehicle stopped for more than 4 hours should show the lower receiver tank sight glass full at room temperature or with some level if ambient temperature is high. This method is less accurate when ambient temperature gets high.
- 2- With the AC on for at least 10 minutes, the moisture indicator sight glass should be clear, not milky. The filter-dryer nearby should be near constant temperature, less than 5°F differential between inlet and outlet. A partially blocked filter will make some flash gas and give a “milky” sight glass.
- 3- At fast idle, the high side pressure should be near the following calculation: add 30° F to the ambient temperature in Fahrenheit. In the refrigerant chart, find this temperature and the corresponding saturation pressure and add 10 psi for the pressure drop between compressor and condenser.

NOTE

Calculation example:
 At 70°F outside, add 30°F. In the chart, find the pressure value for a temperature of 100°F. For 134a refrigerant gas, you will find a value of 124psi. Add 10psi to this value for the compressor to condenser line, this result gives 134 psi. So a high side pressure value between 129 to 139 psi should be OK

8.5.2 Refrigerant addition


1. Install a heated refrigerant bottle at the back of the vehicle, on a scale, straight up.

 Refer to section “Precautions in Handling Refrigerant” for the proper heating method.

NOTE


Use a bottle that is more than half full.
 Always charge the system with the cylinder upright and the valve on top to avoid drawing liquid out of the cylinder.

2. Connect the yellow hose of your manifold gage set to the red (vapor) valve on the bottle. Connect the blue valve of the gage set on the suction side of the compressor. Connect the red valve of the gage set to the discharge side. Hoses should be purged of air at installation.

 **WARNING**

Secure manifold gage hoses so they will not be damaged by engine belts and pulley.

3. Open the suction and discharge valve to mid-point.
4. In order to speed up the charging, unplug unloaders to keep all compressor cylinders active.
5. Let the door and hatches open and maybe open side windows to prevent cooling down the coach too rapidly. Preferably, the interior would be hot, at least over 68 F.
6. Open the condenser door, if not already done.

 **WARNING**

If discharge pressure is above 138 psig, the condenser fans will be running. Keep hands clear of fans

7. Start engine.
8. Switch to fast idle for faster fill and battery protection.
9. Open the blue gage valve. The suction pressure should go up meaning the compressor is sucking from the tank also. If there is almost no pressure rise, the tank is too low or too cold.
10. Check the moisture indicator sight glass and the discharge pressure to meet the criteria described above.
11. When the sight glass gets clear, you can add some reserve, up to 2 pounds, as long as the high pressure does not move up.
12. When finished, close gage valves and bottle valve.

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13. Before stopping the engine, check the compressor oil level and note it in the repair book as well as the amount of refrigerant added.
14. Shut down engine and backseat suction and discharge valves.
15. Remove gages and replace caps.
16. Perform a road test for final verification.

8.6 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 valves by connecting together both male and female connector housing of C24 (located in evaporator compartment) and C44 (located on the ceiling of the spare wheel compartment).
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.

8.6.1 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.
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 compressor may risk drawing air into the system past the 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.

<i>NOTE</i>
<i>This method will aid in preventing unnecessary system failures by ensuring that the refrigeration system is free of contaminants.</i>

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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.

9. CENTRAL HVAC SYSTEM – AIR CONDITIONING COMPONENTS

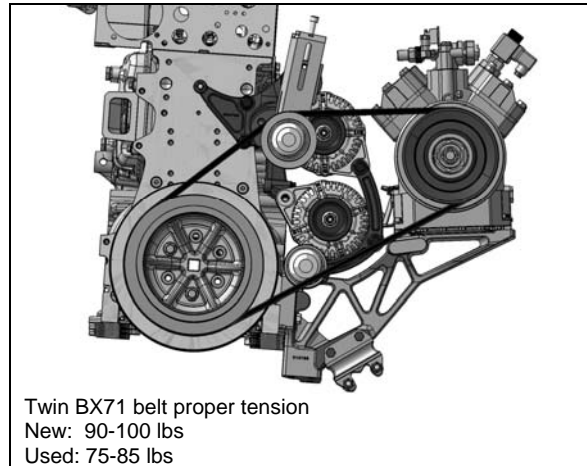
9.1 COMPRESSOR

The central system is equipped with a 4 cylinder, 4NFCY Bitzer compressor. Refer to the “Specifications” section at the end of this chapter.

9.1.1 Belt Replacement

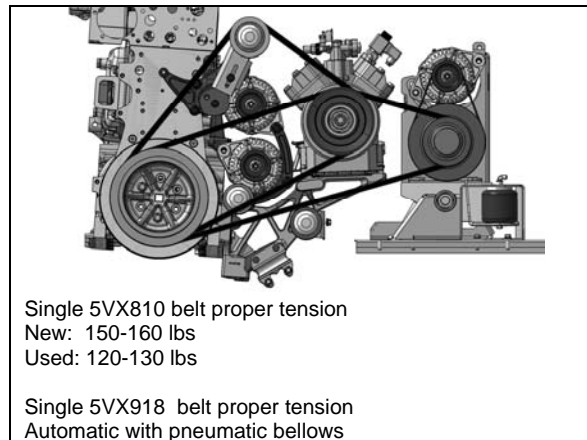
1. Open engine compartment rear doors and locate A/C compressor drive belt tensioner. Loosen tensioner screw to release belt tension.
2. For vehicles equipped with a 3rd alternator, belt tensioning is also applied through air bellows. Turn the belt tensioner two-way control valve counterclockwise to release bellows pressure.
3. Remove the radiator fan drive belt (refer to Section 05 COOLING).

4. Slip the old compressor belts off and the new ones on.



Twin BX71 belt proper tension
New: 90-100 lbs
Used: 75-85 lbs

FIGURE 20: STANDARD BELT LAYOUT WITH CENTRAL HVAC SYSTEM



Single 5VX810 belt proper tension
New: 150-160 lbs
Used: 120-130 lbs

Single 5VX918 belt proper tension
Automatic with pneumatic bellows

FIGURE 21: BELT LAYOUT WITH 3RD ALTERNATOR



DANGER

Set the main battery disconnect switch to the “Off” position. For greater safety, set the engine starter selector switch in engine compartment to the “Off” position.

NOTE

Both belts must always be replaced simultaneously to ensure an equal distribution of load on each of them.

NOTE

Belts specifications may vary. For proper belt selection, always consult your vehicle Coach Final Record.

9.1.2 Belt Tension Adjustment

On the mechanical tensioner, slightly slack lock bolt (A). Adjust tension by turning adjustment screw (B). Tighten the lock bolt (A) to 43 lbf-ft. to preserve adjustment.

Should the idler bearing need to be serviced, tighten shoulder bolt (C) to 74 lbf-ft. at reassembly.

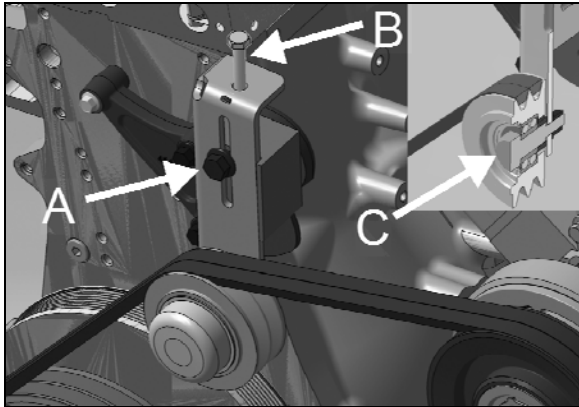


FIGURE 22: TENSIONER ON STANDARD BELT ARRANGEMENT

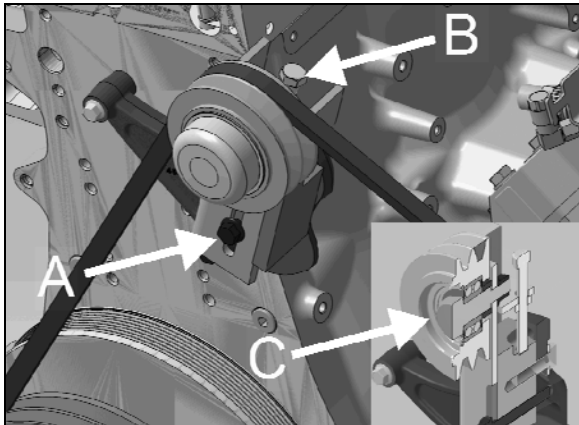


FIGURE 23: TENSIONER ON THREE ALTERNATOR BELT ARRANGEMENT

For vehicles equipped with a 3rd alternator, belt tensioning is also applied through air bellows which is adjusted by an air pressure regulating valve (Fig 24). The correct pressure of 45 psi (310 kPa) is set at the factory. Periodically verify the pressure at the regulating valve using a pressure gauge and correct if required.

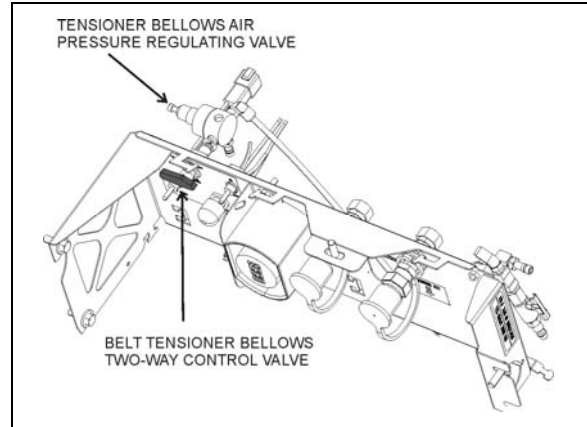


FIGURE 24: TENSIONING VALVE

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9.1.3 Compressor Maintenance

For the maintenance of the A/C compressor, see the manufacturer's instructions included at the end of this section.



CAUTION

Use only Bitzer BSE55 (POE) oil with refrigerant 134a.

Once every 6 months empty the shaft seal oil collecting tube. This tube collects oil seeping through the felt shaft seal.

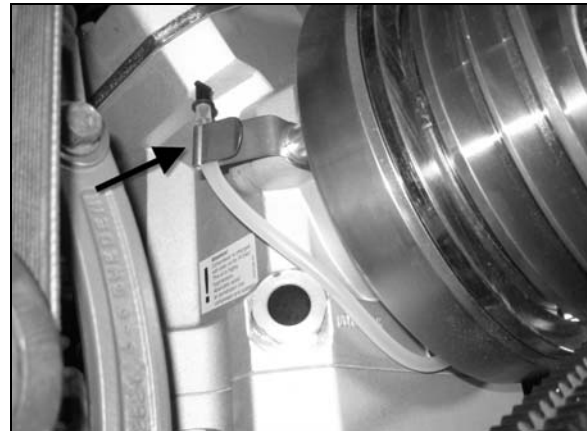


FIGURE 25: SHAFT SEAL OIL COLLECTING TUBE

During the 250 hour run-in period of the shaft seal, an increased oil leak rate may occur.

9.1.4 Troubleshooting Guide

A preliminary check may be made by simply feeling the cylinder heads with the unit in operation at ambient temperatures of 35 °F (2°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,

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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.

9.2 MAGNETIC CLUTCH

Refer to Bitzer Maintenance Instruction KW-540-1 at the end of this section for the description and maintenance of the magnetic clutch.


9.2.1 HVAC Control Unit and Clutch Operation


The A/C compressor starts automatically when the two following conditions are satisfied:

1. The outside temperature is above 30°F (-1°C).
2. The passenger's area temperature has reached 7°F (4°C) under the set point.

NOTE

Upon starting, if the outside temperature is above 30°F (-1°C) and then drops below 30°F (-1°C), the compressor will keep running up to a temperature of 15°F (-9°C) to prevent condensation from forming on the windows.

When A/C compressor clutch engages, the corresponding A/C ON indicator LED  turns on.

The A/C ON indicator LED  will also turn off and the clutch will disengage if a low pressure (5 psi cut-out, 30 psi cut-in) or a high pressure (350 psi cut-out, 245 psi cut-in) condition is present.

9.3 BRUSHLESS EVAPORATOR MOTOR

The brushless evaporator motor is installed in the evaporator compartment (L.H. side of vehicle) (figure 27). It is a 27.5 volt, 2HP (1,5 kW) motor which activates a double blower fan unit.

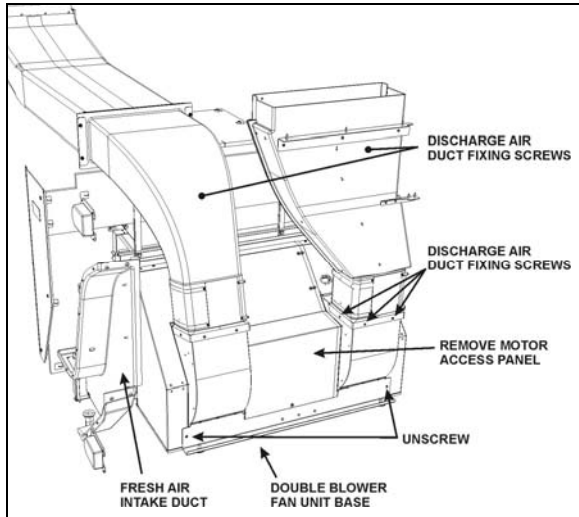


FIGURE 26: EVAPORATOR COMPARTMENT

9.3.1 Removal

1. Set the battery safety switch 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. Identify the discharge ducts inside compartment and remove the Phillips head screws fixing the air duct to blower fan unit.
4. Remove the motor access panel.
5. Disconnect electrical motor speed control wire (white wire, circuit 2F), power cable and ground cable from motor terminals.
6. From under the vehicle, remove the eight bolts fixing the double blower fan unit base. Remove the complete unit from the evaporator compartment (figure 27).



CAUTION

Never support evaporator motor assembly by its output shafts while moving it. Always use double blower fan unit base.

7. Install the complete unit on a work bench, unfasten the fan square head set screws, the Phillips head screws retaining cages to base and slide out the assemblies from the evaporator motor output shaft.
8. Remove motor from double blower fan unit base.

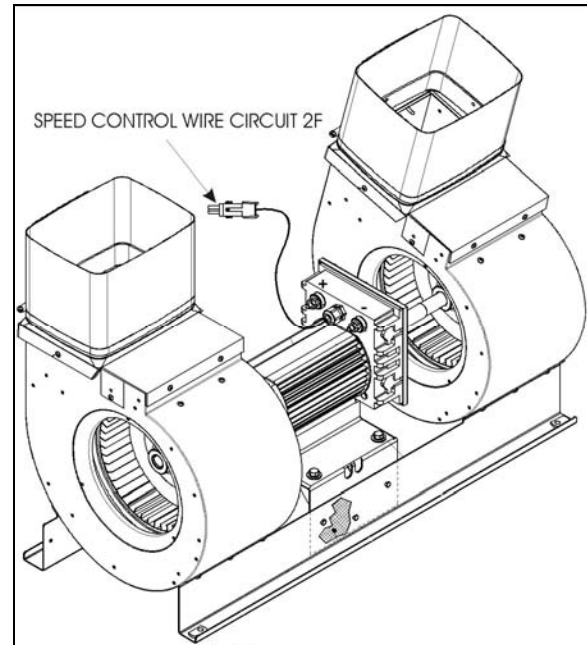


FIGURE 27: EVAPORATOR MOTOR ASSEMBLY

9.3.2 Installation

To reinstall the evaporator motor, reverse "Evaporator Motor Removal" procedure.

9.4 CONDENSER

The central A/C system condenser coil is hinge mounted on the R.H. side of the vehicle on the condenser compartment door. 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.

9.4.1 Condenser Fan Motors

Four brushless fan motors are installed in condenser compartment on R.H. side of vehicle in order to ventilate the condenser coil. The fans pull outside air through the condenser coil and discharge it through an opening at bottom of compartment. Depending on pressure in receiver tank (figure 30), the fan motors may be operated at full speed, half speed or not operated at all. With low pressure in receiver

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tank, fan motors operate at half speed and, with a high pressure in receiver tank, fan motors operate at full speed. Removing 24-volt applied to terminal 5-LOW will reduce fan speed to half speed, applying 24-volt to terminal 5-LOW engages full speed. For details about electrical wiring, refer to “A/C and Heat system” in the master wiring diagram.

NOTE

During normal conditions, fan motors function according to the following specifications:

Half speed: 3100cfm, 5.8A at 28 VDC

Full speed: 6200cfm, 37A at 28 VDC

Fan motor speed: 2950 rpm at full speed

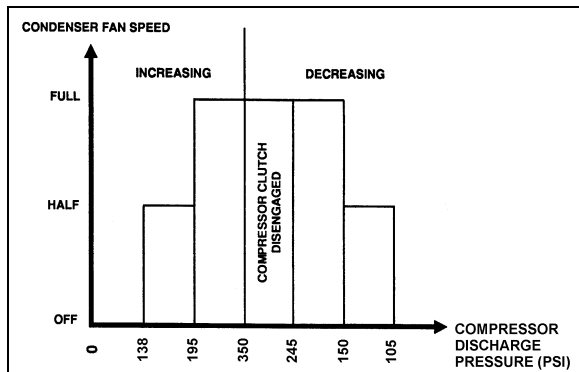


FIGURE 28: CONDENSER FAN SPEED IN RELATION WITH HIGH SIDE PRESSURE

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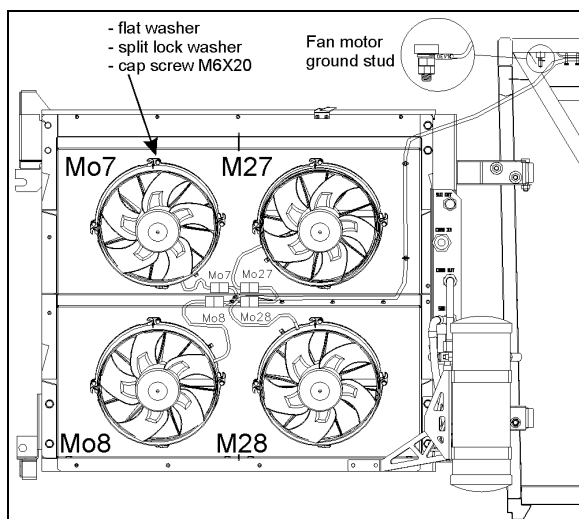


FIGURE 29: CONDENSER FANS

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9.4.2 Condenser Fan Motor Removal

1. Set the main battery disconnect switch to the “Off” position.
2. Unplug the fan motor harness connector.

3. Remove the four hexagonal head cap screws retaining the fan motor assembly to the shroud.
4. Remove the motor.

9.5 RECEIVER TANK

The receiver tank is located in the condenser compartment (figure 30). 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.

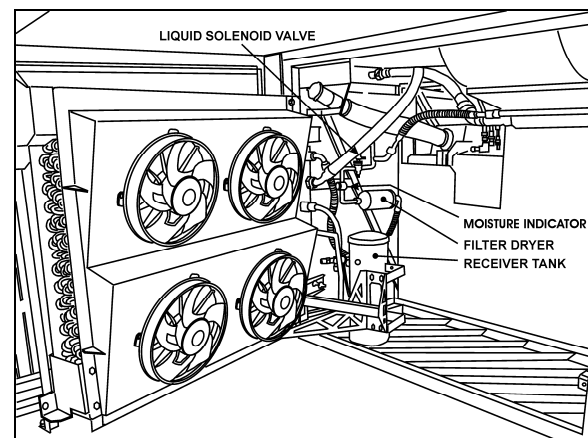


FIGURE 30: A/C CONDENSER COMPARTMENT

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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.

9.6 FILTER DRYER

A filter dryer, also located in the A/C condenser compartment, is installed on the liquid refrigerant line (near 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 to prolonged exposure as shown by the moisture indicator sight glass.


A filter dryer, located in the engine compartment near the radiator is installed on vehicles equipped with a small HVAC system only. Its function is similar to that of filter used on main systems. Replace only when system is opened or a problem occurs.

9.6.1 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.

 <b style="font-size: 1.2em; margin-left: 10px;">CAUTION
<p>Do not use carbon tetrachloride or similar solvents to clean parts. Do not use steam gun. Use mineral spirits or naphtha. All parts should be thoroughly cleaned. Use a stiff brush to wash dirt from grooves, holes, etc.</p>

 <b style="font-size: 1.2em; margin-left: 10px;">DANGER
<p>Cleaning products are flammable and may explode under certain conditions. Always handle in a well ventilated area.</p>

9.6.2 Moisture Indicator

The moisture sensitive element consists of a color changing ring which is reversible from yellow to green and vice versa as the moisture content in the refrigerant changes. Yellow indicates a wet refrigerant, yellow green (caution) and green indicates a dry refrigerant.

Since temperature changes affect the solubility, color change will also vary with the refrigerant temperature. The following 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 eventually failure of the system. Uncontrolled moisture in the system can result in 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.

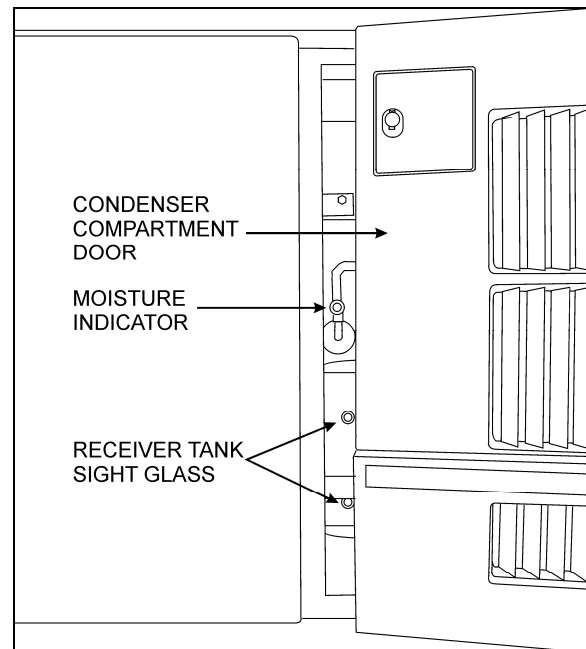


FIGURE 31: A QUICK CHECK OF THE MOISTURE INDICATOR AND THE RECEIVER TANK SIGHT GLASS
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9.7 LIQUID REFRIGERANT SOLENOID VALVE

The flow of liquid refrigerant to both driver's and passenger's evaporators is controlled by a normally-closed solenoid valve. The driver's solenoid valve is located on the ceiling of the spare wheel compartment and is accessible

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through the reclining bumper while the central HVAC system solenoid valve is located in the condenser compartment.

9.7.1 Manual Bypass

To ease purging, pumping down and refilling of refrigerant, it is possible to open the driver's, passengers and overhead compartment system liquid solenoid valves. To do so, connect either male and female connector housing of C24 together for the passenger's area (located in evaporator compartment) or C44 for the driver's area (located on the ceiling of the spare wheel compartment). During normal use, both male and female housings of connector C24 & C44 are kept unplugged.

9.7.2 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.

9.7.3 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 (figure 32).
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 previous procedure must be followed before brazing solder-type bodies into the line.

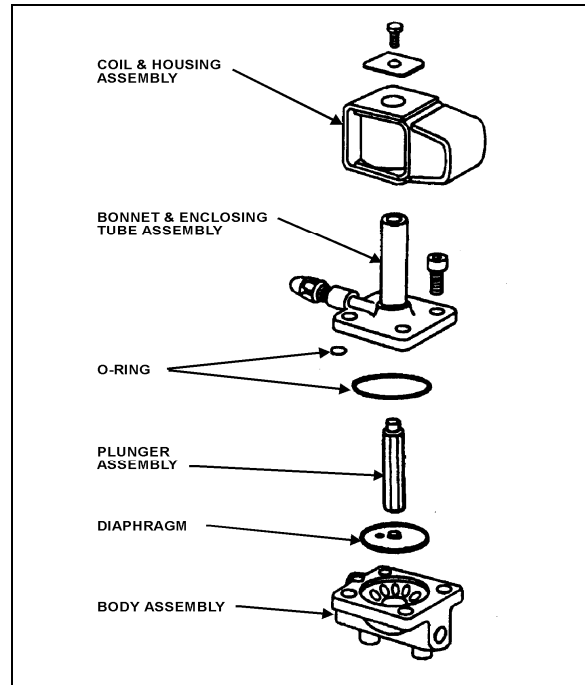


FIGURE 32: REFRIGERANT SOLENOID VALVE

22044



CAUTION

Be careful not to damage the machined faces while the valve is apart.

9.7.4 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.
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.

9.8 EXPANSION VALVE

9.8.1 Central system

The expansion valve for the main system is a thermo-sensitive valve with a remote control bulb head attached to the evaporator outlet line and is accessible by the evaporator filter access

door. 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.

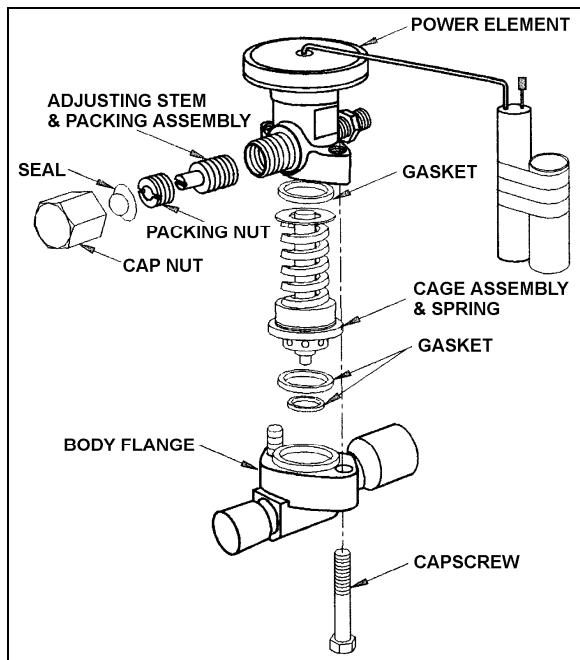


FIGURE 33: EXPANSION VALVE

22215

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.

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 easiest method of adjusting the superheat is to unscrew completely the main evaporator expansion valve adjusting screw, and screw in 13 turns clockwise for 134A (figure 34). If this method does not provide an accurate superheat, 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.

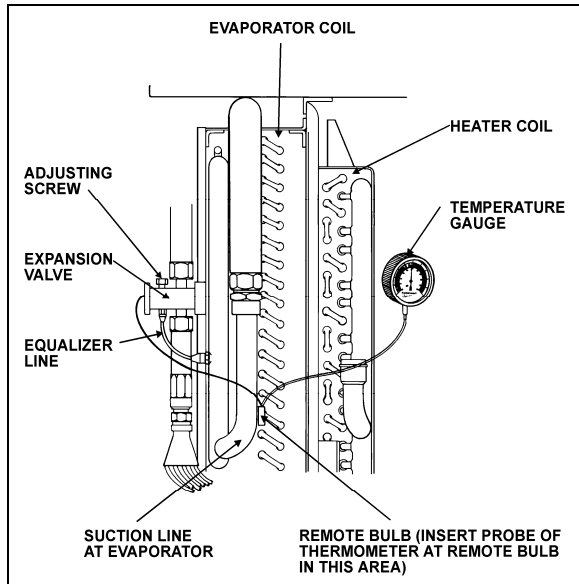


FIGURE 34: SUPERHEAT ADJUST. INSTALLATION 22046

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 (figure 34).
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.
6. Check approximately 5 readings of pressure at 2-minute intervals and convert to temperature using the vapor-pressure table (page 37). 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 figure 35).

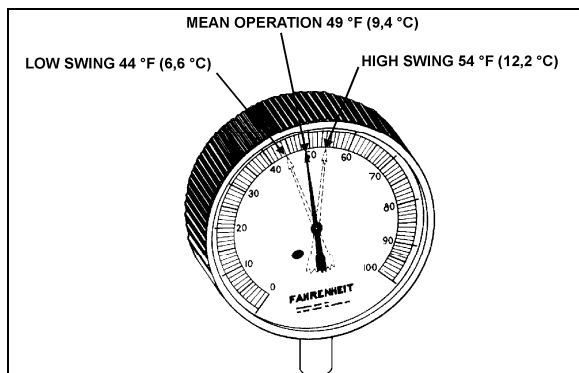


FIGURE 35: HIGH & LOW SWING TEMPERATURE AT REMOTE BULB 22047

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 12 to 16°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.

7. 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 with 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.

9.8.2 Driver's System


The function and operation of the expansion valve for the driver's system are similar to the central system, but no superheat adjustment is required (see figure 33).

9.9 TORCH BRAZING


Use electrode containing 35% silver.

NOTE

A 3.5% silver low temperature brazing electrode can be used on low side pressure and liquid high side.

 **CAUTION**

When using heat near a valve, wrap with water saturated rag to prevent overheating of vital parts.

 **DANGER**

Before welding any part of refrigeration system, make sure the area is well ventilated.

Section 22: HEATING AND AIR CONDITIONING

9.10 TROUBLESHOOTING

9.10.1 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.
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.

9.10.2 A/C Compressor

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 Superheat too high.	Clogged filter. Obstructed or defective expansion valve. 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.
Frequent startings and stoppings on low pressure control switch.	Lack of refrigerant. Check for leaks. Recharge.
Compressor intermittently starts and stops.	Intermittent contact in electrical control circuit. Compressor valves not in operating position.
Non-condensable in the refrigeration system.	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.)

Section 22: HEATING AND AIR CONDITIONING


TROUBLE	CAUSE
	<p>An evaporator just does a proper cooling job without sufficient air. Shortage of air can be caused by the following:</p> <ul style="list-style-type: none"> ○ Dirty filters; or ○ Dirty coils.
<p>Testing condenser pressure.</p> <p>Note: R-134A pressure is function of the temperature variation.</p> <p>Example, for an exterior temperature of 100°F. Exterior temperature (100°F) + 40°F = 140°F. Refer to paragraph "9.11 Temperatures & Pressures". Note the corresponding pressure for a temperature of 140°F., 230.5 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, and then 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 air cooled condenser pressure may be too high. Most frequent causes are:</p> <p>Reduced air quantity. This may be due to:</p> <ul style="list-style-type: none"> ○ 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. 	

9.11 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
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

9.12 LEAK TESTING

Some methods such as nitrogen pressure and 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:



DANGER
Do not inhale fumes from leak detector.

The flow of acetylene to the burner causes a depression 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 specific 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.

10. SMALL HVAC SYSTEM – AIR CONDITIONING COMPONENTS

10.1 COMPRESSOR

Consult the small Compressor Service Manual included at the end of this section.



WARNING
Read the cautionary information in the small Compressor Service Manual included at the end of this section.

10.2 COMPRESSOR REMOVAL

10.2.1 When the compressor is operational

- Perform the "OIL RETURN OPERATION" (Refer to paragraph 10.5).

10.2.2 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. 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.

NOTE
Belts specifications may vary. For proper belt selection, always consult your vehicle Coach Final Record.

10.2.3 When the compressor is inoperable

- Perform the "Refrigerant Recovery" operation (paragraph 10.2.2).
- Slacken bolts fixing small compressor.
- Remove the compressor.

10.2.4 Evacuating System prior Addition of Refrigerant (Driver's or Auxiliary System)

When a system has been opened for repairs, change the filter dryer and evacuate the system. VIPs equipped with a driver's system must use high-pressure service port located on the other

side of check valve and low-pressure port located alongside rear truss (figure 38). It would be good practice to open the solenoid valve.

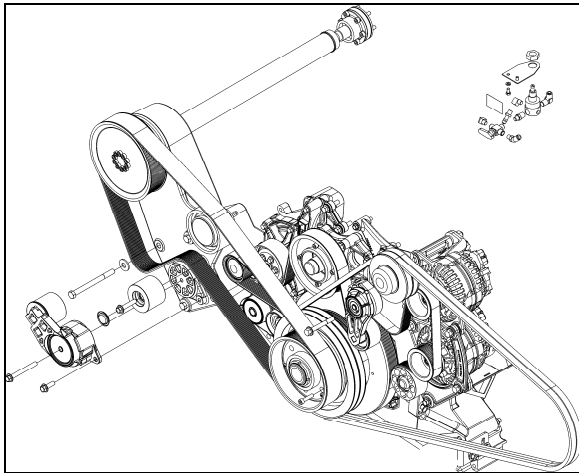


FIGURE 36: BELT LAYOUT WITH SMALL A/C COMPRESSOR

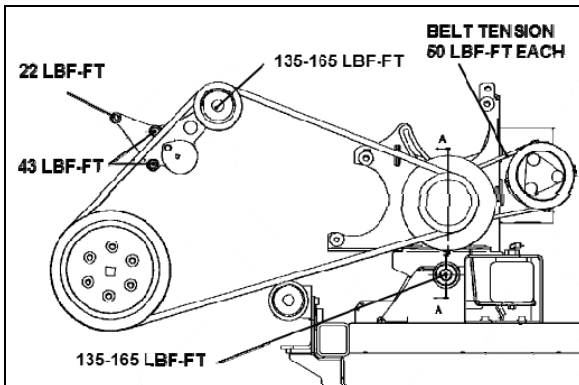


FIGURE 37: BELT LAYOUT WITH SMALL A/C COMPRESSOR

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.

10.3 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 cm ³ (1.7 ozs)
Condenser	30 cm ³ (1.0 ozs)
Filter-Dryer	10 cm ³ (0.3 ozs)

The amount of oil recovered with the refrigerant recovery should be added at the same time.

10.4 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 small Compressor Service Manual included at the end of this section

10.5 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.

Section 22: HEATING AND AIR CONDITIONING

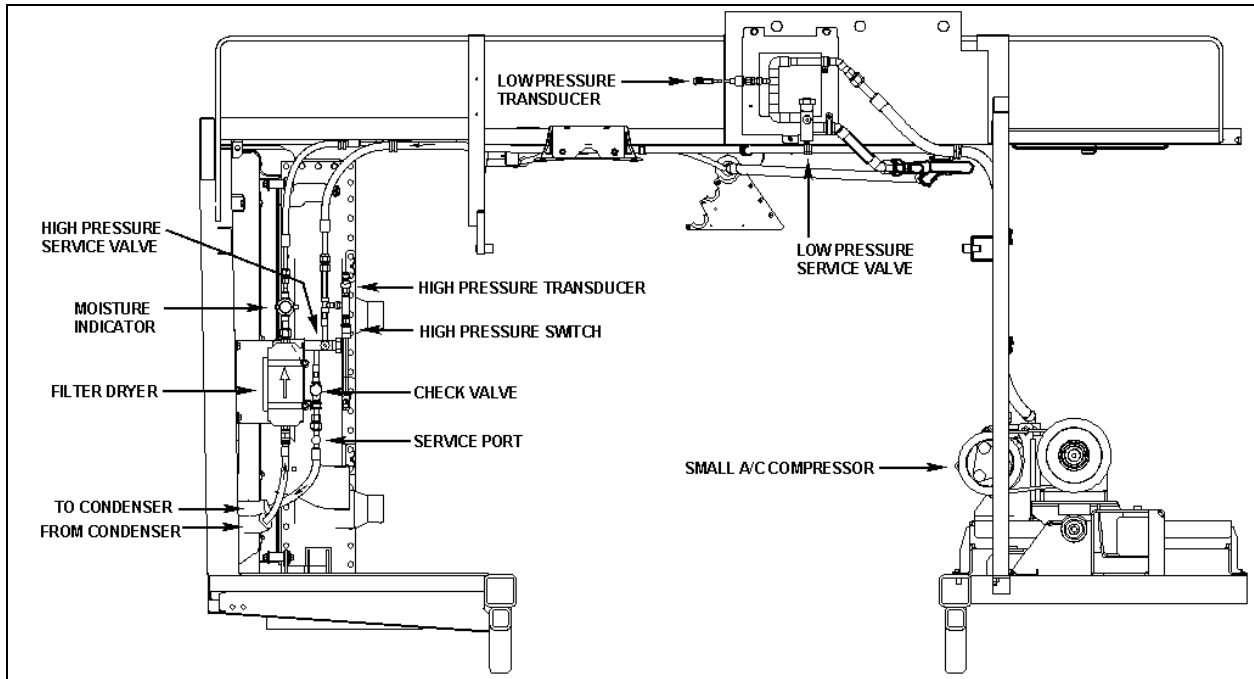


FIGURE 38: SMALL HVAC SYSTEM - AIR CONDITIONING

22344

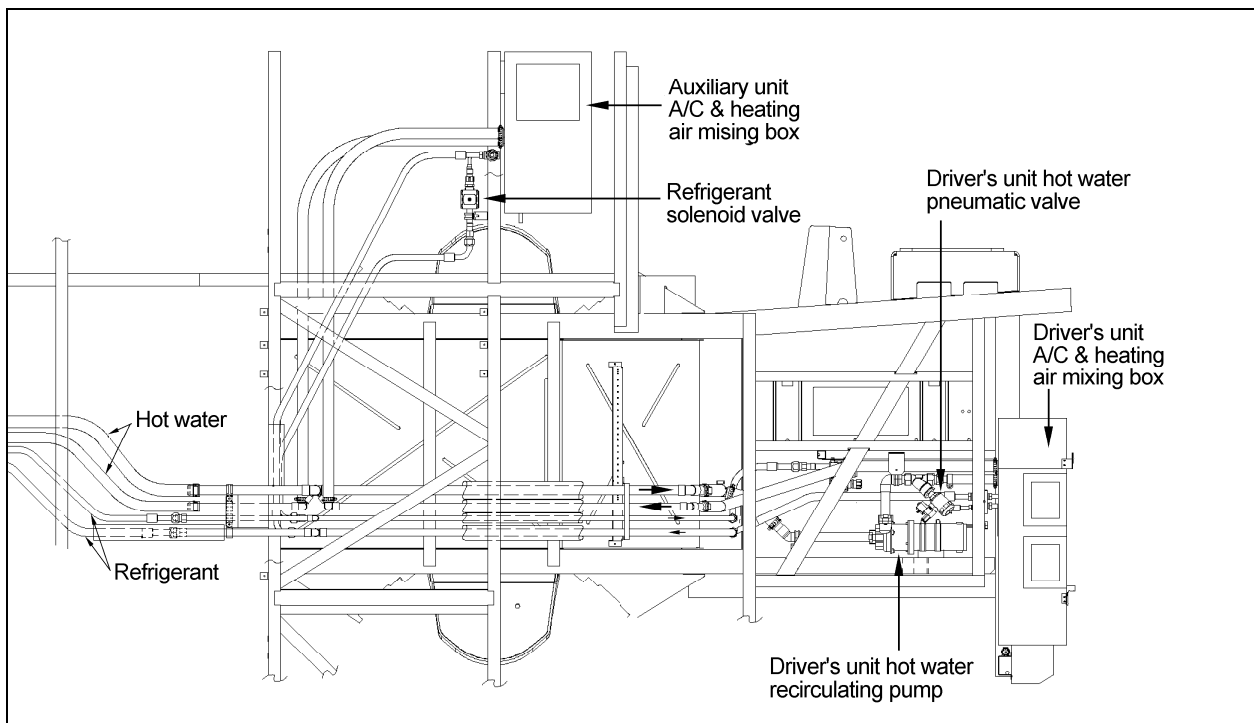


FIGURE 39: SMALL HVAC SYSTEM - DRIVER'S AND AUXILIARY UNIT

22290

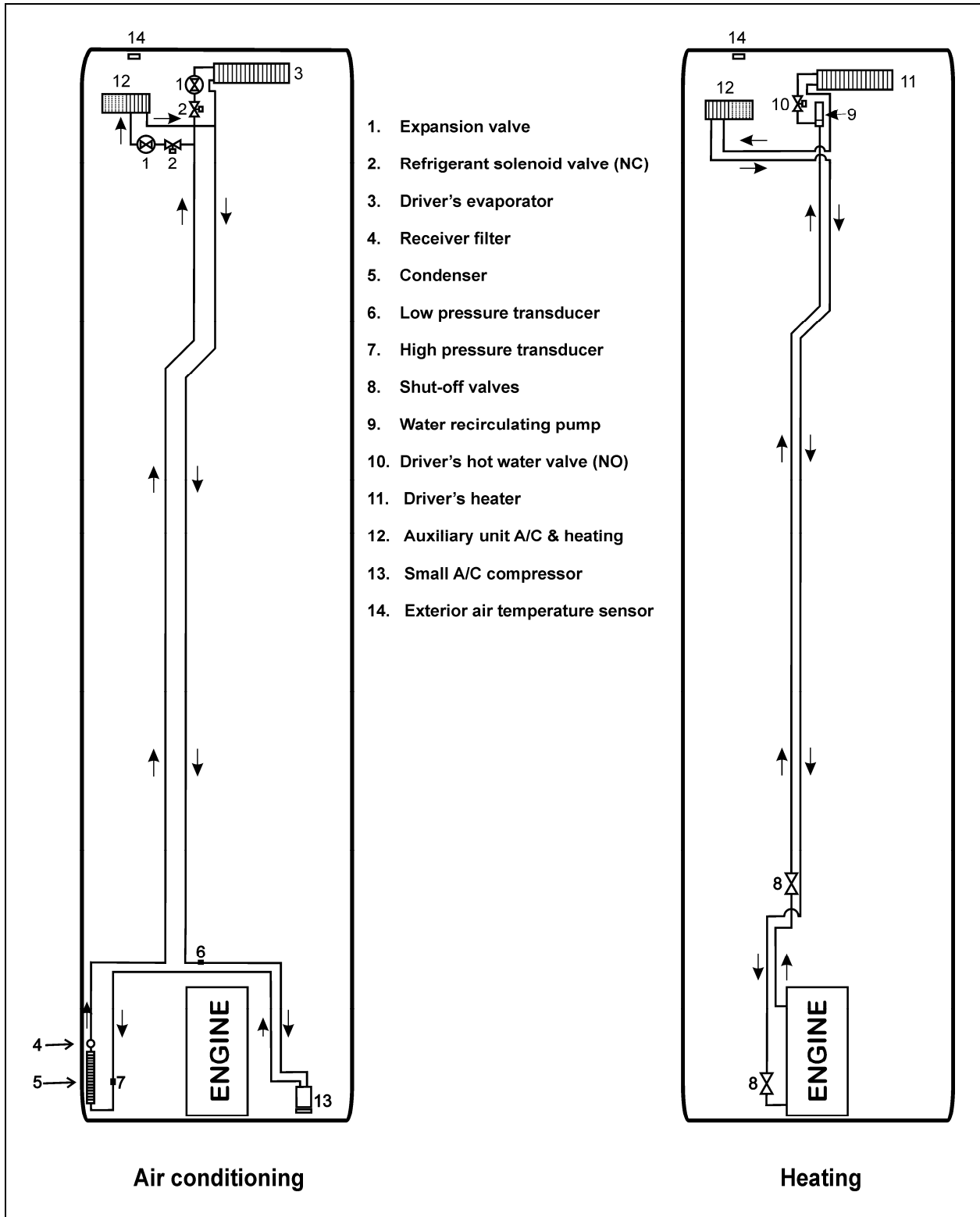
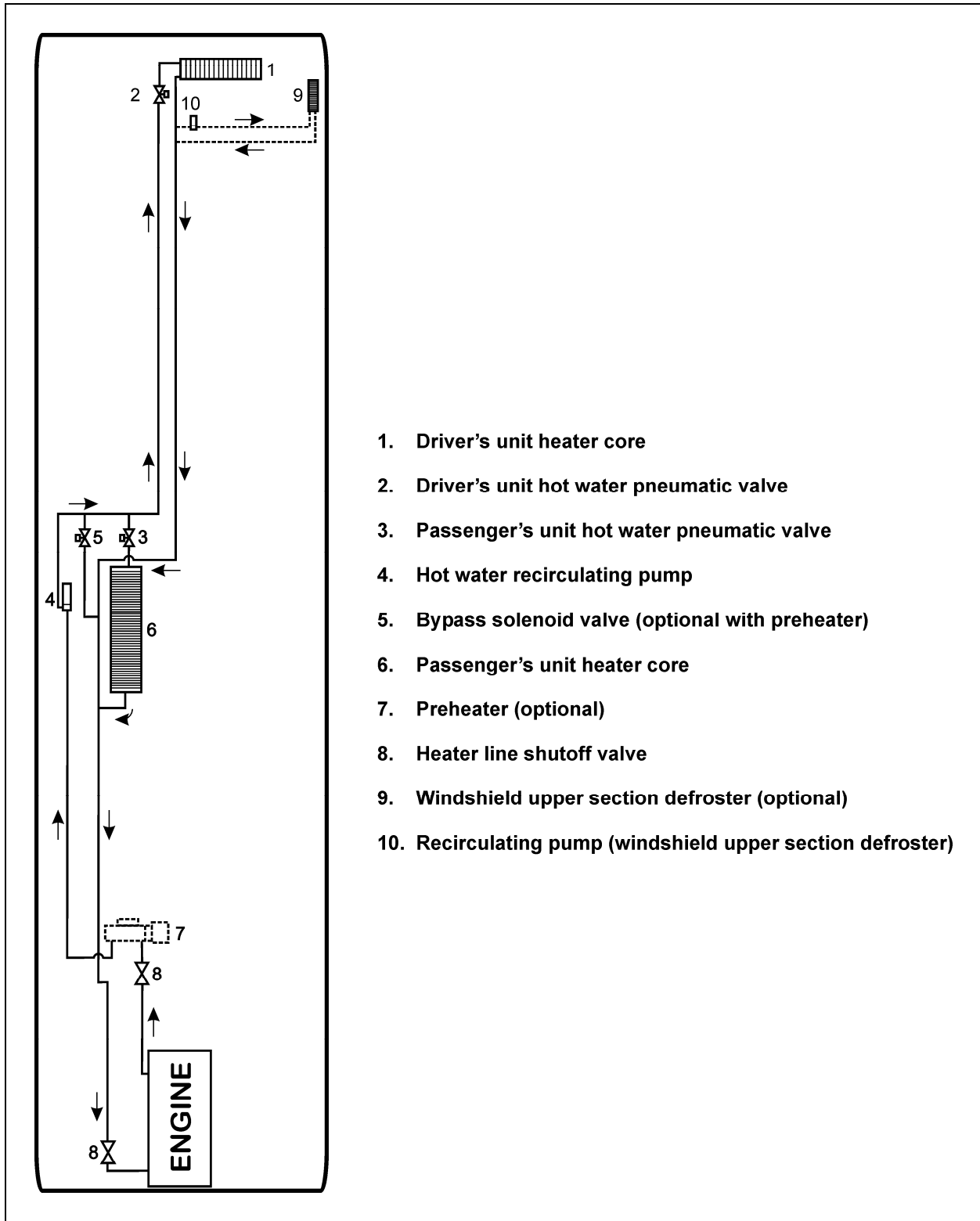


FIGURE 40: SMALL HVAC SYSTEM

22345



1. Driver's unit heater core
2. Driver's unit hot water pneumatic valve
3. Passenger's unit hot water pneumatic valve
4. Hot water recirculating pump
5. Bypass solenoid valve (optional with preheater)
6. Passenger's unit heater core
7. Preheater (optional)
8. Heater line shutoff valve
9. Windshield upper section defroster (optional)
10. Recirculating pump (windshield upper section defroster)

FIGURE 41: CENTRAL HVAC SYSTEM – HEATING

22262

11. HEATING SYSTEM

The schematics of figure 39 & 40 show respectively, the small HVAC system heating and air conditioning arrangement and the central HVAC system heating arrangement.

In addition to the normal heating provided by the engine, a preheating system (104,000 Btu/hr) (optional on coaches only) may have been installed in the vehicle.

11.1 SMALL HVAC SYSTEM

The small HVAC system driver's unit is similar to the driver's unit of the central HVAC system, except that the recirculating pump is located on the ceiling of the spare wheel compartment (figure 39).

Furthermore, an auxiliary unit is added in series on the return line of the small system, it increases the whole system heating capacity and gives the driver more options.

11.2 CENTRAL HVAC SYSTEM

The schematic of figure 41 shows the central HVAC system heating arrangement.

On coaches only, in addition to the normal heating provided by the engine, an optional preheating system (104,000 Btu/hr) may have been installed above the rear wheelhousing on the L.H. side.

11.3 DRAINING HEATING SYSTEM

To drain the entire system, refer to Section 05, "Cooling". If only the driver's unit heater core or passenger's unit heater core must be drained, refer to the following instructions.

11.3.1 Draining Driver's Unit Heater Core

1. Stop engine and allow engine coolant to cool.
2. Locate the normally open hot water pneumatic valve on the ceiling of the spare wheel compartment (figure 39), disconnect its wiring connector, and then connect a 24-volt external power source, using jumper cables, to close 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 hot water pneumatic valve.
4. From inside of vehicle, remove the grill and the access panels. Open the purge valve located inside the driver's unit (figure 42) to ensure an efficient draining.

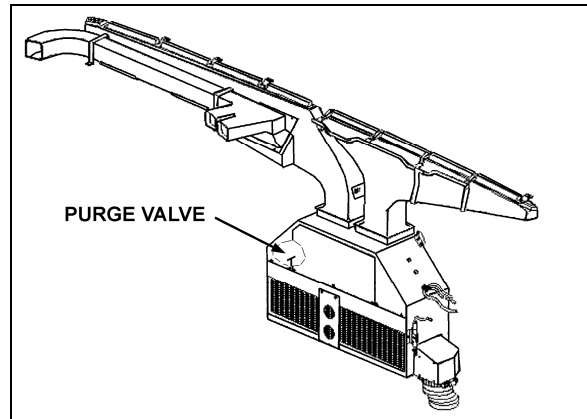


FIGURE 42: DRIVER'S UNIT AIR MIXING BOX 22171PV

11.3.2 Draining Passenger's Unit Heater Core

1. Stop engine and allow engine coolant to cool.
2. Close both heater line shutoff valves (figure 45 & 46). One is located in the engine compartment under the radiator fan gearbox, while the other one is located behind the L.H. hinged rear fender near the preheater. Refer to "Preheater System" in this section to gain access to the heater line shutoff valve.
3. Open the last L.H. side baggage compartment door and then pull the black release button located on the L.H. side in order to unlock and open the evaporator compartment door.



WARNING

Before proceeding with the following step, check that coolant has cooled down.

4. Open drain cock in bottom of heater core, then open purge valve located on top of heater core (figure 43) in order to allow air to enter while draining.

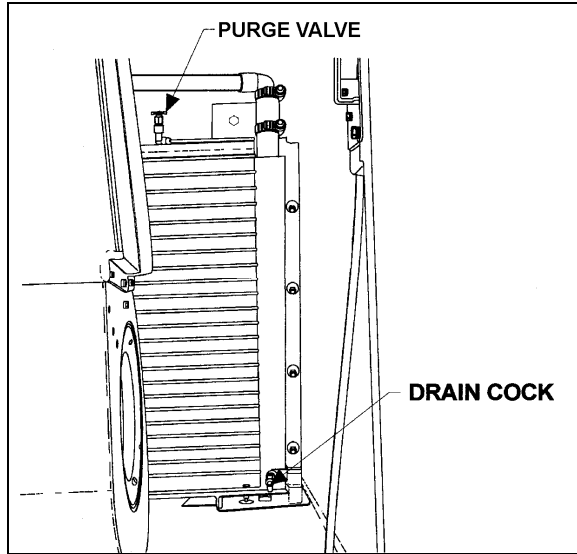


FIGURE 43: PASSENGER'S UNIT HEATER CORE (H3 COACHES) 22229

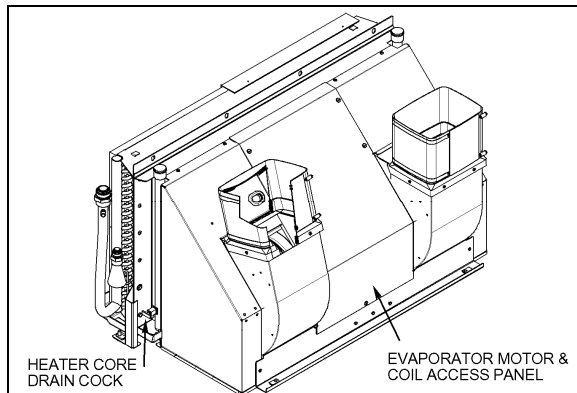


FIGURE 44: HEATER CORE INSIDE EVAPORATOR COMPARTMENT (H3 COACHES) 22332

11.4 FILLING HEATING SYSTEM

1. Ensure that the drain hose is reconnected and the purge valves 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 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. If vehicle is equipped with a windshield upper section defroster, open front baggage compartment R.H. side door. Locate recirculating pump on top of front wheelhousing, momentarily pinch the hose located between the recirculating pump suction and the defroster outlet connector to ensure windshield upper section defroster complete filling.
6. Once the level has been stabilized, replace cap.

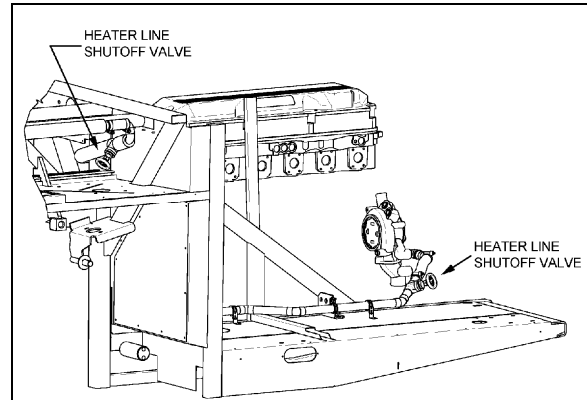


FIGURE 45: HEATER LINE SHUTOFF VALVES (CENTRAL HVAC SYSTEM)

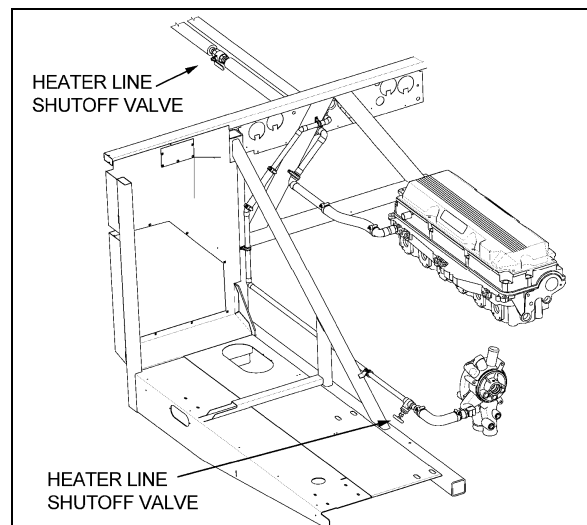


FIGURE 46: HEATER LINE SHUTOFF VALVES (SMALL HVAC SYSTEM)

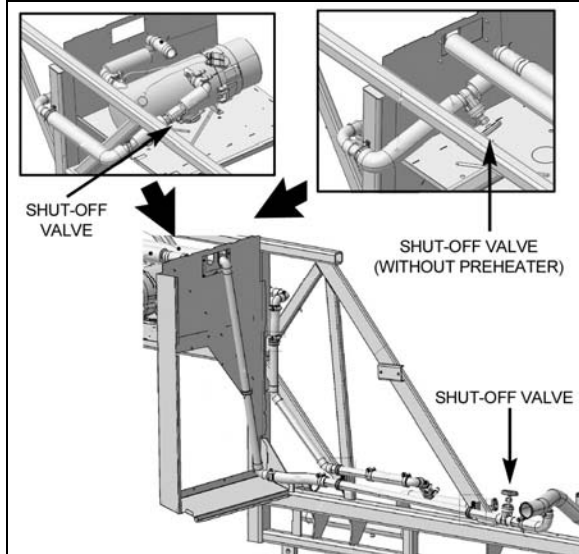


FIGURE 47: HEATER LINE SHUTOFF VALVES (WITH VOLVO D13 ENGINE) 05144

11.5 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 purge valve illustrated in figure 42 & 43, and open them momentarily until no air escapes from the lines.

NOTE

In test mode (see paragraph 7.1 HVAC SYSTEM AND TEST MODE FOR SWITCHES AND SENSORS), 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 is useful when working on the heating system to remove air pockets trapped in the system.

11.6 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 rag saturated of water to prevent overheating of vital parts.

11.7 DRIVER'S UNIT HOT WATER PNEUMATIC VALVE

The flow of hot water to the driver's unit heater core is controlled by a pneumatic valve like the passenger's unit hot water pneumatic valve. It is mounted on the coolant inlet line of the driver's heater core, and is accessible through the spare wheel compartment (see figure 40, 41 & 51). For more information, refer to paragraph 11.8.

11.8 PASSENGER'S UNIT HOT WATER PNEUMATIC VALVE ASSEMBLY

11.8.1 Description

The flow of hot water to the vehicle's central heater core is controlled by a NO pneumatic water valve assembly (figure 48). 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 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.

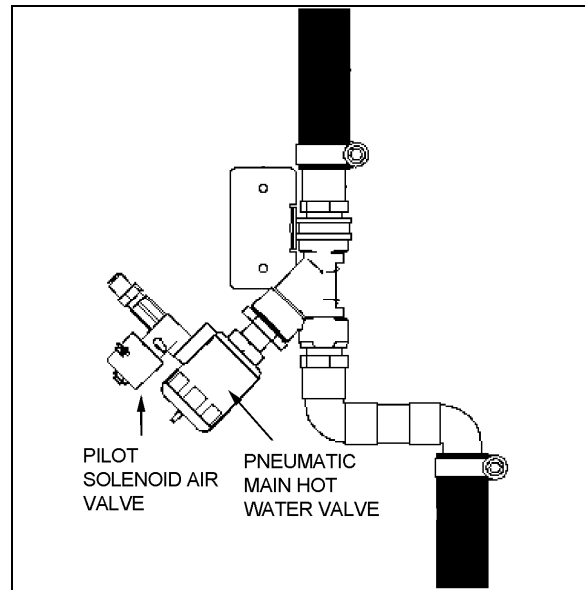


FIGURE 48: PASSENGER'S UNIT HOT WATER PNEUMATIC VALVE ASSEMBLY 22240

The passenger's unit 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.

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11.8.2 Hot Water Pneumatic Valve Disassembly

1. Assemble 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 (figure 49).
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

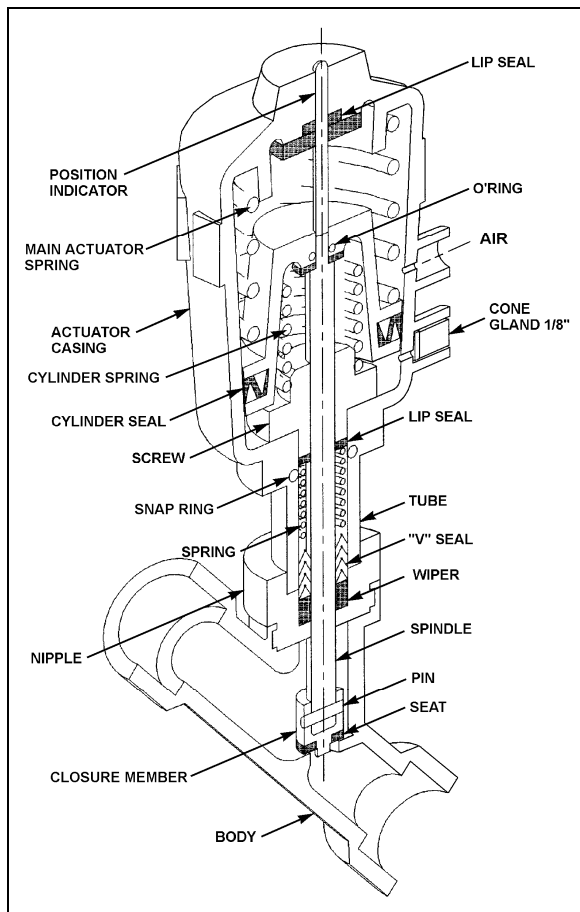


FIGURE 49: PASSENGER'S UNIT HOT WATER PNEUMATIC VALVE

22241

11.8.3 Hot Water Pneumatic 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 49. Fasten pilot solenoid valve to the pneumatic water valve. Reconnect air supply pressure and electrical current to the pilot solenoid valve.
3. Check for proper operation.

11.8.4 Pilot Solenoid Valve

1. No maintenance is needed unless a malfunction occurs.
2. A pilot solenoid valve replacement seal kit is available: 871311.

11.8.5 Valve Troubleshooting

PROBLEM	PROCEDURE
Valve fails to close	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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.

11.9 HOT WATER RECIRCULATING PUMP

This vehicle is provided with a water recirculating pump which is located in the evaporator compartment (figure 50) or on the ceiling of the spare wheel compartment for vehicles equipped with a small HVAC (figure 51). The water recirculating pump consists of a

centrifugal pump and an electric motor which are mounted in a compact assembly.

The motor is equipped with pre-lubricated sealed ball bearings which require no maintenance. The 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 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 impeller failure or motor failure.

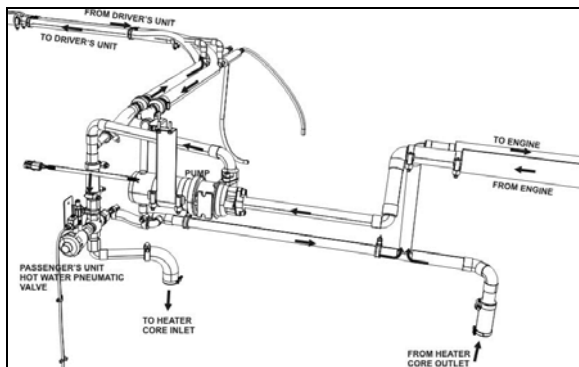


FIGURE 50: HOT WATER RECIRCULATING PUMP INSTALLATION (CENTRAL HVAC SYSTEM)

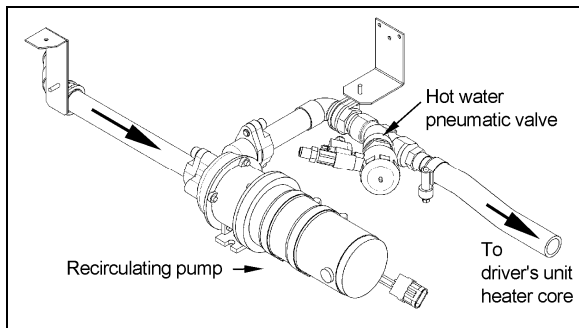


FIGURE 51: HOT WATER RECIRCULATING PUMP INSTALLATION (SMALL HVAC SYSTEM)

22292

11.9.1 Removal

1. Stop engine and allow engine coolant to cool.
2. Close shutoff valves on the heater line. Refer to "Preheater System" in this section to gain access to the heater line shutoff valve.
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 the pump at the flange connections.
5. Remove the two clamps holding the pump motor to its mounting bracket. Remove the pump with the motor as an assembly.

11.9.2 Disassembly

Refer to figure 52.

1. Separate the housing from the adapter by first removing the 4 capscrews. Remove housing carefully to prevent damaging the O-ring.
2. Remove rotor assembly, washers and shaft from the adapter.



CAUTION

Do not scratch or mark the sealing surface of this seat, as its sealing feature will be affected, thus resulting in continuous leakage.

Inspection

Components removed from the recirculating pump and motor assembly should be compared with new parts to determine the degree of wear.

11.9.3 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

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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.

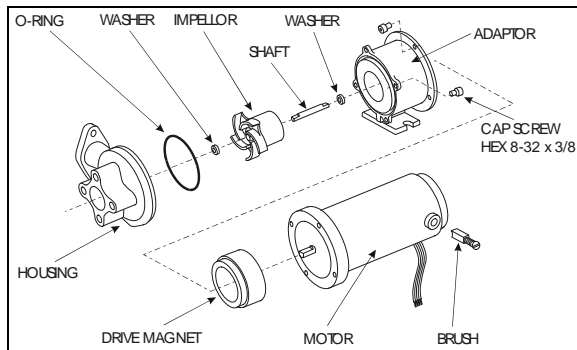


FIGURE 52: HOT WATER RECIRCULATING PUMP

3) Observe the following factors when replacing brushes

- The face of a new brush is carefully cut to cause proper seating during the "wear-in" period.
- Improper installation can harm both the brush and the commutator.
- Replacement brushes should be of the proper grade.
- 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.

11.9.4 Assembly

Refer to figure 52.

- Install washer, shaft and rotor assembly into adaptor.
- Install O-ring into housing and assemble housing to the adaptor.
- Secure housing to adaptor using 4 cap screws.

11.9.5 Installation

- Apply gasket cement to the pump body line adaptor and to the line flanges, put the two gaskets in place, and connect water lines from 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.

- Connect electrical wiring to the pump motor.
- Open both shutoff valves. Refer to "Preheater System" in this section to gain access to the heater line shutoff valves.
- Fill the cooling system as previously instructed in this section under "Filling Heating System" and then bleed the system as previously instructed in this section under "Bleeding Heating System".

11.10 BYPASS SOLENOID WATER VALVE (OPTIONAL)

This valve is optional and is installed on the vehicle equipped with a preheater. The valve is located in the evaporator compartment (Figure 50). Refer to figure 54 for part names.

22277

11.10.1 Improper Operation

- Faulty control circuit: Check the electric system by energizing the solenoid. A metallic clicking noise indicates that the solenoid is operating. Absence of clicking indicates a loss of power or a defective solenoid. Check for open breaker, open-circuited or grounded coil, broken lead wires.
- Burned-out coil: Check for open-circuited coil. Replace coil if necessary.
- Low voltage: Check voltage across the coil leads. Voltage must be at least 85% of nameplate rating.
- Excessive leakage: Disassemble valve and clean all parts. Replace worn or damaged parts with a complete repair kit for best results.

11.10.2 To Remove or Change the Coil

- Stop engine and allow engine coolant to cool.
- Close shutoff valve on the line located in the rear electric compartment. Refer to "Preheater System" in this section to gain access to the heater line shutoff valve.

To remove the solenoid coil:

First take out the retaining screw at the top of the coil housing. The entire coil assembly can be lifted off the enclosing tube.

To reassemble:

Make sure that the parts are placed on the enclosing tube in the following order:

Be sure to change electrical data plate according to coil specifications change.

1. Place coil and yoke assembly on the enclosing tube. Lay data identification plate in place.

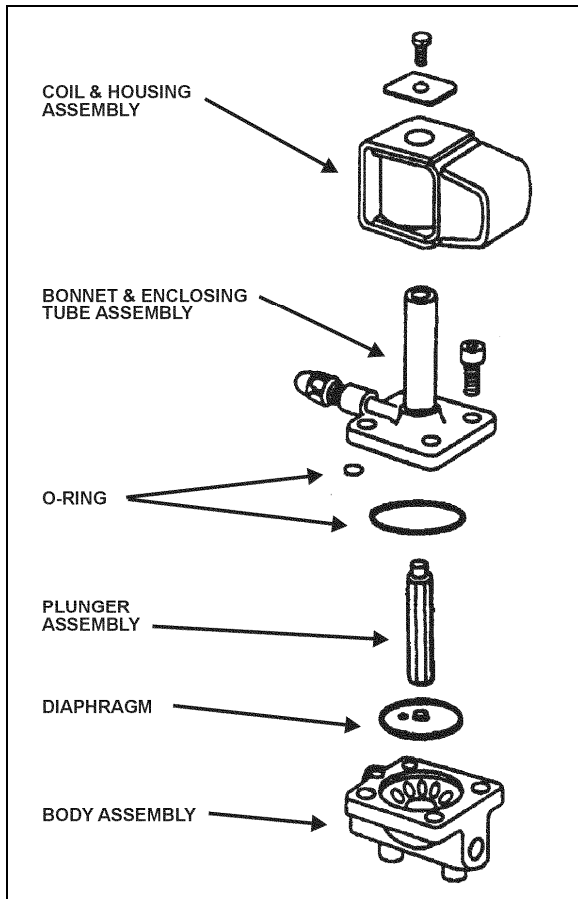


FIGURE 53: BYPASS HOT WATER SOLENOID VALVE
22044

2. Insert the coil retaining screw, rotate housing to proper position and tighten screw securely.

11.10.3 Valve disassembly and Reassembly

Disassembly:

This valve may be taken apart by removing the socket head screws which hold the body and bonnet together. After removing the screws, carefully lift off the bonnet assembly (upper part of the valve). Don't drop the plunger. The diaphragm can now be lifted out. Be careful not to damage the machined faces while the valve is apart.

NOTE

The above procedure must be followed before brazing solder type bodies into the line.

Reassembly:

Place the diaphragm in the body with the pilot port extension up. Hold the plunger with the synthetic seat against the pilot port. Make sure the bonnet O-rings are in place, the bonnet assembly over the plunger, and that the locating sleeve in the bonnet enters the mating hole in the body. Insert body screws and tighten uniformly.

12. PREHEATING SYSTEM (OPTIONAL ON COACHES ONLY)

The coolant heater is located above the rear wheelhousing, behind the vehicle's L.H. side rear fender.

To gain access to the preheater and the heater line shutoff valve next to it (figure 45), remove the L.H side rear fender.

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.

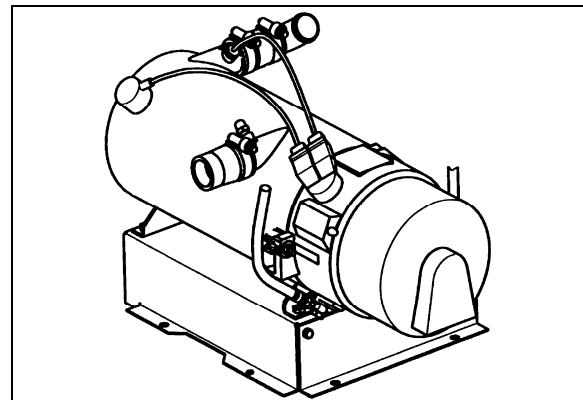


FIGURE 54: COOLANT HEATER (104,000 BTU) 22224

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

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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.

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.

12.1 PREHEATER FUEL FILTER

The preheater fuel filter is located beside the preheater above the rear wheelhousing, behind the vehicle's L.H. side rear fender.

	MAINTENANCE
Replace preheater fuel filter every 50,000 miles (80 000 km) or once a year, whichever comes first.	

12.2 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 $165^{\circ} \pm 6^{\circ}\text{F}$ ($75^{\circ} \pm 3^{\circ}\text{C}$) and turns it on at $154^{\circ} \pm 9^{\circ}\text{F}$ ($68^{\circ} \pm 5^{\circ}\text{C}$). 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.

12.3 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.

12.3.1 Timer operating instructions (Spheros)

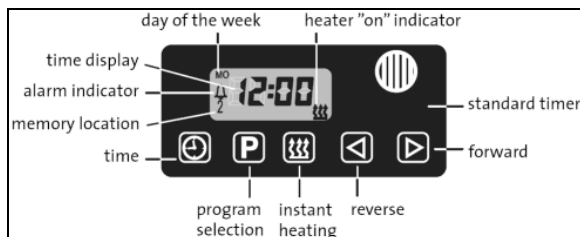


FIGURE 55: COOLANT TIMER

22223

These instructions refer to the timer illustrated in figure 55. They are the same instructions provided in the Spheros 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).
3. Wait 5 seconds. Operating time is stored.

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.

12.4 TROUBLESHOOTING AND MAINTENANCE

Refer to the Spheros 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.

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Failure Symptom	Probable Cause	Check and Correct
1X Flash (F 01) No combustion after completion of startup sequence.	<ul style="list-style-type: none"> - Fuel system - Combustion air - Electronic ignition 	<ul style="list-style-type: none"> - 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	<ul style="list-style-type: none"> - Fuel supply (shortage of fuel) 	<ul style="list-style-type: none"> - 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	<ul style="list-style-type: none"> - Electrical system 	<ul style="list-style-type: none"> - 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	<ul style="list-style-type: none"> - Defective flame detector 	<ul style="list-style-type: none"> - Replace flame detector
5X Flashes (F 05) Flame detector	<ul style="list-style-type: none"> - Wiring - Defective flame detector 	<ul style="list-style-type: none"> - Damaged wiring, open or short circuit - Replace flame detector
6X Flashes (F 06) Temperature sensor	<ul style="list-style-type: none"> - Wiring - Defective temperature sensor 	<ul style="list-style-type: none"> - Damaged wiring, open or short circuit - Replace temperature sensor
7X Flashes (F 07) Fuel solenoid valve	<ul style="list-style-type: none"> - Wiring - Defective solenoid valve 	<ul style="list-style-type: none"> - Damaged or corroded wiring, open or short circuit - Replace solenoid valve
8X Flashes (F 08) Combustion air fan motor	<ul style="list-style-type: none"> - Wiring - Wrong RPM - Defective combustion air fan motor 	<ul style="list-style-type: none"> - Damaged wiring, open or short circuit - Replace combustion air fan - Replace combustion air fan
9X Flashes (F 09) Circulation pump motor	<ul style="list-style-type: none"> - Wiring - Defective circulation pump motor 	<ul style="list-style-type: none"> - Damaged wiring, open or short circuit - Replace circulation pump motor
10X Flashes (F 10) Temperature limiter	<ul style="list-style-type: none"> - Overheat condition - Coolant flow - Wiring - Defective temperature limiter 	<ul style="list-style-type: none"> - 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	<ul style="list-style-type: none"> - Wiring - Defective electronic ignition coil 	<ul style="list-style-type: none"> - Damaged wiring, open or short circuit - Replace electronic ignition coil
12X Flashes (F 12) Heater lock out	<ul style="list-style-type: none"> - 3 repeated faults/flame-outs or 5 repeated start attempts 	<ul style="list-style-type: none"> - Reinitialize control unit by switching heater on and disconnecting power.

13. SPECIFICATIONS

Passenger's unit evaporator motor

Make..... AMETEK ROTRON
Type BRUSHLESS DC MICROPROCESSOR CONTROLLED
Voltage 27.6 V DC
Current draw 68 amps
Horsepower..... 2
Revolution 1400 & 1700 rpm
Insulation Class F
Motor Prevost number..... 563586

Passenger's unit condenser fan motors

Make..... EBMPAPST
Type 12" AXIAL BRUSHLESS
Voltage 24 V DC
Qty 4
Prevost number 563461

Passenger's unit evaporator air filter

Make..... Permatron Corp.
Type Washable 1" X 23 3/8" X 43 1/2" Polypropylene filter
Prevost number 871383

Driver's unit evaporator motors

Make..... MCC
Voltage 24 V DC
Quantity 2
Prevost number 871135

Driver's unit evaporator air filter

Make..... MCC
TYPE Recirculating air 6-1/4" x 28" Washable
Prevost number 871147

Make..... MCC
TYPE Fresh air 3-5/8" X 5-1/4" Washable
Prevost number 871144

Refrigerant

Type R-134a
 Quantity (standard) 24 lbs (10.89 Kg)
 Quantity (with A/C unities Parcel Rack) 26 lbs (11.82 Kg)

Compressor (Central HVAC system)

Make..... Bitzer
 Displacement 41 CFM
 Model, R-134a..... 4NFCY
 No. of cylinders 4
 Cylinder volume 39 in³ (647 cm³)
 Operating speed..... 500 to 3500 rpm
 Oil capacity..... 0.66 U.S. gal (2,5 liters)
 Weight 74 lbs (33 kg)
 Approved oil
 Bitzer BSE55 (POE)
 Prevost number 950001

Magnetic clutch

Make..... Linnig
 Type LA16
 Voltage 24 V DC

A/C Compressor (Small HVAC system)

Make..... ICE (International Components Engineering)
 Model..... TM-16HD
 Prevost number 950436
Approved oil OIL-ICE (PAG)
 Prevost number 950382

Condenser coil

Make..... Carrier Transicold
Aluminum
 Prevost number 452968
Copper
 Prevost number 453013

Receiver tank (with sight glasses)

Make..... HENRY or PARKER
 Maximum pressure..... 450 psig

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Prevost number 950261

Filter Dryer assembly

Make..... ALCO

Prevost number 950332

Moisture indicator

Make..... ALCO

Prevost number 950333

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

Prevost number (without coil) 95-0054

Coil Prevost number..... 950055

Repair kit Prevost number 950056

Driver's & passenger's hot water pneumatic valve

Make..... BURKERT

Type Normally open

Voltage 24 V DC

Pressure range..... 0 to 230 psi

Max. temperature 356°F

Prevost number 871252

Hot Water recirculating pump

Make..... M.P. pumps

Voltage 24 V DC

Prevost number 871342

Driver's expansion valve

Prevost number 950221

Main expansion valve

Make..... CARRIER

Prevost number 950316

Bypass solenoid water valve

Make..... Parker Hannifin
Bypass Previst number 870886
Coil Previst number..... 870886
Repair kit Previst number 870980

Preheating system

Make..... SPHEROS
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)
Previst number 871202

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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 radio, satellite radio, karaoke, wireless microphone, DVD, scenic view and back-up camera system and GPS Navigation System module may be featured.

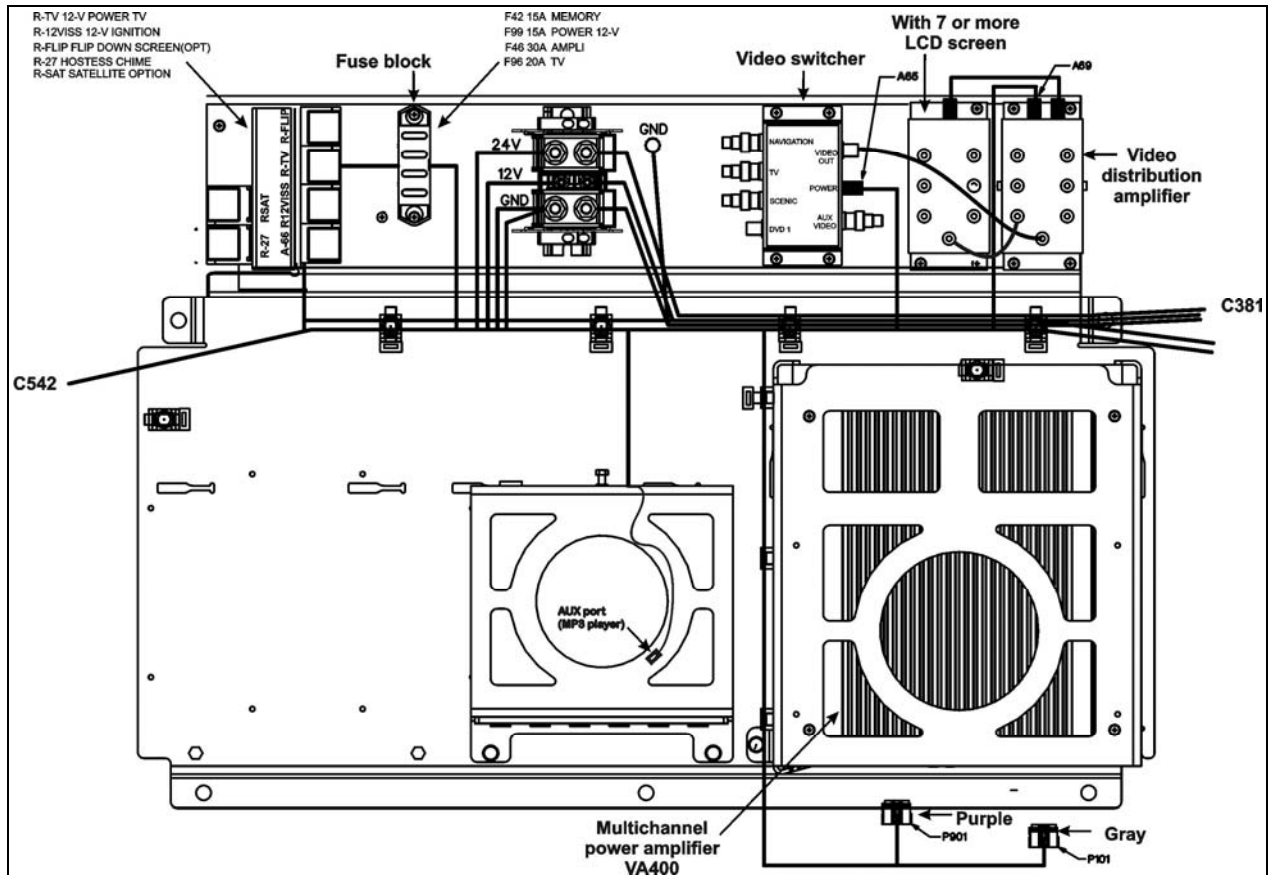
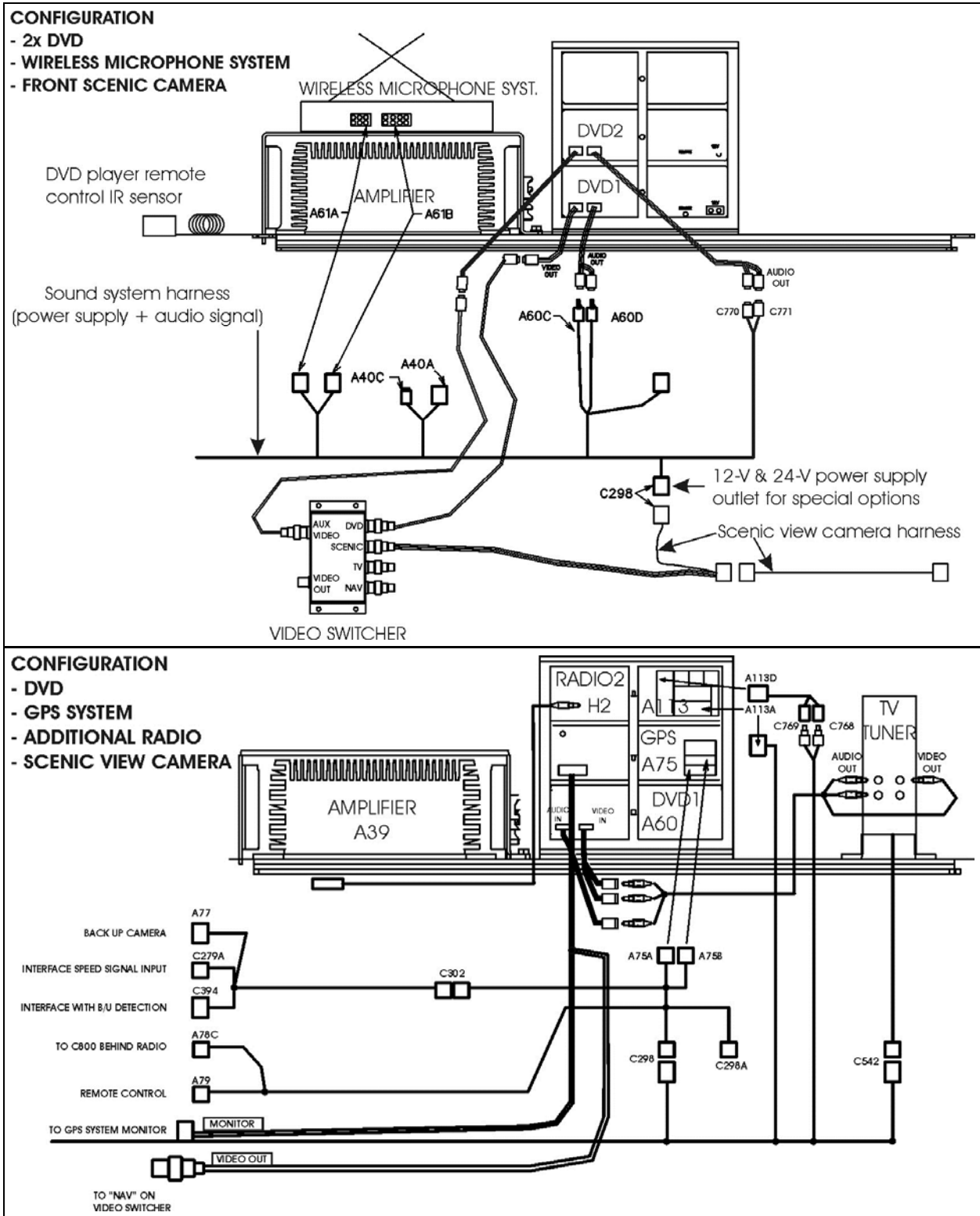


FIGURE 1: AUDIO-VIDEO PANEL

Each service module mounted to the underside of the parcel racks contains a 40-watt speaker. The speakers in the passenger section (twelve in H3-41 or sixteen in H3-45) are wired in stereo and are powered by the amplifier. A microphone outlet mounted in the driver's area is provided as standard equipment.



Section 23: ACCESSORIES

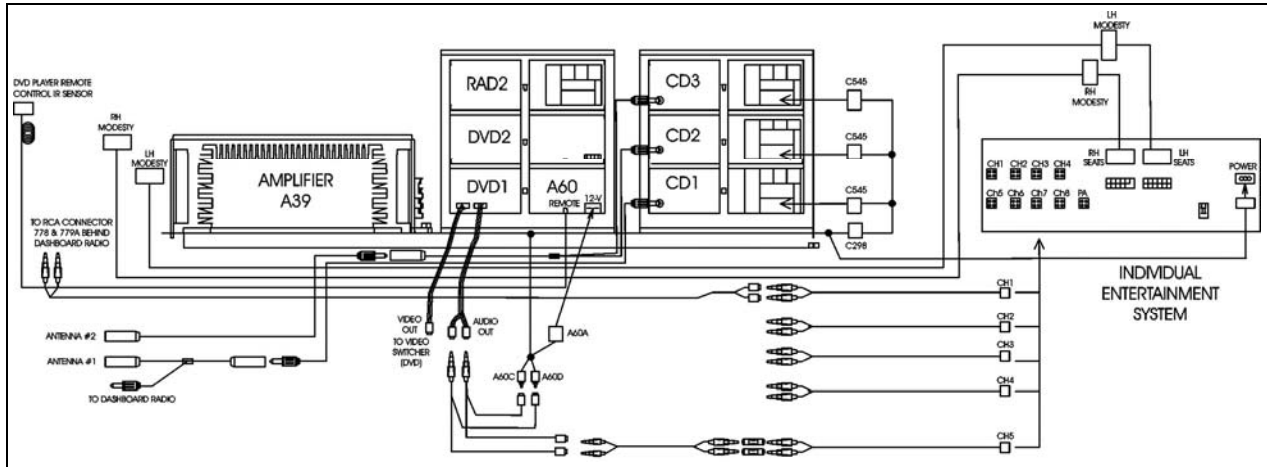


FIGURE 3: AUDIO-VIDEO CONNECTIONS

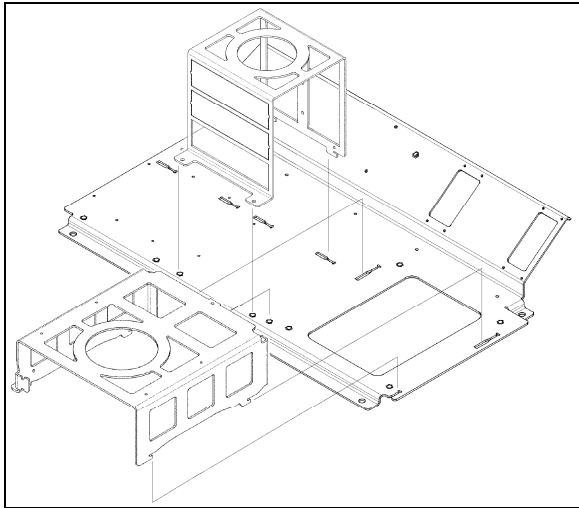


FIGURE 4: RACKS ON AUDIO-VIDEO PANEL

1.1 HOW TO RECEIVE SERVICE FOR YOUR REI AUDIO AND VIDEO PRODUCTS

For assistance in obtaining service for REI products call toll free 877-726-4617 (Continental United States and Canada) between the hours of 7:00 A.M. - 5:00 P.M. CST Monday thru Friday (excluding Holidays).

For assistance in obtaining service for REI products call toll free 877-726-4617 (Continental United States and Canada only) between the hours of 7:00 A.M. - 5:00 P.M. CST Monday thru Friday (excluding Holidays).

Prior to calling REI, please have the part number, serial number, VIN number and detailed description of the problem ready to provide to the REI service representative. After providing information to REI, customers will be issued a return authorization number. When the REI service representative provides the return authorization number, they will also give instructions for returning the item. Any discrepancies in following this procedure may cause delays in the process.

24/7 Tech Support

CALL 1-877-726-4617

E-Mail to technicalsupport@radioeng.com

REI Authorized Repair Facilities

REI
6534 L Street
Omaha, Nebraska 68117

REI
1376 Bennett Drive, Unit 126
Longwood, Florida 32750

TPI Ind. (Canada)
148, Rue Goodfellow
Delson, Quebec J5B 1V4

REI products that may be installed in your coach:

MONITOR, LCD 10.4"

MONITOR, COLOR BACK-UP CAMERA

MONITOR, LCD 15.4"

MONITOR, CENTRAL LCD 15.4"

MONITOR, FLIP19"

MONITOR, 16:9 LCD 15.4"

MONITOR, 16:9 CENTRAL LCD 19"

INDIVIDUAL ENTERTAINMENT SYSTEM

AMPLIFIER, 8-CHANNEL

DVD PLAYER

DVD REMOTE CONTROL

CAMERA, COLOR BACK-UP

CAMERA, COLOR PANORAMIC

MICROPHONE, 10" CB TYPE

MICROPHONE, WIRELESS

RECEIVER, WIRELESS MIC 16-CHANNEL

Section 23: ACCESSORIES

1.2 DASHBOARD RADIO



FIGURE 5: DASHBOARD RADIO

NOTE

Before attempting to solve an electrical problem on the sound system, refer to the wiring diagrams.

The radio operating instructions manual is included at the end of this.

1.2.1 Removal/Installation

To remove the radio from its location, proceed as follows:

1. Place the ignition switch in the "OFF" position.
2. Remove the dashboard cover.
3. Unplug the connectors from the radio and unfasten back plate securing nuts/screws.
4. On the front side of the unit, insert the removal tool #20584494 in the holes found each side in order to separate the unit from the support.
5. From behind, push the unit through the front dashboard panel.
6. Installation of a new unit is the same as removal but in reverse order.

1.3 VSS-05 SOUND SELECTOR



FIGURE 6: VSS-05 SOUND SELECTOR

1.3.1 Removal/Installation

To remove the Sound Selector from its location, proceed as follows:

4. Place the ignition switch in the "OFF" position.
5. Remove the dashboard cover.
6. Unplug the connectors from the radio and unfasten back plate securing nuts/screws.
4. On the front side of the unit, insert the removal tool #20584494 in the holes found

each side in order to separate the unit from the support.

5. From behind, push the unit through the front dashboard panel.
6. Installation of a new unit is the same as removal but in reverse order.

The operating instructions are included in the Operator's Manual.

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.

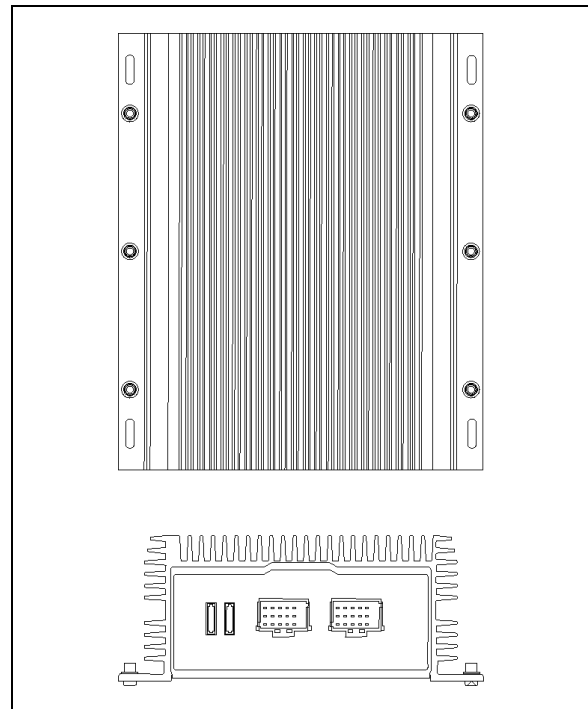


FIGURE 7: MULTICHANNEL POWER AMPLIFIER VA400.8

For optimum sound quality, adjust the subwoofer crossover filter as shown on figure 9. 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.

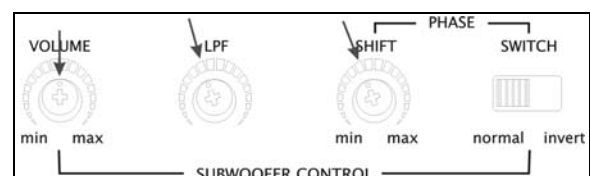


FIGURE 8: CROSSOVER ADJUSTMENT

1.5 SPEAKERS

Each passenger's overhead console mounted to the underside of the parcel racks contains a 20-watt coaxial 10cm speaker. The speakers (24 in H3-41 or 28 in H3-45) in the passenger's section, wired in stereo and arranged in a delta configuration are powered by the amplifier.



FIGURE 9: 10CM COAXIAL 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 are performed through the dashboard radio.

Two specially designed subwoofers are fixed under a passenger seat with anti-vibration supports.

1.6 BOOM-TYPE MICROPHONE

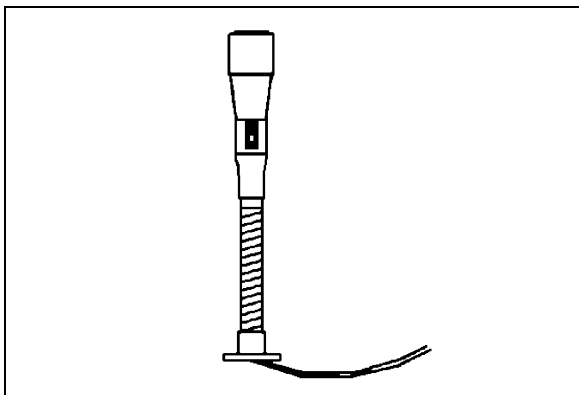


FIGURE 10: BOOM-TYPE MICROPHONE 23083

1.6.1 Removal

1. Place the ignition switch in the "OFF" position.
2. Remove the mounting screws at mounting flange.

3. Disconnect wiring.

1.6.2 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.

1.7 HANDHELD PRIORITY MICROPHONE

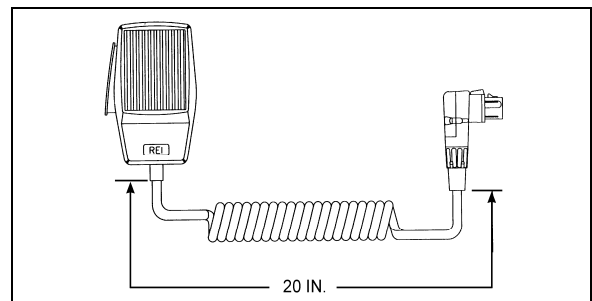


FIGURE 11: HANDHELD PRIORITY MICROPHONE 23216

1.8 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.

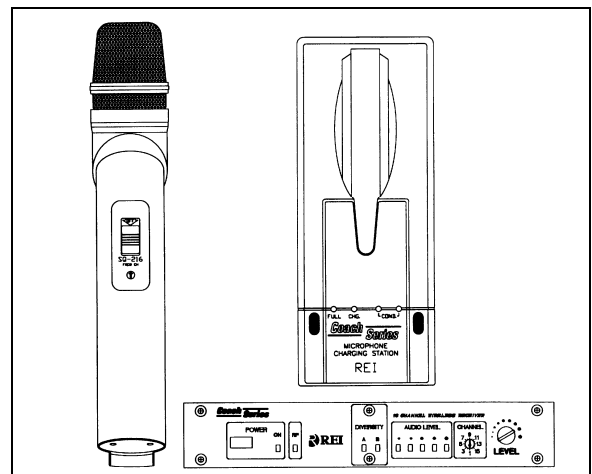


FIGURE 12: WIRELESS MICROPHONE

Section 23: ACCESSORIES

1.9 TV TUNER

For TV tuner control descriptions, refer to fig. 13.

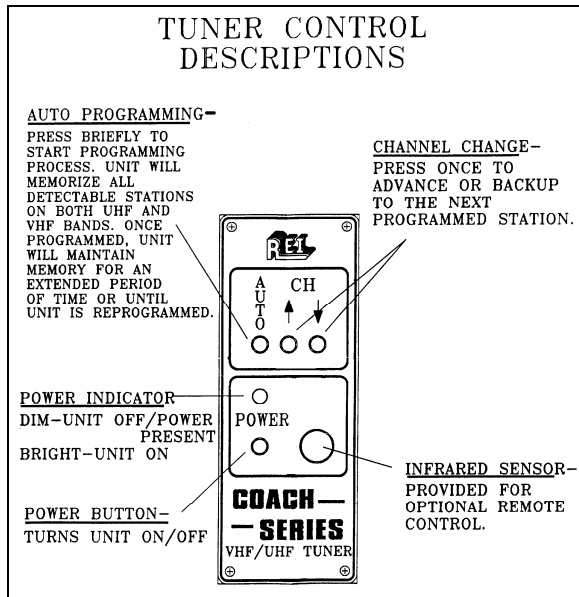


FIGURE 13: TUNER CONTROLS DESCRIPTION

1.10 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.

1.10.1 Karaoke Panasonic Sound System – MOBILE DVD PLAYER DV1500

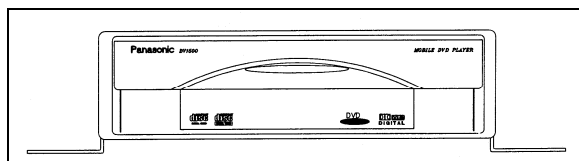


FIGURE 14: PANASONIC DV1500

1.11 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.

1.12 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.

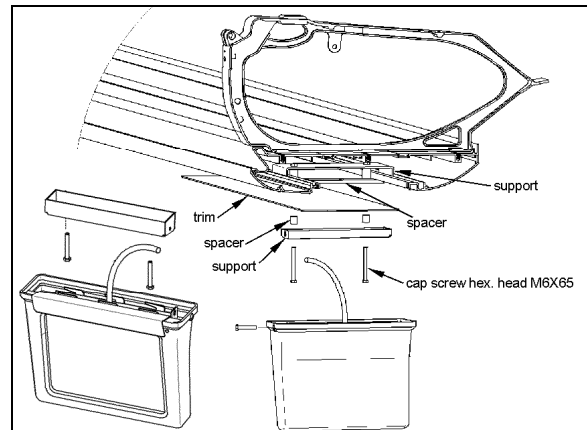


FIGURE 15: MONITOR MOUNTING

23221

1.13 SCENIC VIEWING SYSTEM

The scenic viewing system enables the passengers to view the road ahead of the vehicle.



FIGURE 16: SCENIC VIEW CAMERA

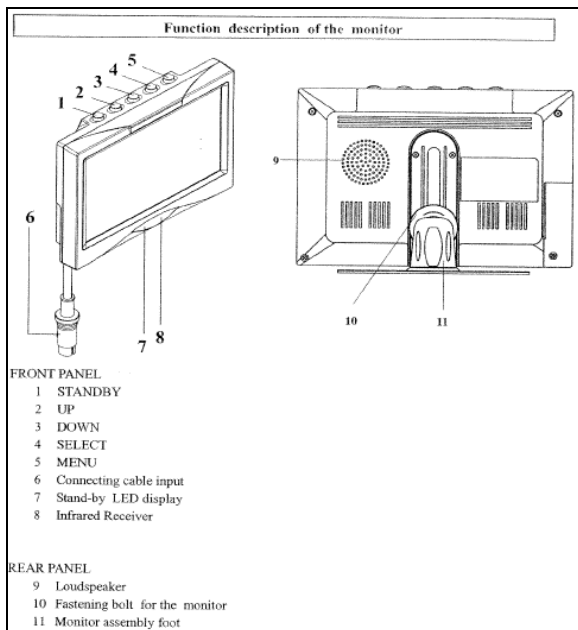
1.14 ROOF ANTENNA INSTALLATION

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 vehicle hole 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. 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".



BUTTON DESCRIPTION

- 1) **STANDBY** On/Off switch
- 2) **UP** This key has 3 functions
 - Increase of the volume during normal operation;
 - Modification of the setting within a function e.g. contrast (after calling up the menu);
 - By pressing this key when putting in the reverse gear, the distance markings move upwards;
- 3) **DOWN** This key has 3 functions
 - Decrease of the volume during normal operation;
 - Modification of the setting within a function e.g. contrast (after calling up the menu);
 - By pressing this key when putting in the reverse gear, the distance markings move downwards;
- 4) **SELECT** This key has 3 functions

- Selection of the video sources (CA1 → CA2 → AV → CA1). Press less than 1.5 seconds;
- Selection of the functions e.g. picture setting (after calling up the menu);
- Deleting and calling OSD letters of title & time (press longer than 1.5 seconds) during normal operation;

5) MENU This key has 2 functions

- Activation of the dimmer function (press less than 1.5 seconds) during normal operation;
- Calling up the menu (press longer than 1.5 seconds, four menus can be called up). Press the key once again to call up the individual menus;
 - a) PICTURE= Functions for the image setting;
 - b) USER= Selection of the system function;
 - c) TIME= Setting time and date;
 - d) INSTALL= Setting the camera function (e.g. mirror function);

6) BUSH FOR THE MONITOR CABLE OF THE CONNECTION BOX

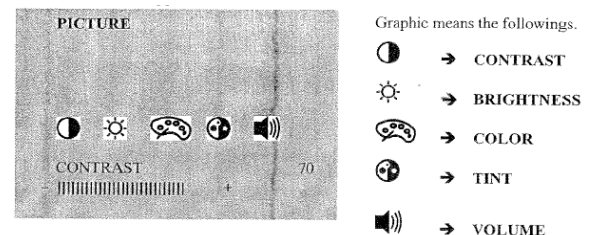
7) STANDBY DISPLAY

8) INFRARED RECEIVER

MONITOR MENU DISPLAY

The monitor (RV59 HD) is equipped with an On-Screen Display (OSD) function which displays date, camera, channel, mirror mode and distance markings. These functions can be selected on MENU. To calling up the menu, press longer than 1.5 seconds. Four menus can be called up. Press the key once again to call up the individual menus.

For calling up the menu PICTURE press the key **MENU** longer than 1.5 seconds. The menu PICTURE appears.



Select the function (e.g. contrast) by pressing the key **SELECT** repeatedly. The setting within the function can be modified with the keys **UP** and **DOWN**.

For calling up the menu USER press the key **MENU** once again. The menu USER appears. Select the function (e.g. SELECTION) by pressing the key **SELECT** repeatedly as necessary. The setting within the function can be modified with the keys **UP** and **DOWN**.

USER	POSSIBLE SETTINGS:
LANGUE ENG	LANGUAGE: ENGLISH/GERMAN (ENG/DEUT)
SCREEN WIDE	SCREEN FORMAT: NOR 4:3, picture format 4:3 WIDE, picture format 16:9 FULL, picture format 16:9 middle enlarge
TITLE ON	TITLE: CAMERA TITLE DISPLAY ON/OFF
TIME ON	TIME: TIME DISPLAY ON/OFF

For calling up the menu TIME press the key **MENU** once again. The menu TIME appears. Select the function (e.g. DATE) by pressing the key **SELECT** repeatedly as necessary. The setting within the function can be modified with the keys **UP** and **DOWN**.

Section 23: ACCESSORIES

TIME		- Hour-Month adjustable by UP BUTTON
TIME	08:25	- Minute/Date adjustable by DOWN BUTTON
DATE	MAY01	- Year adjustable by UP/DOWN BUTTON
YEAR	2005	

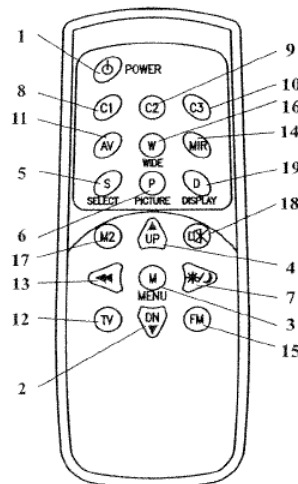
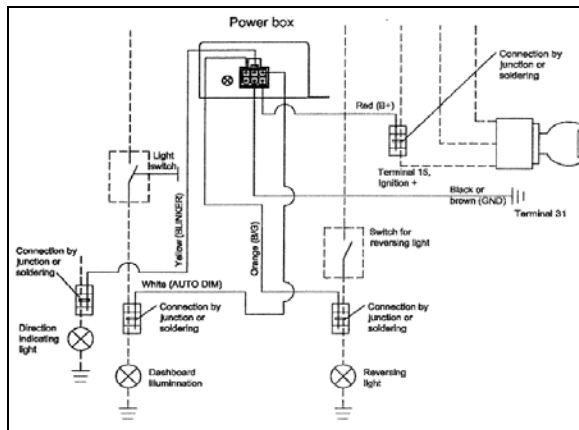
For calling up the menu INSTALL press the key **MENU** once again. The menu TIME appears. Select the function (e.g. SELECTION) by pressing the key **SELECT** repeatedly as necessary. The setting within the function can be modified with the keys **UP** and **DOWN**.

INSTALL	POSSIBLE SETTINGS:
REAR CAM1	REAR: Selection of priority camera (CAM1 or CAM2) which is triggered by rear gear.
CAM1 MIR	CAM1: Selection of real picture or mirrored picture for camera 1
CAM2 NOR	CAM2: Selection of real picture or mirrored picture for camera 2
NOTE 1	The distance mark will appear on the picture of camera which set as MIR (mirrored).
NOTE 2	Engaging the reverse gear, only distance mark will appear on the mirrored camera picture without any OSD. At the moment, no keys are available except UP/DOWN key for moving distance bar.

BACK-UP CAMERA MODULE (Power box)

The connection line consists of 6 branch lines as below:

RED	Voltage supply 12-volt to 24-volt (max. 32-volt)
BLACK/BROWN	Earth cable
WHITE	Control wire for switching on the dimmer function (night operation)
YELLOW	Control wire for switching on the side camera. The connection is to be made at the INDICATOR
ORANGE	Control wire for switching on the reversing camera. The connection is to be made at the reversing light



No	Key	Description
1	STANDBY	On/Off switch
2	DOWN ▼	This key has 3 functions. - Decrease of the volume during normal operation. - Modification of the setting within a function e. g. brightness (after calling up the menu). - By pressing this key when putting in the reverse gear the distance markings move downwards.
3	MENU	Calling up the menu on the screen. Three menus can be called up : a: PICTURE = Functions for the image setting b: USER = Selection of the system function c: TIME = Setting time and date d: INSTALL = Setting the camera function (e.g. mirror function)
4	UP ▲	This key has 3 functions. - Increase the volume during normal operation - Modification of the settings within a function e. g. contrast (after calling up the menu) - By pressing this key when putting in the reverse gear the distance markings move upwards.
5	SELECT	This key has 2 functions Selection of the video sources (CA1→CA2→AV) Selection of the functions e.g. picture setting (after calling up the menu)
6	PICTURER	Calls up the functions CONTRAST, BRIGHTNESS etc. directly for the picture setting. Carry out the setting with the key UP or DOWN.
7	DIMMER	Regulates the brightness to night operation temporarily
8	C1	Selection of the camera 1
9	C2	Selection of the camera 2
10	C3	Selection of the camera 3 (camera input 3 is not available)
11	AV	Selection of the video input (RCA)
12	TV	Not available
13	SEARCH	Not available
14	MIRROR	Reversing left and right of picture temporarily
15	FM	Not available
16	WIDE	Setting of the screen format NOR/NOR: 4:3, picture format 4:3 WIDE/WEIT, picture format 16:9 FULL/BREIT, picture format 16:9 middle enlarged
17	MONITOR2	Not available
18	MUTE	Switches off the tone temporarily
19	DISPLAY	This key has 2 functions - Deleting or calling OSD letters of Tile & Time temporarily - Leaving the menu

3. HUB ODOMETER

3.1 DESCRIPTION

An optional wheel hub odometer (Fig. 17) 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.

3.1.1 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.

3.1.2 INSTALLATION

Place the hub odometer unit over the wheel hub studs. Replace the lock washers and nuts. Torque stud nuts to 110-165 Lbf-ft (150-225 Nm).

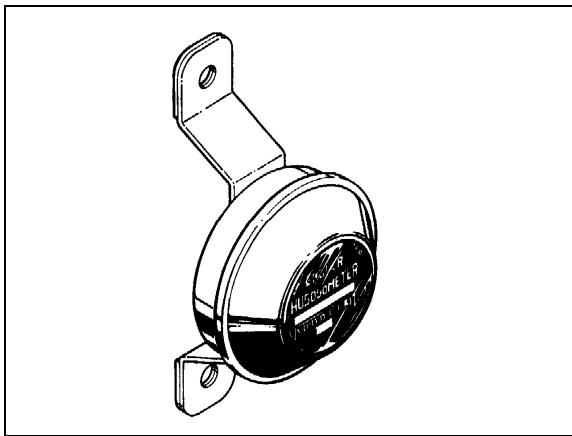


FIGURE 17: HUB ODOMETER

23027

3.2 OPERATION

The hub odometer is calibrated for a specific wheel size (diameter). Wheel rotation causes a mechanism inside the hub odometer 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 hub odometer face or on plastic hubcaps. Do not weld on hub odometer.

4. DESTINATION SIGN

4.1 DESCRIPTION

The destination sign is located at upper front of the vehicle.

ELECTRONIC DESTINATION SIGN (Optional)

To change the destination, depress the selecting switches until the desired destination appears in the LCD display.

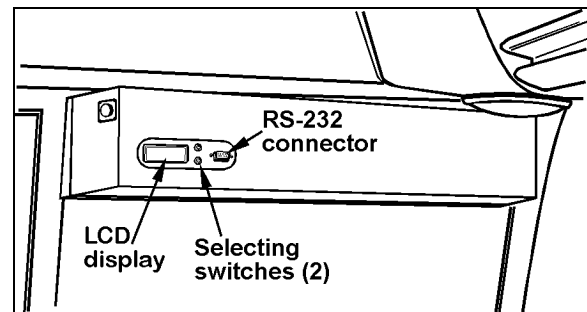


FIGURE 18: DESTINATION SIGN – ELECTRONIC

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: All destination sign models are equipped with lights (bulb light or fluorescent) which illuminates automatically when the headlight or fog light switch is activated.

5. WINDSHIELD SUNSHADES

Two electrically-operated sunshades are installed in the driver's area at the top of the windshields. Two control buttons located on the steering wheel operate each sunshade individually. Refer to Operator's Manual: "Controls and Instruments" chapter for more information.

Caution: The electric sunshades should only be operated electrically. Pulling down manually may damage the mechanism.

5.1 END OF STROKE ADJUSTMENT

The sunshades end positions are pre-adjusted at factory. If an adjustment is required, proceed as follows:

1. Place the ignition key to the ON position.
2. Insert a small nail or similar thin object into sunshade adjustment button access hole and press the appropriate steering wheel sunshade DOWN button **simultaneously** and hold them until a beeping tone sounds. Release both buttons.



FIGURE 19: DRIVER'S SUNSHADE



FIGURE 20: L.H. SUNSHADE CONTROL BUTTON

3. Move the sunshade to the desired lower end of stroke position using the steering wheel button (never move sunshade by hand) and then release button.
4. Proceed to fine adjustment of lower end position by pressing the DOWN button repeatedly.
5. Press the sunshade UP (opposite direction) button to save #1 end position. The confirmation tone will sound.
6. Move the sunshade to the desired upper end of stroke position using the steering wheel button (never move sunshade by hand) and then release button.
7. Proceed to fine adjustment of upper end position by pressing the UP button repeatedly.
8. Press the sunshade DOWN (opposite direction) button to save #2 end position. The confirmation tone will sound. The adjustment mode is then deactivated.

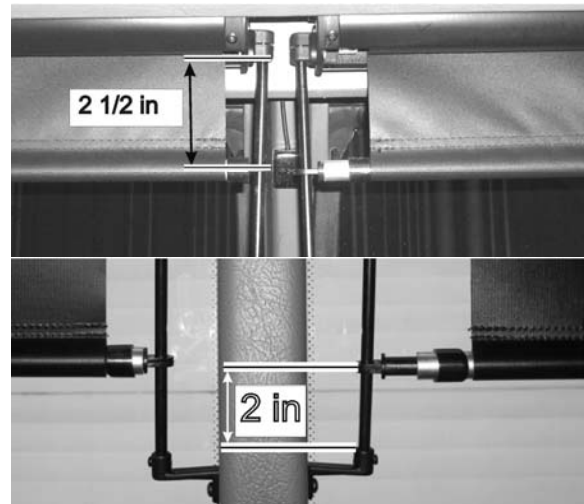


FIGURE 21: FACTORY ADJUSTMENT OF UPPER AND LOWER END POSITION

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.

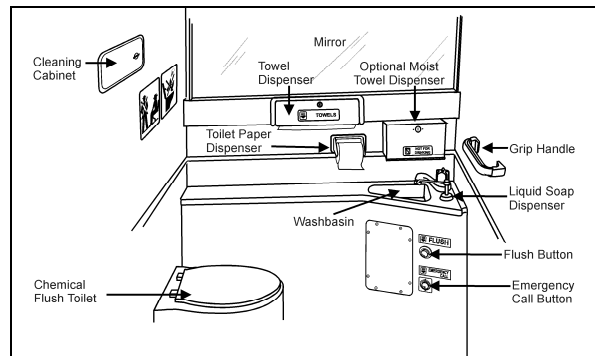


FIGURE 22: LAVATORY

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.

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 over the oil reserve tank (Fig. 23), 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 in the upper section of 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 door opened, remove hose clamp securing duct to ventilation fan inlet, and disconnect duct.
2. Disconnect the ventilation motor wiring connector.
3. Remove the two bolts retaining the ventilation fan housing support to the square tubing. 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.

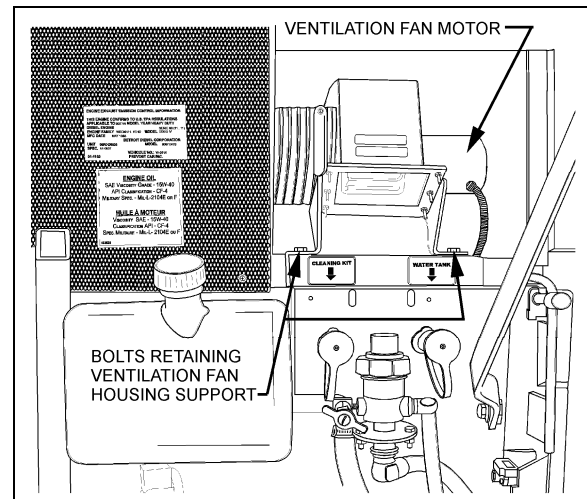


FIGURE 23: VENTILATION FAN INSTALLATION

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, and then readily disassembled and parts replaced, if necessary. A thin coat of lubricant on all moving parts will ensure trouble-free operation.

6.5 LAVATORY LIGHT WITH MOTION SENSOR

The lavatory light, when dimmed, serves as a night-light and is illuminated as soon as the ignition switch is set to the "ON" position. A motion sensor will activate full light intensity whenever motion is detected in the lavatory compartment. The motion sensor will dim the light after a delay of 8 seconds when no additional motion is detected.

NOTE

The lavatory light motion sensor has a warm-up period of approximately 2 minutes after the ignition switch is set to the "ON". During that warm-up period, the motion sensor will not detect motion and will not activate the lavatory light to full intensity.

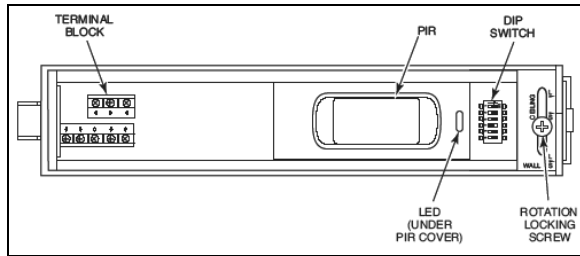


FIGURE 24: LAVATORY LIGHT MOTION SENSOR

6.5.1 Removal and Installation

1. Open the sensor housing by pressing on the latch with a screwdriver. The latch is located on the side of the sensor nearest the lens. Pull the cover up away from the sensor's base.
2. Loosen rotation locking screw two (2) turns (do not remove). Then, remove PCB assembly from the back plate of the sensor.
3. Insert the wiring into one of the wire channels on the sensor's back plate.
4. Securely affix the sensor's back plate to the wall using #6X3/4 screws.
5. Reinstall the PCB assembly and then, tighten rotation locking screw.

6.5.2 Dip Switch Settings

Adjust DIP switches as follows:

1=off	2=off	3=off
4=on	5=off	6=off

6.6 EMERGENCY BUZZER

The lavatory emergency buzzer is mounted on the alarm junction box in the front service compartment 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.

6.7 FRESH WATER TANK

The fresh water tank located at rear of lavatory

wall (over cleaning cabinet), supplies water to the washbasin by gravity. Two tubes are connected in the upper section of tank (Fig. 27). One serves as overflow as well as vent tube and runs along the wall to the underside of the lavatory close to the engine air filter housing, while the other tube is connected to the fresh water fill valve which is mounted besides the engine oil reserve tank.

A third tube connected in the lower section of fresh water tank is provided with a T-connector and allows fresh water to flow to the washbasin faucet and to the low temperature water safety valve for automatic or manual draining. An access panel, located at rear of last R.H. side row of seats and secured in place using 6 Phillips-head screws, allow access to the cleaning cabinet and fresh water tank tubing, fresh water tank heater and different wiring connectors.

6.7.1 Fresh Water Tank Heater (Optional)

75 watts, 110 volts AC immersion-type water heater may have been installed in the bottom of the fresh water tank. The heated portion of element must be immersed at all times to ensure proper heater life. The 110-120 volts in-station connector mounted on the engine compartment rear door provides the water heater power source.

6.7.2 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.

Caution: If fresh water tank heater is inoperative or not installed on your vehicle, water should be drained from reservoir under cold weather conditions since it might freeze and damage both reservoir and connecting links.

6.7.3 Fresh Water Tank Filling

Plug the fresh water supply hose to the fresh water tank fill connection (Fig. 27); fill the tank until the overflow tube leaks, signaling that tank 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.

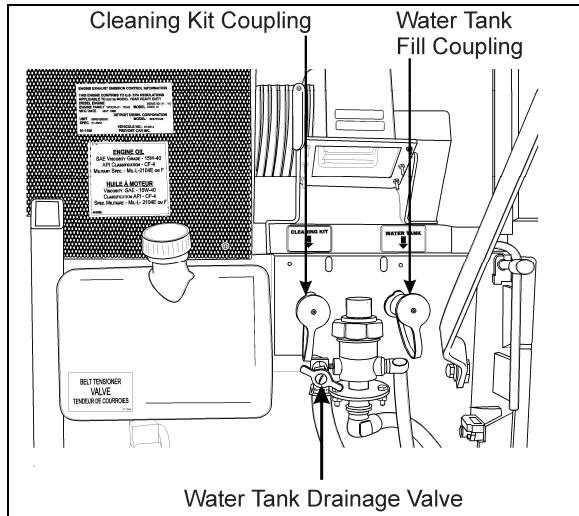


FIGURE 25: FRESH WATER TANK SERVICE VALVES

6.8 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. Insert projection at end of "BOBRICK" key into rectangular hole in cover (Fig. 25). Push straight in. While holding "BOBRICK" key in, turn cover counterclockwise about 1/8 turn.

Caution: Do not use "BOBRICK" key to turn cover.

3. Lift out piston and spout, cover and supply tube.
4. Fill dispenser with soap. This model can dispense vegetable oil soaps, synthetic detergents, and lotion soaps.

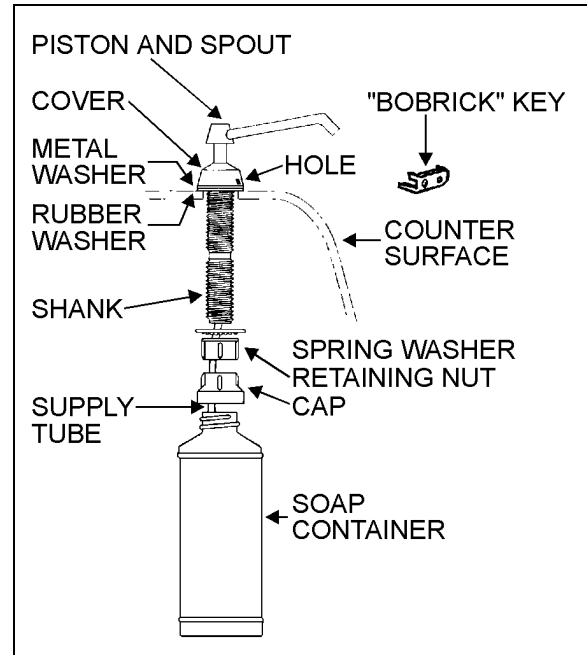


FIGURE 26: LIQUID SOAP DISPENSER 23039

Caution: Never use abrasive cleaners.

5. Replace supply tube, piston, and spout mechanism reversing the steps above.
6. 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.

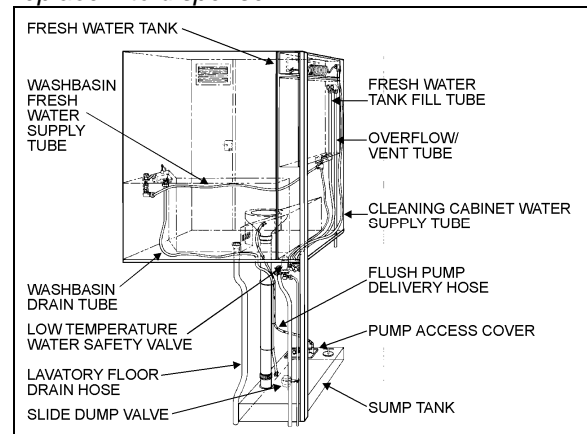


FIGURE 27: FUNCTIONING OF LAVATORY 23038

6.9 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.

Section 23: ACCESSORIES

This timer allows an electric current flow during a preset time to a pump into the sump tank.

6.9.1 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).

6.9.2 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".

6.10 FLUSH PUMP

The submersible-type flush pump is mounted inside an enclosure in the sump tank (Fig. 30). 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.

6.10.1 Flush Pump Pressure Adjustment

The flush pump is provided with a manually-adjustable control valve mounted on the flush pump enclosure cover and serves to limit the flush pump output pressure. To adjust, ask an

assistant to activate the flush pushbutton and check the liquid projection while you manually adjust the control valve

6.11 SUMP TANK

6.11.1 Sump Tank Draining

To drain sump tank, unscrew cap a few turns then turn drain valve handle CCW. Flush tank and pump cage with clean water. Close drain valve by turning handle CW.

Caution: The lavatory should be serviced by maintenance personnel after emergency draining. Lavatory tanks should be serviced only at suitably equipped stations.

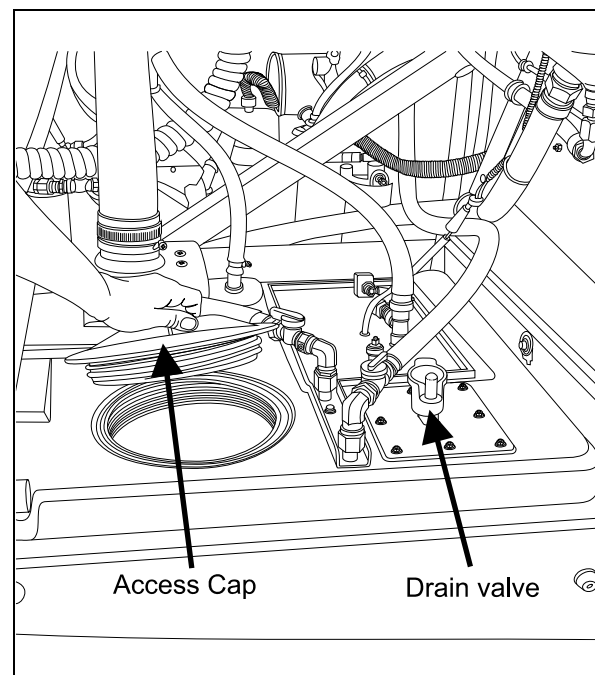


FIGURE 28: SUMP TANK

23294

6.11.2 Sump Tank Filling

Remove cap on sump tank. Fill Tank with 2 gallons (9 liters) of antifreeze and two gallons of water.

Caution: Do not overfill sump tank.

Note: The antifreeze solution in the sump tank will be diluted by fresh water coming from the lavatory sink. Regular maintenance of the sump tank is required to prevent freezing.

6.12 CLEANING CABINET

A coiled hose located in the cleaning cabinet above the toilet can be used during lavatory cleaning. To use, connect a fresh water supply to the "Hansen" quick-release coupling, identified as "Cleaning Kit", located besides the engine oil reserve tank (Fig. 27). To prevent freezing during cold weather, drain the hose after every use. To drain the hose, uncoil and open the nozzle near the lavatory floor drain. Have an assistant push on the spring ball of the quick-release coupling to allow air into the system.

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.

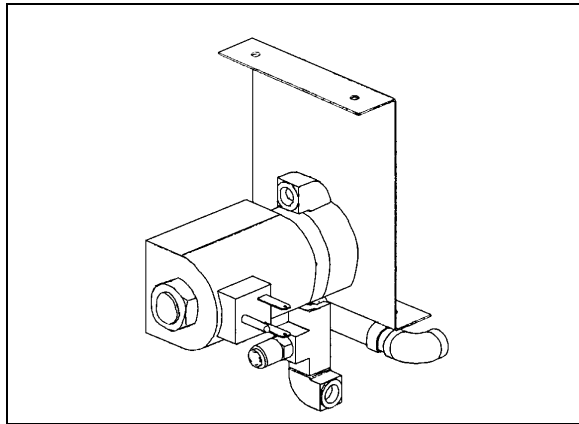


FIGURE 29: AIR HORN VALVE

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 switch than the upper windshield washer (refer to Operator or Owner's manual for operation). Each pressing of this switch produces 2 successive 0.7 seconds jets.

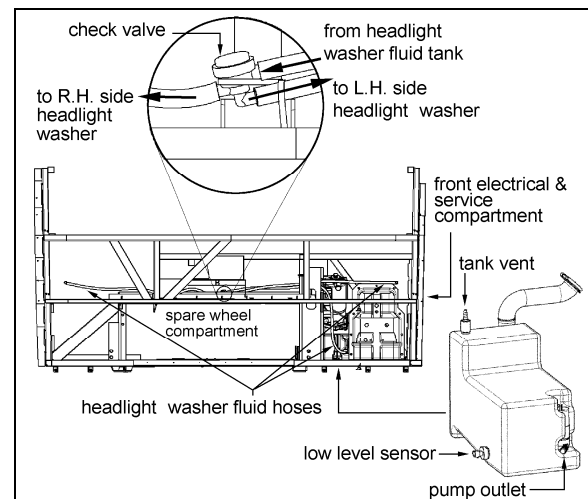
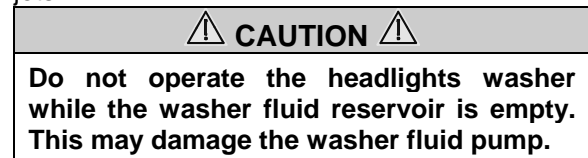


FIGURE 30: HEADLIGHT CLEANING SYSTEM

23361

8.2 WASHER FLUID REFILLING

Open the filler neck cap and add 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 31. Align the jet adjustment tool #800377 with the reference line shown on the front view detail. As seen on the side view, position the adjustment tool vertically for proper aiming.

⚠ CAUTION ⚠

Because they are made of plastic, firmly tighten nozzle and bulkhead fittings by hand only.

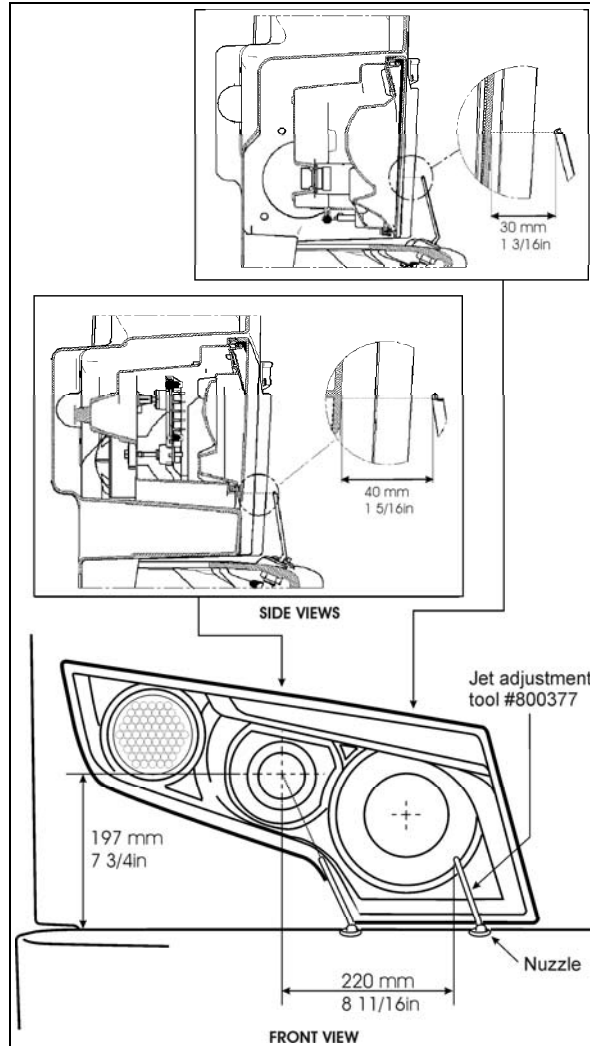


FIGURE 31: WASHER NOZZLES ADJUSTMENT 23386

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 two electric wiper motors that are accessible for maintenance after raising the appropriate access panel at the front of the coach (refer to figure 32).

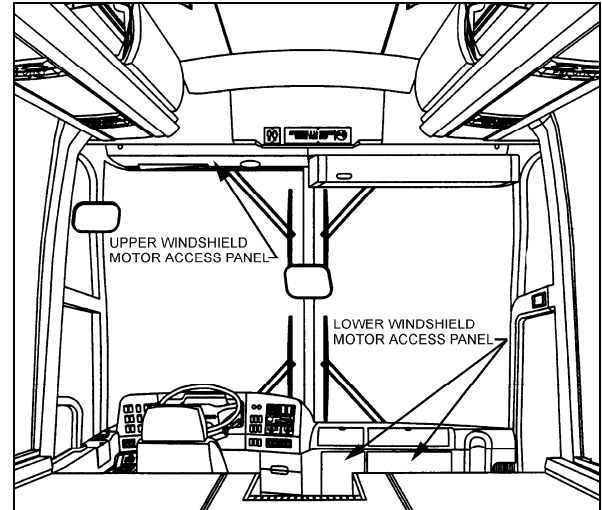


FIGURE 32: WIPER MOTORS LOCATION 23319

Each wiper motor is independently operated:

Depress the upper windshield wiper switch located on the dashboard L.H. side to the first position for intermittent wiping, and to the second position for continuous wiping (fig. 33).

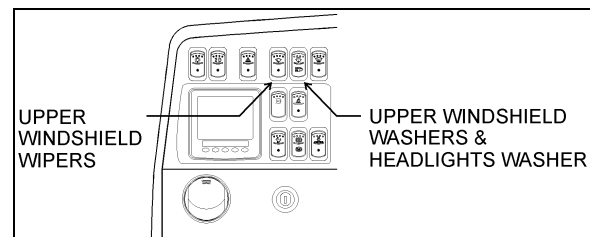


FIGURE 33: DASHBOARD

Rotate the multifunction lever forward to activate lower windshield wipers (arrow 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.

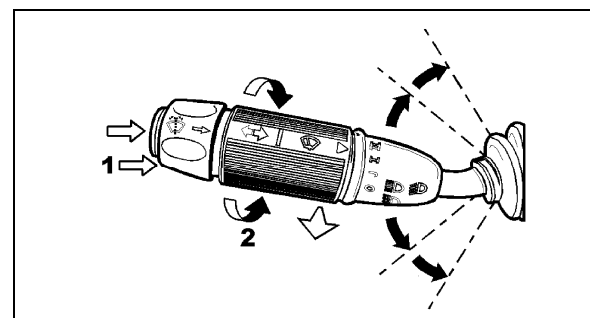


FIGURE 34: MULTIFUNCTION LEVER 23133

Each windshield washer pump is independently operated:

To activate the upper windshield washer pump, depress and hold the top of the rocker switch on dashboard L.H. side (fig. 34). The upper wipers will come on automatically and will shut off a few seconds after releasing the rocker switch.

The lower windshield washer pump is electrically operated and is controlled by a washer control ring on the multifunction lever (item 1, fig. 34).

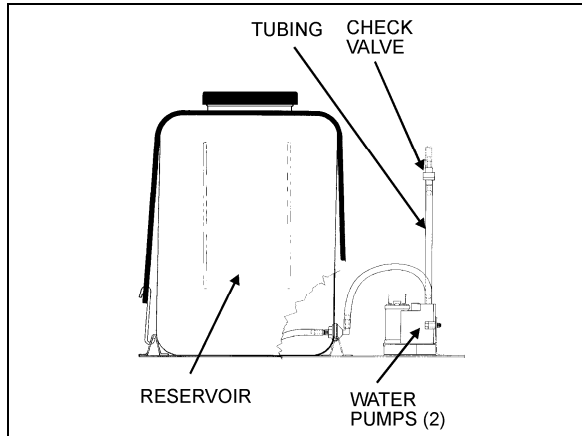


FIGURE 35: WINDSHIELD WASHER RESERVOIR 23085

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. Adjust nozzles with a flat tip screwdriver as needed to get proper spray coverage.

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 Sweep Adjustment

On a dry windshield, to avoid possible damage to the arm assembly or wiper motors, hold the wiper arms away from the windshield by inserting a small nail, or other such object, through the holes at the base of each wiper arm specially drilled for this purpose.

Sweep adjustment is a rough adjustment. It must be followed by lower and upper linkage adjustment. See paragraph 10.3 and 10.4.

In order to obtain the sweep adjustment, it may be necessary to remove and reposition the wiper arms, proceed as follows:

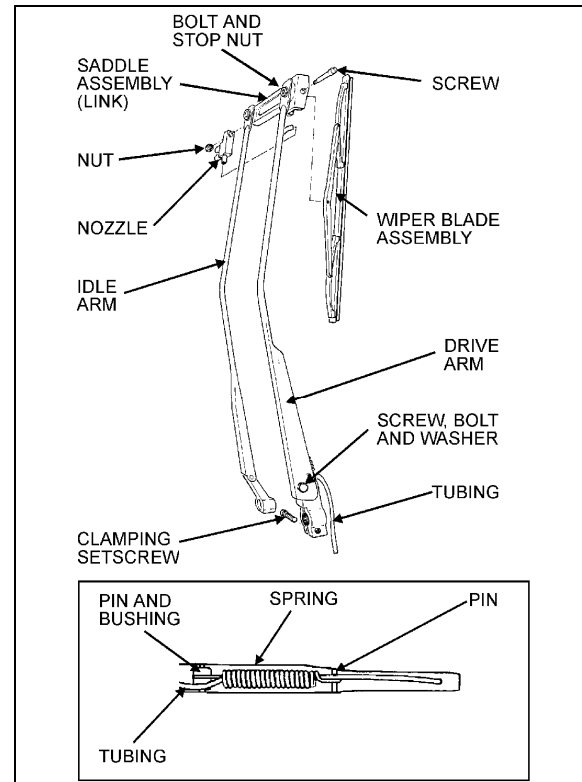


FIGURE 36: LOWER WINDSHIELD WIPER 23086

1. Remove the cap nuts from the wiper arm pivot shafts (Fig. 36 and 37);
2. Disconnect the windshield washer tubing at the base of the wiper arm;
3. Lower windshield wiper: loosen the clamping set screw securing the drive arm to the knurled arm pivot shaft;
4. Remove the drive and idler arms or arm assembly;
5. Relocate the drive arm or arm assembly on its knurled pivot shaft to obtain the desired position;
6. Lower windshield wiper. Tighten the clamping set screw to secure the drive arm to the knurled shaft. Fit the idler arm onto the idler pivot shaft.
7. Install the cap nut pivot shafts.
8. Connect the windshield washer tubing at the base of the wiper arm;

9. Check the adjustment on a wet windshield.

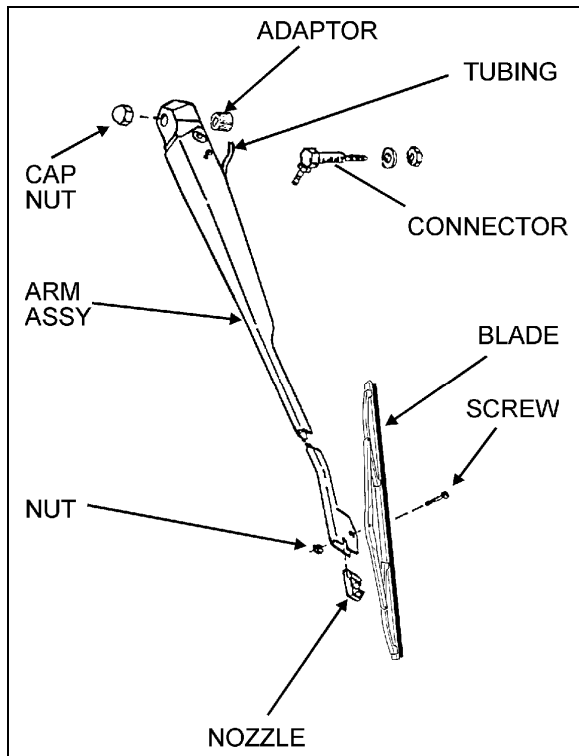


FIGURE 37: UPPER WINDSHIELD WIPER 23087

9.2.2 Removal

1. Remove the cap nuts from;
2. Disconnect the windshield washer tubing at the base of the wiper arm;
3. Mark the relationship of the arm head to the end of the knurled drive shaft to ensure the original position if the arm is to be reinstalled;
4. Lower windshield wiper: loosen the clamping set screw on the base of the drive arm;
5. Remove the wiper arm assembly.

9.2.3 Installation

1. Make sure the wiper motor is in the stop position. Lower windshield wiper: position the wiper arm on the knurled drive shaft and idler arm on the pivot shaft. Upper windshield wiper: position the wiper arm assembly on the knurled drive shaft;
2. If the original arm is reinstalled, align the marks made during removal;
3. Operate the wipers on a wet windshield to check the wiper blade sweep and angle. Readjust as necessary;

4. Lower windshield wiper: Tighten clamping nut onto the drive arm. Install cap nuts onto the arm shafts;
5. Connect the windshield washer tubing at the base of the wiper arm;
6. Check the adjustment on a wet windshield.

9.3 LOWER LINKAGE ADJUSTMENT

1. Make sure the wiper motor is in the stop position prior to working on the linkage.
2. Adjust the two pivot shafts vertically.
3. Adjust the rod length of the connecting pivot shafts. During rod length adjustment, maintain the pivot shafts in the vertical position.
4. Adjust the rod located between right pivot shaft and motor to a 40.5° angle (fig. 38). The motor lever must be on the same axis as the rod.
5. Install the right wiper arm in its normal position (in the middle of the windshield). Refer to paragraph "Sweep Adjustment".
6. The right wiper arm final adjustment is made by adjusting the smallest rod length.
7. Install the left wiper arm in its normal position (in the middle of the windshield). Refer to paragraph "Sweep Adjustment".
8. The left wiper arm final adjustment is made by adjusting the longest rod length.
9. Check the adjustment on a wet windshield.

9.4 UPPER LINKAGE ADJUSTMENT

1. Make sure the wiper motor is in the stop position prior to working on the linkage.
2. Adjust rods length.
3. Install the left wiper arm in its normal position (in the middle of the windshield). Refer to paragraph "Sweep Adjustment".
4. The left wiper arm final adjustment is made by adjusting the rod length to 8.46 inches (215 mm).
5. Install the right wiper arm in its normal position (in the middle of the windshield). Refer to paragraph "Sweep Adjustment".
6. The right wiper arm final adjustment is made by adjusting the rod length to 23.54 inches (598 mm).

7. Check the adjustment on a wet windshield

9.5 WINDSHIELD WIPER MOTORS

9.5.1 Lower Windshield Wiper Motor Replacement

The lower windshield wiper motor is located at lower front of the vehicle, behind the defroster panel. Refer to figure 32 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 two Phillips-head screws retaining the defroster panel, and remove panel.
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 (Prevost #800304), reverse removal procedure to reinstall.

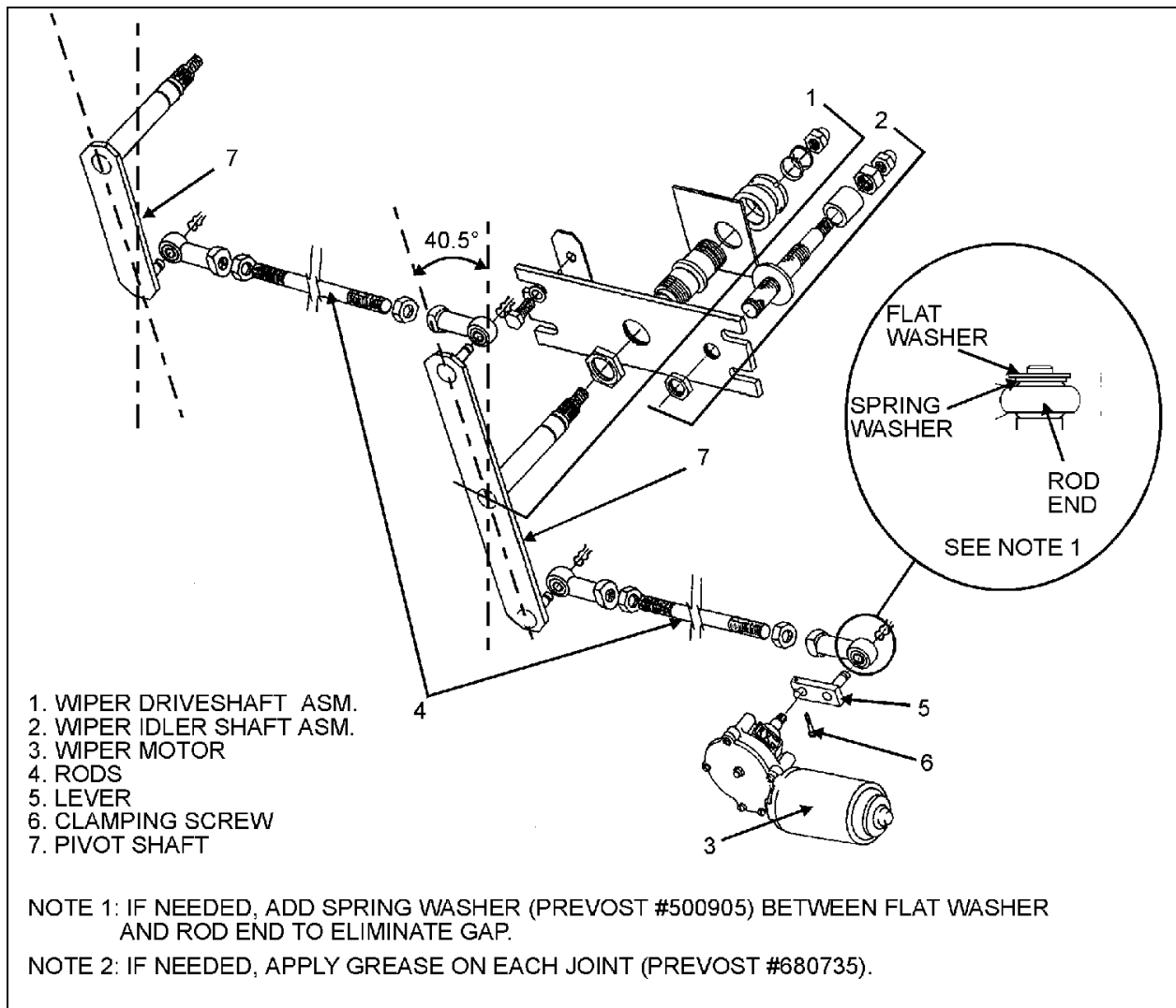


FIGURE 38: LOWER WINDSHIELD WIPER INSTALLATION

23088

9.5.2 Upper Windshield Wiper Motor Replacement

The upper windshield wiper motor is located above L.H. upper windshield panel. To remove the motor, it is necessary to remove left sun visor and upper windshield panel.

Warning: Park vehicle safely, apply parking brake, stop engine and set battery master switch to the "OFF" position prior to working on the vehicle.

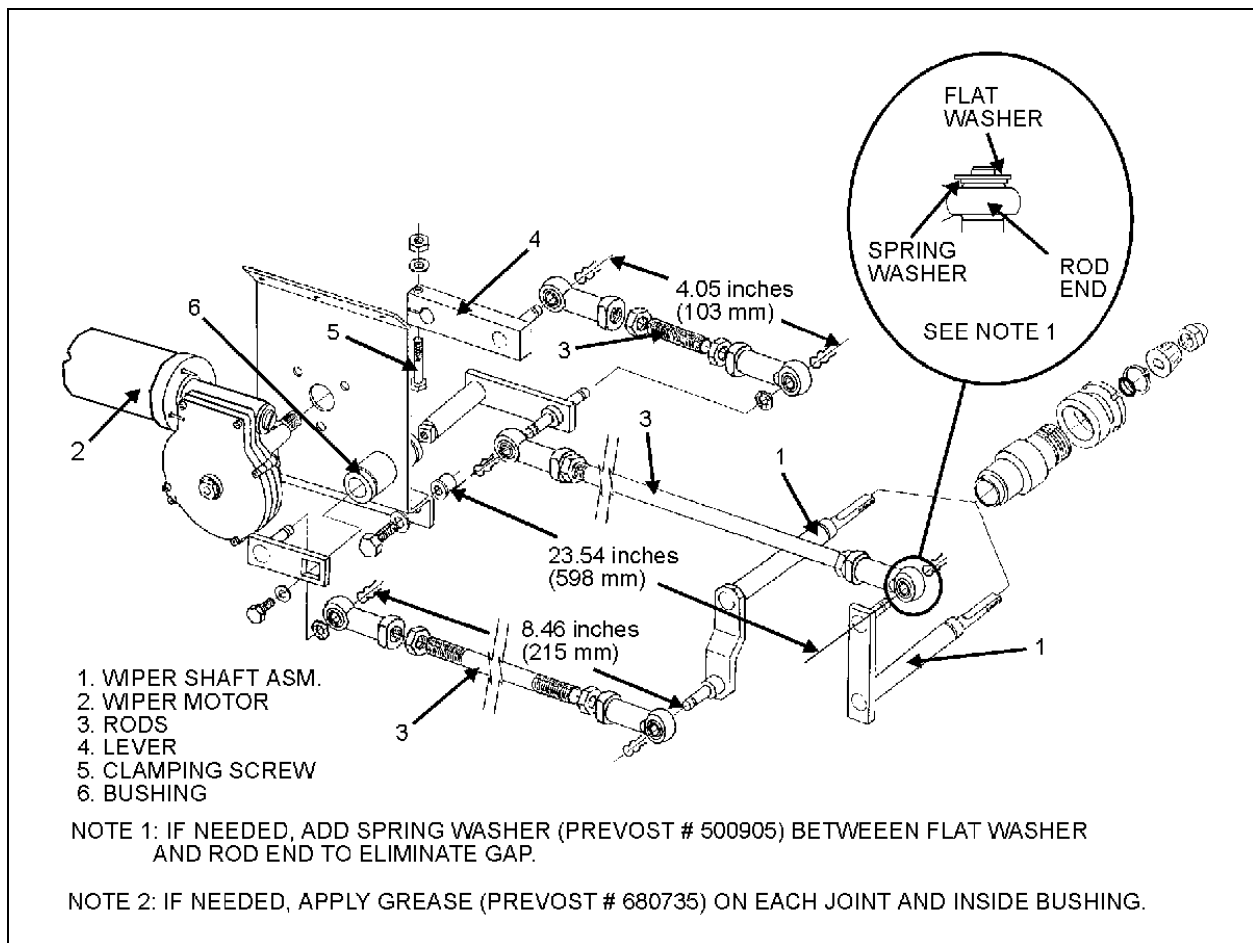


FIGURE 39: UPPER WINDSHIELD WIPER INSTALLATION

23089

1. Pull out the wiring connector (black and red wires) located on sun visor L.H. side and disconnect.
2. Remove the two Phillips-head screws at the bottom end of the sun visor arms.
3. Remove the two Phillips-head screws on each roller side, pull out the sun visor.
4. Remove the Phillips-head screws retaining the upper windshield panel.
5. If equipped with blower defroster, loosen hose clamp to remove air duct from hose.
6. Disconnect wiring connector from the windshield wiper motor.
7. Loosen the bolt retaining the lever at the end of the motor driving shaft (Fig. 37).
8. Remove the three bolts holding the motor to the steel plate.
9. Remove the windshield wiper motor (Prevost #800304), reverse removal procedure to reinstall.

10. AUTOMATIC FIRE SUPPRESSION SYSTEM (AFSS) (OPTIONAL)

This optional system is used to shut down the engine and to extinguish a fire in the engine compartment or in the vicinity of the preheating system if so equipped.

The system operation is fully automatic and does not require assistance from the operator, however if required, the system can be manually activated by the operator at any time.

Refer to Prevost Operator's Manual or Owner's Manual for system operation and operational sequence (fire).

If more information is needed on the system, please refer to Kidde Dual Spectrum "Operation & Maintenance Manual annexed at the end of this section.

10.1 STARTING THE VEHICLE AFTER TRIGGERING OF A FIRE ALARM

The vehicle may be started after a fire alarm without resetting the system. Refer to ignition switch sequence below. This will not reset the system, rather it will instruct the vehicle's multiplex system to ignore vehicle interface outputs from the protection panel. This feature is intended to be used only in emergency situations that require the vehicle to be restarted and moved a short distance prior to system

reset. It should not be performed if the cause of the fire has not been clearly identified and corrected.

To start the vehicle, perform this ignition switch (key) sequence:

1. From the on position;
2. Turn to **OFF**, return to **ON** and **START** vehicle within 2 seconds.

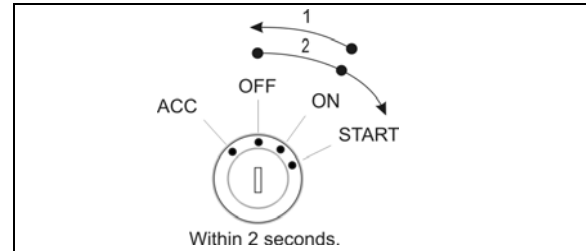


FIGURE 40: IGNITION SWITCH SEQUENCE

10.2 PERIODIC MAINTENANCE

PRE-TRIP

- o Verify that the Protection Panel "SYSTEM OK" lamp is on solid green.

EVERY 3000 MILES OR MONTHLY (whichever comes first)

General

- o Verify that neither the protected equipment nor the hazard has changed.
- o Verify that no obvious physical damage or condition exists that might prevent system operation.

Protection Panel

- o Verify that all warning lamps and the audible alarm are operational by pressing the "TEST/RESET" button.

Manual Activation Switch

- o Verify that the tamper seal is intact and access to the switch is unobstructed.

Fire Detectors

- o Optical
 - Verify that the status lamp on the detector face is on solid green.
 - Verify that nothing is blocking the detector's field of view.
 - Verify that the windows on the face of the detector are free of excess contami-

nation (dirt, oil, grease, etc.) – if necessary, clean using a water soaked non-abrasive towel.

Engineered Fire Suppression System: Installation, Operation and Maintenance Manual”.

- Linear Thermal
 - Verify that there is no obvious physical damage and that the unit is free of excess contamination (dirt, oil, grease, etc.) – if necessary, clean using a water soaked non-abrasive towel.
 - Verify that mounting is secure and taught.

Electrical Harness

- Verify that electrical connectors and electrical wiring have no visible damage and all connectors are securely seated.

Extinguisher & Distribution System

- Verify that the extinguisher pressure gauge pointer is in the green arc at room temperature.
- Verify that distribution piping and nozzles are intact and unobstructed and that nozzle blow-off caps are in place.

EVERY 18000 MILES OR SEMI-ANNUALLY (whichever comes first)

- Perform a comprehensive fire system test using a Kidde Dual Spectrum System Test Set (Optical Test Kit P/N 420871-2).
- Service the extinguisher in accordance with KDS Document 160296, “KDS Pre-Engineered Fire Suppression System: Installation, Operation and Maintenance Manual”.

EVERY SIX YEARS

- Have the fire extinguisher rebuilt by a qualified fire protection equipment company familiar with Kidde Dual Spectrum equipment and in accordance with KDS Document 160296, “KDS Pre-Engineered Fire Suppression System: Installation, Operation and Maintenance Manual”. Rebuilt shall include actuator, O-ring seals and dry chemical replacement.

EVERY TWELVE YEARS

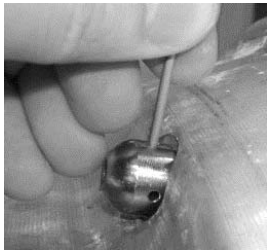


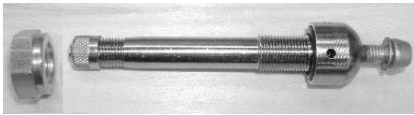
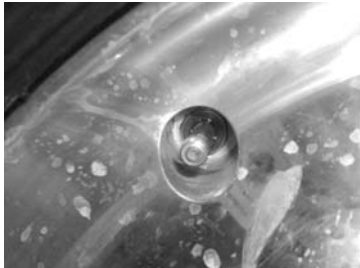


- Have the Extinguisher cylinder hydrostatically tested by a qualified fire protection equipment company familiar with Kidde Dual Spectrum equipment and in accordance with KDS Document 160296, “KDS Pre-

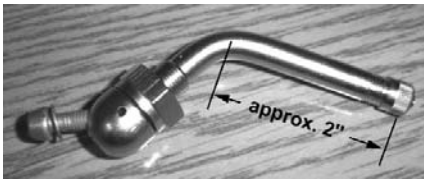

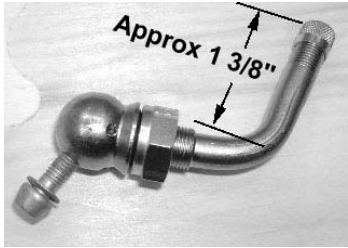



11. TIRE PRESSURE MONITORING SYSTEM (TPMS)

The optional active tire pressure and temperature monitoring system is a sensing device designed to identify and display tire operating data and activate an alert or warning when pressure or temperature irregularities are detected.

For more information on the operation and troubleshooting of the system, refer to the Operator's Manual, chapters "Controls and Instruments", "Safety Features and Equipment" and also "Appendix G".

11.1 TIRE VALVE INSTALLATION

<p>Use as required a small rod to hold the valve in place when tightening.</p>			
<p>Steel Wheels</p>	<p><u>All wheels</u> a) Install Beru valve Torque valve to 44.5lb-in +/- 9.5 b) no extension piece</p>	 #Prevost 681083	
	<p><u>Front axle and tag axle wheels with 365 tires</u> a) Remove Alcoa valve b) Install Beru valve Torque valve to 102lb-in +/- 22 c) No extension piece</p>	 #Prevost 651080	
<p>Aluminum Wheels (new Hub-Mounted wheels)</p>	<p><u>Front axle and tag axle wheels with 315 tires</u> a) Remove Alcoa valve b) Install Beru valve Torque valve to 102lb-po +/- 22 c) Small extension piece (approx. 50mm)</p>	 #Prevost 651081	

Aluminum wheels (new Hub-Mounted wheels)	<p><u>Drive axle inner and outer wheels with 315 tires-</u></p> <p>a) Remove Alco valve b) Install Beru valve Torque valve to 102lb-in +/- 22 c) no extension piece</p>	 <p>#Prevost 651081</p>	
	<p><u>"Super Single" Tires</u></p> <p>a) Remove Alcoa valve b) Install Beru valve Torque valve to 102lb-in +/- 22 c) no extension piece</p>	 <p>#Prevost 651079</p>	
Aluminum wheels (former Stud-Mounted wheels)	<p><u>All wheels</u></p> <p>a) Remove Alcoa valve b) Install Beru valve Torque valve to 102lb-in +/- 22 c) no extension piece</p>	 <p>#Prevost 651082</p>	



CAUTION



When replacing Alcoa valve stems, it is recommended to lubricate the threads and O-ring with Permatex Dielectric Tune-Up grease.

When valve stem extensions are used, it is recommended that valve stem stabilizers be used.

11.2 BERU SENSORS INSTALLATION

IMPORTANT NOTE

Beru sensors have a limited lifespan (5 years on average)

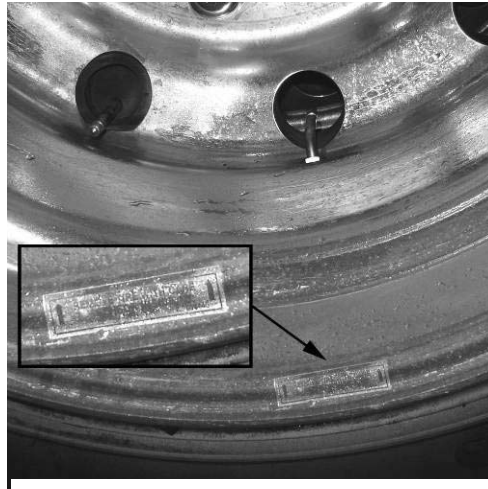
<p>Check proper valve positioning before installing sensor onto valve (risk of damaging the sensor or air leaks).</p>	
<p>Beru pressure sensor 564078 Remove bar code with supplied removable tie- rap. Make sure not to mix bar codes up between wheels (bar code is linked to sensor)</p>	
<p>Position sensor onto wheel Install oval wave spring washer</p>	
<p>Torx screw T-20. Torque to 35lb-in (4Nm) (supplier specification for the screw). IMPORTANT Use the screw only once. This screw uses a thread lock. Never use Loctite (incompati- bility between Loctite and thread lock) Replacement screw #651084.</p>	
<p>Install bar code and tie it up using wheel holes. Use supplied removable tie- rap.</p>	

Decal

Glue decal facing the valve.



#651091 ENGLISH #651090 BILINGUAL



DRIVE AXLE OUTER WHEEL

SECTION 24: LUBRICATION & SERVICING

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1 LUBRICATION

The efficiency and life expectancy of mechanical equipment is largely dependent on 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.

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 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.

2.1.1 Hose 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.



WARNING

Personal injury and property damage may result from fire caused by leaking flammable fluids.

2.1.2 Leaks

Hoses have a limited service life. Thoroughly inspect hoses annually. Look for surface damage or indications of twisted, worn, crimped, cracked or leaking lines. Replace damaged hoses immediately.

Hoses should be replaced during major overhaul or after a maximum of seven years service. Be certain that replacement hoses match the original equipment manufacturer's specifications.

2.1.3 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.

Section 24: LUBRICATION & SERVICING

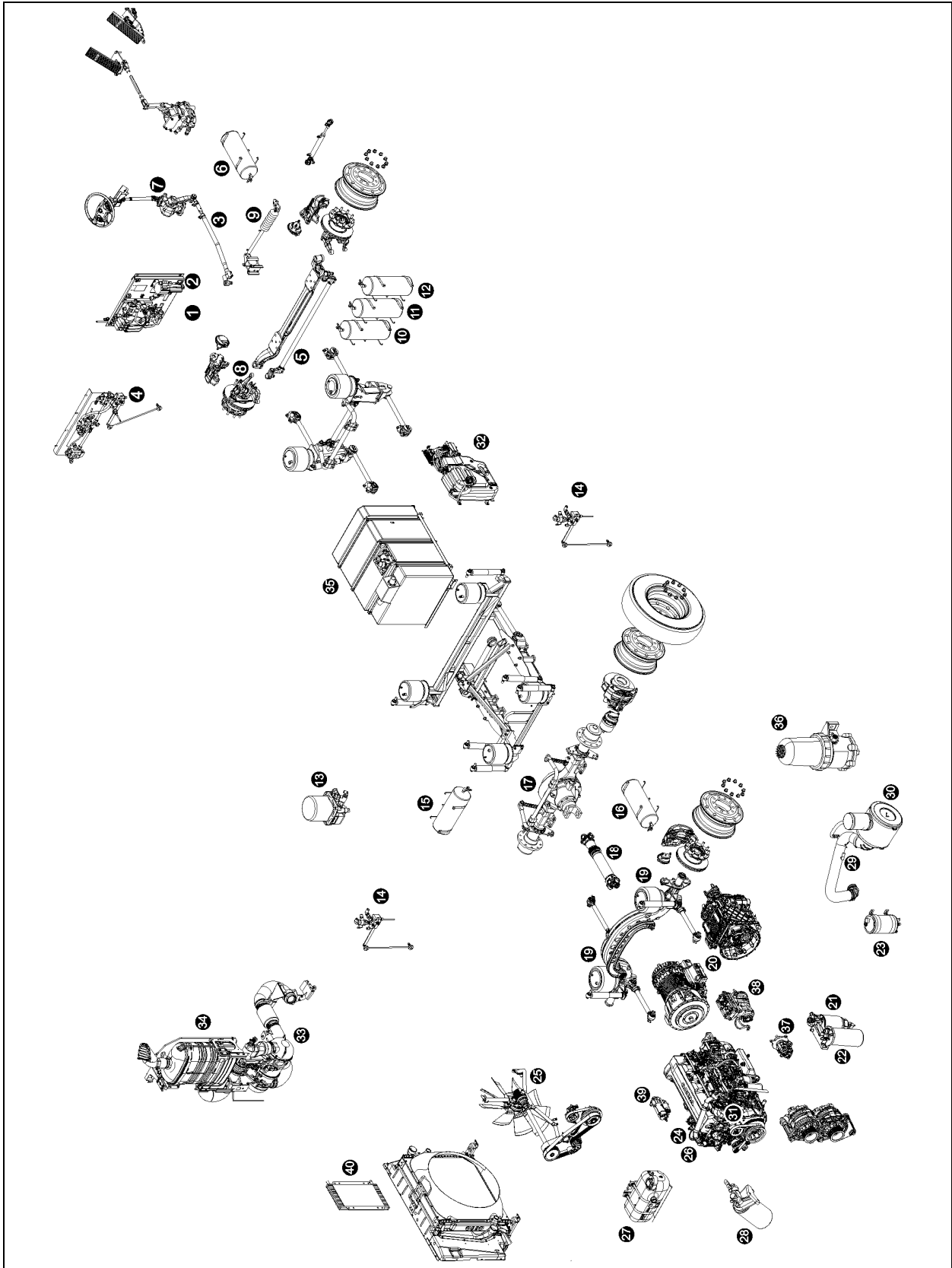


FIGURE 1: LUBRICATION AND SERVICING POINTS (I-BEAM FRONT AXLE SHOWN) TYPICAL

Section 24: LUBRICATION & SERVICING

1	Accessories air tank drain cock	21	Primary fuel filter
2	Accessories air filter	22	Secondary fuel filter
3	Steering drag link	23	Power steering fluid tank
4	Height control valve (front)	24	Engine oil filter
5	Steering tie rod	25	Cooling fan gearbox
6	Accessories air tank	26	Allison transmission oil dipstick
7	Steering column U-joints	27	Engine coolant surge tank
8	Steering knuckle pins	28	Coolant filter & conditioner
9	Steering damper cylinder	29	Engine air filter restriction indicator
10	Emergency / parking brake overrule tank	30	Engine air filter
11	Secondary air tank	31	Engine oil dipstick and filler tube
12	Kneeling air tank	32	DEF tank
13	Air dryer	33	Diesel particulate filter
14	Height control valve (rear)	34	SCR catalytic converter
15	Wet air tank	35	Diesel fuel tank
16	Primary air tank	36	Davco Fuel Pro 382 fuel filter
17	Differential	37	Power steering pump
18	Propeller shaft	38	Air compressor
19	Tag axle lever pivot	39	Starter
20	Transmission	40	Fuel cooler

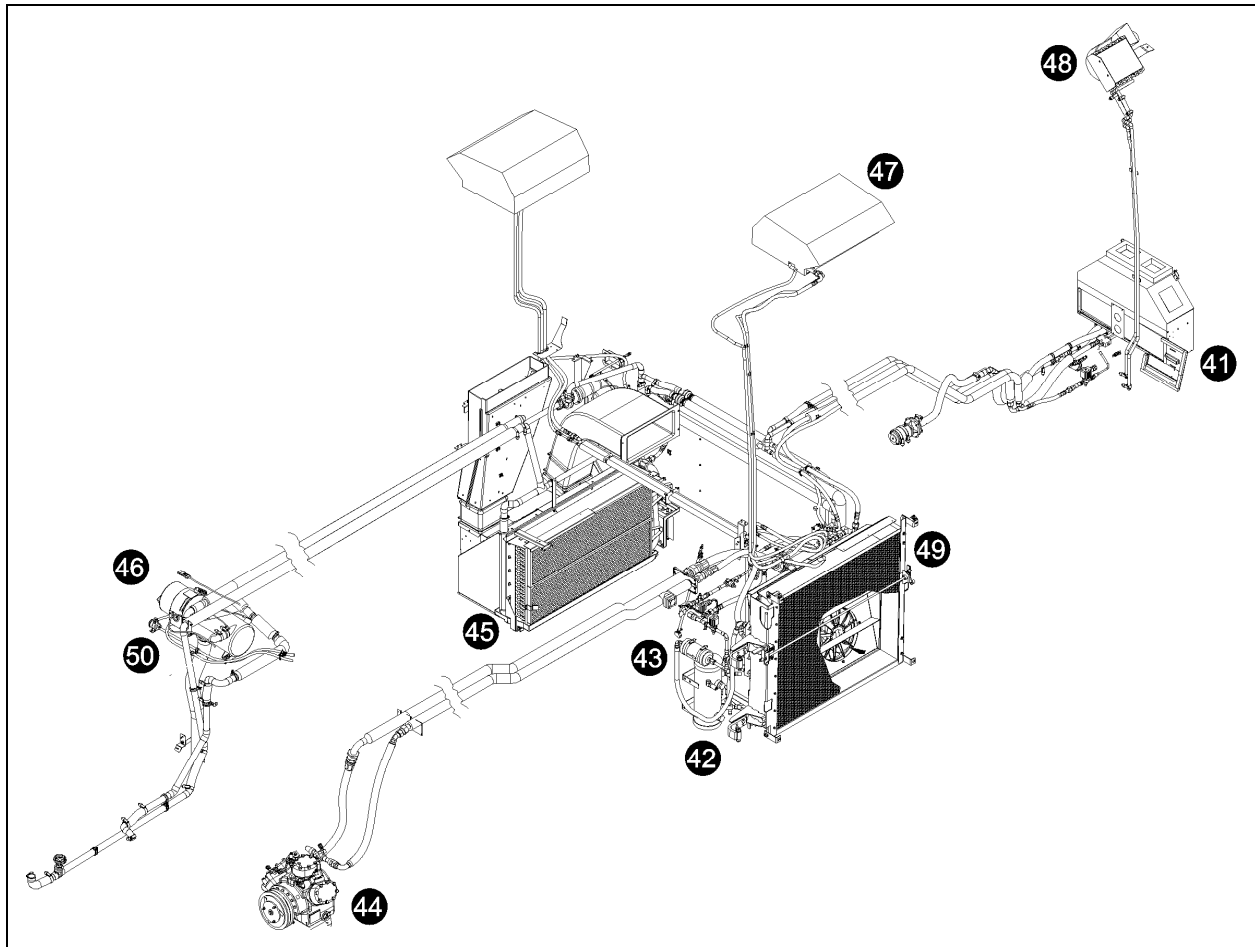


FIGURE 2: LUBRICATION AND SERVICING POINTS – HVAC UNIT

- | | | | |
|----|------------------------------------|----|---|
| 41 | HVAC air filter – driver's unit | 46 | Coolant preheater |
| 42 | A/C receiver tank | 47 | A/C system – passenger's overhead console |
| 43 | Refrigerant moisture indicator | 48 | Upper windshield defrost unit |
| 44 | A/C compressor | 49 | Condenser coil |
| 45 | HVAC air filter – passenger's unit | 50 | Preheater fuel filter |

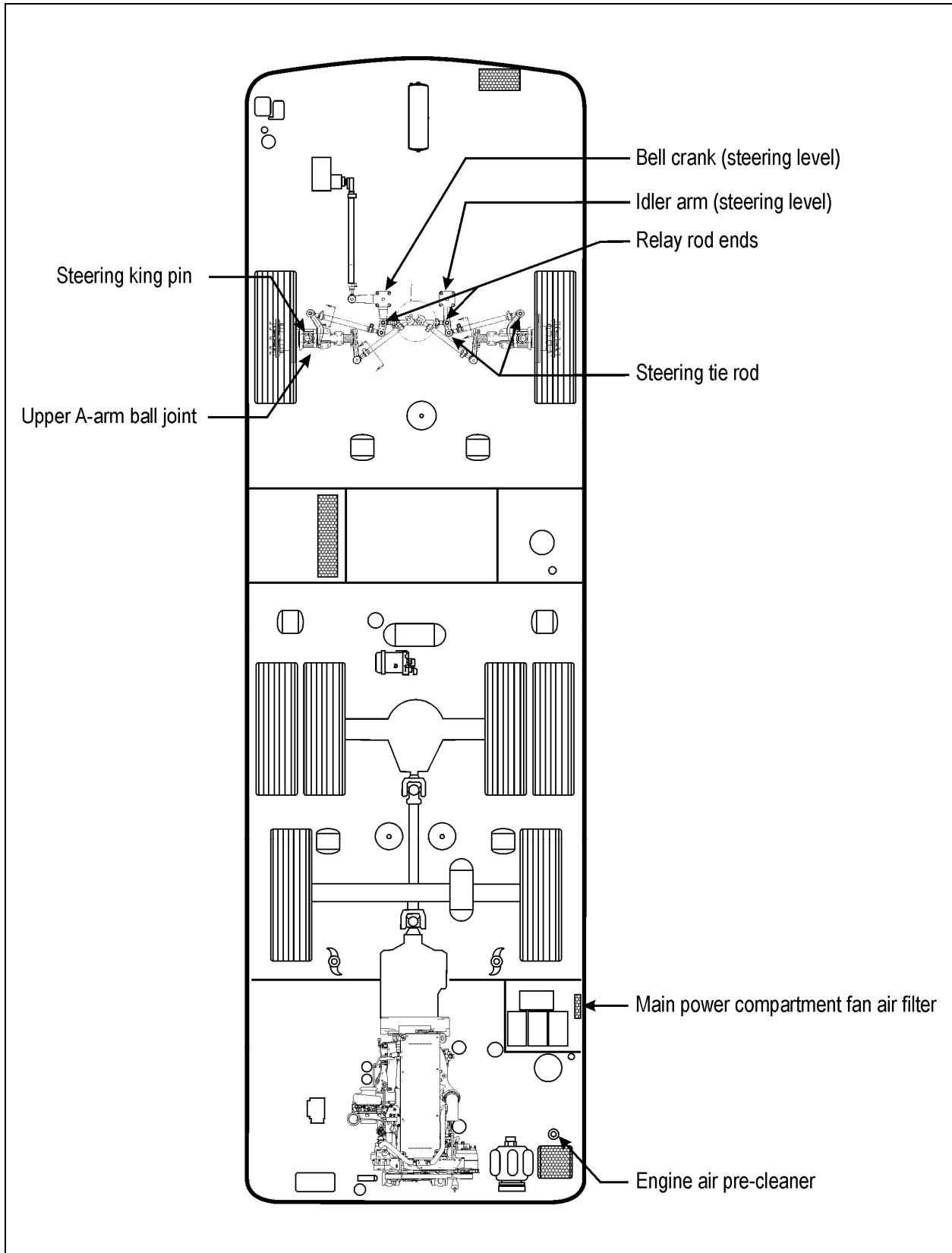


FIGURE 3: LUBRICATION AND SERVICING POINTS - INDEPENDENT FRONT SUSPENSION VEHICLES (TYPICAL)

Section 24: LUBRICATION & SERVICING

2.2 FLUIDS AND LUBRICANTS SPECIFICATIONS

FLUIDS & LUBRICANTS		
REF	DESCRIPTION	SPECIFICATIONS
A	Engine Oil	VOLVO D13 SAE Viscosity Grade: 10W-30 API Classification CJ-4 meeting Volvo specification VDS-4 and EO-O Premium Plus
B	Power Steering Oil	Automatic Transmission Oil, Dexron-III
C	Engine Coolant	VOLVO D13 Texaco or Chevron Extended Life Coolant (ELC) 50% antifreeze/water solution is normally used
D	A/C Compressor Oil	Central HVAC system: Polyolester oil, HFC 134a compatible; Castrol SW-68 (POE) or equivalent Small HVAC system: PAG oil
E	Differential Oil	Multigrade gear oil meeting MIL-L-2105-D: 85W140. 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)
F	Differential Oil (Full Synthetic)	Multigrade gear oil meeting MIL-L-2105-D: 85W140. If temperature drops below 10°F (-12°C), 80W90 should be used. Below -15°F (-26°C), 75W90 should be used.
G	Cooling Fan Gearbox Oil	Synthetic gear lubricant 75W-90 (refer to Linnig bulletin 142.377 for the list of approved oils)
H	Allison Automatic Transmission Oil	Castrol TranSynd™ Synthetic Transmission Fluid for Allison or TES 295 approved equivalent
I	Allison Automatic Transmission Oil	Dexron-VI® or approved equivalent 1 Schedule 1 TES-389 fluids;
J	Volvo I-Shift Transmission	Castrol Syntrans Grade SAE 75W-85 synthetic oil
K	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
L	Multi Purpose Grease	Molykote longterm 2/78 grease

2.3 LUBRICATION AND SERVICING SCHEDULES

For lubrication and servicing schedule, refer to the two following tables.

<i>IMPORTANT NOTE</i>
<i>Refer to the manufacturers documentation included in this maintenance manual for specific manufacturer's maintenance requirements.</i>

LUBRICATION AND SERVICING SCHEDULE		PROCEED TO MAINTENANCE OPERATION <u>EVERY</u> ¹											Lubricant / Fluid ²				
		Item	Month	6 250 mi / 10 000 km	12 500 mi / 20 000 km	31 250 mi / 50 000 km	50 000 mi / 80 000 km	100 000 mi / 160 000 km	106 000 mi / 170 000 km	125 000 mi / 200 000 km	150 000 mi / 240 000 km	185 000 mi / 300 000 km		250 000 mi / 400 000 km	300 000 mi / 500 000 km	500 000 mi / 800 000 km	600 000 mi / 960 000 km
GENERAL																	
1	Flexible hoses – thoroughly inspect all hoses	12				●											
01 ENGINE																	
1	Engine oil & filter – heavy ³ operation condition, change every 35 000mi / 60 000km	24															A
2	Engine oil & filter – normal ³ operation condition, change every 45 000mi / 75 000km	24															A
3	Air cleaner – replace filter element when indicated by restriction indicator or after a maximum of 2 years	30	24														
4	Drive belt (water pump) – inspect for cracks or frayed material, replace belt that display obvious wear or defects	12			●												
5	Valves & injectors – initial adjustment	24	12							●							
6	Valves & injectors – check & adjust	24	24										●				
7	Drive belt tensioners (water pump, fan, alternators) – remove belts, check for noisy bearings, play, bushing play												●				
03 FUEL																	
1	Primary & secondary fuel filters – replace at every engine oil change	21															
		22															
2	Preheater fuel filter – change	50	12			●											
04 EXHAUST AND AFTERTREATMENT SYSTEM																	
1	Diffuser assembly, rain cap & drain tube – check proper functioning, clean	34	12														
2	DEF pump filter – replace	32	36							●							
3	DEF tank – drain, clean with water, clean filler neck strainer	32	12							●							
4	Aftertreatment Hydrocarbon Injector (AHI) nuzzle – replace									●							
5	DPF filter – either clean or replace filter cartridge every 400 000mi / 650 000km																
05 COOLING																	
1	Coolant surge tank – test coolant solution	27	12	●													
2	Radiator fan gearbox – check oil level	25	6	●													
3	Radiator fan drive belt – inspect for cracks or frayed material, replace belt that display obvious wear or defects		12		●												
4	Radiator – inspect exterior core & clean with low pressure water jet if necessary								●								
5	Radiator fan gearbox – change oil	25	12						●								G
6	Coolant filter – change at every engine oil change (Chemical Additive Filter must be used with Fully Formulated Coolant)	28															
7	Coolant filter – change (Long-Life Filter without additives to be used with Extended Life Coolant)	28	12							●							

¹ Proceed to maintenance operation at mileage indicated on odometer or specified number of month, whichever comes first.

² See paragraph 2.2 of this section for lubricant specifications.

³ Normal = fuel consumption more than 6mpg (less than 39 L/100km); Heavy = fuel consumption between 4.7mpg and 6mpg (between 39 L/100km and 50 L/100km).

Section 24: LUBRICATION & SERVICING

LUBRICATION AND SERVICING SCHEDULE H3 Series coaches X3 Series coaches H3 VIP commercial use X3 VIP commercial use		PROCEED TO MAINTENANCE OPERATION <u>EVERY</u> ¹											Lubricant / Fluid ²						
		Item	Month	6 250 mi / 10 000 km	12 500 mi / 20 000 km	31 250 mi / 50 000 km	50 000 mi / 80 000 km	100 000 mi / 160 000 km	106 000 mi / 170 000 km	125 000 mi / 200 000 km	150 000 mi / 240 000 km	185 000 mi / 300 000 km		250 000 mi / 400 000 km	300 000 mi / 500 000 km	500 000 mi / 800 000 km	600 000 mi / 960 000 km		
8	Cooling system – drain, flush & refill (fully formulated coolant)	27	24														●		
9	Cooling system – drain, flush & refill (extended life coolant) every 750 000mi / 1 200 000km	27	96															C	
06 ELECTRICAL																			
1	Power cables inspection – Perform MI15-24		3																
2	Battery terminals – clean & coat terminals		12																
3	HD10 Bosch alternators drive belt – inspect for cracks or frayed material, replace belt that display obvious wear or defects		12			●													
4	HD10 Bosch alternators brushes – check & replace brushes if needed							●											
07 TRANSMISSION ⁴																			
1	Allison transmission filled with TES389 approved fluid and Prognostics mode disabled – change transmission fluid, Main & Lube filter (Refer to TABLE 1 in Section 07: Transmission for Main & Lube filter change intervals)	20																I	
2	Allison transmission filled with TranSynd or TES295 synthetic fluid only, no mixture^{5,6} and Prognostics mode disabled – change transmission fluid, Main & Lube filter (Refer to TABLE 2 in Section 07: Transmission for Main & Lube filter change intervals)	20																H	
3	Allison transmission filled with TranSynd or TES295 synthetic fluid only, no mixture^{5,6} and Prognostics mode enabled – change fluid & filters when indicated by TRANSMISSION SERVICE indicator or 60 month whichever occurs first. In addition, change filters with every fluid change	20	60															H	
4	Allison transmission filled with TES389 approved fluid with Prognostics mode enabled^{5,6} – change fluid & filters when indicated by TRANSMISSION SERVICE indicator or 24 month whichever occurs first. In addition, change filters with every fluid change.	20	24															H	
5	Transmission oil cooler, replace unit if vehicle is equipped with transmission retarder		24																
6	Volvo I-Shift Transmission not filled with Castrol Syntrans SAE 75W85, change fluid & filter	20	36														●		
7	Volvo I-Shift Transmission filled with Castrol Syntrans SAE 75W85 (extended oil drain), change fluid & filter	20	60															●	J
09 PROPELLER SHAFT																			
1	Perform Spicer’s Driveshaft Assembly Inspection Procedures	18				●													
2	Grease one fitting on each universal joint	18	6					●											K
11 REAR AXLES																			
1	Drive axle – check differential oil level, add if necessary every 25 000 mi	17	6																E
2	Tag axle lever pivot – grease one fitting on each pivot	19	6	●															K

⁴ In the absence of a fluid analysis program, the fluid change interval listed in Table 1, Table 2 & Table 3 should be used. Change filters according to Table 1, Table 2 & Table 3 even if a fluid analysis shows that the fluid doesn’t need to be changed.

⁵ When the transmission contains a mixture of fluids (defined as the quantity of non-TranSynd or non- TES 295 fluid remaining in the transmission after a fluid change combined with the quantity of TranSynd or TES295 required to fill the transmission to the proper level), perform the fluid and filter change according to the TES389 intervals.

⁶ Extended TranSynd or TES 295 fluid and filter change intervals are only allowed with Allison High-Capacity filters.

LUBRICATION AND SERVICING SCHEDULE		PROCEED TO MAINTENANCE OPERATION <u>EVERY</u> ¹											Lubricant / Fluid ²				
		Item	Month	6 250 mi / 10 000 km	12 500 mi / 20 000 km	31 250 mi / 50 000 km	50 000 mi / 80 000 km	100 000 mi / 160 000 km	106 000 mi / 170 000 km	125 000 mi / 200 000 km	150 000 mi / 240 000 km	185 000 mi / 300 000 km		250 000 mi / 400 000 km	300 000 mi / 500 000 km	500 000 mi / 800 000 km	600 000 mi / 960 000 km
H3 Series coaches																	
X3 Series coaches																	
H3 VIP commercial use																	
X3 VIP commercial use																	
3	Drive axle – change differential oil, clean breather	17	12					●									F
4	Drive axle – change differential oil, clean breather (with full synthetic oil)	17	48										●				F
12 BRAKE & AIR SYSTEM																	
1	Check proper functioning of the adjuster, check caliper running clearance, check caliper movement along guide pins, check sealing elements, at every pad replacements or once a year whichever comes first		12														
2	ABS & Electronic Stability Control systems – check proper functioning		12														
3	Air tanks – drain water from all tanks		6	●													
4	Brake pads – check pad wear indicator. Visually check condition of the slack adjuster cap & guide pin covers			●													
5	Accessories air filter – change filter element	2	24					●									
6	Air dryer – change cartridge	13	24					●									
13 WHEELS, HUBS & TIRES																	
1	Unitized hub bearing, front and tag axle – inspect, check end play. Refer to See Dana Spicer Maintenance Manual Model NDS Axle Range	8	12		●												
14 STEERING																	
1	Drag link end ball joints – inspect for corrosion	3	12														
2	Tie rod end ball joints – inspect for corrosion	5	12														
3	Steering knuckle (king) pins – grease two fittings per knuckle	8	6	●													K
4	Steering knuckle (king) pins – check play	8	6		●												
5	X3 Series only: Drag link ends – clean and grease two fittings at each end		6	●													
6	X3 Series only: Idler arm – grease fitting		6	●													
7	X3 Series only: Bell crank – grease fitting		6	●													
8	X3 Series only: Relay rod ends – grease one fitting at each end		6	●													
9	Steering tie rod ends – clean & grease one fitting at each end	5	6	●													K
10	Steering damper cylinder – grease one fitting at rod end	9	6	●													K
11	Power steering reservoir filter cartridge and fluid – replace	23	12			●											B
18 BODY																	
1	Structure inspection for corrosion – Perform MI15-18 every 5 years for normal duty vehicles and normal environment operation																
2	Structure inspection for corrosion – Perform MI15-18, every 2 years starting from the 5 th year in service for severe duty vehicles and harsh environment operation																
22 HEATING & AIR CONDITIONING																	
1	A/C compressor – check oil level, add if necessary	44	6	●													D
2	A/C compressor – empty shaft seal oil collection tube	44	6	●													
3	A/C receiver tank – check refrigerant level, add if necessary	42	6	●													
4	Refrigerant moisture indicator – check filter dryer unit, replace according to moisture indicator	43	6	●													
5	Evaporator compartment return air filters (2x) – clean or replace	45	6		●												
6	X3 Series only. Evaporator compartment door fresh air intake filter – clean or replace		6	●													



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Section 24: LUBRICATION & SERVICING

LUBRICATION AND SERVICING SCHEDULE H3-45 VIP & X3-45 VIP MOTORHOMES (Private Use)	ITEM	EVERY (months)	LUBRICANT / FLUID ⁸
GENERAL			
All flexible hoses – inspect		12	
H3 VIP Series only: Main power compartment fan air filter – inspect		12	
01 ENGINE			
Engine oil and filters – replace	24	12	A
Air cleaner – replace filter element	30	24	
Engine mounted alternators & house alternator(s) – replace drive belts and intermediary drive belts		24	
Coolant pump drive belt – replace		24	
Valves and injectors – initial adjustment: after 2 500 hours or 36 months whichever occurs first	24	36	
Valves and injectors – check and adjust: every 5 000 hours or 72 months whichever occurs first	24	72	
03 FUEL			
Primary fuel filter & secondary fuel filter – change at every engine oil change	21, 22		
04 EXHAUST AND AFTERTREATMENT SYSTEM			
DPF filter – either clean or replace filter cartridge after 4 500 hours	33		
Aftertreatment Hydrocarbon Injector (AHI) nozzle – replace after 4 500 hours			
DEF tank – drain and clean with water, clean filler neck strainer	32	12	
Diffuser assembly, rain cap & drain tube – check proper functioning, clean	34	24	
DEF pump – replace filter element	32	36	
05 COOLING			
Radiator fan gearbox – check oil level, add if required	25	12	G
Coolant surge tank – test coolant solution	27	12	
Coolant filter – change (long life filter with extended life coolant)	28	12	
Radiator fan drive belt – inspect for cracks or frayed material, replace if required	25	24	
Radiator fan gearbox – change oil	25	48	G
Cooling system – drain, flush & refill (with extended life coolant)	27	96	C
06 ELECTRICAL			
Battery terminals – clean and coat terminals		12	
Power cables inspection – Perform MI15-24		24	
Bosch HD10 alternator brushes – check and replace if required		48	
07 TRANSMISSION⁹			
Filled with TES389 approved fluid, with Prognostics mode disabled – see TABLE 1 in <i>Section 07: Transmission</i> for fluid and filter change	20		I
Filled with TranSynd or TES295 approved fluid only, no mixture ¹⁰ , with Prognostics mode disabled – See TABLE 2 in <i>Section 07: Transmission</i> for fluid and filter change	20		H
Filled with TranSynd or TES295 approved fluid only, no mixture with Prognostics mode enabled ¹¹ - Change fluid & filters when indicated by TRANSMISSION SERVICE indicator or 60 month whichever occurs first. In addition, change filters with every fluid change.	20	60	H

⁸ See paragraph 2.2 of this section for lubricant specifications.

⁹ In the absence of a fluid analysis program, the fluid change interval listed in Table 1, Table 1 & Table 3 should be used. Change filters according to Table 1, Table 2 & Table 3 even if a fluid analysis shows that the fluid doesn't need to be changed.

¹⁰ When the transmission contains a mixture of fluids (defined as the quantity of non-TranSynd/ non- TES 295 fluid remaining in the transmission after a fluid change combined with the quantity of TranSynd or TES295 required to fill the transmission to the proper level), perform the fluid and filter change according to the TES389 intervals.

LUBRICATION AND SERVICING SCHEDULE			
H3-45 VIP & X3-45 VIP MOTORHOMES (Private Use)			
	ITEM	EVERY (months)	LUBRICANT / FLUID⁸
Filled with TES389 approved fluid only, no mixture with Prognostics mode enabled – Change fluid & filters when indicated by TRANSMISSION SERVICE indicator or 24 month whichever occurs first. In addition, change filters with every fluid change.	20	24	H
09 PROPELLER SHAFT			
Universal joint – grease on fitting on each universal joint	18	12	K
11 REAR AXLE			
Drive axle – check differential oil level, add if necessary	17	12	E
Drive axle – change differential oil, clean breathers	17	12	E
Tag axle lever pivot, grease one fitting on each pivot	19	12	K
Drive axle – change differential oil, clean breathers (with full synthetic oil)	17	48	F
12 BRAKE & AIR			
Air tanks – drain water from all tanks		12	
Brake pads ¹² – check pad wear indicator		12	
Check caliper running clearance, check condition of caliper cover, slack adjuster cap and guide pin assembly covers		12	
Abs & electronic stability control systems – check proper functioning		12	
Air dryer – change cartridge	13	24	
Accessories air filter – change filter element	2	48	
13 WHEELS, HUBS & TIRES			
Unitized hub bearing, front and tag axle – inspect, check end play. Refer to See Dana Spicer Maintenance Manual Model NDS Axle Range	8	12	
14 STEERING			
Steering knuckle (king) pins – check play	8	12	
Steering knuckle (king) pins – grease two fittings per knuckle	8	12	K
Tie rod ends – clean and grease one fitting at each end		12	K
Drag link ends – clean and grease two fittings at each end		12	K
Tie rod end & drag link end ball joints – inspect for corrosion		12	
Power steering reservoir filter cartridge and fluid – replace	23	12	B
Idler arm – grease fitting		12	K
Bell crank – grease fitting		12	K
Relay rod ends – grease one fitting at each end		12	K
16 SUSPENSION			
Independent front suspension upper a-arm ball joint – grease fittings		12	L
22 HEATING & AIR CONDITIONING			
A/C compressor – check oil and replenish if required	44	12	D
A/C compressor – empty shaft seal oil collection tube (Bitzer A/C compressor)	42	12	
A/C receiver tank – check refrigerant level, add if required	42	12	
Refrigerant moisture indicator – check filter dryer unit, replace according to moisture indicator	43	12	
HVAC air filters – clean all filter elements	41, 45	12	

¹¹ Extended TranSynd or TES295 fluid and filter change intervals are only allowed with Allison High-Capacity filters.

¹² At each pad replacement, check slack adjuster operation, perform caliper slide check and inspect visually all sealing elements & caps.

Section 24: LUBRICATION & SERVICING

LUBRICATION AND SERVICING SCHEDULE H3-45 VIP & X3-45 VIP MOTORHOMES (Private Use)		
ITEM	EVERY (months)	LUBRICANT / FLUID ⁸
A/C compressor drive belt – check tension, inspect for cracks or frayed material, replace if required	24	

CHANGE LOG - LUBRICATION AND SERVICING SCHEDULE <small>A red stripe in the left margin of the schedule highlights the latest changes</small>		DATE
1	ADDED: 04 EXHAUST & AFTERTREATMENT SYSTEM - Diffuser assembly, rain cap & drain tube – check proper functioning, clean	Sept.04, 2014
2	05 COOLING – Cooling system with extended life coolant, drain flush & refill, was 48 months, changed to 96 months	Jan.08, 2015
3	ADDED: 06 ELECTRICAL – Power cables inspection	May 27, 2015
4	ADDED: 04 EXHAUST AND AFTERTREATMENT SYSTEM – AHI nuzzle replacement	Aug.12, 2015
5		
6		
7		
8		
9		
10		

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1 SLIDE-OUT

1.1 INNER STOPPER

The front slide-out is equipped with six inner stoppers laid out in the following way: two stoppers on the top horizontal member of the slide-out, and two stoppers on each vertical upright, while the rear slide-out is equipped with only three stoppers (FIGURE 1 and figure 2). The upper inner stoppers are used to provide a support to position the slide-out perpendicularly with the vehicle structure.

The side inner stoppers are used to block the extension of the slide-out. They act as ultimate physical limits but take note that when the "out limit" sensors are properly adjusted, the slide-out extension stops before the side inner stoppers reach the side structure keys (figure 1 & 2).

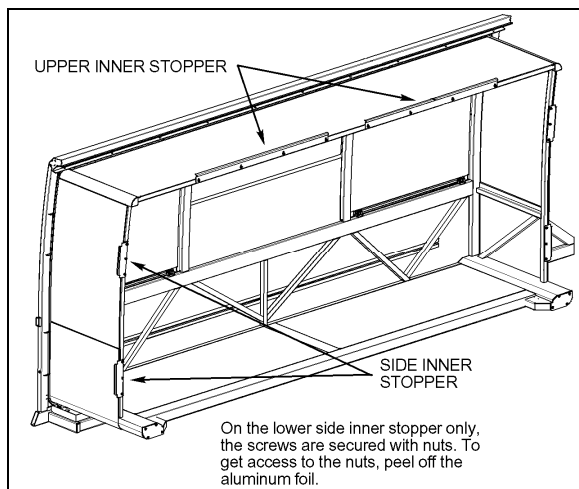


FIGURE 1 : FRONT SLIDE-OUT

1.1.1 Maintenance

Check that the inner stopper screws are tight and that no damage or deformation has taken place for both the side and the upper stoppers.

1.1.2 Adjustment

1. Adjust the side inner stoppers at 1/8" from the vehicle side structure keys, and tighten the screws. Make sure there is a minimum gap of 2mm (0.079") between the side inner stopper and the side window pane (figure 3). Use shim as required.
2. Adjust the upper inner stoppers according to FIGURE 4 with the seal deflated. When inflating, the seal presses the roof structure upward and at that moment, the upper inner

stopper comes into contact with the structure key.

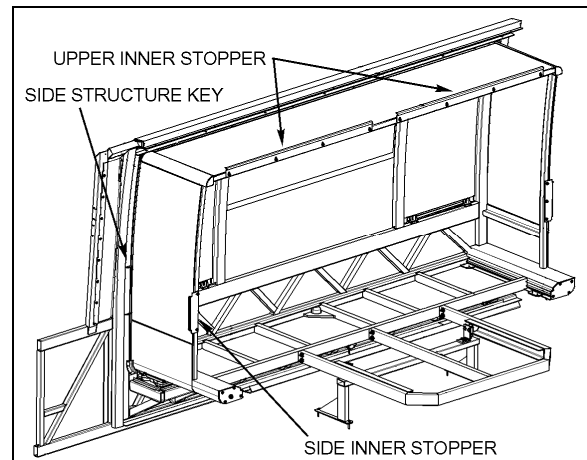


FIGURE 2 : REAR SLIDE-OUT

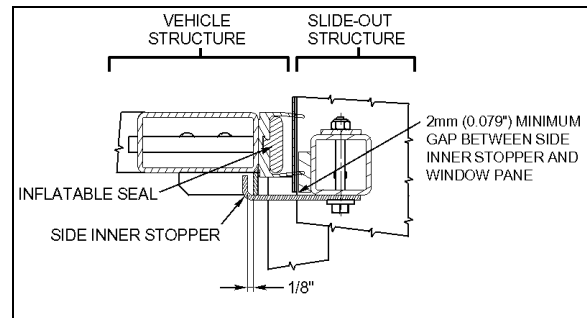


FIGURE 3 : SIDE INNER STOPPER ADJUSTMENT

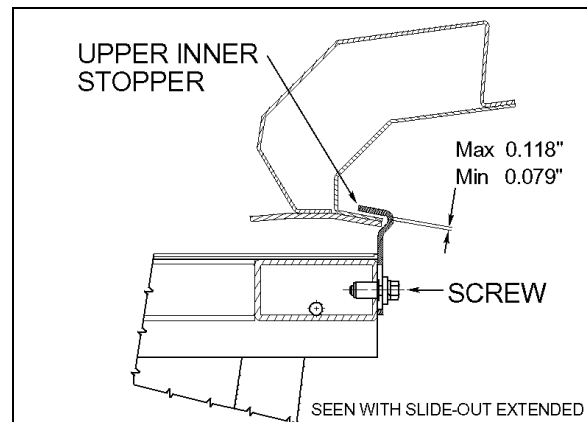


FIGURE 4: UPPER INNER STOPPERS ADJUSTMENT

1.2 "IN LIMIT" STOPPER

Each slide-out has four "in limit" stoppers. Two "in limit" stoppers are mounted on the exterior extrusion at the top of the slide-out (FIGURE 6) and two other "in limit" stoppers are mounted under the slide-out, next to the rail (Figure 5). These stoppers are use to position the outer face of the slide-out flush with the vehicle body when retracted.

1.2.1 Maintenance

Check that the "in limit" stoppers are clean and that there is no foreign matter accumulated between the stopper and its bearing surface. Check that the screws and set screws (where applicable) locking the stoppers in proper position are tight.

1.2.2 Adjustment

<i>NOTE</i>
<i>To properly adjust the "in limit" stoppers, the slide-out system must be turned off to prevent the "in limit" sensors from stopping the slide-out movement before having the "in limit" stoppers contacting their bearing surface.</i>

1. Extend the slide-out partially.
2. Set the ignition switch to the OFF position.
3. To adjust the lower "in limit" stoppers, loosen the set screw and then rotate the stopper CW or CCW to move it back or forward depending on the required adjustment. To adjust the upper plastic "in limit" stoppers, add or remove shims as required between the stopper and the extrusion.
4. Using the manual override procedure (paragraph 18), move the slide-out up to its full "in" position.
5. Using a straight edge, check if the outer face of the slide-out is flush with the vehicle body with the stoppers contacting their bearing surface. Readjust the stoppers if necessary.
6. Readjust the "in limit" sensor.

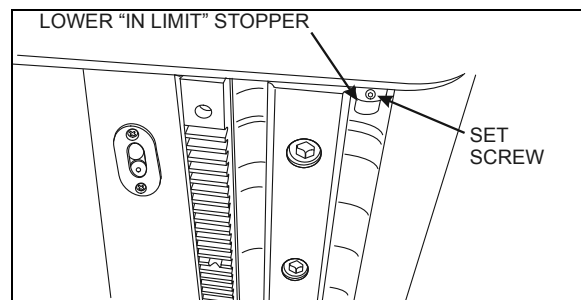


FIGURE 5: LOWER "IN LIMIT" STOPPER

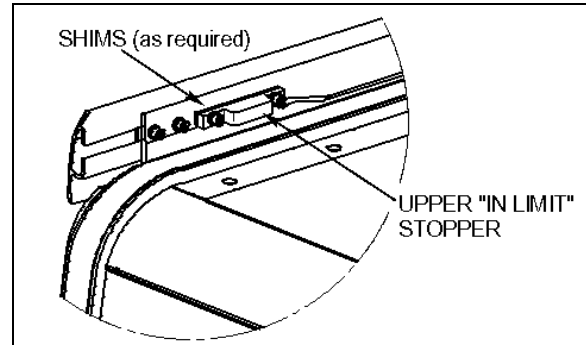


FIGURE 6: UPPER "IN LIMIT" STOPPER

<i>NOTE</i>
<i>To make sure that the lower "in limit" stoppers are contacting their bearing surface (the acetal plastic blocks) when the slide-out is closed, put white paint on the "in limit" stopper before and check if the acetal plastic blocks are marked with paint.</i>

1.3 EXTERIOR EXTRUSION

The exterior extrusion assembly function is to provide a leaning surface for the inflatable seal. When inflating, the seal presses against the extrusion support (angle), lifting the roof structure upward until it rests on the inner side of the extrusion support.

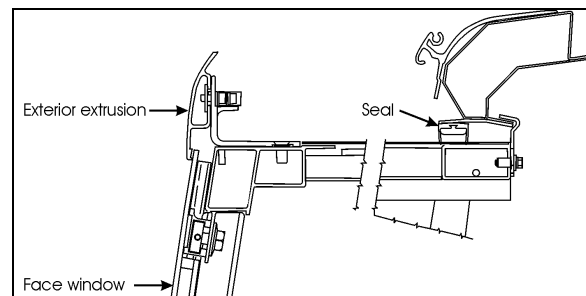


FIGURE 7 : EXTERIOR EXTRUSION

1.3.1 Maintenance

Inspect the exterior extrusion & support for any deformation or deterioration. Check that the screws are tight. Inspect the sealant condition on screw head and between the extrusion and the vehicle structure, and also at both ends of the extrusion. If needed, clean old sealant and replace with Sika 221 sealant or equivalent product.

1.3.2 Removal

Using a knife, cut the sealant between the extrusion and the roof (figure 7). Unscrew and remove the central exterior extrusion screws and the two end extrusion screws.

2 SECURITY PIN

During normal ride, the slide-out cannot extend by itself because the 740:1 ratio speed reduction worm gear type gearbox system is not reversible, the output shafts are self-locking. The security pin purpose is to lock the slide-out in retracted position if an accident occurs. It is built to stand a great lateral acceleration of the slide-out.

The system consists of a stainless steel pin connected to a single action/spring return pneumatic cylinder (FIGURE 8). The pin engages in the slide-out receptacle with releasing of the parking brake. A knocking sound may be heard at this moment. An O-ring is located at the base of the pin housing to reduce knocking when the pin retracts. The lower hole on the pin housing permits water to drain. The upper hole permits to insert a small screwdriver to prevent the pin from rotating when the air cylinder has to be removed.

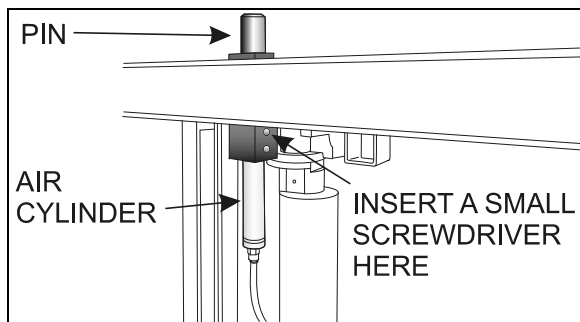


FIGURE 8: SECURITY PIN AIR CYLINDER REMOVAL

2.1 MAINTENANCE

Inspect air cylinder and fitting for air leaks. Periodically, check that the pin retracts and engages in the receptacle as it should when the parking brake is applied or released. To do so, the slide-out must be in its full "IN" position with the engine running. If the pin produces excessive knocking when it engages with releasing of the parking brake, reduce air cylinder speed by adjusting the air flow regulator on the pneumatic control module (FIGURE 30, item 11).

2.2 AIR CYLINDER REPLACEMENT

1. Assure the parking brake is applied.
2. Disconnect the cylinder air tubing from the 2nd baggage compartment (front slide-out) or under the bed structure (rear slide-out).

3. Using a wrench at its lower end, unscrew the air cylinder from the pin housing.
4. Insert a small screwdriver through the pin and housing to prevent rotation of the pin and then, unscrew the cylinder rod from the pin.
5. Transfer the fitting on the new cylinder. Place Teflon on threads.
6. Cylinder installation is the same as removal but in reverse order.

3 ROOF REINFORCING ROD

The roof reinforcing rod is located near the upper horizontal member of the front slide-out opening and is welded on the roof arches (figure 9).

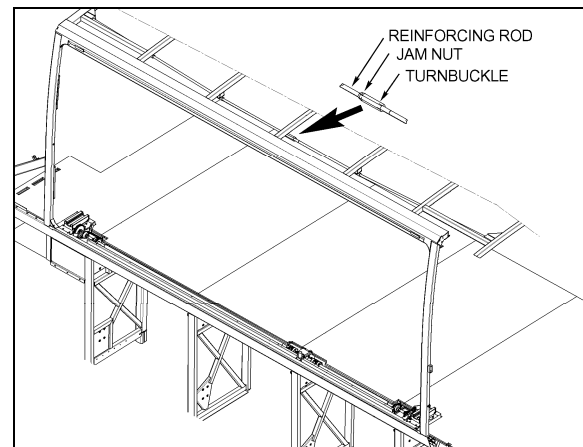


FIGURE 9 : FRONT SLIDE-OUT ROOF REINFORCING ROD

⚠ CAUTION ⚠

The maximum allowed upward shifting is 0.118" (3mm). To prevent permanent warping of the roof arches, never exceed that measurement.

The roof reinforcing rod may have already been adjusted up to the maximum shifting limit at the factory, do not attempt to move the roof any further. If an adjustment is required after a load variation inside the vehicle or on top of the vehicle, it must be done under supervision of a Prevest service representative.

4 RACK

Slide-out movement is made by a system of racks and pinions. There are two racks on each slide-out.

4.1 MAINTENANCE

Once a year, check the racks for broken or worn tooth, especially the front slide-out racks. Also, check the rack fastening hole teeth that are weaker and might break (figure 10). Replace the racks if excessive wear is present. Clean racks from sand or other debris. Check that the racks are properly secured. Check the backlash between the gear and the rack. Excessive backlash indicates rack wear.

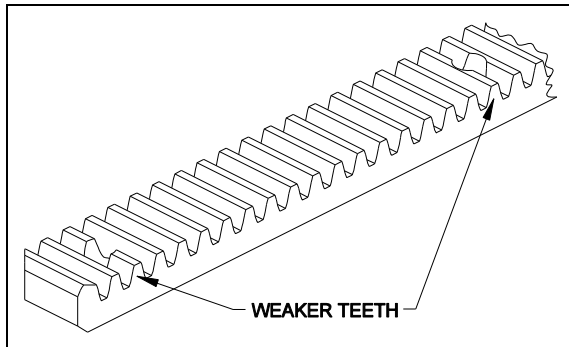


FIGURE 10 : RACK

4.2 FRONT SLIDE-OUT RACK REPLACEMENT

1. Remove the slide-out from the vehicle (removal must be performed according to the Slide-Out Removal Procedure. Ask to your Prevest service representative).
2. From under the slide-out, unscrew all the rack screws and remove the rack.
3. Install a new rack. Tighten the 2 screws located at each ends first and then the other screws to a maximum torque of 2 ft-lbs. Use Loctite™ 242 or equivalent product on threads. The clearance between rack and rail can be verified with jig #30710.

⚠ CAUTION ⚠

The counterborings required for recessed screw heads reduce plastic thickness. Do not torque higher than specified.

4. Reinstall the front slide-out inside the vehicle.

4.3 REAR SLIDE-OUT RACK REPLACEMENT

1. Using the slide-out handheld control or the manual override procedure (paragraph 18, if using the manual override procedure, do not forget to deflate the inflatable seal completely), extend the slide-out about one foot.
2. From outside, unscrew and remove only the first two screws of the rack to be changed.
3. Using the manual override procedure (paragraph 18) only, retract the slide-out to its fully closed position.
4. Loosen the pinion keyless bushing of the rack to be changed.
5. From under the slide-out, unscrew all the rack screws and remove the rack.
6. Install a new rack between the slide out structural rack seat and the pinion. Tighten the screws to a maximum torque of 2 ft-lbs. Use Loctite™ 242 or equivalent product.

⚠ CAUTION ⚠

The counterborings required for recessed screw heads reduce plastic thickness. Do not torque higher than specified.

7. Tighten the pinion keyless bushing as described in paragraph 5.4.
8. Using the slide-out manual override procedure only, extend the slide-out about one foot.
9. Tighten the two remaining crews to a maximum torque of 2 ft-lbs. Use Loctite™ 242 or equivalent product.
10. Using the slide-out handheld control switch or the manual override procedure, retract the slide-out to its fully closed position.
11. Re-inflate the air seal at 10 psi.

5 PINION

⚠ CAUTION ⚠

Make sure all keyless bushings are tightened to 125 lb-ft before moving the slide-out. Refer to paragraph 5.4 for torque wrench settings. A lower torque value may cause the bushing to slip on the shaft, and a higher torque value may break the bushing.

5.1 PINION AND KEYLESS BUSHING POSITIONING

For proper functioning, respect the positioning shown on the following figure.

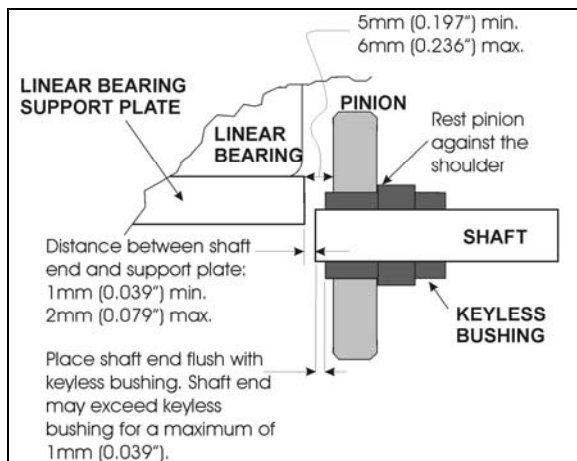


FIGURE 11: PINION AND KEYLESS BUSHING POSITIONING

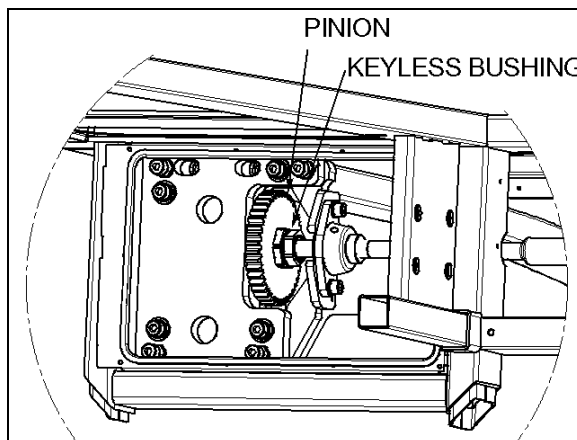


FIGURE 12: PINION AND KEYLESS BUSHING (BOTTOM VIEW)

5.2 FRONT SLIDE-OUT SHAFT PINION REPLACEMENT

⚠ CAUTION ⚠

Before reinstalling the pinion, clean the following surfaces with alcohol to prevent slippage.

- Pinion bore;
- Keyless bushing I.D. and O.D.;
- Shaft.

Before proceeding with the front slide-out shaft pinion replacement, check the following conditions:

- The locking collars located on the side of the pinion being replaced are disengaged;
- The drive motor/gearbox assembly is removed (see paragraph 7.2);

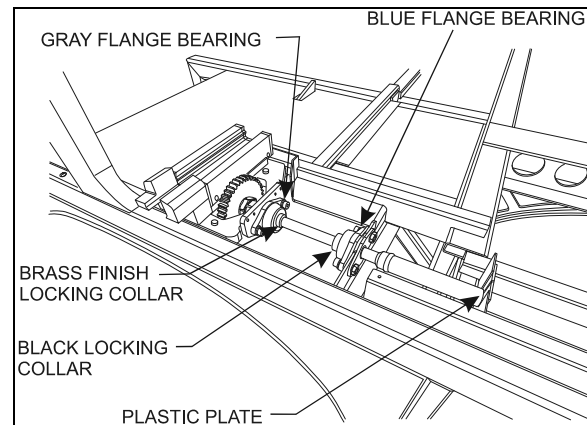


FIGURE 13: MECHANICAL COMPONENTS (TYPICAL)

1. Loosen the keyless bushing (see paragraph 5.4) of the pinion to be replaced. Slide the pinion and its bushing out of the shaft. Check the keyless bushing condition and replace if needed.

NOTE

If necessary, loosen the blue and gray flange bearing to move the pinion away from the rack.

2. Assemble new pinion on the keyless bushing and then slide on the shaft. Do not tighten the bushing at this moment.
3. Properly position the shaft end in relation to the linear bearing support plate (see FIGURE 11) and then tighten the locking collars to maintain the shaft in that position.
4. Position pinion and keyless bushing as shown on FIGURE 11 and tighten the keyless bushing as described in paragraph 5.4.

5. Reinstall the drive motor/gearbox assembly.

⚠ CAUTION ⚠

Make sure the keyless bushing is tightened to 125 lb-ft before moving the slide-out. Refer to paragraph 5.4.1 for torque wrench settings.

5.3 REAR SLIDE-OUT SHAFT PINION REPLACEMENT

The procedure is similar to the front slide-out shaft pinion replacement. Gain access to the mechanism from under the bed structure. Refer to paragraph 5.2.

5.4 KEYLESS BUSHING

The keyless bushings need a specific tightening torque value to ensure proper pinion transmitting torque. They also need specific tools to be tightened.

To tighten or loosen the keyless bushing, use those specific tools:

- crowfoot wrench 1 1/2";
- torque wrench;
- combination wrench 1 3/4";
- pipe wrench;
- drive extension 5";
- socket 1 1/2".

5.4.1 Installation

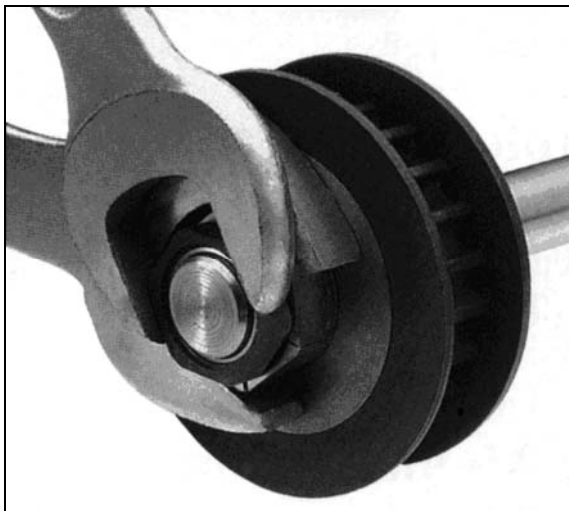


FIGURE 14 : KEYLESS BUSHING TIGHTENING

To tighten the keyless bushing, use a special open-end wrench to retain the yellow part and another wrench to tighten the black part. Figure 20 shows how to tighten the keyless bushing. When tightening, make sure the pinion does not move or rotate.

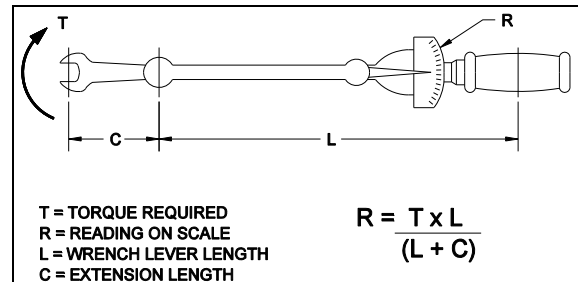


FIGURE 15 : TORQUE WRENCH FORMULA

⚠ CAUTION ⚠

Make sure all keyless bushings are tightened to 125 lb-ft before moving the slide-out. A lower torque value may cause the bushing to slip on the shaft, and a higher torque value may break the bushing. The torque may need to be recalculated depending of the wrench size. Refer to figure 15 for wrench size compensation.

Take note that when the keyless bushing nut is tightened, the pinion moves about 1/16" to 3/32" toward the slide-out center.

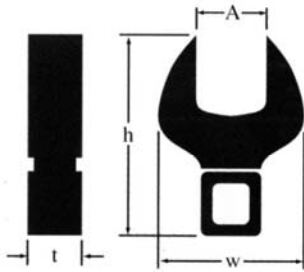
NOTE

On the front slide-out, the driver side keyless bushing is not accessible for tightening or removal unless you remove the front left wheel. If the slide-out has been removed, this keyless bushing should be tightened before reinstalling the slide-out.

WRENCHES FOR INSTALLATION

Fenner Drives offers a complete line of high-quality crowfoot wrenches for installation and to provide counter-torque. These wrenches are much narrower than earlier designs and are specifically for use with Trantorque GT units. It is recommended that both wrenches be used when installing a Trantorque GT unit.

1/2" SQUARE DRIVE



**Style C
Installation Nut**

Shaft Size	Part Number	Wrench Style	Dimensions (inches)			
			A	h	w	t
13/16 to 1	6202990024	C	1-1/2	3.44	2.75	0.75

INSTALLATION INSTRUCTIONS

A Trantorque GT Keyless Bushing offers flexible and easy installation while providing exceptional holding power. To ensure a Trantorque GT unit performs as specified, it must be installed properly.

Warning: Use no lubricants in this installation.

1. Shaft and component bore must be within $\pm 0.003"$ ($\pm 0.08\text{mm}$) [$\pm 0.0015"$ ($\pm 0.04\text{mm}$) Mini Series] of stated bore diameter and must have a surface finish of 32-125 Ra (roughness average). If the surface finish is outside these specified values, consult Fenner Drives.

2. Both shaft and component bore must be completely free of paint, grease, oil, and dirt. If necessary, clean the surfaces with a non-petroleum based solvent, such as isopropyl alcohol.

Warning: Do not lubricate the Trantorque GT bushing or shaft. The use of any lubricant on the contact surfaces could result in bushing failure and will void all warranties.

3. Insert the Trantorque GT unit into the component to be mounted, making sure the mating hub is flush against the shoulder at the hex flats.

4. Position the assembly at the desired location on the shaft and hand-tighten the nut (clockwise) until the assembly becomes snug on the shaft.

Warning: Do not hammer or use any type of impact to force the Trantorque GT assembly along the shaft.

Warning: The shaft must fully engage the shaft gripping area (Figure 1) of the Trantorque GT unit. Figure 2 illustrates minimum shaft engagement.

5. Using a torque wrench, tighten the nut to the proper installation torque. See table for torque value. (Note: Fenner Drives has available crowfoot wrenches for square drives in sizes from 1/2" to 3-1/2".) The hex flats on the outer ring are provided for counter-torque, eliminating the need to hold the component or shaft while applying installation torque.

Note: At full installation torque, the assembly will have moved approximately $\pm 0.075"$ ($\pm 1.9\text{mm}$) [$\pm 0.045"$ ($\pm 1.1\text{mm}$) Mini Series] axially along the shaft away from the nut. If axial position is critical it may be necessary to loosen the nut and reposition the assembly.

Warning: Over-tightening the nut could damage the Trantorque GT unit and/or the mounted component.

Do not use an impact wrench in the installation.

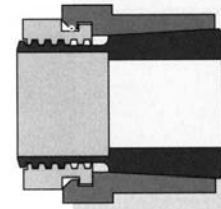


Figure 1

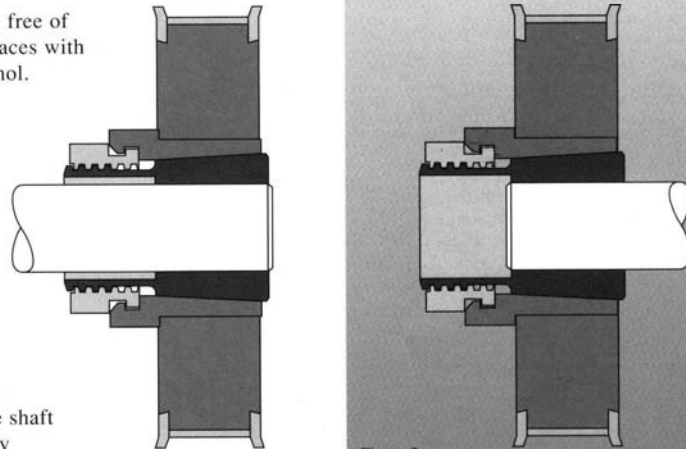


Figure 2

Installation Torque on Nut

	Inch Pound System		Metric System	
	Shaft Size	In. Lbs.	Shaft size	N-m
MINI SERIES	3/16-1/4	125	5-6mm	14.1
	5/16-3/8	150	7-9mm	17.0
	7/16-1/2	175	10-12mm	19.8
	9/16-5/8	200	14-16mm	22.6
	3/4	700	17mm	80.0
STANDARD SERIES	5/8-3/4	1200	15-19mm	136
	13/16-1	1500	20-25mm	170
	1-1/16-1-1/4	2000	28-32mm	225
	1-5/16-1-1/2	2300	34-38mm	260
	1-9/16-1-3/4	2800	40-42mm	316
LARGE SERIES	1-13/16-2	4900	45-50mm	554
	2-1/16-2-1/4	5300	55mm	600
	2-5/16-2-1/2	5600	60mm	635
	2-9/16-2-3/4	6000	65-70mm	680
	2-13/16-3	6600	75mm	750

FIGURE 16 : KEYLESS BUSHING INSTALLATION INSTRUCTION

6 ELECTRIC MOTOR

The power is supplied by a 24V 1/3 HP electric motor coupled with a speed reduction gearbox. Opposite to the gearbox, the motor is equipped with a 3/8 hexagonal shaft extension permitting to move the slide-out without using the handheld control. This is very useful when moving the slide-out very slowly is required like during the inner stoppers adjustment, the tilt adjustment or the 2" inside retraction. See paragraph 18 for the manual override procedures.

⚠ CAUTION ⚠

When moving the slide-out with a cordless power drill as described in the manual override procedure, be careful as the slide-out approaches its opened or closed position, in order not to overload the mechanism.

6.1 MAINTENANCE

Inspect the electrical connections for watertightness. Check that the mounting bolts are tight (FIGURE 18).

6.2 REPLACEMENT

1. The slide-out must be retracted.
2. Unplug the electric cable connector.

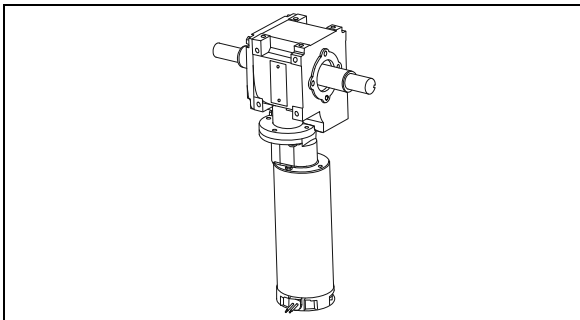


FIGURE 17: ELECTRIC MOTOR AND SPEED REDUCTION GEARBOX

3. Remove the motor from the gearbox.
4. Fasten the new motor to the gearbox using screws.
5. Connect the electric cable connector.

7 SPEED REDUCTION GEARBOX

The speed reduction gearbox used is a helical worm gear type. This gearbox has a 2-stage 740:1 ratio and the output shafts are self-locking. Keys on output shafts are glued into keyseats.

7.1 MAINTENANCE

Inspect the gearbox for leakage or backlash in the box. Replace the gearbox if excessive wear is present. Check that all bolts are tight.

The gearbox is lubricated for life and the oil should not have to be changed.

7.2 GEARBOX REPLACEMENT

1. The slide-out must be retracted.
2. Disengage the shafts jaw couplings (refer to paragraph 8: JAW COUPLING).
3. Remove the 4 cap screws securing the motor/gearbox assembly and dismount the assembly (see FIGURE 18).
4. Remove the gearbox from the motor and install the new one.
5. Reinstall the drive motor/gearbox assembly on the vehicle mounting bracket. Tighten mounting bolts to a torque of 18 ± 2 lbf-ft in a criss-cross pattern.

⚠ CAUTION ⚠

To prevent damaging threads, use your fingers to drive the bolts into the aluminum gearbox housing mounting holes.

6. Reinstall the jaw couplings.

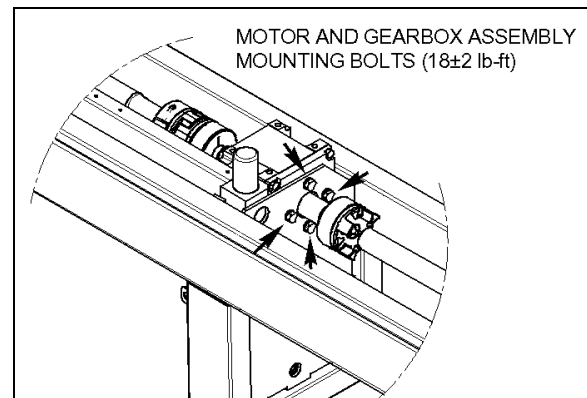


FIGURE 18: MOTOR/GEARBOX ASSEMBLY MOUNTING BOLTS

8 JAW COUPLING

8.1 MAINTENANCE

Inspect the jaw couplings for backlash between the key and the keyway. Also, check the spider condition. Check that the clamping screws are tight.

8.2 REPLACEMENT & ADJUSTMENT

1. The slide-out must be retracted.
2. Disengage the jaw coupling: loosen the clamping screw on each clamping hub. If required, rotate the motor shaft extension as described in the manual override procedure (paragraph 18) to get to the clamping screws.
3. Separate both clamping hubs.

NOTE
<i>It may be necessary to loosen the blue flange bearings to move the shaft out of the way.</i>

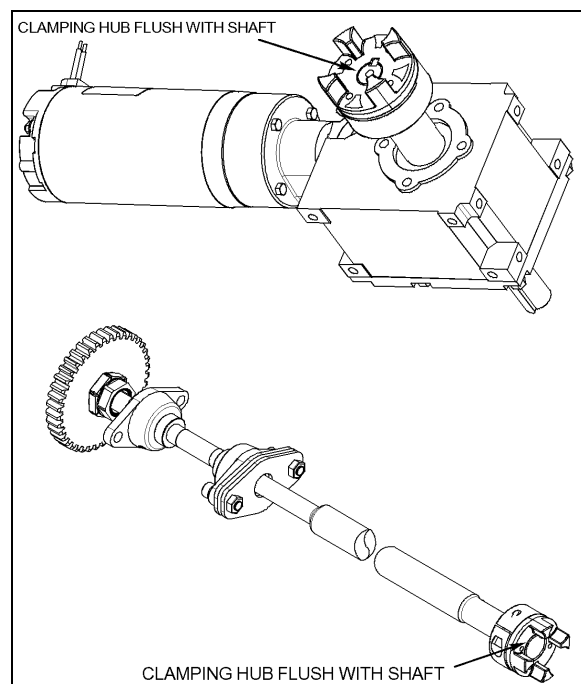


FIGURE 19: CLAMPING HUB POSITION ON SHAFTS

4. Clean and degrease the hub bore and the shaft.
5. Push the new clamping hubs onto the shaft (pinion side).
6. Install a clamping hub on one of the gearbox shaft (opposite side of gearbox mounting

bolts) flush with the shaft extremity (see FIGURE 19). Tighten the clamping screw to a torque of 18 lbf-ft.

7. Install the second clamping hub on the gearbox shaft. Position the clamping hubs so that they are flush with the shafts extremity (see FIGURE 19).
8. Reconnect the clamping hubs with the spider. Leave a gap of 20mm (0.787inch) between each clamping hubs as shown on FIGURE 20. Use the motor hexagonal output shaft to align the keyways.
9. Tighten clamping screws to a torque of 18 lbf-ft dry.

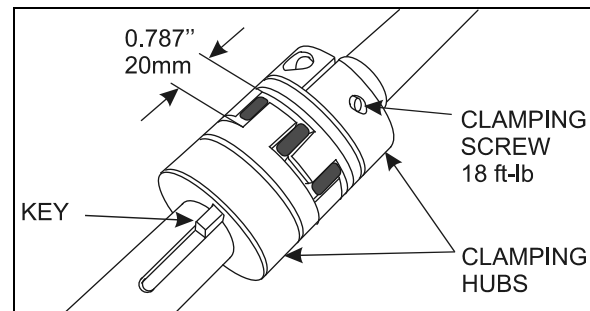


FIGURE 20: JAW COUPLING

9 FLANGE BEARING

There are two different types of flange bearing on the slide-out mechanism (FIGURE 13). Their purpose is to maintain the shaft in position while permitting rotation. The gray flange bearings are fixed to the linear bearing support plate and are not adjustable. The blue flange bearings are fixed to a support with oblong holes permitting to raise or lower the flange bearing as the linear bearing support plate level is being adjusted.

The flange bearings are pre-lubricated and no subsequent lubrication is required due to the very low extending and retracting speed of the slide-out system.

10 LOCKING COLLAR

The locking collar locks the shaft and the flange bearing together using friction. Once locked, it permits no axial translation of the shaft and prevents rotation of the shaft into the flange bearing bore.

10.1 INSTALLATION

Slide the locking collar along the shaft up to the flange bearing (FIGURE 13). Turn the locking collar clockwise while maintaining it pressed against the flange bearing. Knock the collar with a punch to lock it in place, there is a cavity on the collar made for that purpose. Tighten the set screw.

To remove, loosen the set screw and release the locking collar using channellock pliers or a small pipe wrench.

11 LINEAR BEARING

11.1 MAINTENANCE

Make every effort not to allow dust and foreign objects to enter inside the linear bearing.

The linear bearings are pre-lubricated and no subsequent lubrication is required due to the very low demanding use of the slide-out system.

11.2 REPLACEMENT & ADJUSTMENT

1. Remove the slide-out from the vehicle (removal must be performed according to the Slide-Out Removal/Installation Procedure. Ask to your Prevost service representative).
2. Disconnect the jaw coupling on the side of the linear bearing being replaced (refer to paragraph 8).
3. Dismount the blue flange bearing.
4. From the mechanism access panel, remove the retaining screws A, B, C & D (see FIGURE 23).
5. Now, you have access to the linear bearing mounting bolts if you turn its support up side down. Dismount the linear bearing and install the new one.
6. Tighten the mounting bolts in a criss-cross pattern to a torque of 60 ft-lb dry.
7. Reinstall the support plate, retaining screws, blue flange bearing and reengage the jaw coupling. Refer to the specific procedures.

11.3 LEVEL & TILT ADJUSTMENT

Leveling of the slide-out is done by changing the linear bearing support plate height using the leveling screws 1, 2, 3, 4 (figure 23). When

proper level is attained, the retaining screws A, B, C & D maintain the support plate seated on the leveling screws. Also, the retaining screws prevent the slide-out from tipping inside the vehicle when it is retracted.

The slide-out is slightly tilted. When retracting, the upper "in limit" stoppers touch first the vehicle structure, followed by the lower "in limit" stoppers. Tilt adjustment is done by changing the linear bearing support plate inclination using the leveling screws 1 & 2 as pivot and 3 to adjust the angle (figure 23).

11.3.1 Procedure

NOTE

For the **front slide-out**, the front linear bearing leveling screws are accessible from the access located over the front wheel (remove the front fender first) while the rear linear bearing leveling screws are accessible from the access panel in the evaporator compartment. For the **rear slide-out**, gain access to the linear bearing from under the bed structure or the radiator compartment.

WARNING

The slide-out must be retracted when the level and tilt adjustment is performed.

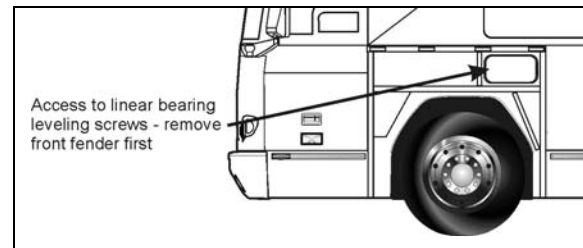


FIGURE 21: ACCESS LINEAR BEARING LEVELING SCREWS

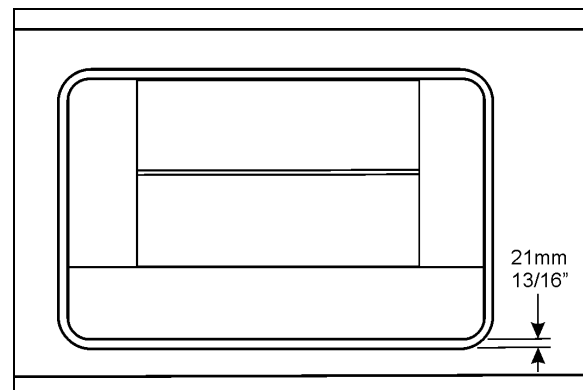


FIGURE 22: SLIDE-OUT LEVEL ADJUSTMENT

Section 26: SLIDE-OUT

Before proceeding with the level and tilt adjustment, check the following conditions:

- The slide-out is retracted;
 - The 2 lower “in limit” stoppers are perfectly adjusted, that means that the lower edge of the slide-out outer panel is flush with the vehicle body when retracted;
 - The 2 upper “in limit” stoppers are removed from the slide-out (see paragraph 1.2).
1. Loosen the blue flange bearings mounting screws (FIGURE 13).
 2. For front slide-out only, loosen the two plastic plates mounting screws along the shafts (FIGURE 13).
 3. With the lower edge of the slide-out outer panel flush with the vehicle body, adjust the slide-out level. The distance between the top of the horizontal member under the slide-out and the slide-out under panel must be 21mm (13/16” approximately).

⚠ WARNING ⚠

Never unscrew completely retaining screw A, B, C, D or the slide-out may tip inside.

To raise the linear bearing support plate, turn levelling screw 1 & 2 clockwise. Slightly and gradually, loosen the retaining screws A & B as the support plate elevates, but keep the retaining screws tighten.

To lower the linear bearing support plate, turn screw 1 & 2 counterclockwise. As the support plate goes down, maintain the retaining screw A & B tighten.

4. Loosen retaining screws C & D. Unscrew levelling screw 4. Now, the support plate should be resting on levelling screw 1, 2 & 3.
5. Using levelling screw 3, adjust the tilt in order to have the top of the slide-out recessed between 5mm and 10mm (7/32” and 3/8”) (see FIGURE 24).
6. When proper tilt is attained, tighten leveling screw 4 so that it comes into contact with the support plate.
7. Loosen slightly levelling screw 3 and then tighten it so it is perfectly in contact with the support plate. Make sure screws 1, 2, 3 & 4 are in contact with the support plate.
8. Loosen retaining screw A & B.

9. Using a crisscross pattern, tighten progressively (3 rounds) the retaining screw A, B, C & D to a torque of 50±5 ft-lb dry.
10. Assure that the levelling screw 1, 2, 3 & 4 are firmly leaning on the support plate and then firmly tighten the jam nuts.
11. Verify that the tilt is still properly adjusted (between 7/32” and 3/8”).

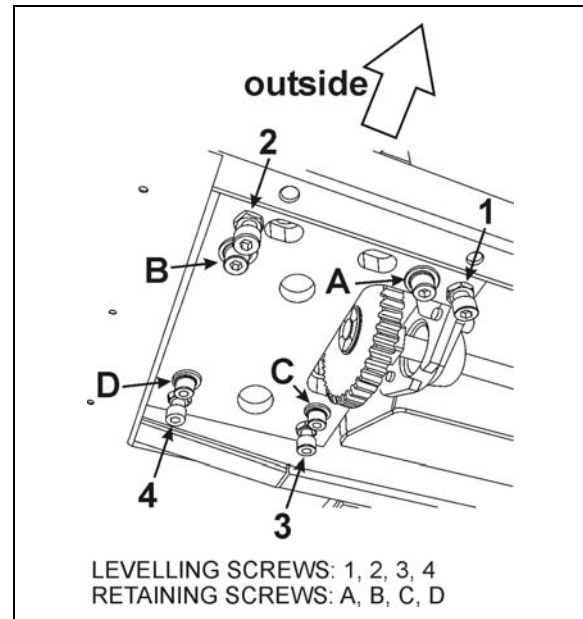


FIGURE 23 : SLIDE-OUT LEVELING

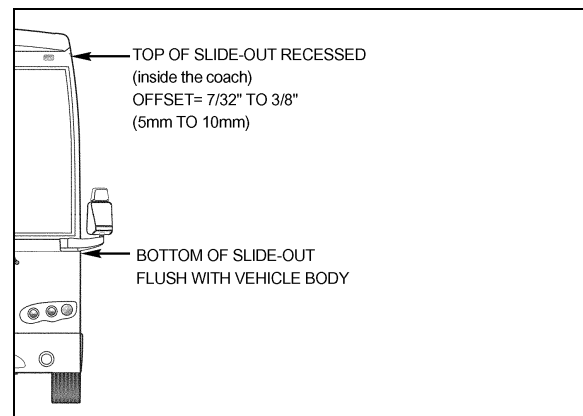


FIGURE 24: TILT ADJUSTMENT

12 RAIL

Rail and linear bearing system provide precise frictionless linear movement together with high load carrying capacity and high stiffness. These standardized equipments are fully interchangeable.

To prevent corrosion, an electrolytic film treatment is performed to the rail. Do not strike the rail with metal tools and avoid cleaning the rail surface with solvent, this could damage the treatment.

After the rail is mounted to the slide-out base, a cap is used to cover the bolt hole to prevent foreign matters from clogging up the hole or from entering into the ball slide. The cap for the bolt hole is made of synthetic resin which is superb in its resistance to oil and wear.

12.1 MAINTENANCE

Check that all the caps for the bolt hole are present. Missing caps must be replaced. To insert a cap into the rail bolt hole, use a rubber mallet. Pound the cap gradually until its height becomes flush with the rail top face.

Clean accumulated dirt from the rails with a soft cloth.

12.2 REPLACEMENT

1. Remove the slide-out from the vehicle (removal must be performed according to the Slide-Out Removal/Installation Procedure. Ask to your Prevost service representative).
2. Remove the bolt hole cap covers. To do so, pierce a hole in the center and hook them out. They will not be reusable.
3. Remove the rail mounting bolts.
4. Wipe off the rust preventive oil applied to the new rail. Remove burrs and small bumps on the slide-out mounting face with an oilstone.
5. Carefully place the rail on the bed on its mounting face.

NOTE

The rail is bolted to a flat bar on which weldnuts are mounted. The flat bar is inserted in the slide-out lower body extrusion and can be removed through the end cap (FIGURE 25).

6. Adjust the flat bar position to align the weldnuts with the rail mounting holes.
7. Temporarily tighten the bolts.
8. Adjust the rail position as per FIGURE 25. For each rail, make sure the gap is the same both side of the rail.

NOTE

Jig #30534 (2 required) can be used to properly position the rail.

9. Tighten bolts according to the following order: 1st, 6th, 2nd, 5th, 3rd and 4th. Use blue Loctite™ on threads.

10. Cap the bolt holes.

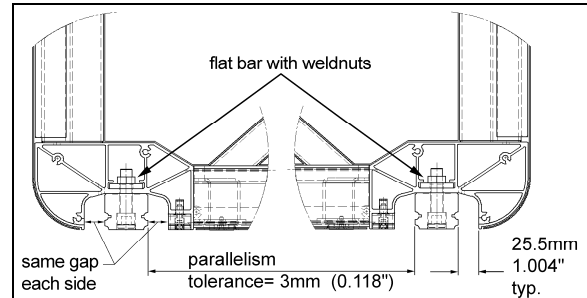


FIGURE 25 : RAIL POSITIONING

13 ACETAL PLASTIC BLOCKS

Three different acetal plastic blocks are installed next to each linear bearing to prevent dirt and foreign matter from entering inside the vehicle. They also serve as bearing surface for:

1. The inflatable seal each side of the rail.
2. The "in limit" stoppers.

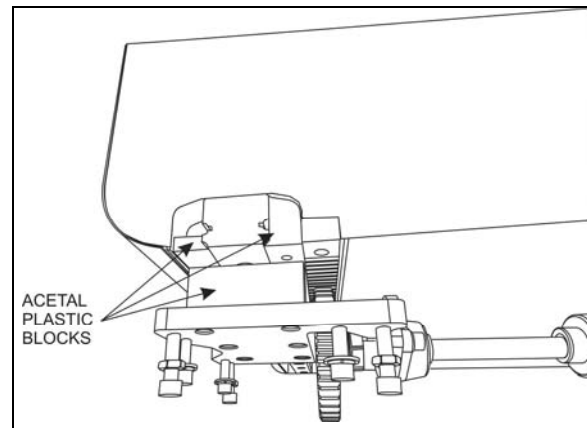


FIGURE 26: ACETAL PLASTIC BLOCKS

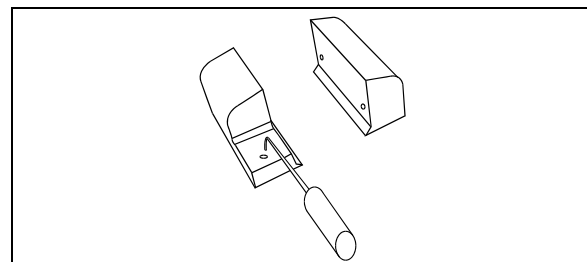


FIGURE 27: REMOVE THE UPPER ACETAL PLASTIC BLOCKS WITH A PICKING TOOL

13.1 REMOVAL / INSTALLATION

1. Gain access to the linear bearing support plate.
2. From under the support plate, remove the acetal plastic block mounting screws (see the oblong holes on figure 23).
3. Extend the slide-out just enough to gain access to the about acetal plastic blocks.
4. Remove the 2 upper acetal plastic blocks. They have holes so they can be removed with a picking tool (FIGURE 27) from outside the vehicle. If the acetal plastic blocks are too hard to reach, slightly extend the slide-out, the movement of the slide-out should bring them out.
5. To remove the lower acetal plastic block, gain access to the compartment under it. Slide the acetal plastic block toward the center of the slide-out. Proceed the same way to reinstall it.
6. Installation is the same as removal but in reverse order. When reinstalling the upper acetal plastic blocks, fold the wiper seal toward the outside with a flat tool to ease installation (FIGURE 28). Before tightening, make sure the acetal plastic blocks are leaning against the rail and the linear bearing. Tighten the mounting screws to a torque of 7 ft-lb.

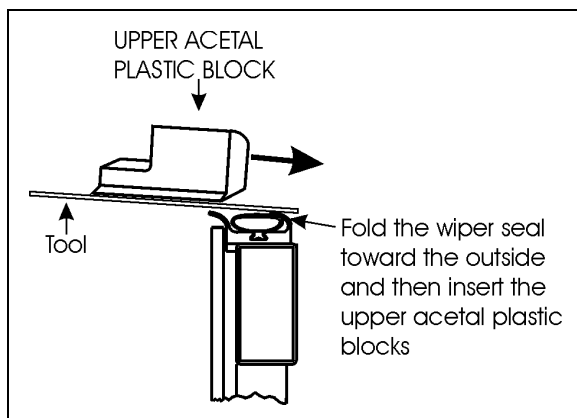


FIGURE 28: LOWER ACETAL PLASTIC BLOCK INSERTION

14 SLIDE-OUT PNEUMATIC SYSTEM

The slide-out is controlled by a pneumatic and electrical system. Mainly, the pneumatic system consists of electrically operated valves that control certain slide-out components and safety operations.

14.1 DESCRIPTION

AIR PRESSURE DELIVERY VALVE

The slide-out air pressure comes from the air pressure delivery valve on the pneumatic panel in the front service compartment (figure 29).

INFLATABLE SEAL VALVE

The inflation and the deflation of a seal are done with a 5-port 2-position valve with two solenoids. One solenoid is used for inflating of the seal and the other for deflating of the seal. When one solenoid is activated (seal deflating valve for example), the valve keeps its state even if the solenoid is deactivated. The inflating valve solenoid is activated to re-inflate the seal when the slide-out reaches its inner or outer limit. The inflatable seal pressure is set to 10 psi and in full "IN" or full "OUT" position, this pressure is continuously applied to the seal as long as the accessory air tank which supplies the slide-out is not empty.

VACUUM GENERATOR

A vacuum generator using Venturi principle is controlled by a 5-port 2-position valve and is used to evacuate the air faster from the seal and to ensure that the seal surface does not stay in contact with the slide-out.

The vacuum generator valve is activated simultaneously with seal deflating valve solenoid for 10 seconds. A pressure transducer will detect a seal, vacuum valve or generator failure if -5 psig is not reached after a 10 seconds delay. In that situation, an error code will be stored in the MCD (message center display). In normal operating condition, -5 psig is a necessary condition to consider the seal as deflated.

NOTE

When air pressure is relieved using the shut-off valve, the normal extending and retracting operation cycle is disabled, because the pressure transducer reads 0 psig and that is higher than -5 psig (vacuum). For that reason the slide-out cannot be moved with the handheld control.

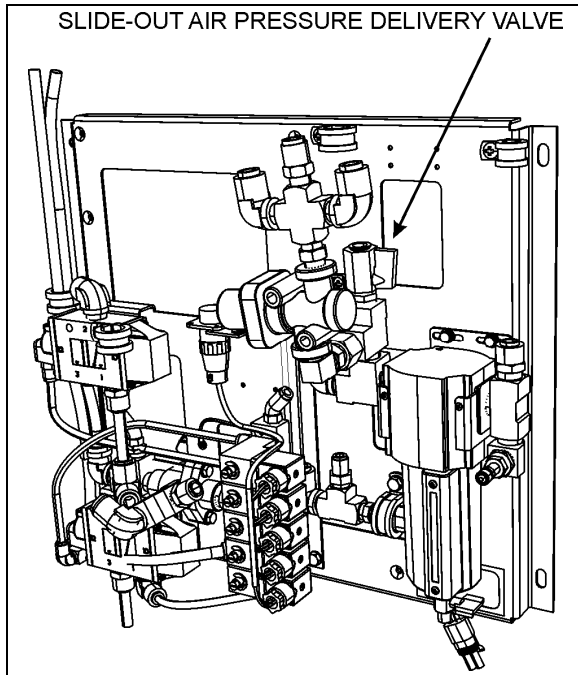


FIGURE 29 : FRONT SERVICE COMPARTMENT 12220

14.2 MAINTENANCE

COMPRESSED AIR LINE

Inspect all compressed air line tubing for cut, swelling, and kink or other damage or deterioration. Inspect the pneumatic fittings and components for any leak. The slide-out air supply is connected to the accessory air tank and the required maintenance is described in Section 12 of this manual.

INFLATABLE SEAL CIRCUIT

The efficiency of the seal could be affected by impurities, such as white powder in the pneumatic control valve. It is recommended to inspect the inflatable seal control components once a year to prevent malfunction. In this case, remove the seal valves and clean the interior valve components using a compressed air nozzle. Do the same thing with the vacuum generators.

The inflatable seal pressure must be set from 7 to 10 psi maximum. It is recommended to check the inflatable seal pressure once a month to ensure sealing efficiency and prevent any infiltration from outside.

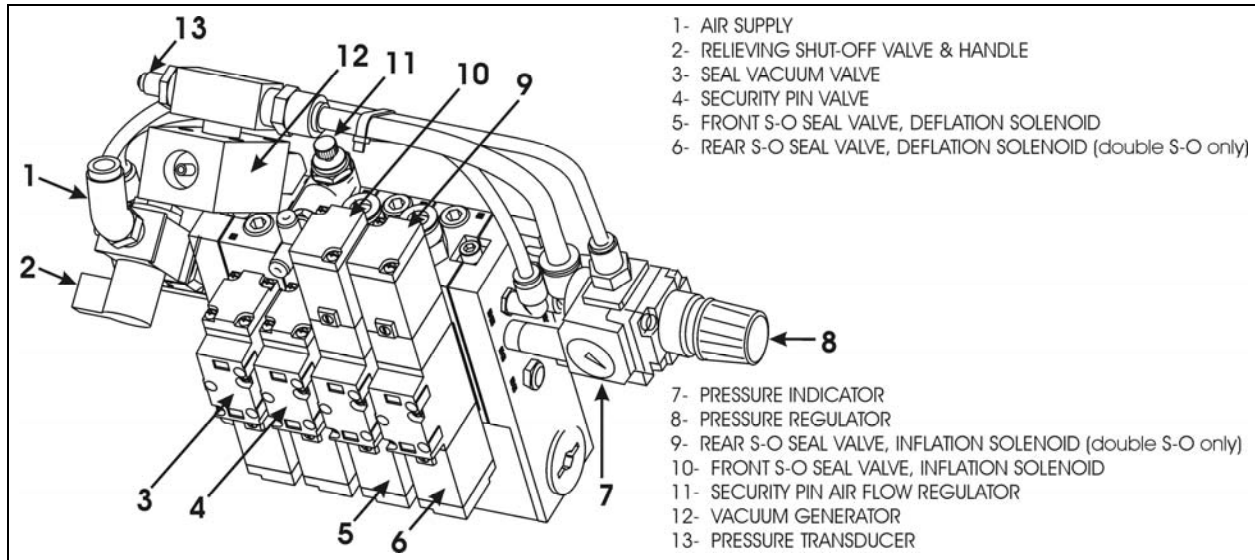


FIGURE 30: PNEUMATIC CONTROL UNIT

14.3 SEAL

NOTE

Refer to the Prevest parts manual for description of sealant and adhesives used.

The slide-out sealing device is used to prevent any type of infiltration that may occur between the body structure and the slide-out itself. It is composed of an inflatable seal which is used as a primary sealing device for both retracted and extended slide-out position and a wiper seal as a secondary sealing device which is used to wipe water out and to ensure sealing during slide-out movement.

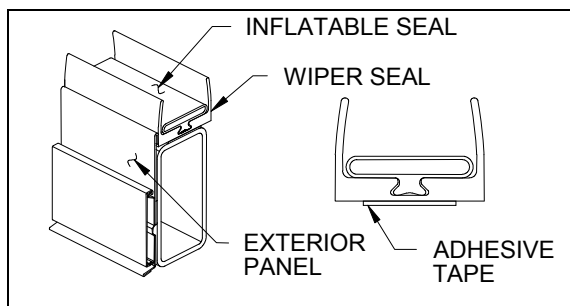


FIGURE 31 : SEAL ASSEMBLY

The seal deflation is done each time the slide-out moves. The deflating valve solenoid is activated before and during the slide-out movement. When the slide-out reaches its retracted or extended position, the deflating

solenoid is deactivated before activation of the inflating solenoid to inflate the seal.

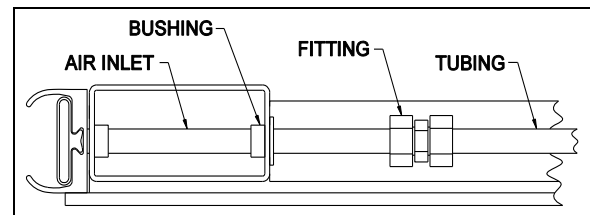


FIGURE 32: REAR SLIDE-OUT INFLATABLE SEAL AIR INLET

CAUTION

Make sure the inflatable seal is deflated when moving the slide-out manually during service maintenance. Deflate both inflatable seals completely by turning the relief shut-off valve handle clockwise (see FIGURE 30, item 2).

CAUTION

Before using any cleaning or adhesive product on seal, panel or glass to prevent alteration or damage.

14.3.1 Maintenance

The inflatable seal pressure must be set to 10 psi maximum with the pressure regulator. It is recommended to check the inflatable seal pressure once a month to ensure sealing efficiency and prevent any infiltration from outside. Check both seals for air leaks or cracks. Check the sealant between the inflatable seal

and the exterior panels and glasses. Add sealant if necessary.

14.3.2 Seal assembly removal

⚠ WARNING ⚠

Always wear the appropriate safety equipment. Maintain adequate ventilation at all time.

1. Retract the slide-out 2" inside the vehicle (paragraph 14.3.4).
2. Unplug the tubing from the inflatable seal air inlet (FIGURE 32). Keep the bushing.
3. Unstick and remove the wiper seal from the structure.
4. Scrape remaining tape from the structure and remove old sealant if applicable.

14.3.3 Seal assembly installation

NOTE

This procedure is to install the inflatable seal assembly on the structure.

⚠ CAUTION ⚠

Always apply product in the same direction to prevent dirt from being brought back.

⚠ CAUTION ⚠

Check before using any cleaning or adhesive product on seal, panel or glass to prevent alteration or damage.

NOTE

Refer to procedure PR00001 in Section 18: BODY for primer, cleaner, adhesive specifications & application.

NOTE

Refer to the product specification for drying time.

1. Retract the slide-out 2" inside the vehicle (paragraph 14.3.4).
2. Clean the area where the inflatable seal will be placed with anti-silicone. Make sure that the surface is perfectly smooth.
3. Rub the area a Scotch Brite (or equivalent product) (see PR00001paragraphe G).

4. Clean the area with anti-silicone once again.
5. Apply Sika 206 G+P on the area (see PR000001paragraphe D).
6. Insert inflatable seal air inlet tube through the hole on the frame vertical member.
7. Remove the inflatable seal adhesive tape protection in the lower corners area.
8. Press the lower corners on the frame and hold them in place for 90 to 120 seconds. Place the seal as close as possible from the exterior side of the frame.
9. Remove the inflatable seal adhesive tape protection on the rest of the lower frame area.
10. Press the seal on the frame and hold it in place for 90 to 120 seconds. Align the wiper seal drainage holes with the drainage holes on the frame. Place the seal as close as possible from the exterior side of the frame.
11. Remove the inflatable seal adhesive tape protection in the upper corners area and press the upper corners on the frame and hold them in place for 90 to 120 seconds. Place the seal as close as possible from the exterior side of the frame.
12. Install the rest of the straight upper area in the same way. Place the seal as close as possible from the exterior side of the frame.
13. Install the remaining straight inflatable seal sections on the frame. Place the seal as close as possible from the exterior side of the frame. Press for at least 15 seconds. Use a small roller to ensure a good adhesive contact on the structure.

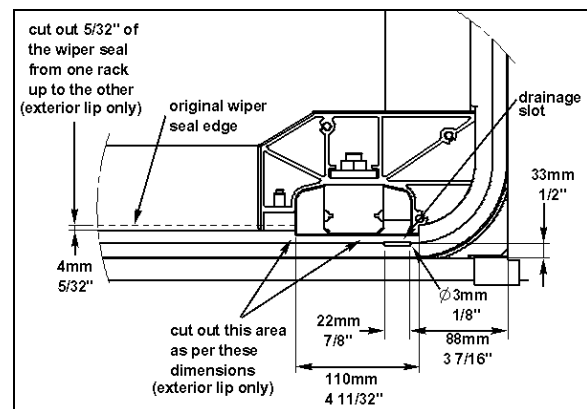


FIGURE 33: WIPER SEAL CUT-OUT

14. Cut out the exterior lip of the wiper seal as per FIGURE 33.

15. Replace the bushing and plug the pneumatic tubing on the inflatable seal air inlet (FIGURE 32).

14.3.4 Slide-out 2" inside retraction

1. For both sides of the slide-out, remove the 2 upper acetal plastic blocks shown on FIGURE 27 (refer to paragraph 13).
2. Extend the slide-out a few inches so the exterior extrusion assembly screws located on the top of the slide-out are accessible from outside (figure 7).
3. Using a knife, cut the sealant between the extrusion's support and the roof (figure 7).
4. Unscrew and remove the exterior extrusion and support.
5. Using the handheld control, retract the slide-out up to its normal "IN" position.
6. Manually deflate the seal completely by turning the relieving shut-off valve clockwise (FIGURE 30). Make sure the pressure indicator reading is "0 psi".
7. Set the ignition to the off position.
8. Using the manual override procedure (paragraph 18), move the slide-out 2" inside the vehicle, so the seal is accessible from outside (FIGURE 34).

9. Once completed, use the manual override procedure to extend the slide-out to reinstall the exterior extrusion. Apply appropriate sealant on the exterior extrusion screws and between the extrusion, the roof and the edges to prevent water infiltration.
10. Reinstall the acetal plastics blocks.
11. Finally, the seal can be re-inflated by turning the shut-off valve handle counterclockwise. Check the pressure gage on the inflatable seal regulator to see if the pressure is increasing to 10 psi.

15 SLIDE-OUT ELECTRICAL SYSTEM

⚠ WARNING ⚠

Never modify the slide-out electrical wiring without the Prevest Car approval. Any modifications may cause an unexpected slide-out action and could result in personal injuries.

Multiplexed slide-out electrical system is mainly composed of the current vehicle's Master ID module, CECM module and VEC module plus slide-out dedicated I/O-B modules.

Each slide-out has its own I/O-B module and two power relays. The I/O-B modules analyze the input signal conditions and activate outputs like the pneumatic valves, the retracting or extending programmed sequence, etc. The power relays are used to supply power coming from the I/O-B module to the electric motor and to change polarity to reverse motor rotation.

The I/O-B modules input signals are:

- Handheld control switch IN;
- Handheld control switch OUT;

Also, the following input signals are required for a safe operation of the slide-out:

- Pressure transducer;
- Parking brake;
- "in limit" sensor;
- "out limit" sensor;

The I/O-B modules output signals are:

- Handheld control green indicator light;
- Power relay current reversing;
- Seal valve inflating solenoid;
- Seal valve deflating solenoid;

⚠ CAUTION ⚠
Do not use the slide-out handheld control to move the slide-out 2" inside the vehicle, because the stroke limits are not recognized over the closed position. The slide-out would not stop and damage may occur.

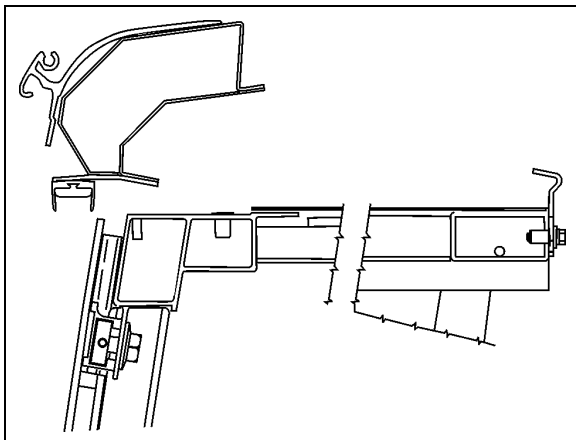


FIGURE 34: SLIDE-OUT 2" INSIDE – UPPER PART

- Vacuum generator valve solenoid;
- Security pin valve solenoid;
- Electric motor, first power output 15 amps;
- Electric motor, second power output 15 amps;

The CECM module output signals related to slide-outs are:

- Dashboard telltale light;
- Transmission inhibit;

⚠ WARNING ⚠

Before working on the slide-out electrical system, turn the ignition key to the "OFF" position.

15.1 ELECTRICAL INTERCONNECTION WITH PREVOST VEHICLE

The slide-out power supply comes from the 24-volts and 12-volts circuit breakers (FIGURE 36) in the main power compartment. The other interconnections are located on the pneumatic panel and the electrical panel in the front service compartment. All the interconnections are shown on the electrical diagrams of your vehicle.

A blinking signal is added on the dashboard telltale panel (figure 35) to indicate that an error condition or a missing operation condition is present on a slide-out. The slide-out telltale light also illuminates to indicate that at least one of the slide-outs is extended.

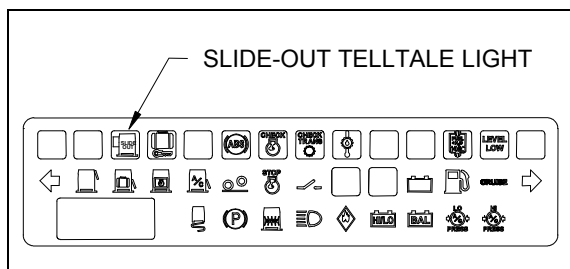


FIGURE 35 : DASHBOARD SLIDE-OUT TELLTALE LIGHT

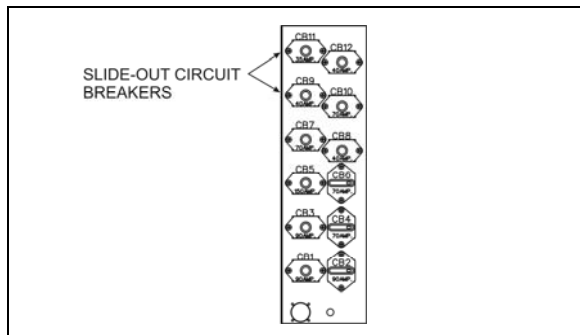


FIGURE 36: MAIN BREAKER IN MAIN POWER COMPARTMENT 26091

15.2 SLIDE-OUT BREAKERS

The 24-volts and 12-volts breakers are located in the main power compartment. Other electrical components are found on the slide-out control panel located in the first baggage compartment on the driver's side (figure 37).

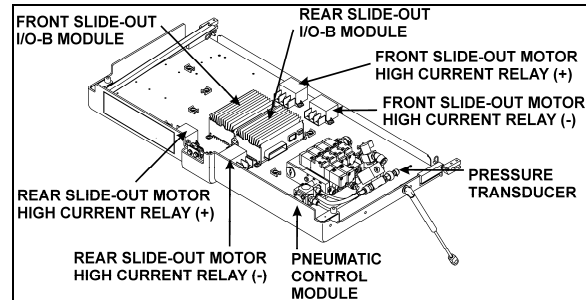


FIGURE 37 : SLIDE-OUT CONTROL PANEL

15.3 PROBING VOLTAGE ON THE MULTIPLEX CIRCUITS

Multiplex modules are supplied by 24 volts.

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

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

NOTE

For a 24V module: an active voltage would be 24V or 0V but not in between. If you measure an intermediate voltage (ex. 12V, 4V, or 8V) this must be interpreted as if the input or the output is inactive.

⚠ CAUTION ⚠

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

15.4 MODULE REPLACEMENT

I/O-B multiplex modules can be replaced and reprogrammed as described in Section 6: Electrical of this manual.

15.5 SLIDE-OUT LIMIT SENSORS

Two Hall-effect sensors are used on each slide-out to define stroke end limit positions. The "in

Section 26: SLIDE-OUT

limit" and "out limit" sensor detect two pairs of permanent magnets fixed on the slide-out underbody.

15.5.1 Maintenance and adjustment

The rear slide-out sensors are accessible from inside of the vehicle, under the bed structure while the front slide-out sensors can be reached from the 3rd baggage compartment access panel. To remove the sensors, unsnap them from the mounting bracket.

To adjust the "in limit" sensors:

Prior to adjust the "in limit" sensors, assure that the "in limit" stoppers are perfectly adjusted (see paragraph 1.2.2).

1. Retract the slide-out to its full "IN" position with the "in limit" stoppers in contact with their bearing surface.
2. Loosen the "in limit" sensor mounting bracket screws and move back the sensor completely (toward the inside of the vehicle).
3. Bring slowly the sensor toward the outside of the vehicle until the light emitting diode (LED) turns on. When it does, move it 0.079" (2mm) further in the same direction and tighten the mounting bracket screws.
4. Check if the "in limit" sensor is properly adjusted. At the moment when the slide-out stops during normal retraction, the "in limit" stoppers must contact their bearing surface (lower acetal plastic block). Put white paint on the "in limit" stopper before and check if the acetal plastic blocks are marked with paint.

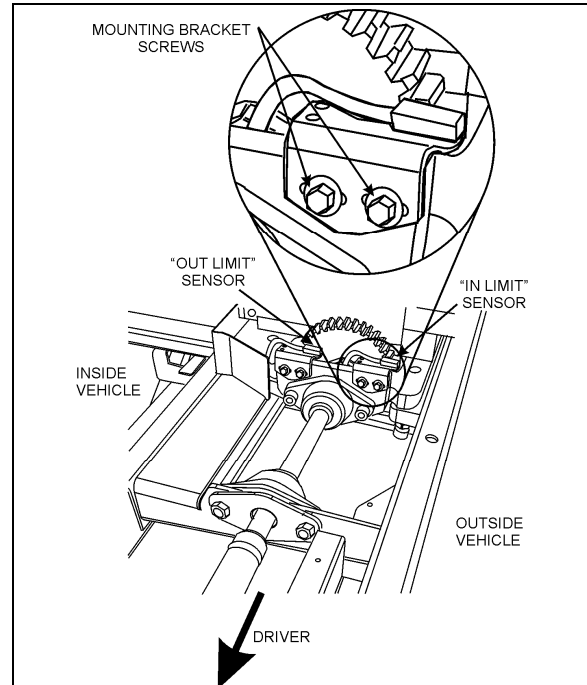


FIGURE 38: FRONT SLIDE-OUT SENSORS

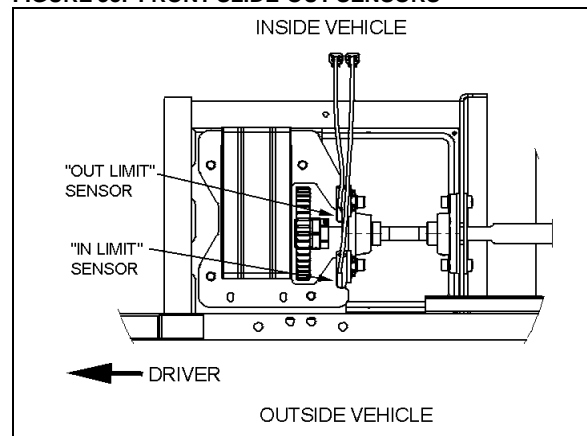


FIGURE 39: REAR SLIDE-OUT SENSORS

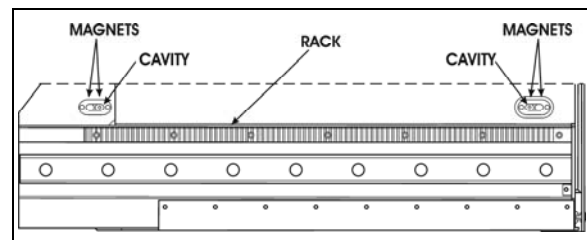


FIGURE 40 : MAGNETS ON SLIDE-OUT UNDERBODY
26097

To adjust the "out limit" sensors:

Prior to adjust the "out limit" sensors, assure that the inner stoppers are perfectly adjusted (see paragraph 1.1).

1. The slide-out is slightly tilted except when it is in its full "IN" or "OUT" position. Extend the slide-out near its full "OUT" position.

When the slide-out straitens up and that it is perpendicular with the vehicle body, stop the slide-out.

2. Loosen the “out limit” sensor mounting bracket screws and move back the sensor completely (toward the inside of the vehicle).
3. Bring slowly the sensor toward the outside of the vehicle until the light emitting diode (LED) turns on. When it does, tighten the mounting bracket screws.

NOTE

When the “out limit” sensors are properly adjusted, the slide-out extension stops before the side inner stoppers reach the vehicle structure.

16 SLIDE-OUT EXTERIOR FINISHING PANELS & WINDOWS

NOTE

The removal and installation procedures are all based on standard service methods described in section 18: BODY. Refer to this manual for procedures, tools, cleaner, adhesives and other product needed.

16.1 FACE PANEL REMOVAL

Use the same procedure as described in section 18: BODY for side panel removal, and:

- Keep the slide-out retracted;
- Check where adhesive, sealant and double face adhesive tape are on the structure and the panel back side, in order to be able to stick the new panel in the same way;
- Check the tape width and thickness. Use tape with same width and thickness when installing new panels.

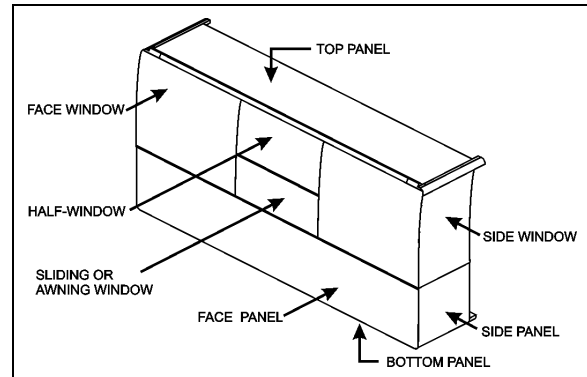


FIGURE 41 : SLIDE-OUT PANELS AND WINDOWS

16.2 FACE PANEL INSTALLATION

For surface cleaning, and preparation, panel installation and products needed, use the same procedure as the H3 or VIP “side panel installation” procedure described in section 18: BODY.

- Keep the slide-out retracted for panel alignment;
- Make sure to apply sealant between the face panels and the side panels, and also between face panel and bottom panel.

16.3 SIDE PANEL REMOVAL

Caution: Be careful not to damage the adjacent surfaces.

1. Remove the slide-out (according to the Slide-Out Removal Procedure. Ask to your Prevost service representative).
2. Drill through the rivets located at the bottom of the panel. Be careful not to let aluminum or stainless steel filings enter the corner extrusion. If necessary, remove the corner extrusion end cap to remove trapped filings.
3. Insert a flat screwdriver between the panel and the slide-out structure, in the top left and right corners of the panel, and unstick the panel from the structure.
4. Use C-clamp to peel the panel from the slide-out structure.
5. Check where adhesive, sealant and double face adhesive tape are on the structure and the panel back side, in order to be able to stick the new panel in the same way.

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6. Check the tape width and thickness. Use tape with same width and thickness when installing new panels.

Caution: Make sure the heat gun nozzle tip is at least 4" from surface.

7. Use a heat gun and putty knife to remove the dried off adhesive and tape residue from the structure.

Warning: Because of the adhesive toxicity, never use a buffer or other sanding method to remove it.

16.4 SIDE PANEL INSTALLATION

NOTE

The side panels are made of aluminum or stainless steel in option. Use rivet of same material as the panels.

For surface cleaning and preparation, panel installation and products needed, refer to the "side panel installation" procedure described in section 18: BODY.

1. Protect adjacent surfaces with appropriate material;
2. Refer to figure 42 for 1/4X1 (#5060038) and 3/16X1 (#506207) double face adhesive tape location on diagonal member of front slide-out only. Do not remove the tape blue protective layer;

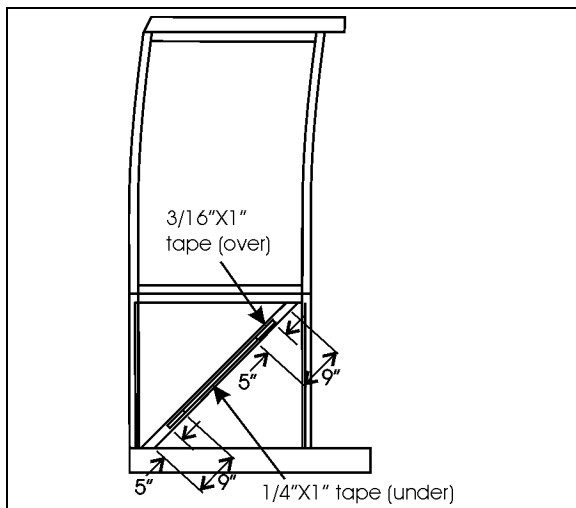


FIGURE 42 : SIDE PANEL INSTALLATION – DOUBLE FACE ADHESIVE TAPE APPLICATION ON THE SLIDE-OUT STRUCTURE (FRONT SLIDE-OUT ONLY)

NOTE

Do not remove the tape blue protective layer. The purpose of the tape is to maintain a certain gap and not to hold the panel in place.

3. Refer to figure 43 for 1/16x1/4 double face adhesive tape location on structure Do not remove the tape blue protective layer [7mm≈9/32"] [5mm≈6/32"];]
4. Inspect the Sika bead at the intersection of the corner vertical member and the flat bar as shown in FIGURE 44. if it is damaged, remove adhesive residue and apply a new 3mm diameter bead of Sika 221;
5. Inspect the Sika bead shown in FIGURE 45. If it is damaged, remove adhesive residue and apply a new 5mm diameter bead of Sika 221 or 252;
6. Clean panel with anti-silicone. Sand surface using a Scotchbrite. Clean sanded surface with anti-silicone;
7. Apply Sika 206 G+P on side panel as shown in figure 46;
8. Apply a 5mm diameter bead of Sika 221 or 252 on side panel as shown on FIGURE 47;

Apply Sika Tack+Booster (triangular bead: 9mm width X 6mm high [11/32"x1/4"]) as shown in Figure 48 and glue panel in place as shown in FIGURE 49. Do not remove the tape blue protective layer;

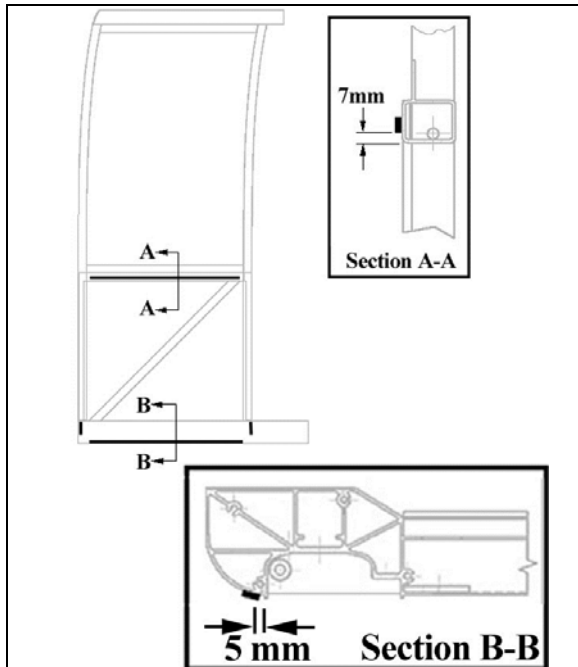


FIGURE 43 : SIDE PANEL INSTALLATION – DOUBLE FACE ADHESIVE TAPE APPLICATION ON THE SLIDE-OUT STRUCTURE

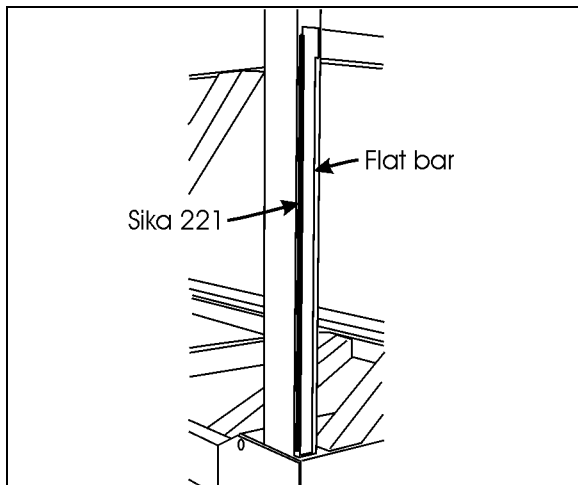


FIGURE 44 : SIDE PANEL INSTALLATION – SIKA 221 APPLICATION ON STRUCTURE

9. Exert pressure and let dry for at least 90 minutes;
10. Smooth down the joint and remove glue in excess;
11. Install rivets as per instruction sheet IS-06028 (ask to your Prevost service representative);

12. After drying, apply Sika 252 as a finishing joint. Refer to paragraph 16.12 for the finishing joint application procedure;

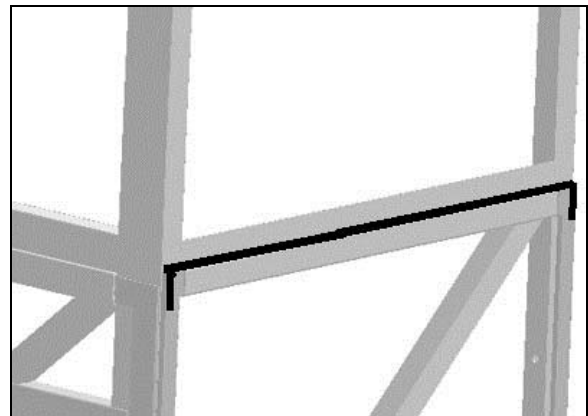


FIGURE 45 : SIDE PANEL INSTALLATION – SIKA 221 OR 252 APPLICATION ON STRUCTURE

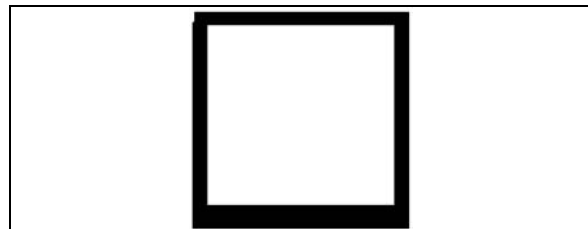


FIGURE 46 : SIDE PANEL INSTALLATION – SIKA 206 G+P APPLICATION

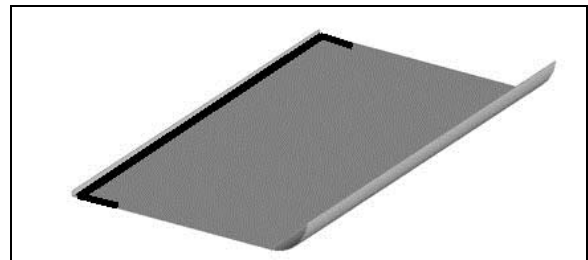


FIGURE 47 : SIDE PANEL INSTALLATION – SIKA 221 OR 252 APPLICATION ON SIDE PANEL

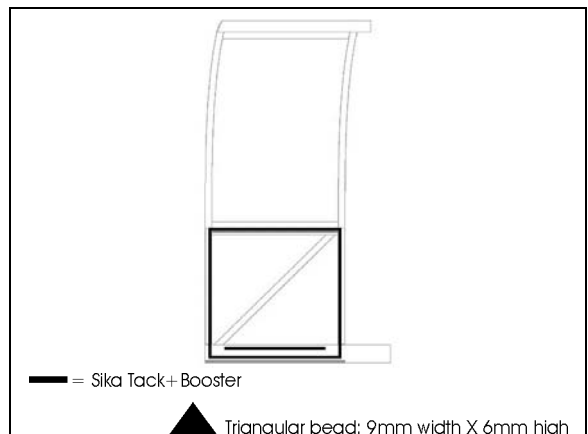


FIGURE 48 : SIDE PANEL INSTALLATION – SIKA TACK+BOOSTER APPLICATION

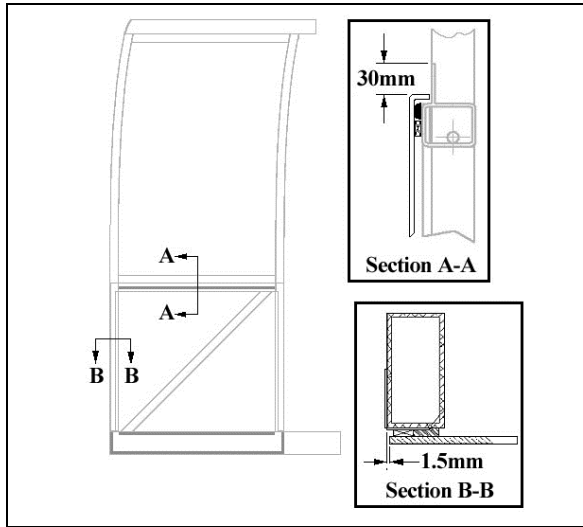


FIGURE 49 : SIDE PANEL INSTALLATION

16.5 TOP AND BOTTOM PANEL REMOVAL

NOTE

The top and bottom panels are made of aluminum sheets.

1. Remove the slide-out (as per the Slide-Out Removal/Installation Procedure. Ask to your Prevost service representative).
2. Insert a flat screwdriver between the panel and the slide-out structure and unstick the panel from the structure.
3. Use C-clamp to peel the panel from the slide-out structure.
4. Check where adhesive, sealant and double face adhesive tape are on the structure and the panel back side, in order to be able to stick the new panel in the same way.
5. Check the tape width and thickness. Use tape with same width and thickness when installing new panels.
6. Use a heat gun and putty knife to remove the dried off adhesive and tape residue from the structure.

Warning: *Because of the adhesive toxicity, never use a buffer or other sanding method to remove it.*

16.6 TOP AND BOTTOM PANEL INSTALLATION

NOTE

The top and bottom panels are made of aluminum sheets and need aluminum rivet.

For surface cleaning, preparation, panel installation and products needed, refer to the side panel installation procedure described in section 18: BODY.

1. Protect adjacent surfaces with appropriate material.
2. Refer to FIGURE 50 for 1/16x1/4 double face adhesive tape location on structure [5mm≈6/32”];

NOTE

Do not remove the tape blue protective layer. The purpose of the tape is to maintain a certain gap and not to hold the panel in place.

3. Clean panel with anti-silicone. Sand surface using a Scotchbrite. Clean sanded surface with anti-silicone;
4. Apply Sika 206 G+P on panel as shown in FIGURE 51;
5. Apply Sika Tack+Booster (triangular bead: 9mm width X 6mm high) has shown in FIGURE 52 and glue panel in place as shown in figure 53 & figure 54 ;
6. Exert pressure and let dry for at least 90 minutes;
7. Smooth down the joint and remove glue in excess;
8. After drying, apply Sika 252 as a finishing joint. Refer to paragraph 16.12 for the finishing joint application procedure.

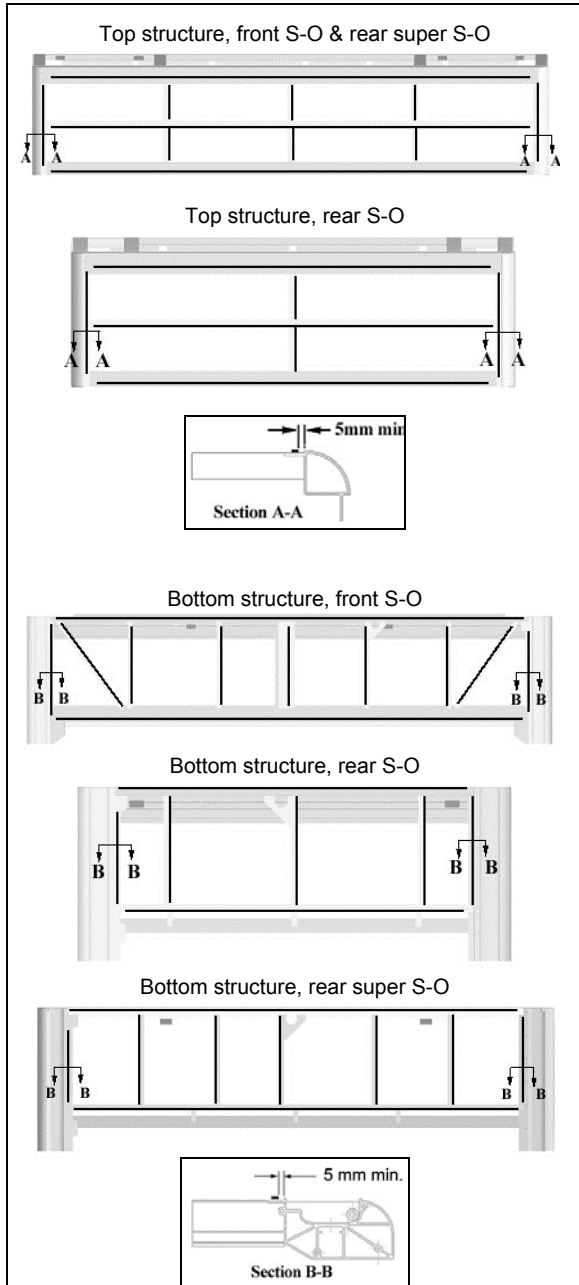


FIGURE 50 : TOP AND BOTTOM PANEL INSTALLATION - DOUBLE FACE ADHESIVE TAPE APPLICATION

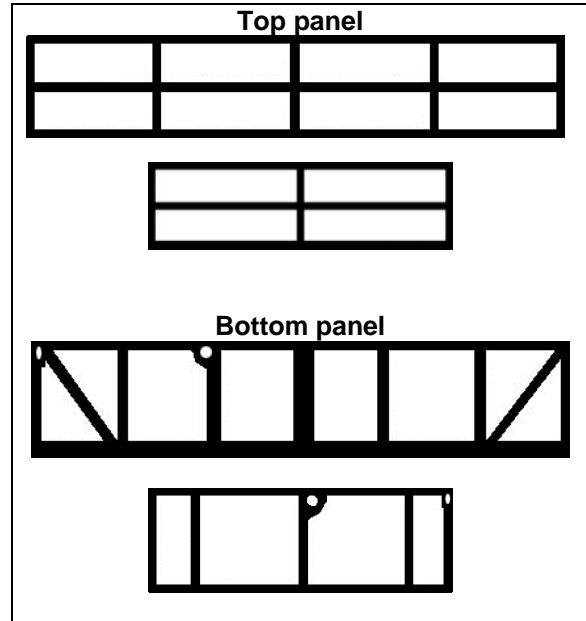


FIGURE 51 TOP AND BOTTOM PANEL INSTALLATION - SIKA 206 G+P APPLICATION

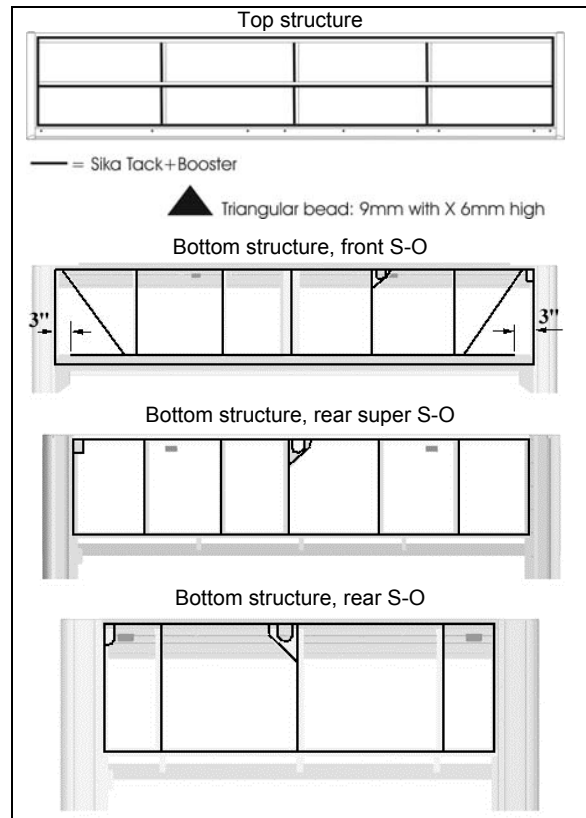


FIGURE 52 : TOP AND BOTTOM PANEL INSTALLATION - SIKA TACK+BOOSTER APPLICATION

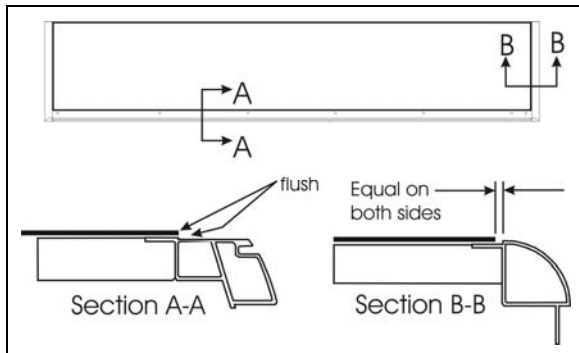


FIGURE 53 : TOP PANEL INSTALLATION

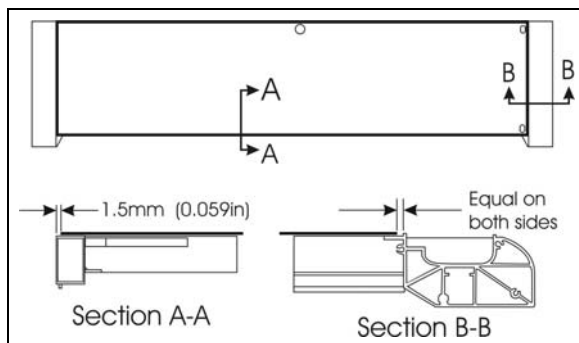


FIGURE 54 : BOTTOM PANEL INSTALLATION

NOTE

The removal and installation procedures are based on standard service methods described in section 18: BODY. Refer to these procedures for tools and adhesives specifications.

Warning: Always wear safety equipment when working with glass and chemical adhesives.

16.7 SIDE WINDOW & HALF-WINDOW REMOVAL

1. Remove the slide-out (for side window removal only).
2. If needed, remove the exterior extrusion as described in paragraph 1.3.

Caution: Be careful not to damage the adjacent surfaces.

3. With a knife or a wire, cut the sealant and the adhesive between the windows and the structure where applicable. Make sure not to damage the rubber seal between the windows.
4. With a helper, remove the window from the slide-out.

16.8 HALF-WINDOW & SIDE WINDOW INSTALLATION

Refer to procedures described in section 18: BODY of the maintenance manual for details.

1. Clean and prepare window and slide-out structure surface with appropriate cleaner, abrasives and primers [48mm≈1 7/8"];
2. If necessary, install rubber seals as per FIGURE 55. Press the seal against the structure with a roller;
3. Apply 1/4" X 1/2" double face self adhesive tape on the slide-out structure for side fixed window (see FIGURE 56) [10mm≈3/8"] [15mm≈19/32"];

NOTE

Do not remove the tape blue protective layer. The purpose of the tape is to maintain a certain gap and not to hold the panel in place.

4. Clean window with appropriate window cleaner;
5. Apply Sika Aktivator on the window pane as per FIGURE 57 (half-window) or FIGURE 58 (side window);
6. **HALF-WINDOW ONLY:** clean the sliding or awning window frame with anti-silicone and then, apply Sika Aktivator as shown on FIGURE 59;
7. **HALF-WINDOW ONLY:** place masking tape on awning or sliding window frame to protect it from smudge (see FIGURE 60);
8. **HALF-WINDOW ONLY:** On awning window, place 3 shims #790392 on frame, one at the center and the 2 other at each edge. On sliding window, place 3 shims #790392 on frame, one at the center and the 2 other at each edge in order to have a gap of 10mm between both windows (see FIGURE 60);
9. **HALF-WINDOW ONLY:** insert anchoring blocks in window extrusion (see FIGURE 64);
10. Apply Sika Tack+Booster (triangular bead: 20mm width X 15mm high) as per FIGURE 61 (side window) or FIGURE 62 (half-window) [20mm≈13/16"] [15mm≈19/32"];
11. Install side window on the slide-out structure as per FIGURE 63;
12. Install half-window centered with the awning or sliding window;

13. Press the jigs on the windows and wait for the adhesive to dry (90 minutes minimum).
14. Smooth down the joint and remove glue in excess. Clean excess adhesive with Sika 208.
15. Refer to paragraph 16.12 for the finishing joint application procedure.

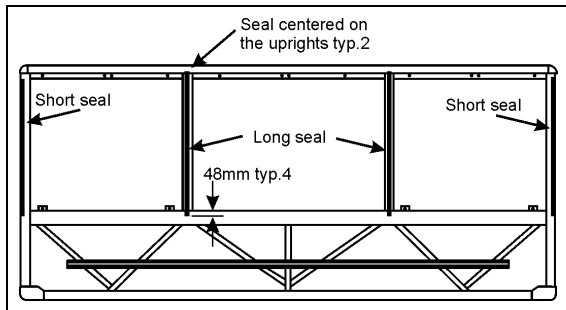


FIGURE 55 : FACE WINDOW - RUBBER SEAL INSTALLATION

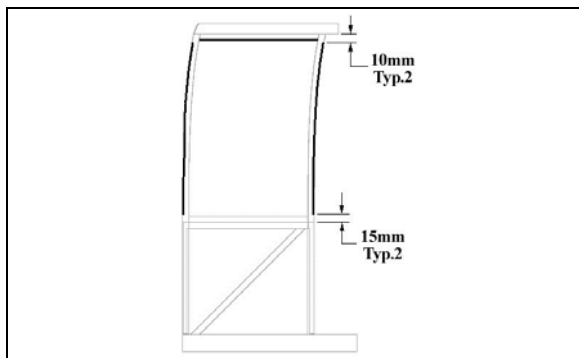


FIGURE 56 : SIDE WINDOW – ¼ X ½ DOUBLE FACE ADHESIVE TAPE INSTALLATION

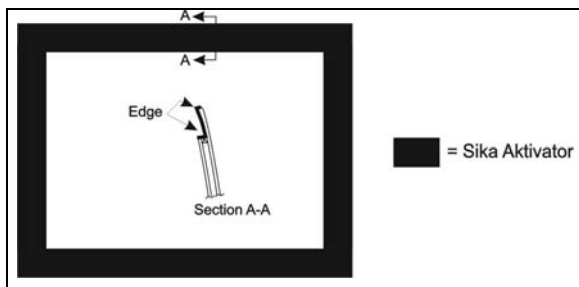


FIGURE 57 : HALF-WINDOW – SIKA AKTIVATOR

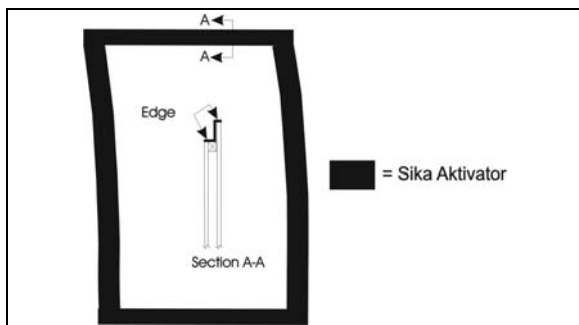


FIGURE 58 : SIDE WINDOW – SIKA AKTIVATOR

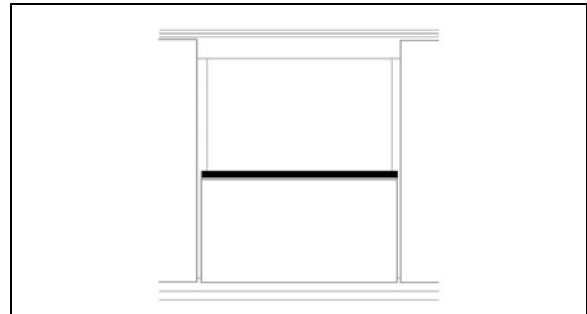


FIGURE 59 : HALF-WINDOW INSTALLATION – SIKA AKTIVATOR

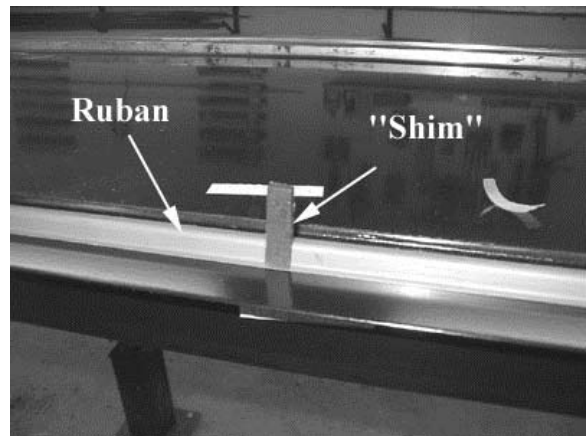


FIGURE 60 : HALF-WINDOW INSTALLATION

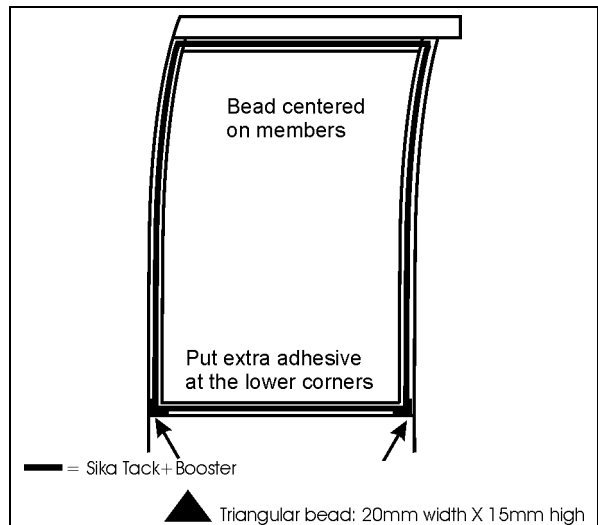


FIGURE 61 : SIDE WINDOW – SIKA TACK + BOOSTER

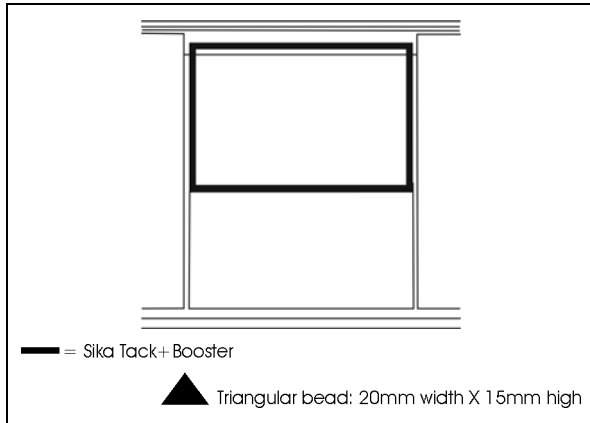


FIGURE 62 : HALF-WINDOW INSTALLATION – SIKA TACK+BOOSTER

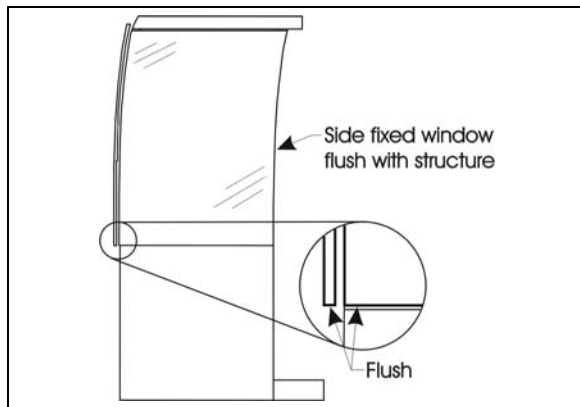


FIGURE 63 : SIDE WINDOW

16.9 FACE WINDOW INSTALLATION

Refer to procedures described in section 18: BODY of the maintenance manual for details.

1. If necessary, install the rubber seals as per FIGURE 55. Press the seal against the structure with a roller;
2. Insert anchoring blocks in window extrusion (see FIGURE 64) and install window with the lower edge flush with the sliding or awning window (see FIGURE 65);
3. Leave a gap between the face window and the sliding/awning window according to the slide-out overall length (see FIGURE 65);

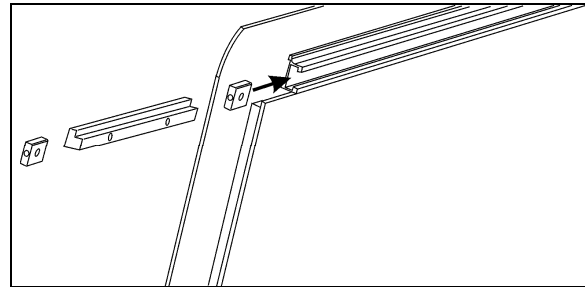


FIGURE 64 : FACE WINDOW INSTALLATION - ANCHORING BLOCKS

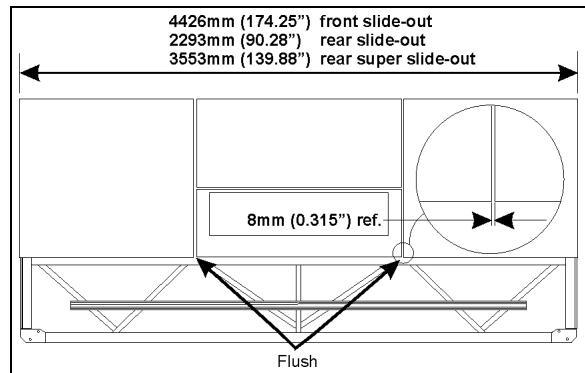


FIGURE 65 : FACE WINDOW INSTALLATION

16.10 AWNING WINDOW INSTALLATION

1. Clean and prepare window and slide-out structure surface with appropriate cleaner, abrasives and primers;
2. Glue 6 rubber bumpers (#790602) on the awning window frame as per FIGURE 66;

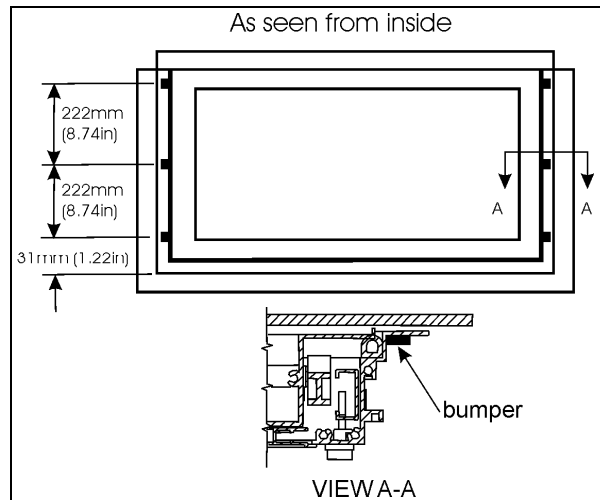


FIGURE 66: SIDE BUMPERS

3. Apply Sika 255 (or 252) at the upper and lower frame corner as per FIGURE 67.

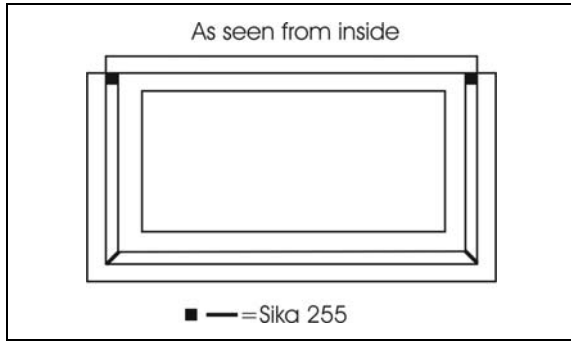


FIGURE 67: SIKA 255 APPLICATION

- Place masking tape on the inside of the window pane as per FIGURE 68 to protect it from smudge;

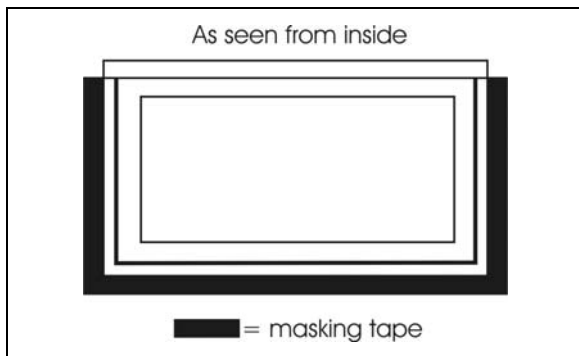


FIGURE 68: MASKING TAPE APPLICATION

- Previously clean surface with anti-silicone and then apply Sika Aktivator as per FIGURE 69;

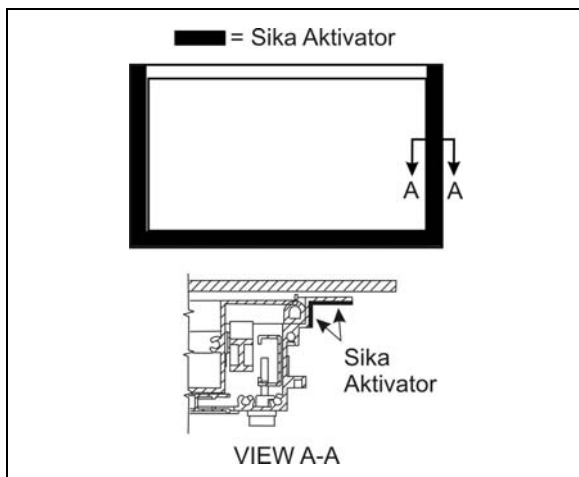


FIGURE 69 : AWNING WINDOW – SIKA AKTIVATOR

- Glue on the structure horizontal member, 3 rubber bumpers (#790597) (see FIGURE 70) [50mm≈2”].

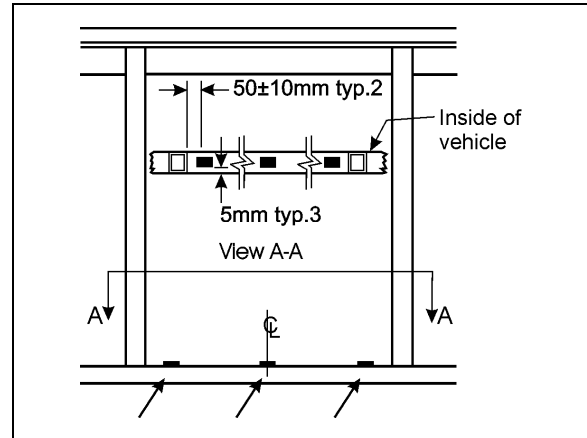


FIGURE 70: AWNING WINDOW - RUBBER BUMPER INSTALLATION

- Apply Sika 252 as per FIGURE 71 (triangular bead: 10mm width X 10mm high) [10mm≈3/8”];

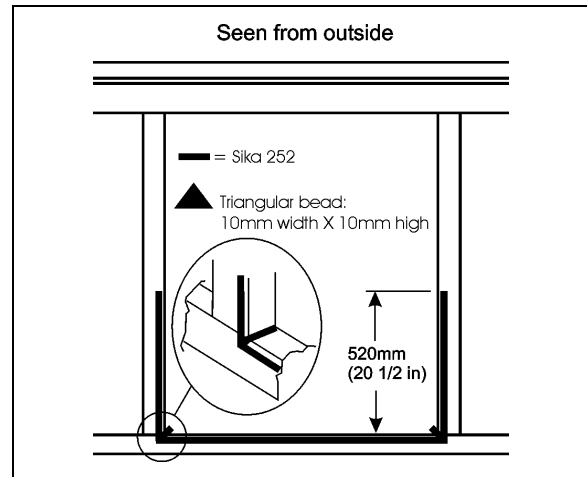


FIGURE 71: AWNING WINDOW – SIKA 252 APPLICATION

- Install the awning window centered in the opening.
- While a helper is pressing on the window from outside, install the awning window clamping frame and tighten screws according to the sequence shown in FIGURE 72;

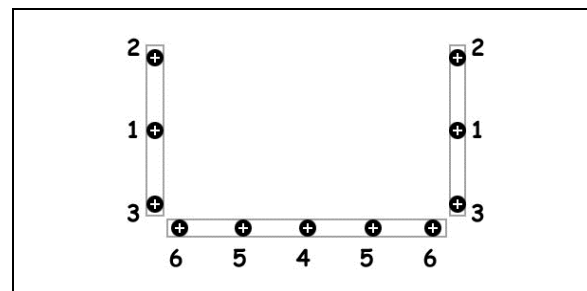


FIGURE 72 : CORRECT TIGHTENING SEQUENCE

Section 26: SLIDE-OUT

10. Open the awning window manually and smooth down the joint (FIGURE 73) and remove glue in excess with Sika 208;

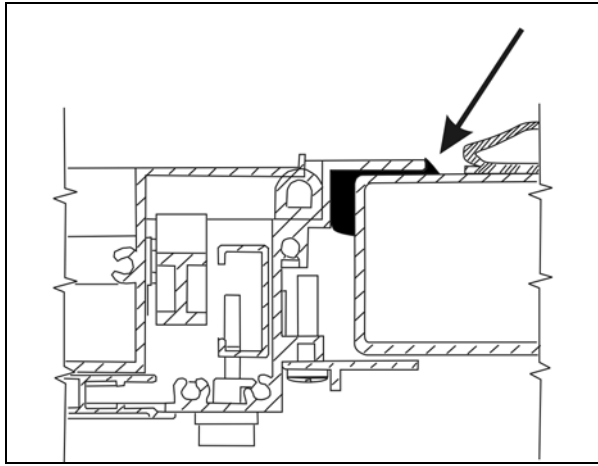


FIGURE 73 : SMOOTH DOWN THE JOINT

11. Using Sika 252 or 255, seal the upper corner of the awning window, both side (FIGURE 74);
12. Smooth down the joint from inside the vehicle;
13. Using Sika 252 or 255, seal the chink between the structure vertical member and the awning window, both side (FIGURE 75);

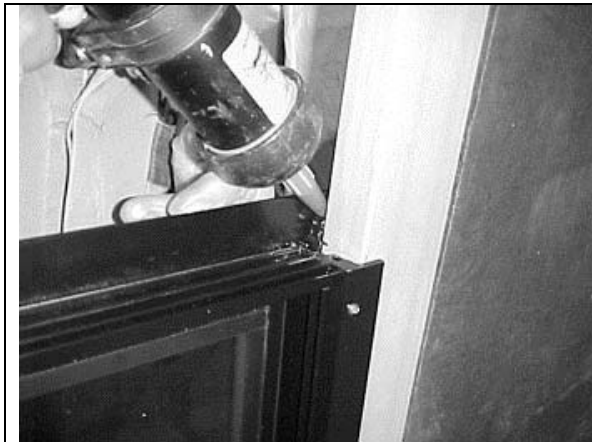


FIGURE 74 : AWNING WINDOW – SEAL THE UPPER CORNERS

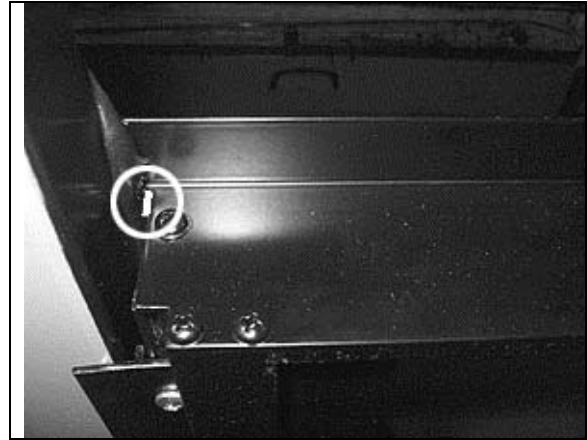


FIGURE 75 : AWNING WINDOW – SEAL THE CHINK

16.11 SLIDING WINDOW INSTALLATION

1. Clean and prepare window and slide-out structure surface with appropriate cleaner, abrasives and primers. Clean surfaces with anti-silicone;
2. Clean sliding window frame with anti-silicone and then apply Sika Aktivator as per FIGURE 76;
3. Check for presence of 1 rubber bushing at each interior corner (see FIGURE 77) and 2 other bushings under the sliding window;
4. Apply Sika 252 as per FIGURE 78 (triangular bead: 20mm width X 10mm high [13/16" X 3/8"]).
5. Install the sliding window centered in the opening;
6. While a helper is pressing on the window from outside, install the sliding window clamping frame and tighten screws according to the sequence shown in FIGURE 79;
7. Using Sika 252 or 255, seal the inside upper corner of the sliding window, both side (FIGURE 80);
8. Remove glue in excess and clean with Sika 208.

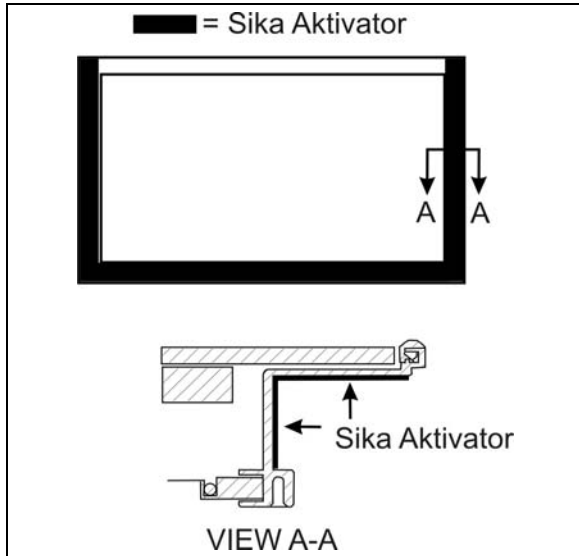


FIGURE 76 : SLIDING WINDOW - SIKA AKTIVATOR

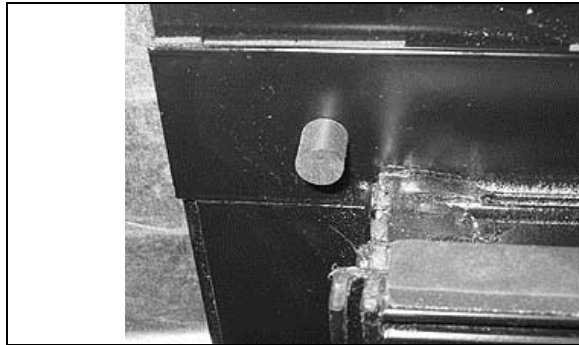


FIGURE 77 : SLIDING WINDOW - RUBBER BUSHING

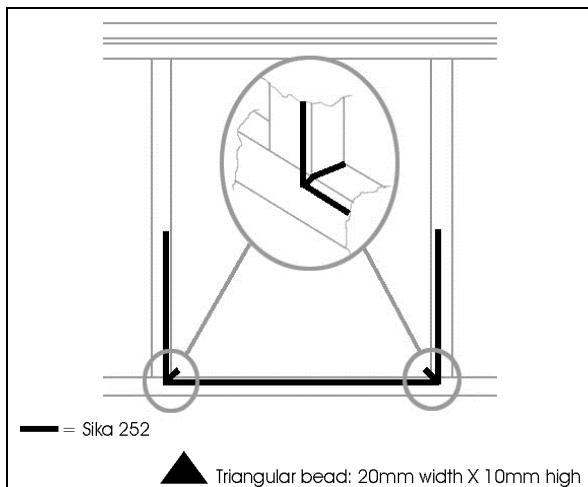


FIGURE 78 : SLIDING WINDOW - SIKA 252 APPLICATION

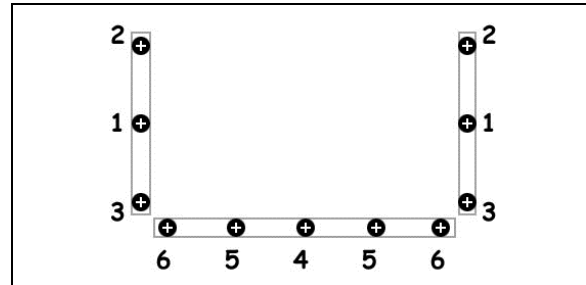


FIGURE 79 : CORRECT TIGHTENING SEQUENCE

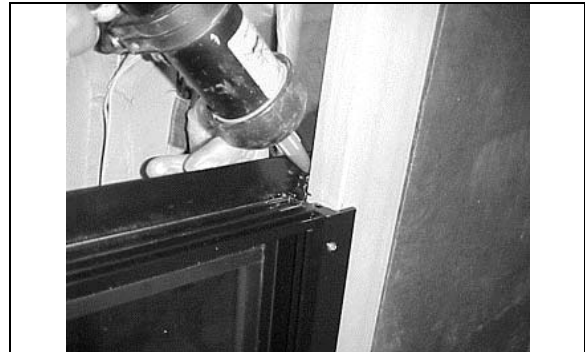


FIGURE 80 : SLIDING WINDOW – SEAL THE UPPER CORNERS

16.12 FINISHING JOINT

For surface cleaning and preparation, tools, cleaner, adhesives and other product needed, refer to the “side panel installation” procedure described in section 18: BODY.

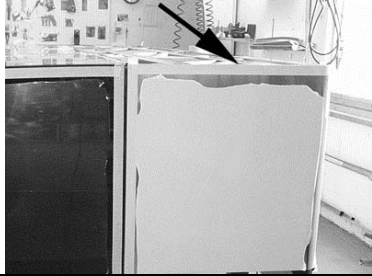
1. Place masking tape to protect surfaces from smudge.
2. Apply Sika Aktivator and then apply Sika 252 as per the following pictures.
3. Remove Sika 252 in excess. Using soapy water, smooth down the joint with your finger (wear vinyl gloves).

Section 26: SLIDE-OUT

Apply Sika Aktivator and then apply Sika 252 (black) between:

- 1- face panel & vertical structural member at the corner;
- 2- side panel & vertical structural member at the corner;

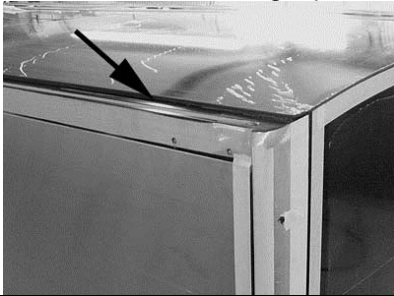
Note: as seen on the picture, protect the adjacent surface with masking tape.



Apply Sika Aktivator and then apply Sika 252 (black) between:

- 1- top of face window & upper horizontal structural member
- 2- top of half-window & upper horizontal structural member

Note: as seen on the picture, protect the adjacent surface with masking tape



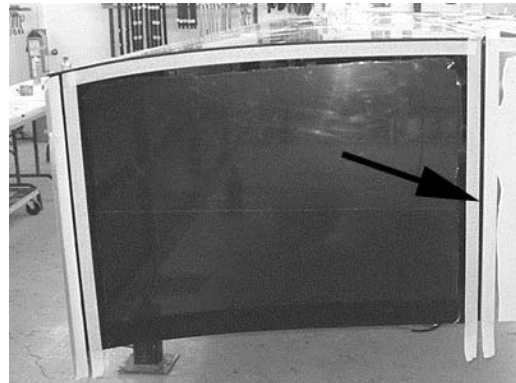
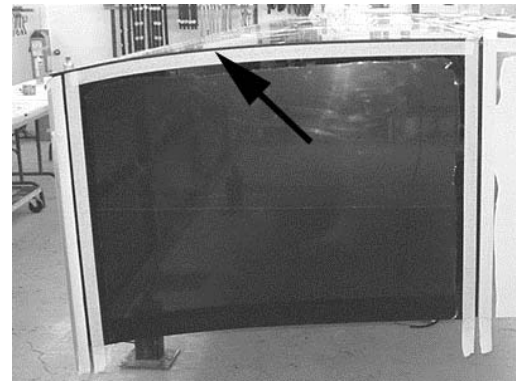
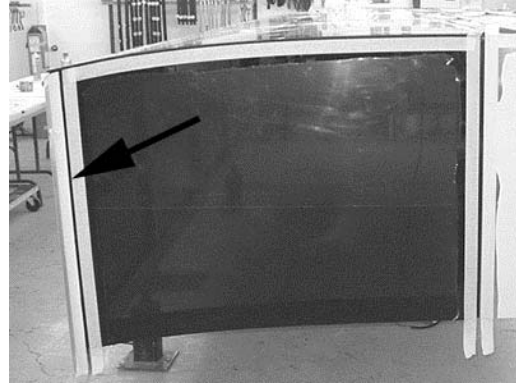
Apply Sika Aktivator and then apply Sika 252 between edge of bottom panel and structural member

Bead must overlap both surfaces about 2mm



Apply Sika Aktivator and then apply Sika 252 between side window and structural member

Bead must overlap both surfaces about 2mm

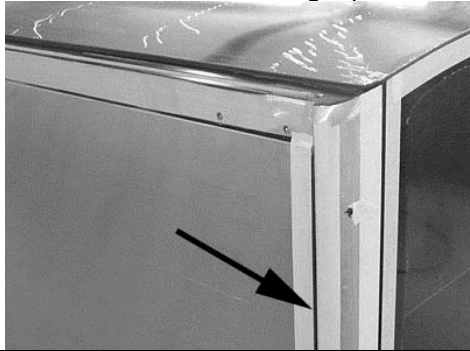


Apply Sika Aktivator and then apply Sika 252 between R.H. side edge of top panel and structural member

Apply Sika Aktivator and then apply Sika 252 between L.H. side edge of top panel and structural member

Bead must overlap both surfaces about 2mm

Note: as seen on the picture, protect the adjacent surface with masking tape



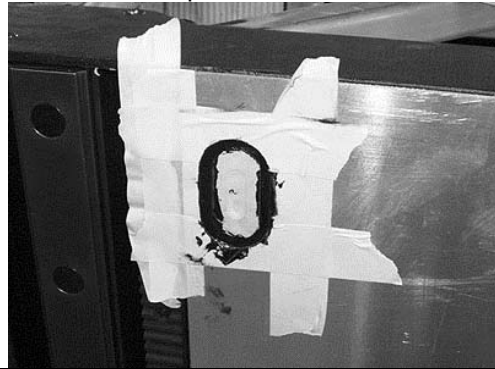
Apply Sika Aktivator and then apply Sika 252 around the security pin cavity

Bead must overlap both surfaces about 2mm



Apply Sika Aktivator and then apply Sika252 between the bottom panel and the magnets

Bead must overlap both surfaces about 2mm



17 WELDING PRECAUTION



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

18 SLIDE-OUT MANUAL OVERRIDE PROCEDURES

In case of power retracting system failure, it is possible to use the manual override procedure to retract or extend the slide-out.

The manual override procedures consist in rotating the slide-out motor shaft extension using a cordless power drill with a 3/8" hexagonal socket.

However, it is very important to follow all the instructions very carefully to assure that the inflatable seal or the retraction mechanisms are not damaged.

18.1 PRELIMINARY CONDITIONS FOR MANUAL OVERRIDE PROCEDURE

Before using the slide-out manual override procedure, make sure that the problem cannot be solved by one of the following simple checks:

- Make sure that none of the breakers are tripped (slide-out circuit breakers CB9 & CB11 are located inside the main power compartment on the breaker panel).

Section 26: SLIDE-OUT

- Make sure the parking brake is applied and that transmission is in the "NEUTRAL" position.
- Make sure the voltage is high enough by running the engine at fast idle or having a battery charger connected.

CAUTION

Before extending or retracting the slide-out, always open a window to avoid movement restriction and to prevent the motor from stopping in overcurrent because of a vacuum or pressure build up inside the vehicle.

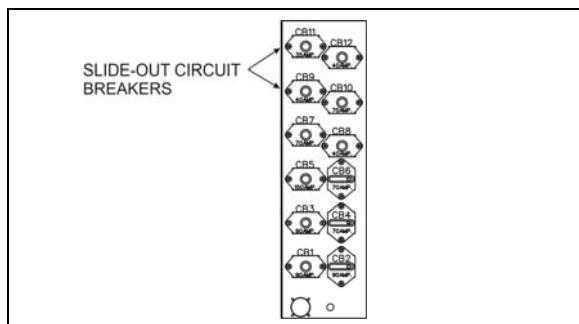


FIGURE 81 : SLIDE-OUT CIRCUIT BREAKERS CB9 & CB11 IN MAIN POWER COMPARTMENT

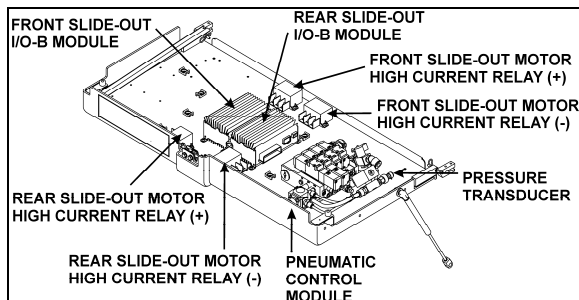


FIGURE 82 : SLIDE-OUT CONTROL PANEL IN FIRST BAGGAGE COMPARTMENT 26107

18.1.1 Manual retracting procedure – Front and rear slide-out

1. Turn the ignition switch to the "OFF" position, and remove the ignition key for more safety.
2. Deflate the inflatable seal by using the relieving shut-off valve located on the slide-out control panel. Turn the handle clockwise to deflate the seal. Make sure the pressure indicator reading is "0 psi".

CAUTION

The pressure in the inflatable seal must be completely relieved to prevent any damage to the seal. Also, check that the security pin is retracted so it does not stop slide-out movement.

NOTE

When air pressure is relieved using the shut-off valve, the normal extending and retracting operation cycle is disabled, for that reason the slide-out cannot be moved using the handheld control.

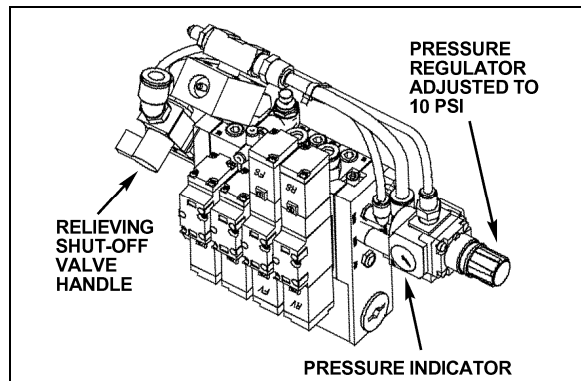


FIGURE 83 : INFLATABLE SEAL RELIEVING SHUT-OFF VALVE 26098

3. To move the slide-out, use a cordless power drill with a 3/8" hexagonal socket on the shaft extension of the slide-out motor.
4. Rotate the slide-out motor shaft extension with the cordless power drill until the slide-out comes to its closed position.
5. Once the slide-out room is lined up to its closed position, remove the tool from the motor.

NOTE

The **front slide-out motor** is located inside the 2nd baggage compartment while the **rear slide-out motor** is accessible from inside the vehicle, under the bed structure.

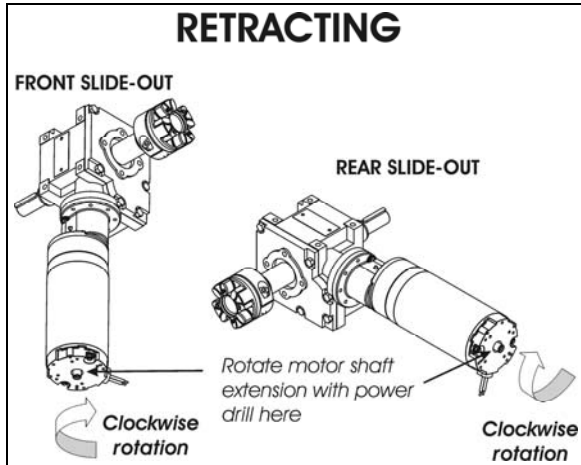


FIGURE 84 : SLIDE-OUT MOTOR ROTATION 26038

CAUTION
 Slow down on the closing speed as the slide-out approaches its closed position. As soon as the "in limit" stoppers come in contact with their bearing surface, stop immediately the cordless power drill rotating movement. Not doing so could overload the drive mechanism and cause damage to the reduction gearbox.

- Finally, the inflatable seal can be re-inflated by turning the shut-off valve handle counterclockwise. Check the pressure gage on the inflatable seal regulator to see if the pressure is increasing to 10 psi.

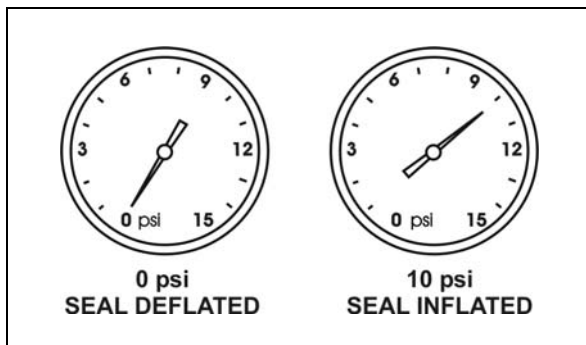


FIGURE 85 : INFLATABLE SEAL PRESSURE GAGE 26108

NOTE
 The slide-out control system inhibits transmission range selection to prevent the vehicle from moving if the slide-out is not in its full "IN" position.

18.1.2 Manual extending procedure – Front and rear slide-out

- Apply parking brake to disengage the security pin from the receptacle.
- Turn the ignition switch to the "OFF" position, and remove the ignition key for more safety.
- Deflate the inflatable seal by using the relieving shut-off valve located in the slide-out control panel. Turn the handle clockwise to deflate the seal. Make sure the pressure indicator reading is "0 psi".

CAUTION
 The pressure in the inflatable seal must be completely relieved to prevent any damage to the seal. Also, check that the security pin is disengaged from the receptacle so it does not stop slide-out movement.

NOTE
 When air pressure is relieved using the shut-off valve, the normal extending and retracting operation cycle is disabled, for that reason the slide-out cannot be moved with the handheld control.

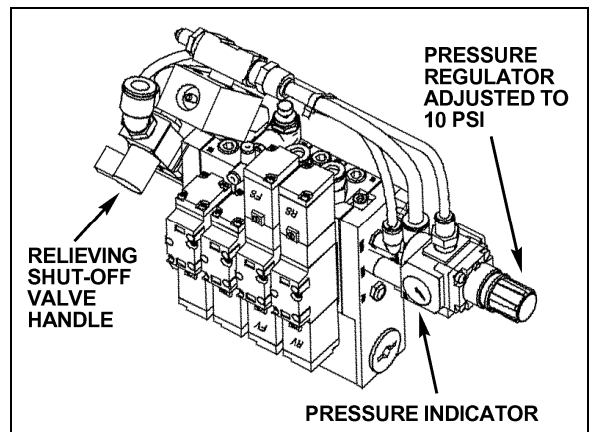


FIGURE 86 : INFLATABLE SEAL RELIEVING SHUT-OFF VALVE 26098

- To move the slide-out, use a cordless power drill with a 3/8" hexagonal socket on the shaft extension of the slide-out motor.
- Rotate the slide-out motor shaft extension with the cordless power drill until the slide-out comes to its opened position.

Section 26: SLIDE-OUT

- Once the slide-out is lined up to its opened position, remove the tool from the motor.

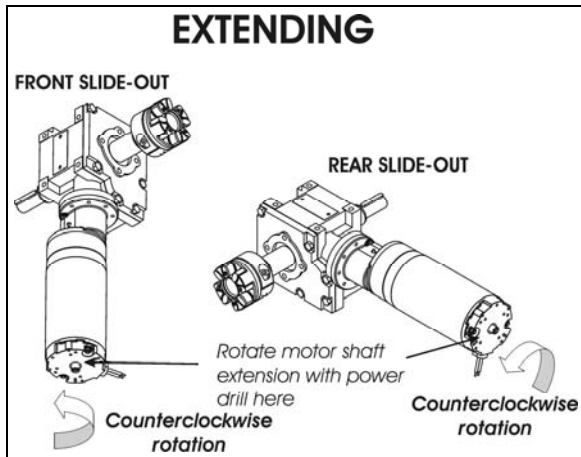


FIGURE 87 : SLIDE-OUT MOTOR ROTATION 26037

NOTE

The **front slide-out motor** is located inside the 2nd baggage compartment while the **rear slide-out motor** is accessible from inside the vehicle, under the bed structure.



CAUTION

Slow down on the closing speed as the slide-out approaches its extended position. As soon as the "out limit" stoppers come in contact with their bearing surface, stop immediately the cordless power drill rotating movement. Not doing so could overload the drive mechanism and cause damage to the reduction gearbox.

- Finally, the inflatable seal can be re-inflated by turning the shut-off valve handle counterclockwise. Check the pressure gage on the inflatable seal regulator to see if the pressure is increasing to 10 psi.

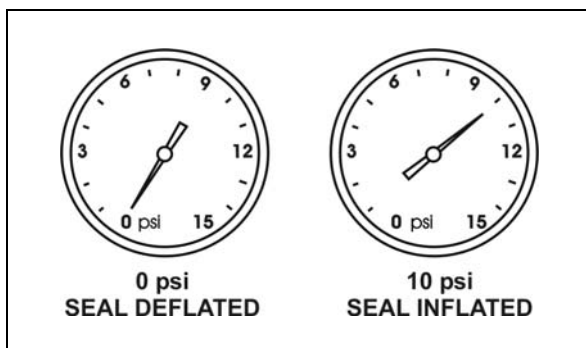


FIGURE 88 : INFLATABLE SEAL PRESSURE GAGE 26108

NOTE

The slide-out control system inhibits transmission range selection to prevent the vehicle from moving if the slide-out is not in its full "IN" position.

19 SLIDE-OUT MAXIMUM LOAD

Front slide-out:

Maximum load with vehicle at stand still (retracted or extended)1500 lb
 Maximum load with vehicle moving or slide-out moving1200 lb¹

Rear slide-out:

Maximum load with vehicle at stand still (retracted or extended)1500 lb
 Maximum load with vehicle moving or slide-out moving1000 lb¹

NOTE

Maximum load includes people weight and equipment added by the converters in the slide-out

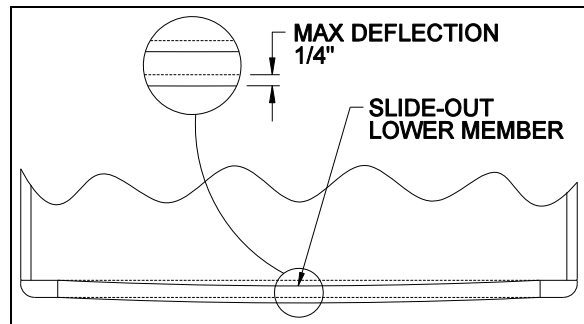
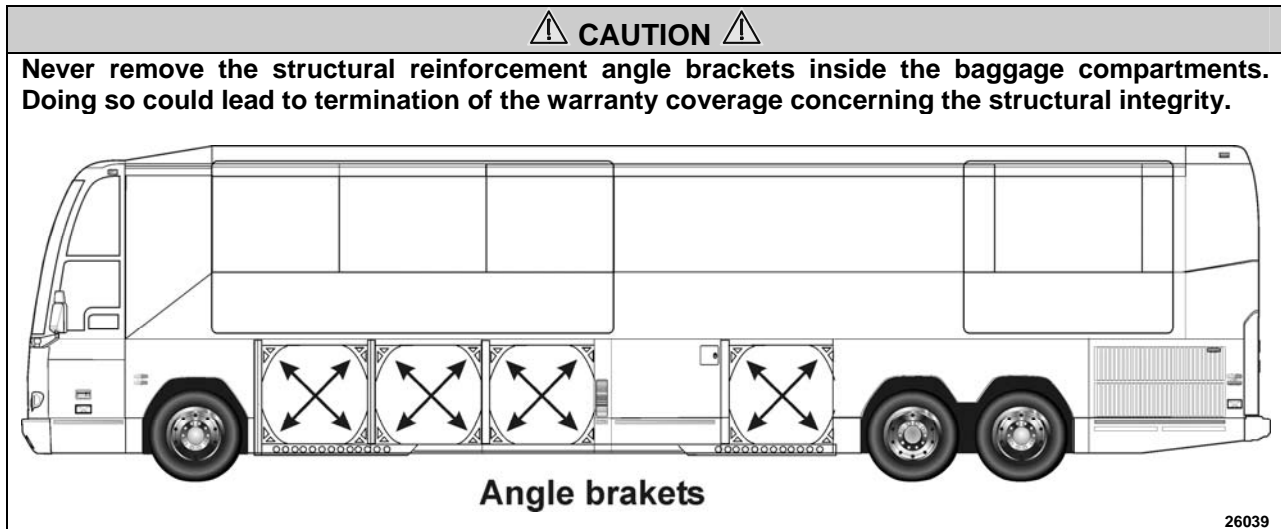


FIGURE 89 : FRONT SLIDE-OUT DEFLECTION

¹ With load distributed in the slide-out, to prevent a deflection of the inside lower member greater than 1/4" that could damage the seal.



20 CONVERSION CHECKLIST

The converter should check these points before closing the walls covering the roof reinforcing rod and the pinions:

1. Check that the front slide-out exterior panels are parallel with the vehicle panels when retracted. If not, readjust the tilt.
2. Check that the slide-out is straight when completely extended, and that it leans against upper inner stoppers.
3. Check if the vehicle upper member is parallel with the front slide-out structure. If not, an adjustment of the roof reinforcing rod may be required. This may be affected by the loading on the roof. See section 3 and contact your Prevest service representative.
4. Make sure the front slide-out lower member deflection is within 1/4". If not, redistribute the slide-out load.
5. Check the whole slide-out mechanism proper functioning. The slide-out should retract and extend smoothly without vibration.

Final check:

- Make sure the slide-out air pressure inlet valve is completely opened.
- Check the inflatable seal air pressure on the pressure regulator. The pressure should be 10 psi.

21 TROUBLESHOOTING

21.1 ERROR CONDITION OR MISSING OPERATION CONDITION

When an error condition or a missing operation condition is present on a slide-out, the green indicator light on its respective handheld control starts blinking upon releasing of the IN/OUT rocker switch. Turning the ignition OFF and ON again, will stop the blinking and reset the fault. If the error condition or a missing operation condition is still present, the blinking will start again the next time that the slide-out is operated. So, to get a fault diagnostic, use the MCD right after operating the slide-out without cycling the ignition switch.

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.

Fault diagnostic

To get more specific information about the error condition or the missing operation condition, request a diagnostic from the slide-out CECM using the dashboard message center display (MCD). Check if there are active errors in the slide-out 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 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.

21.2 TROUBLESHOOTING – OPERATING CONDITIONS & CONTROL

PROBLEM	CAUSE	CORRECTIVE ACTION
The slide-out functions normally but the handheld control green indicator light blinks	<p>Something is defective and may eventually create an issue if not repaired. The problem may be:</p> <ul style="list-style-type: none"> A. Faulty limit sensor causing the slide-out to stop in overcurrent; B. CAN network problem causing the transmission inhibit safety to be non-operational; C. Vacuum pressure transducer disconnected or damaged (vacuum is applied for a fixed time of 7 seconds); D. Seal inflating valve solenoid open circuit (the seal is not re-inflated and water can penetrate in the vehicle); E. Security pin valve solenoid open circuit (the security pin is not extended while vehicle is riding). 	Request a diagnostic from the electrical system using the MCD SYSTEM DIAGNOSTIC menu and refer to the Fault Message list in paragraph 21.4.

PROBLEM	CAUSE	CORRECTIVE ACTION
The slide-out does not extend	<p>A. The parking brake is not seen by the controller as being applied;</p> <p>B. Not enough air pressure in the accessory air tank to permit proper operation of the vacuum generator;</p> <p>C. Faulty vacuum generator, connection to the vacuum generator open, seal deflating valve solenoid open circuit;</p> <p>D. I/O-B module output defective, regulated 5-volt supply to sensors shorted to ground, "out limit" sensor shorted to ground, connection to the motor negative relay solenoid open circuit;</p>	<p>A. Make sure the parking brake is applied. Confirm parking brake application with the parking brake light on the telltale panel.</p> <p>B. Run the engine at fast idle a few minutes to increase air pressure in the accessory air tank and try again.</p> <p>C. Turn the relieving shut-off valve handle clockwise to deflate the inflatable seal, disconnect the pressure transducer. Do not forget to reconnect the pressure transducer and to close the relieving shut-off valve. Failure to do so could damage the seal and lead to water infiltration;</p> <p>D. Operate the slide-out with the manual override procedures.</p>
The slide-out does not retract	<p>A. Not enough air pressure in the accessory air tank to permit proper operation of the vacuum generator;</p> <p>B. Faulty vacuum generator, connection to the vacuum generator open, seal deflating valve solenoid open circuit;</p> <p>C. I/O-B module output defective, "in limit" sensor shorted to ground, connection to the motor positive relay solenoid open circuit;</p>	<p>A. Run the engine at fast idle a few minutes to increase air pressure in the accessory air tank and try again.</p> <p>B. Turn the relieving shut-off valve handle clockwise to deflate the inflatable seal, disconnect the pressure transducer. CAUTION, do not forget to reconnect the pressure transducer and to close the relieving shut-off valve. Failure to do so could damage the seal and lead to water infiltration;</p> <p>C. Operate the slide-out with the manual override procedures.</p>
When extending, the slide-out stops after having extended by 1 inch	<p>A. The security pin valve solenoid circuit is shorted to (+) 24-volt and the pin remains engaged;</p>	<p>A. Disconnect air supply from the safety pin cylinder;</p>
Transmission DRIVE range or REVERSE cannot be selected (the slide-out telltale light is illuminating).	<p>A. Slide-out not in full "in" position;</p> <p>B. Faulty "in limit" sensor. The slide-out is retracted but the controller doesn't see it as retracted.</p>	<p>A. Retract slide-out.</p> <p>B. Confirm that all slide-out are retracted. On the slide-out control panel, disconnect the 5 pins green connector on the I/O-B module to disable the transmission inhibit. CAUTION, this is a temporary measure, the vehicle must be serviced as soon as possible.</p>

21.3 TROUBLESHOOTING - MECHANICAL COMPONENTS

PROBLEM	CAUSE	CORRECTIVE ACTION
Slide-out does not retract or extend when depressing the control switch.	A. Electrical motor failure; B. Speed reduction gearbox failure; C. Security pin still engaged in receptacle;	A. Replace motor. B. Inspect gearbox components, particularly: bronze wheel or first reduction stage output shaft. Replace damaged components. C. Disengage pin and check if air cylinder is damaged.
Slide-out is not straight once retracted or during retracting or extending operation.	A. Broken rack tooth; B. Faulty rack attachment; C. Faulty shaft key at speed reduction gearbox or jaw coupling; D. Pinion keyless bushing slipping; E. Shaft breaking; F. Flange bearing attachment loosen;	A. Replace rack. B. Tighten mounting bolts, apply proper torque and use Loctite threadlocker (replace rack if necessary). C. Replace key or component having a damaged keyway. D. Realign slide-out and apply proper torque to keyless bushing. E. Replace shaft. F. Reposition shaft and tighten flange bearing mounting bolts.
Slide-out moves out slightly when vehicle is traveling.	A. Lower "in limit" stoppers are not leaning against the structure at the moment when the "in limit" sensor detects the magnet;	A. Adjust the sensor position in order to have contact of the stoppers against the structure at the time when the system stops the slide-out retraction.
Slide-out moves when vehicle is moving.	A. Inflatable seal not inflated	A. Check seal condition and seal air supply system.
Slide-out retracts or extends difficultly.	A. Foreign matters accumulated in the linear bearing;	A. Inspect the linear bearing end seals to see if they are in good condition. If not, replace the end seals and clean the inside of linear bearing.
Slide-out oscillates vertically when retracting or extending	A. Linear bearing balls hardened due to a too heavy load; B. Linear bearing mounting bolts loosen;	A. If balls clearance is excessive, replace linear bearing. B. Tighten mounting bolts.
Slide-out vibrating or noisy when extending or retracting	A. Acetal plastic block rubbing against the slide-out structure; B. Worn-out anti-friction coating on wiper seal around slide-out; C. Lower acetal plastic block rubbing against rail;	A. Realign acetal plastic block. B. Replace wiper seal. C. Remove lower acetal plastic block and machine down 1mm (0.039").
Top of slide-out moves sideways when vehicle is	A. Roof reinforcing rod misadjusted;	A. Readjust as per procedure.

PROBLEM	CAUSE	CORRECTIVE ACTION
moving		
Slide-out does not retract up to its full "in" position	A. Interference between the exterior extrusion and the vehicle upper horizontal member above the slide-out;	A. Check for straightness of horizontal member and adjust the roof reinforcing rod. B. Check for outer wiper seal lip straightness on the slide-out roof.
Bottom of slide-out not flush with vehicle body	A. Broken or misadjusted lower "in limit" stopper; B. Lower "in limit" stoppers are not leaning against the structure at the moment when the "in limit" sensor detects the magnet; C. Acetal plastic block serving as leaning surface for lower "in limit" stopper broken or moved;	A. Replace or adjust lower "in limit" stopper. B. Adjust the sensor position in order to have contact of the stoppers against the structure when slide-out is stopped. C. Replace or adjust acetal plastic block proper position.
Top of slide-out not flush with vehicle body	A. Broken or misadjusted leveling or retaining screw; B. Faulty upper "in limit" stopper;	A. Check and replace screw. B. Replace upper "in limit" stopper.
Lower edge of slide-out not parallel with vehicle body opening	A. Faulty leveling and retaining screw (8 screws each side).	A. Inspect screw, replace and adjust slide-out level.
Watertightness problem	A. Inflatable seal and/or wiper seal damaged or unstuck; B. Insufficient air pressure in the seal; C. No air pressure in the slide-out pneumatic system; D. Sealant missing; E. Wiper seal draining hole clogged; F. Faulty water recovery pan; G. Faulty internal gutter;	A. Check both seals condition. B. Check the pressure regulator, the relieving shut-off valve and the seal valve condition. C. Check the slide-out air pressure inlet valve condition and the accessory air tank pressure. D. Check the exterior extrusion screws, the windows and the exterior panels sealant condition. E. Unclog draining hole. F. Check the recovery pan. G. Check internal gutter.
Knocking sound at end of travel when extending slide-out	A. Inner stoppers misadjusted;	A. Readjust the inner stoppers.
Knocking sound when parking brake is released	A. Security pin retracts too rapidly;	A. Adjust security pin air flow regulator.
Inflatable seal damaged or	A. Slide-out has been retracted or extended	A. Always deflate the seal when

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PROBLEM	CAUSE	CORRECTIVE ACTION
removed, or wiper seal unstuck from the structure.	<p>with the manual procedure with the inflatable seal not deflated;</p> <p>B. Pressure transducer malfunction;</p> <p>C. Faulty roof reinforcing rod adjustment;</p> <p>D. Seal valve malfunction;</p> <p>E. Excessive load in the slide-out;</p> <p>F. Slide-out not centered in the structure opening;</p>	<p>manually retracting or extending the slide-out.</p> <p>B. Check the pressure transducer condition, replace if necessary.</p> <p>C. Readjust the roof reinforcing rod.</p> <p>D. Check the seal valve condition.</p> <p>E. Reduce load or distribute load evenly in order to respect the deflection criterion and slide-out load capacity.</p> <p>F. Readjust the slide-out height and center horizontally in opening.</p>
Friction at end of travel when in full OUT position or at beginning of retraction	A. Interference between upper structure key and upper inner stopper;	A. Readjust the upper inner stopper.

21.4 SLIDE-OUT FAULT MESSAGE ON MESSAGE CENTER DISPLAY (MCD)

SID #	FAULT MESSAGE	TEXT	PROBABLE CAUSE	CORRECTIVE ACTION
1	Voltage Module A56	Value Too Low	Module A56 sees a Voltage less than 18 V on its power supply connector. Breaker, fuse or wiring harness open.	Check/ reset circuit breaker CBSo and CBSo1. Check/ replace fuse FSo5 Fix wiring harness
2	No Response Mod A56	Data Error	CECM module does not receive CAN communication from module A56. CAN connector A56 J3 Disconnected or CAN wiring harness open, or module A56 is defective.	Check connection A56 J3 Fix CAN wiring harness Replace module A56
3	Voltage Module A57	Value Too Low	Module A57 sees a voltage less than 18 V on its power supply connector. Breaker, fuse or wiring harness open.	Check/ reset circuit breaker CBSo and CBSo2. Check/ replace fuse FSo2 Fix wiring harness
4	No Response Mod A57	Data Error	CECM module does not receive CAN communication from module A57. CAN connector A57 J3 disconnected or CAN wiring harness open or module A57 is defective.	Check connection A57 J3 Fix CAN wiring harness Replace module
5	SldO Vacuum Sensor	Open Circuit	Pressure transducer disconnected. Faulty pressure transducer. Connection or wiring harness open.	Check/ replace vacuum transducer Check/ reconnect the connector SESo1 Fix wiring harness
		Shorted High	Pressure transducer is faulty Wiring harness shorted to 12v or 24v	Check/ replace vacuum transducer Fix wiring harness
6	SldO Seal Deaf Vac	Mechanical Fault	Does not reach vacuum level (-5 PSIG). Slide-out seal damaged or air leak in the seal deflating pneumatic circuit.	Check the seals and the pneumatic circuit.
7	SldO Motor/Limit se	Mechanical Or Electrical Fault	Slide-Out motor is activated for more than 5 seconds and the limit sensor from the departing end is still seen as active. Either the motor is defective and the slide-out is not moving or the limit sensor from the departing end is broken active.	If the slide-Out is not moving, then check the motor and its wiring. If the slide-out is moving, then check the limit sensor from the departing end. (If problem occurs when extending, check the in-limit sensor. If the problem occurred when retracting, then check the out-limit sensor).
8	SldO Park Br Signal	Mechanical Or Electrical Fault	Parking brake is not applied. Wire between parking brake switch and CECM is open.	Make sure the parking brake is applied and the parking brake telltale illuminates. Check / replace parking brake switch. Fix wiring harness.
		Shorted High	Wire between parking brake	Fix wiring harness.

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SID #	FAULT MESSAGE	TEXT	PROBABLE CAUSE	CORRECTIVE ACTION
			switch and CECM is shorted to 12v or 24v.	
9	SldO Mot SpeedA Ctr	Shorted High	Wiring harness shorted to 12v or 24v	Fix wiring harness
		Current Above normal	Security pin or object stop the movement of a slide-out	Check / fix security pin functionality. Check / remove any object around the slide-out.
10	SldO Mot SpeedB Ctr	Shorted High	Wiring harness shorted to 12v or 24v	Fix wiring harness
		Current Above normal	Security pin or object stop the movement of a slide-out	Check / fix security pin functionality. Check / remove any object around the slide-out.
11	SldO Remote Led	Shorted High	LED or wiring harness shorted to 12v or 24v	Fix LED or wiring harness
		Shorted Low	Led or wiring harness shorted to ground	Fix LED or wiring harness
		Open Circuit	LED is broken. Bad connection on handheld control. Wiring harness is cut.	Check / fix remote LED or connection Check /fix wiring harness
		Current Above normal	Led or wiring harness shorted to 12v or 24v	Fix Led or wiring harness
12	SldO Seal Inf Sol	Shorted High	Solenoid or wiring harness shorted to 12v or 24v	Fix solenoid or wiring harness
		Shorted Low	Solenoid or wiring harness shorted to ground	Fix solenoid or wiring harness
		Open Circuit	Solenoid is broken or open. Bad connection on solenoid or bloc valve. Wiring harness is cut.	Check / fix solenoid or connection Check /fix wiring harness
		Current Above normal	Solenoid or wiring harness shorted to 12v or 24v	Fix solenoid or wiring harness
13	SldO Seal Def Sol	Shorted High	Solenoid or wiring harness shorted to 12v or 24v	Fix solenoid or wiring harness
		Shorted Low	Solenoid or wiring harness shorted to ground	Fix solenoid or wiring harness
		Open Circuit	Solenoid is broken or open. Bad connection on solenoid or bloc valve. Wiring harness is cut.	Check / fix solenoid or connection. Check /fix wiring harness
		Current Above normal	Solenoid or wiring harness shorted to 12v or 24v	Fix solenoid or wiring harness
14	SldO Vacc Gen Sol	Shorted High	Solenoid or wiring harness shorted to 12v or 24v	Fix solenoid or wiring harness
		Shorted Low	Solenoid or wiring harness shorted to ground	Fix solenoid or wiring harness
		Open Circuit	Solenoid is broken or open. Bad connection on solenoid or bloc valve. Wiring harness is cut.	Check / fix solenoid or connection Check / fix wiring harness
		Current Above normal	Solenoid or wiring harness shorted to 12v or 24v	Fix Solenoid or wiring harness
15	SldO Mot Neg Rly	Shorted High	Relay coil or wiring harness shorted to 12v or 24v	Fix relay coil or wiring harness
		Shorted Low	Relay coil or wiring harness shorted to ground	Fix relay coil or wiring harness
		Open Circuit	Relay coil is broken or open.	Check / fix relay coil or

SID #	FAULT MESSAGE	TEXT	PROBABLE CAUSE	CORRECTIVE ACTION
			Bad connection on relay. Wiring harness is cut.	connection Check / fix wiring harness
		Current Above normal	Relay coil or wiring harness shorted to 12v or 24v	Fix relay coil or wiring harness
16	SldO Mot Pos Rly	Shorted High	Relay coil or wiring harness shorted to 12v or 24v	Fix relay coil or wiring harness
		Shorted Low	Relay coil or wiring harness shorted to ground	Fix relay coil or wiring harness
		Open Circuit	Relay coil is broken or open. Bad connection on relay. Wiring harness is cut.	Check / fix relay coil or connection Check / fix wiring harness
		Current Above normal	Relay coil or wiring harness shorted to 12v or 24v	Fix relay coil or wiring harness
17	SldO Open Sw	Shorted High	Switch or wiring harness shorted to 12v or 24v	Fix switch or wiring harness
18	SldO Close Sw	Shorted High	Switch or wiring harness shorted to 12v or 24v	Fix switch or wiring harness
19	SldO Limit In Se	Shorted High	Sensor or wiring harness shorted to 12v or 24v	Fix sensor or wiring harness
20	SldO Limit Out Se	Shorted High	Sensor or wiring harness shorted to 12v or 24v	Fix sensor or wiring harness
21	SldO Secu Pin Sol	Shorted High	Solenoid or wiring harness shorted to 12v or 24v	Fix solenoid or wiring harness
		Shorted Low	Solenoid or wiring Harness shorted to ground	Fix solenoid or wiring harness
		Open Circuit	Solenoid is broken or open. Bad connection on solenoid or bloc valve. Wiring harness is cut.	Check / fix solenoid or connection. Check / fix wiring harness
		Current Above normal	Solenoid or wiring harness shorted to 12v or 24v	Fix solenoid or wiring harness
22	SldO Limit In Out	Mechanical Or Electrical Fault	In Limit and Out Limit are seen at the same time. In Limit or Out Limit problem.	Check / replace in limit or out limit sensors Fix wiring harness.
23	Limit Sensor 5 V supply	Shorted Low	5v IO-B output is less than 2v. Wiring harness is open or shorted to ground.	Check 5v output on IO-B / replace IO-B module. Fix wiring harness.