PREVOST

MAINTENANCE MANUAL

X3-45 COMMUTER COACH

PA-1648

MAINTENANCE MANUAL

X3-45 COMMUTER

DOB 1300-1556

B40668

PA-1648

PA-1648

Featuring:

- New front and rear aerodynamic design
- New flush mount windshield aerodynamic extrusion
- New Electrical Architecture
- New Electrical Fan Cooling

This manual is applicable from the following vehicles:

- Short VIN M-7751

REV	FROM V.I.N.	DESCRIPTION	ISSUED
00		Initial release	Oct 2020
01	M-7751	Maintenance schedule updated	Dec 2021
02	N-7978	Introduction of Davco Fuel Pro 386 primary fuel filter	Aug 2022
03	-	Maintenance schedule modified	Oct 2022
04	-	Maintenance schedule modified	Dec 2023

CRITICAL EMISSION-RELATED MAINTENANCE

Source of parts and repair:

A repair shop or person of the owner's choosing must maintain, replace, or repair emission control devices and systems per manufacturer's recommendations.

Replacement of tires that are GHG certified:

The original equipment tires installed on this vehicle at the factory were certified to the U.S. EPA Greenhouse Gas (GHG) and **National Highway Traffic Safety Administration (NHTSA)** Fuel Efficiency regulations. Replacement of these tires should be with a tire of equal or lower rolling resistance levels (TRRL or Crr). Please consult your tire supplier(s) for appropriate replacement tires.

Maintaining a GHG certified tire:

In order to maintain the certified rolling resistance of the tires which optimize fuel economy, the maintenance procedures provide by the tire manufacturer must be followed.

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1. FOREWORD

This manual includes procedures for diagnosis, service, maintenance and repair for components of all series of Prevost coaches and motorhomes listed on the front cover. 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 26 pertains to standard equipment items, systems and components as well as the most commonly used optional equipment and special equipment offered on the vehicle models covered by this manual. At the beginning of each section: a Table of Contents gives the page number on which each subject begins.

Vehicle operating information is provided in a separate Operator's Manual for coaches or Owner's Manual. Audio/Video system operator instructions are also included in a separate manual.

More specific information on the engine, transmission and other systems or components operating, maintenance, and overhaul information is contained in the applicable service manual published by the OEM. Parts information may be contained in the applicable OEM parts catalog or service manual published by the OEM. 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
Illustrations in this manual are used for reference only and may differ slightly from the actual vehicle, however, key components addressed in the manual are represented as accurately as possible.

Prevost 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 pneumatic and electrical schematics can be found in your technical publications box. Refer to those schematics for detailed circuit information and diagnosis.

3. 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:

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

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

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

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

3.1 DATA PLATES AND CERTIFICATIONS

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

3.1.1 Engine

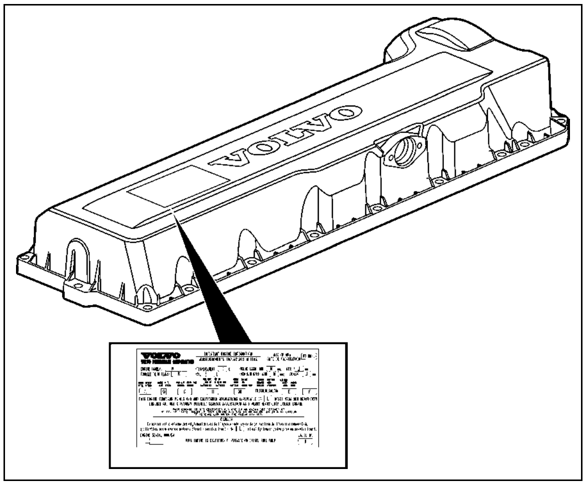

FIGURE 1: VOLVO D13 ENGINE DATA PLATE 00052

Volvo D13 engine serial and model numbers are stamped on the cylinder head. Also, the engine data plate certifies that the engine conforms to federal and any state exhaust emission regulations. It gives the operating conditions under which certification was made (Figure 1).

3.1.2 Transmission

The transmission identification plate is located on the oil level dipstick side of the Allison transmission (Figure 2). The identification plate shows the transmission serial number, part number (assembly number), and model number. Use all three numbers when ordering parts.

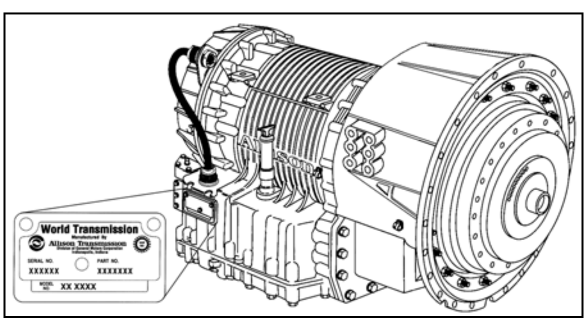

FIGURE 2: ALLISON TRANSMISSION DATA PLATE
07076

3.1.3 Drive Axle

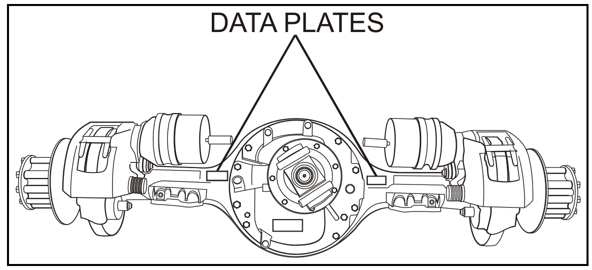

FIGURE 3: DATA PLATE LOCATION 00007

3.1.4 Front Axles

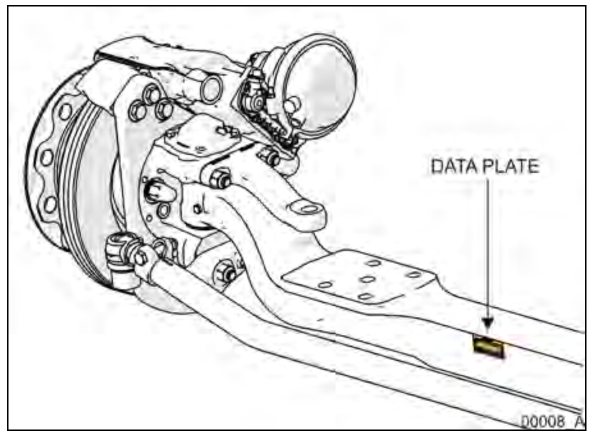

FIGURE 4: I-BEAM AXLE DATA PLATE

3.1.5 Power Steering Pump

Power steering pump is mounted on the R.H. side of the engine and located at the connection between the engine and the transmission (Figure 5).

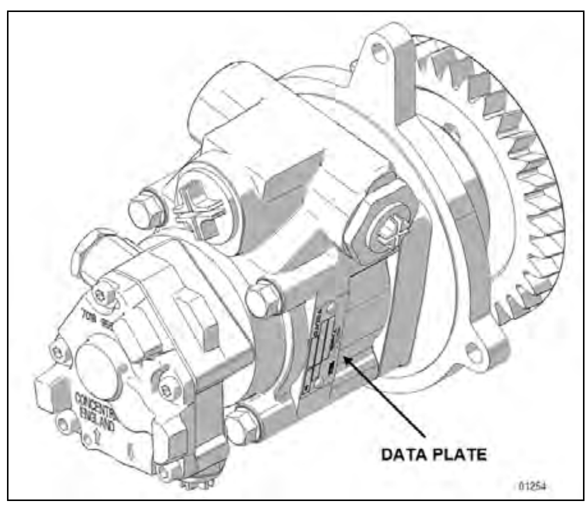

FIGURE 5: POWER STEERING PUMP DATA PLATE

3.1.6 Coach Final Record

The Coach Final Record is a record of all data pertaining to the assembly of the vehicle. This record is given to the new customer on the vehicle delivery. Retain this record in the company records office for reference and safe-keeping.

3.1.7 Safety Certification

Vehicle 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.

3.1.8 DOT Certification Label

This certifies that vehicles manufactured by Prevost Car Inc., comply with all Federal Motor Vehicle Safety Standards at the time of manufacture. Information such as the date of manufacture, model year, gross vehicle weight rating, tire types and inflation pressure is also etched on this plate. The DOT Certification plate is affixed behind the driver's seat (Figure 6).

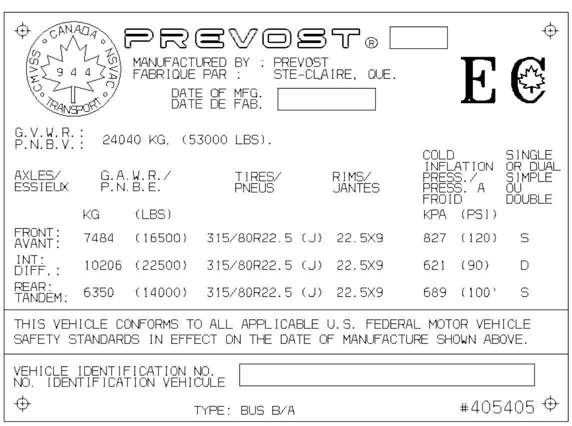

FIGURE 6: DOT CERTIFICATION PLATE 00016

3.1.9 Fuel Tank Label

The fuel tank label is molded in front of the fuel tank (**Figure 7**).

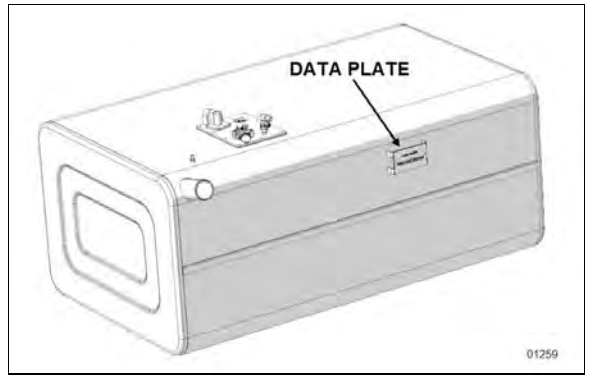

Figure 7: FUEL TANK DATA PLATE

3.1.10 EPA Engine Label

The exhaust emission certification label affixed in the engine compartment certifies that the engine conforms to federal and any state exhaust emission regulations (Figure 8). It gives the operating conditions under which certification was made.

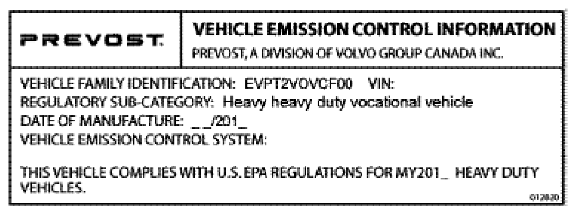

FIGURE 8: EMISSION CONTROL LABEL 23229

3.1.11 Vehicle Identification Number (VIN)

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

FIGURE 9: VEHICLE VIN

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

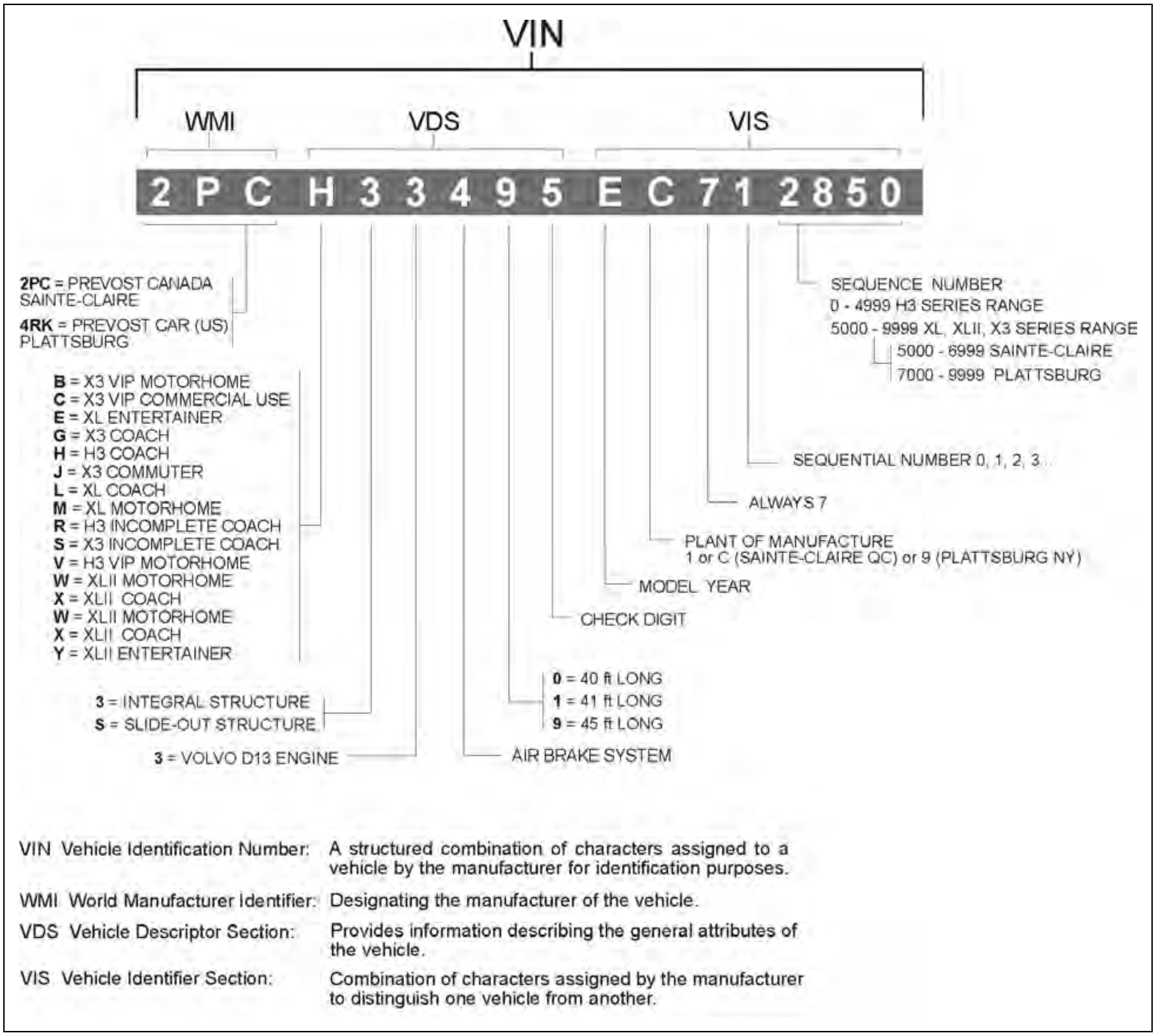

FIGURE 10: VEHICLE IDENTIFICATION NUMBER 00057_5

YEAR	CODE	YEAR	CODE	YEAR	CODE
1997	V	2005	5	2013	D
1998	W	2006	6	2014	E
1999	X	2007	7	2015	F
2000	Y	2008	8	2016	G
2001	1	2009	9	2017	H
2002	2	2010	A	2018	J
2003	3	2011	B	2019	K
2004	4	2012	C	2020	L

4. FASTENER

4.1 FASTENER STRENGTH IDENTIFICATION

Most commonly used metric fastener strength property classes are 9.8 and 10.9 with the class identification embossed on the head of each bolt. Customary (inch) strength classes range from grades 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. Figure 12 shows the different strength markings.

When replacing metric fasteners, be careful to use fasteners of the same or greater strength than the original fasteners (the same number marking or higher). It is also important to select replacement fasteners of the correct size. Correct replacement fasteners are available through the parts division. Some metric fasteners available in aftermarket parts sources were designed to metric standards of countries other than the United States and may be of a lower strength, may not have the numbered head marking system, and may be of a different thread pitch.

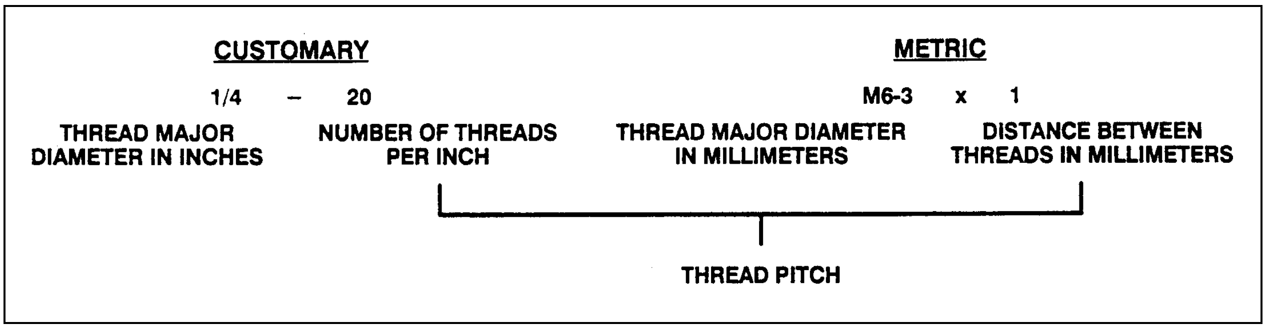

FIGURE 11: THREAD NOTATION 00002

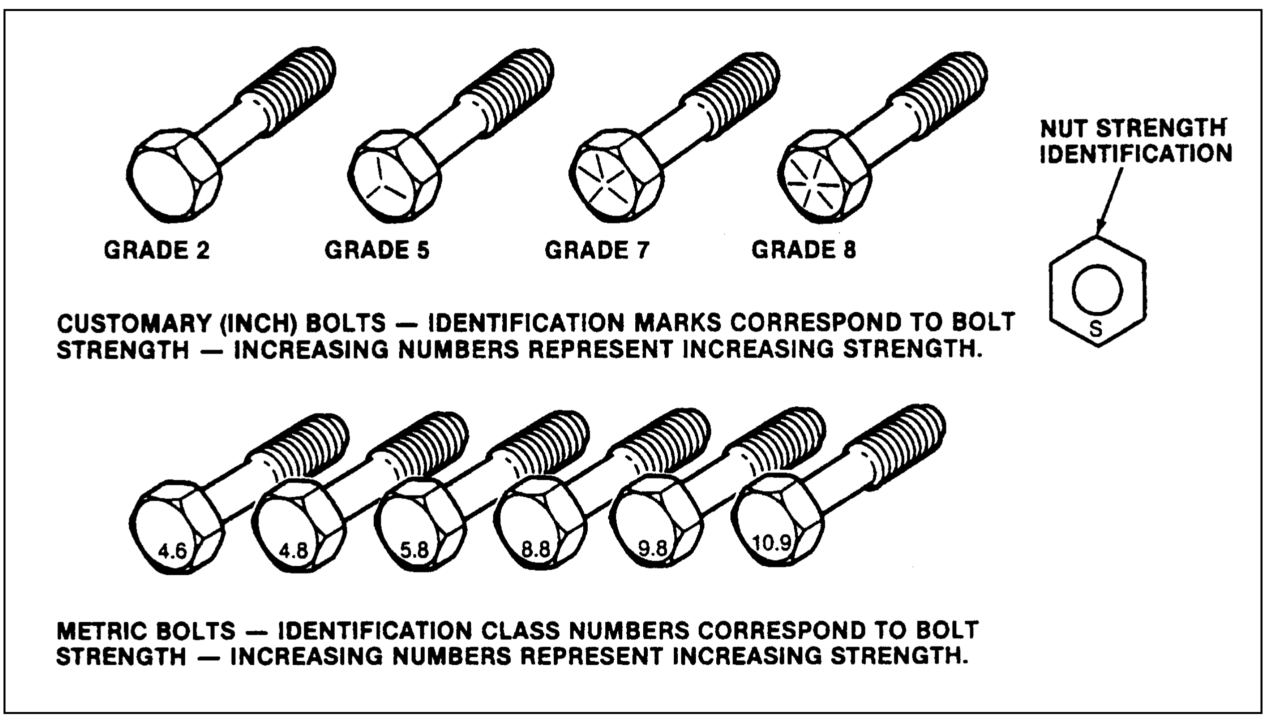

FIGURE 12: BOLT STRENGTH MARKINGS 00003

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

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

4.2 STANDARD TORQUE SPECIFICATIONS

The following table lists the standard tightening torque for bolts and nuts, relating tightening torque to thread diameter. Use the following table as a general guide for tightening torque. 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.

4.2.1 SAE

TYPE	DESCRIPTION	THREAD	GRADE	RECOMMENDED TORQUE Tolerance: ±10%
SAE	1/4-20	unc	5	96 lb-in (11 Nm)
SAE	1/4-20	unc	8	135 lb-in (15 Nm)
SAE	1/4-28	unf	5	106 lb-in (12 Nm)
SAE	1/4-28	unf	8	149 lb-in (17 Nm)
SAE	5/16-18	unc	5	188 lb-in (21 Nm)
SAE	5/16-18	unc	8	266 lb-in (30 Nm)
SAE	5/16-24	unf	2	131 lb-in (15 Nm)
SAE	5/16-24	unf	5	202 lb-in (23 Nm)
SAE	5/16-24	unf	8	286 lb-in (32 Nm)
SAE	3/8-16	unc	5	27 lb-ft (37 Nm)
SAE	3/8-16	unc	8	38 lb-ft (52 Nm)
SAE	3/8-24	unf	5	30 lb-ft (41 Nm)
SAE	3/8-24	unf	8	42 lb-ft (57 Nm)
SAE	7/16-14	unc	5	43 lb-ft (58 Nm)
SAE	7/16-14	unc	8	60 lb-ft (81 Nm)
SAE	7/16-20	unf	5	46 lb-ft (62 Nm)
SAE	7/16-20	unf	8	65 lb-ft (88 Nm)
SAE	1/2-13	unc	5	65 lb-ft (88 Nm)
SAE	1/2-13	unc	8	92 lb-ft (125 Nm)
SAE	1/2-20	unf	5	71 lb-ft (96 Nm)
SAE	1/2-20	unf	8	100 lb-ft (136 Nm)
SAE	9/16-12	unc	5	94 lb-ft (127 Nm)

TYPE	DESCRIPTION	THREAD	GRADE	RECOMMENDED TORQUE Tolerance: ±10%
SAE	9/16-12	unc	8	132 lb-ft (179 Nm)
SAE	9/16-18	unf	5	101 lb-ft (137 Nm)
SAE	9/16-18	unf	8	143 lb-ft (194 Nm)
SAE	5/8-11	unc	5	130 lb-ft (176 Nm)
SAE	5/8-11	unc	8	184 lb-ft (249 Nm)
SAE	5/8-18	unf	5	142 lb-ft (193 Nm)
SAE	5/8-18	unf	8	200 lb-ft (271 Nm)
SAE	3/4-10	unc	5	228 lb-ft (309 Nm)
SAE	3/4-10	unc	8	321 lb-ft (435 Nm)
SAE	3/4-16	unf	5	245 lb-ft (332 Nm)
SAE	3/4-16	unf	8	346 lb-ft (469 Nm)
SAE	7/8-9	unc	5	368 lb-ft (499 Nm)
SAE	7/8-9	unc	8	519 lb-ft (704 Nm)
SAE	7/8-14	unf	5	392 lb-ft (531 Nm)
SAE	7/8-14	unf	8	554 lb-ft (751 Nm)

SAE	A2-70 (NSS-SS)
DESCRIPTION COARSE THREAD	RECOMMENDED TIGHTENING (LB-FT) Tolerance: ±10%
	DRY
8-32	21
10-32	34
1/4-20	77
5/16-18	152
DESCRIPTION COARSE THREAD	RECOMMENDED TIGHTENING (LB-FT) Tolerance: ±10%
	DRY
3/8-16	22
7/16-14	34
1/2-13	53

4.2.2 Metric

TYPE	DESCRIPTION	THREAD	GRADE	RECOMMENDED TORQUE, ±10% lb-ft (dry) otherwise specified Tolerance: ±10%
METRIC	M6 X 1		nut 8 / screw 8.8	7 lb-ft (10 Nm)
METRIC	M6 X 1		nut 10 / screw 10.9	10 lb-ft (13 Nm)
METRIC	M6 X 1		nut 12 / screw 12.9	12 lb-ft (16 Nm)
METRIC	M8 X 1.25		nut 8 / screw 8.8	17 lb-ft (23 Nm)
METRIC	M8 X 1.25		nut 10 / screw 10.9	24 lb-ft (32 Nm)
METRIC	M8 X 1.25		nut 12 / screw 12.9	28 lb-ft (38 Nm)
METRIC	M10 X 1.5		nut 8 / screw 8.8	35 lb-ft (47 Nm)
METRIC	M10 X 1.5		nut 10 / screw 10.9	48 lb-ft (65 Nm)
METRIC	M10 X 1.5		nut 12 / screw 12.9	56 lb-ft (76 Nm)
METRIC	M12 X 1.75		nut 8 / screw 8.8	59 lb-ft (80 Nm)
METRIC	M12 X 1.75		nut 10 / screw 10.9	82 lb-ft (111 Nm)
METRIC	M12 X 1.75		nut 12 / screw 12.9	96 lb-ft (130 Nm)
METRIC	M14 X 2		nut 8 / screw 8.8	94 lb-ft (128 Nm)
METRIC	M14 X 2		nut 10 / screw 10.9	130 lb-ft (176 Nm)
METRIC	M14 X 2		nut 12 / screw 12.9	152 lb-ft (206 Nm)
METRIC	M16 X 2		nut 8 / screw 8.8	143 lb-ft (194 Nm)
METRIC	M16 X 2		nut 10 / screw 10.9	198 lb-ft (268 Nm)
METRIC	M16 X 2		nut 12 / screw 12.9	231 lb-ft (314 Nm)
METRIC	M16 X 1.5		nut 10 / screw 10.9	206 lb-ft (279 Nm)
METRIC	M16 X 1.5		nut 12 / screw 12.9	241 lb-ft (326 Nm)
METRIC	M20 X 2.5		nut 8 / screw 8.8	280 lb-ft (379 Nm)
METRIC	M20 X 2.5		nut 10 / screw 10.9	387 lb-ft (524 Nm)
METRIC	M20 X 2.5		nut 12 / screw 12.9	452 lb-ft (613 Nm)
METRIC	M20 X 1.5		nut 10 / screw 10.9	415 lb-ft (563 Nm)
METRIC	M20 X 1.5		nut 12 / screw 12.9	485 lb-ft (658 Nm)
METRIC	M22 X 2.5		nut 8 / screw 8.8	373 lb-ft (506 Nm)
METRIC	M22 X 2.5		nut 10 / screw 10.9	516 lb-ft (700 Nm)
METRIC	M22 X 2.5		nut 12 / screw 12.9	604 lb-ft (818 Nm)
METRIC	M24 X 3		nut 8 / screw 8.8	481 lb-ft (652 Nm)
METRIC	M24 X 3		nut 10 / screw 10.9	665 lb-ft (902 Nm)
METRIC	M24 X 3		nut 12 / screw 12.9	777 lb-ft (1054 Nm)

METRIC: STAINLESS NUT A2-70 AND STAINLESS SCREW A2-70 (NSS-SS)		
DESCRIPTION	RECOMMENDED TIGHTENING Tolerance: ±10% (N-M) DRY	RECOMMENDED TIGHTENING Tolerance: ±10% (LB-IN) DRY
M4 X 0.7	2.3	20
M5 X 0.8	4.4	39
M6 X 1	7.7	68
DESCRIPTION	RECOMMENDED TIGHTENING Tolerance: ±10% (N-M) DRY	RECOMMENDED TIGHTENING Tolerance: ±10% (LB-FT) DRY
M8 X 1.25	18.6	13.7
M10 X 1.5	37.3	27.5
M12 X 1.75	63.8	47.0

4.3 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 (Figure 13).

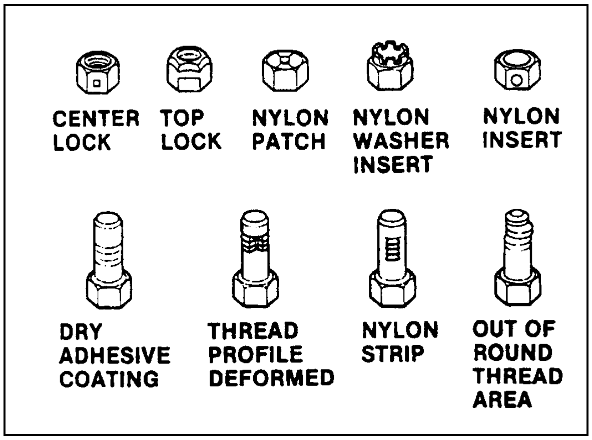

FIGURE 13: SELF-LOCKING FASTENERS 00004

4.4 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 over tightening. 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 the following table. 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

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SELF-LOCKING TORQUE CHART BEFORE FASTENER SEATS

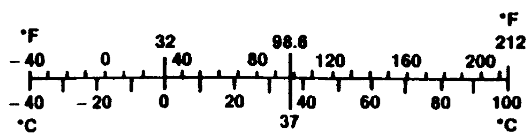
METRIC		6 & 6.3	8	10	12	14	16	20
NUTS AND ALL-METAL BOLTS	Nm	0.4	0.8	1.4	2.2	3.0	4.2	7.0
	lb-in	4.0	7.0	12	18	25	35	57
ADHESIVE OR NYLON COATED BOLTS	Nm	0.4	0.6	1.2	1.6	2.4	3.4	5.6
	lb-in	4.0	5.0	10	14	20	28	46

US STANDARD		¼	5/16	3/8	7/16	½	9/16	5/8	¾
NUTS AND ALL-METAL BOLTS	Nm	0.4	0.6	1.4	1.8	2.4	3.2	4.2	6.2
	lb-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
	lb-in	4.0	5.0	9.0	12	15	22	28	43

4.5 SIX LOBBED SOCKET HEAD

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

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



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

FIGURE 14: METRIC - US STANDARD CONVERSION TABLE

00005

DECIMAL AND METRIC EQUIVALENTS

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

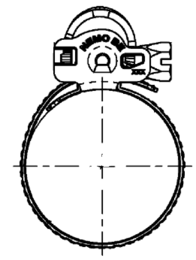
FIGURE 15: CONVERSION CHART 00006

4.6 HOSE CLAMP TORQUE

<u>ENGLISH</u>:	**HOSE CLAMP**	
DESCRIPTION CONSTANT TORQUE	**RECOMMENDED TIGHTENING (LB-IN)**	
		DRY
3/8 Hex		90-110

<u>ENGLISH</u>:	**HOSE CLAMP (WAVE SEAL AND BREEZE)**	
DESCRIPTION CONSTANT TORQUE	**RECOMMENDED TIGHTENING (LB-IN)**	
		DRY
5/16 Hex		55-65

<u>METRIC</u>:	**HOSE CLAMP (CAILLAU)**	
	RECOMMENDED TIGHTENING (LB-IN)	
		DRY
7 mm Hex		30±2.2



CAUTION

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

CAUTION

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

CAUTION

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

Refer to *Multiplex Modules Disconnection Procedure Prior to Welding* annexed at the end of this section.

5. WELDING PROCESS

5.1 STEEL – STEEL WELDING

CAUTION

Before welding, perform multiplex modules disconnection procedure.

NOTE

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

DANGER

Only a qualified and experienced person must do welding.

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

Material Thickness	Voltage	Current	Wire Feed Rate	Shielding Gas
1/8” to ½”	26 ± 2 volts	260 Amps	450 ipm approx.	75% argon – 25% CO_2 or 100% CO_2

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

- SMAW (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.

5.2 STEEL WITH STAINLESS OR STAINLESS WITH STAINLESS WELDING

CAUTION

Before welding, perform multiplex modules disconnection procedure.

NOTE

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

DANGER

Only a qualified and experienced person must do welding.

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

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

STAINLESS STEEL - STAINLESS STEEL WELDING

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

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

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

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

DISCONNECTION PROCEDURE PRIOR TO WELDING

Equipment(s):	Ratchet handle 3/8" socket
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.**

⚠ CAUTION

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

⚠ CAUTION

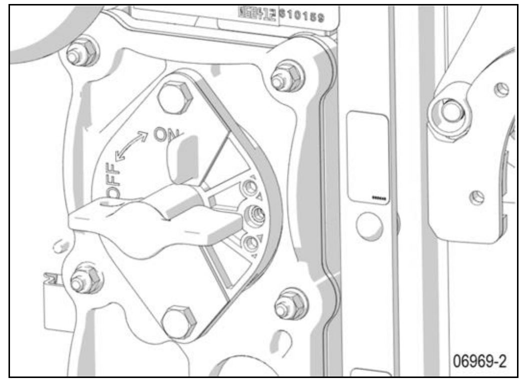
Do not use TIG welding process on the vehicle. This high frequency current process can seriously damage the electronic components.

Disconnection procedure prior to welding

PRECAUTIONS TO BE OBSERVED BEFORE ARC WELDING TO MINIMIZE THE RISK OF MAJOR AND COSTLY DAMAGES CAUSED TO THE VEHICLE ELECTRONIC COMPONENTS

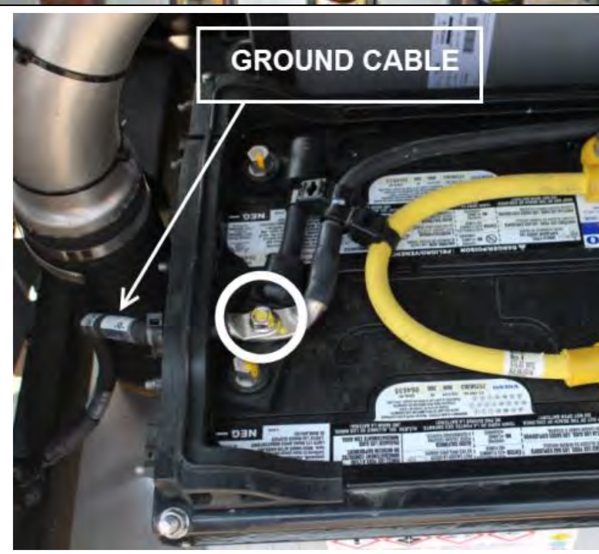
1. Turn the ignition switch to the OFF position.

2. Set the main electrical shut-off switch to the OFF position.



3. Trip circuit breakers CB2 & CB6.

4. Disconnect the chassis ground cable “00” (GND) from the appropriate battery post (figure on your right).



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.

5. Once the welding works completed, perform the previous steps in reverse order. Torque the ground cable nut according to specifications found in Section 06 Electrical.

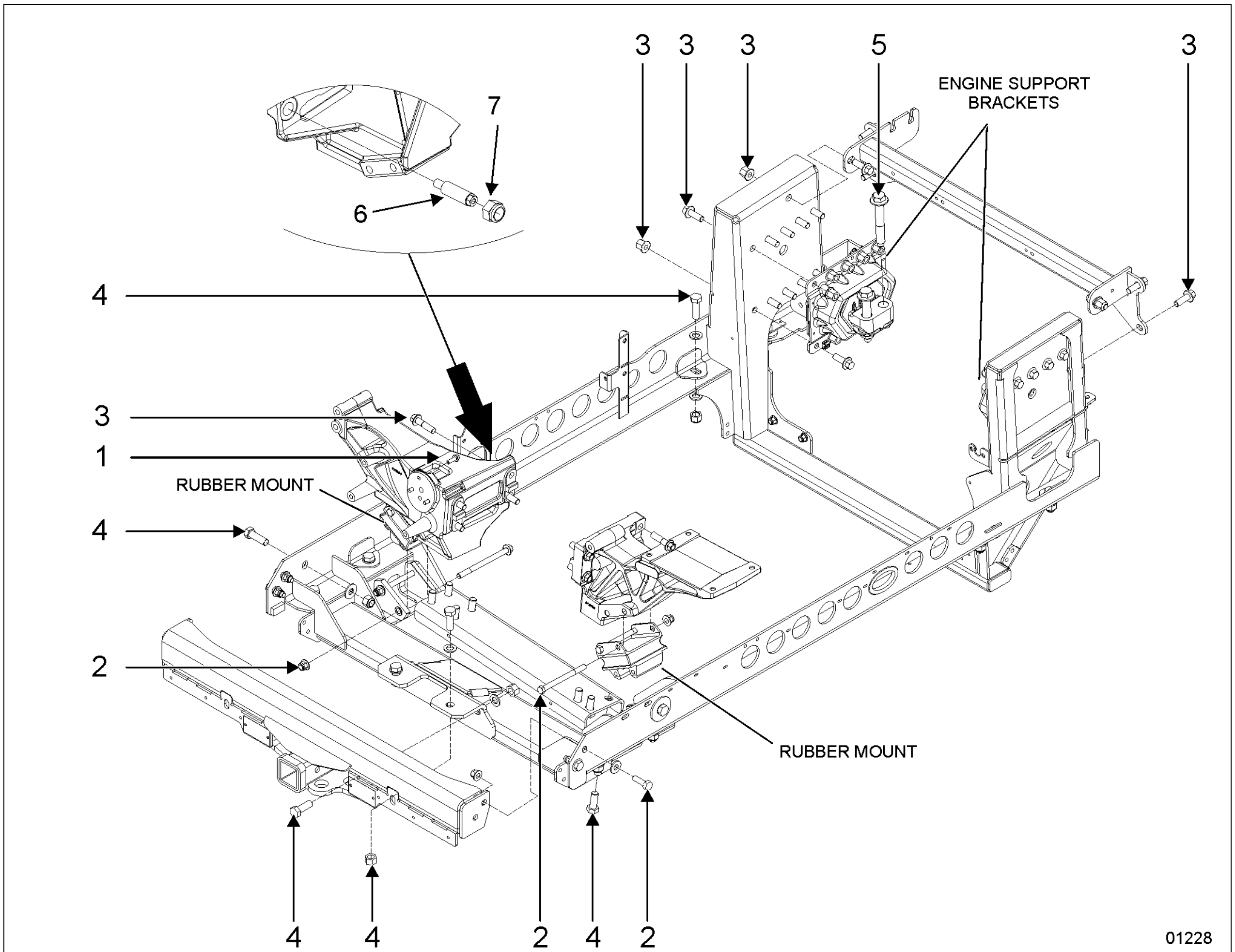
CONTENT

SECTION CHANGE LOG

	DESCRIPTION	DATE
1	Mention about 5w-30 oil added	Jan 15 2021
2		
3		
4		
5		
6		

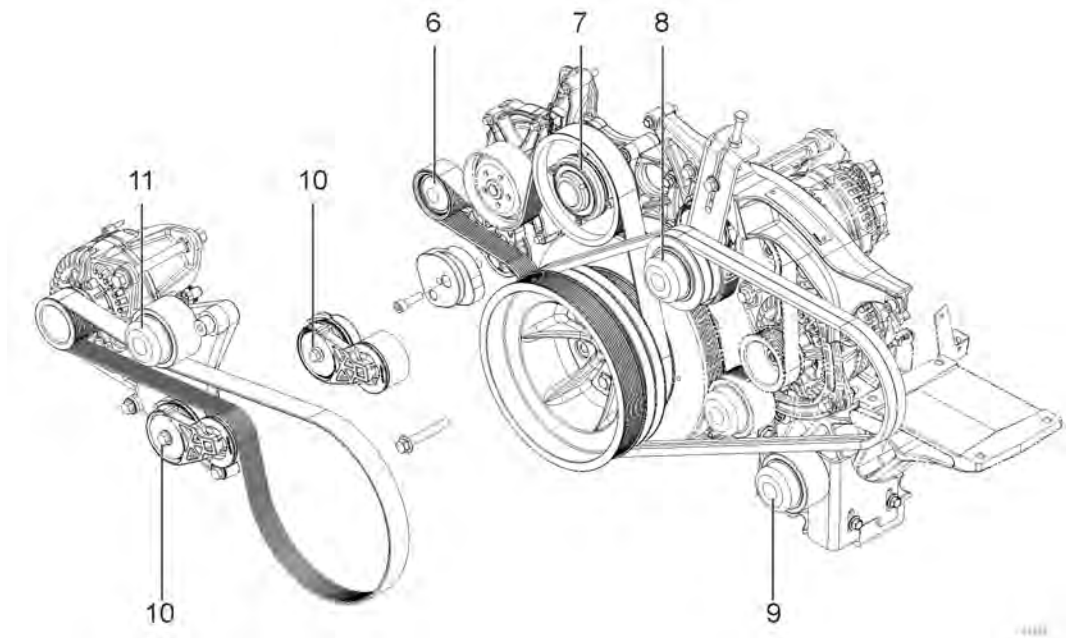
1. TORQUE TABLES

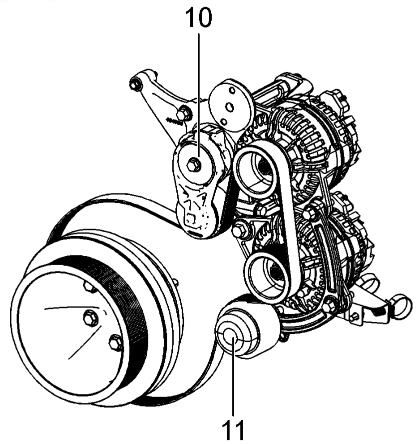
1.1 POWER PLANT CRADLE INSTALLATION



VOLVO ENGINE CRADLE INSTALLATION		
No	DESCRIPTION	TORQUE
1	Screw, cap hexagonal head M8 – 1.25 g8.8	14 lb-ft (19 Nm)
2	Screw, cap hexagonal head M12 – 1.75 g8.8	60 lb-ft (81 Nm)
3	Screw, cap hexagonal head M14 – 2.0 g8.8	94 lb-ft (128 Nm)
4	Screw, cap hexagonal head M16 – 2.0 g10.9	190 lb-ft (258 Nm)
5	Screw, cap hexagonal head M20 – 2.5 g10.9	450 lb-ft (610 Nm)
6	Ground stud M14 – 2.0	85-103 lb-ft (115-140 Nm)
7	Nut on ground stud M22 – 2.5	165-201 lb-ft (224-273 Nm)

1.2 BELT TENSIONERS AND IDLERS





VOLVO ENGINE – DRIVE BELT IDLERS & TENSIONERS		
No	DESCRIPTION	TORQUE
6	Idler, water pump drive	43 lb-ft (58 Nm)
7	Idler, water pump drive	pulley 16 lb-ft (22 Nm) shaft 32 lb-ft (43 Nm)
8	Idler, A/C compressor drive	31.5-38.5 lb-ft (43-52 Nm)
9	Idler, A/C compressor drive	82 lb-ft (111 Nm)
10	Tensioner, alternator drive	48 lb-ft (65 Nm)
11	Idler, alternator drive	82 lb-ft (111 Nm)

2. VOLVO D13 ENGINE

2.1 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. 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. 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 technician's diagnostic capabilities with additional data and tests.

For diagnostic software, contact your local dealer.

NOTE
For maintenance or repair information of engine components or engine-related components, please refer to Volvo Trucks USA Web site under: Parts & Services, Online Manuals. *http://www.volvotrucks.us/parts-and-services/service/online-manuals/*

2.2 ENGINE HARNESS

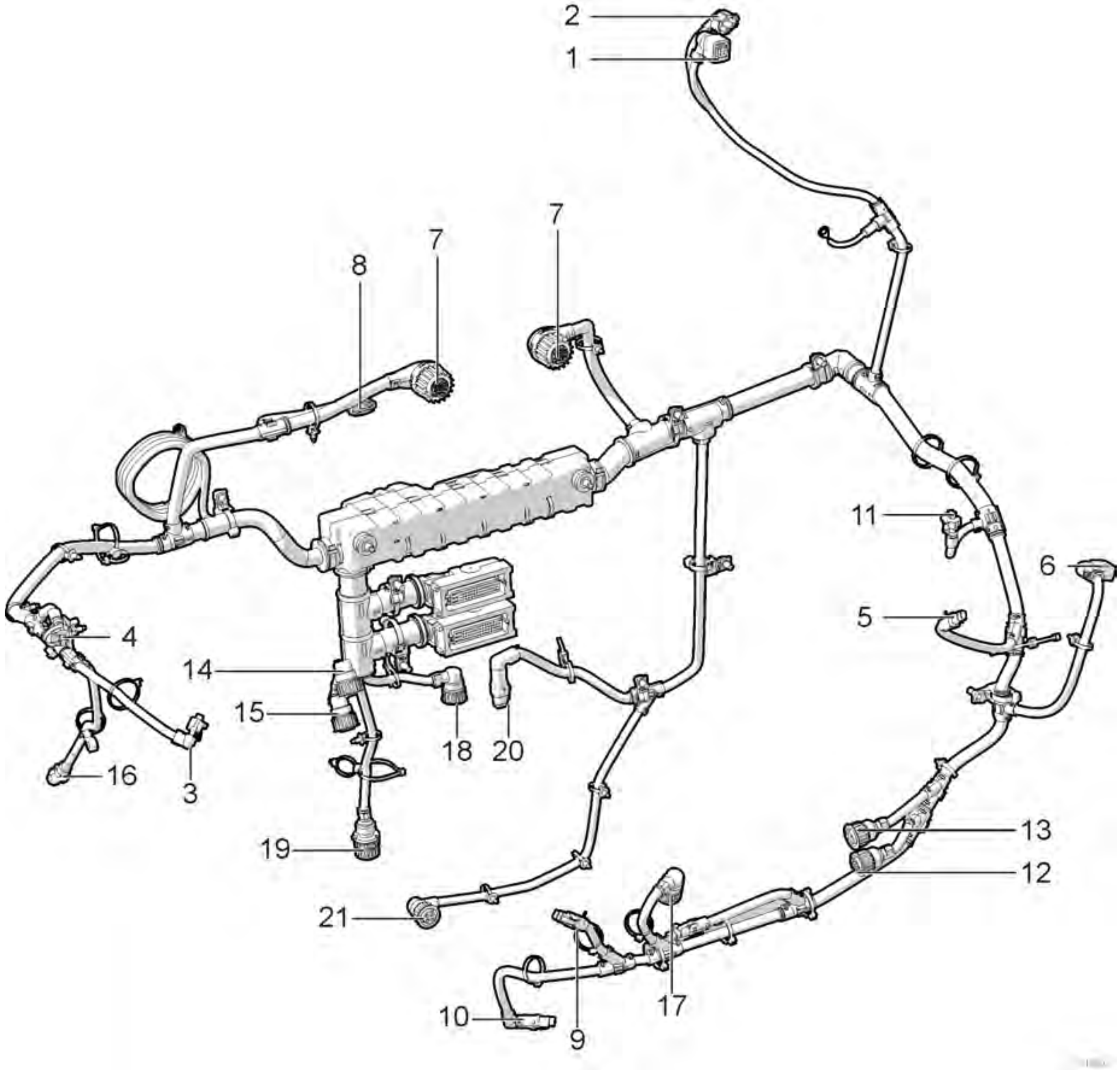
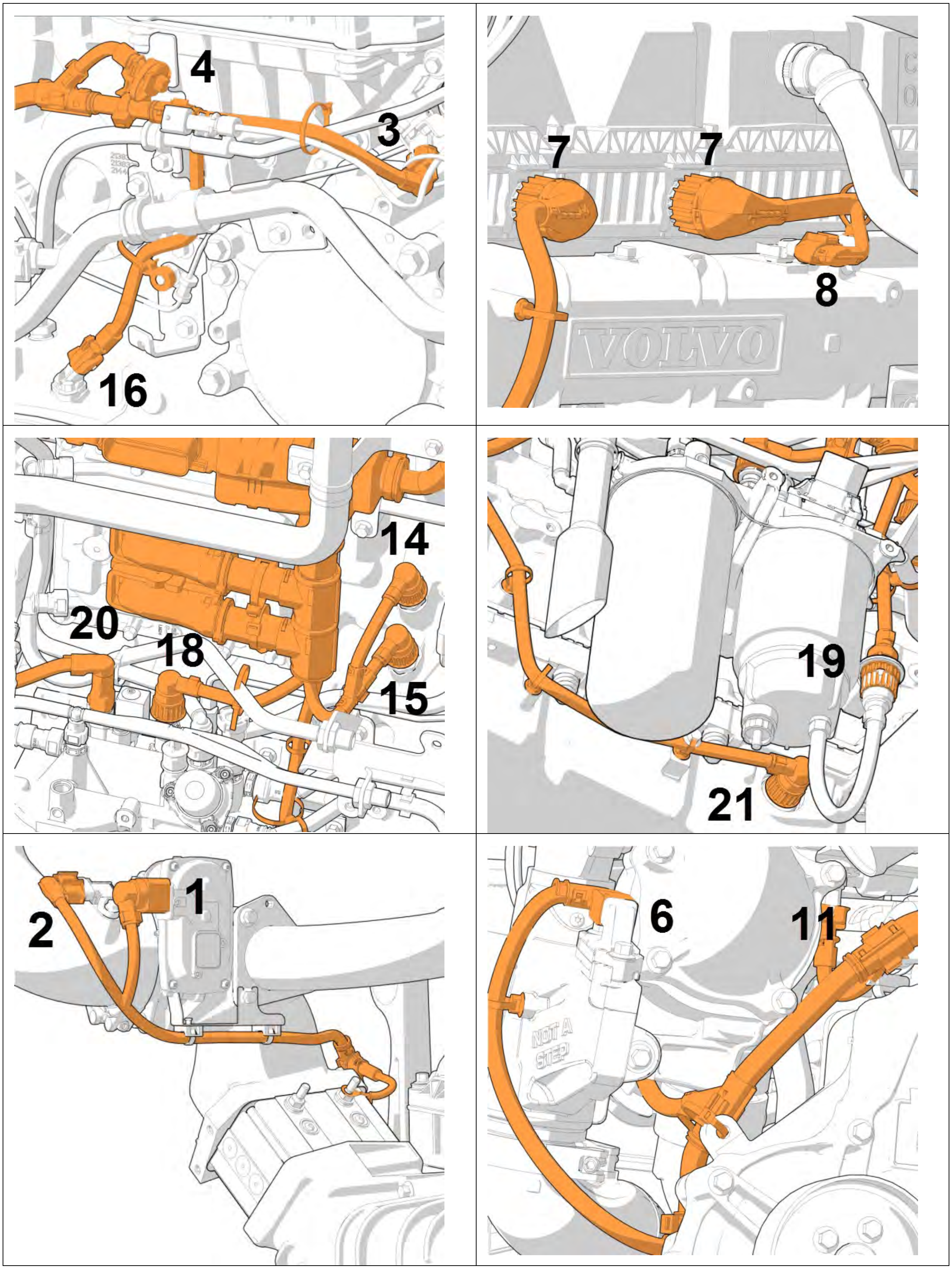


FIGURE 1: D13 ENGINE HARNESS

1. Throttle, Engine Air Mass Regulation 2. Charge Air Cooler Temperature Sensor 3. EGR Solenoid Valve 4. Engine Speed Sensor Camshaft 5. EGR Temperature sensor 6. EGR Delta-P (differential pressure) 7. Injector Harness 8. Boost Pressure & Temp sensor 9. Solenoid Valve Oil Thermostat 10. Solenoid Valve Oil Piston Cooling Jet 11. Engine Coolant Temperature Sensor	12. Variable geometry Turbo Actuator 13. Turbocharger Speed Sensor 14. Oil Pressure Sensor 15. Crankcase Pressure Sensor 16. Engine Speed Sensor Crankshaft 17. Oil Piston Cooling Jet Pressure 18. Aftertreatment Fuel Injector Pressure Valve 19. Water Level Sensor (water separator) 20. Safety Valve, AHI Fuel System 21. Oil Level & Temperature Sensor


4
3
16
7
7
8
VOLVO
14
20
18
15
19
21
1
2
6
11
NOT A STEP

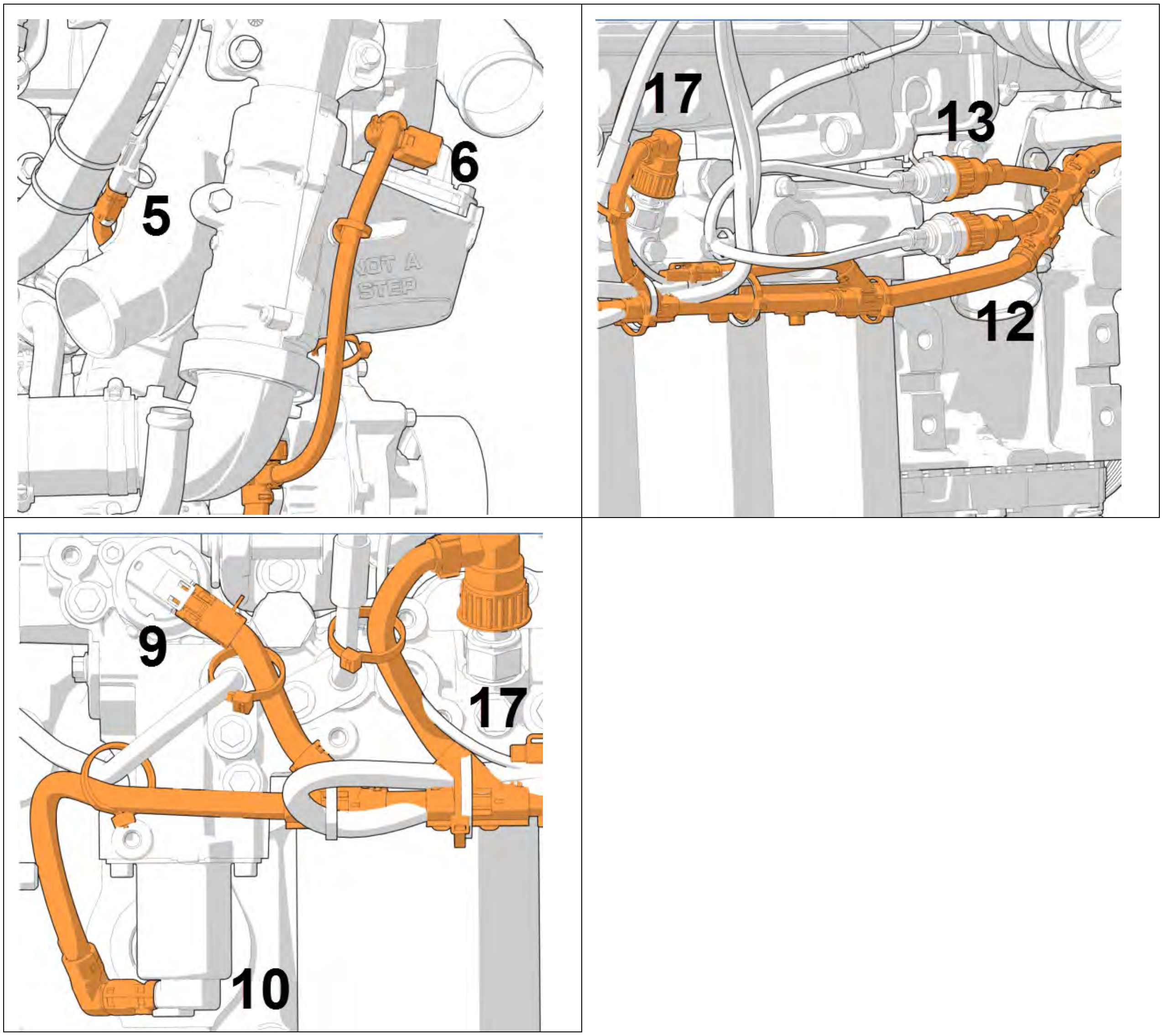


FIGURE 2: ENGINE HARNESS CONNECTION POINTS

IMPORTANT NOTE

Disconnection of Auxiliary Emission Control Device - 25% engine derate

Auxiliary Emission Control Device (EACD) defines as any element of design which senses temperature, vehicle speed, engine RPM, transmission gear, manifold vacuum, or any other parameter for the purpose of activating, modulating, delaying, or deactivating the operation of any part of the emission control system.

Disconnection of the following EACD produces immediate activation of the Malfunction Indicator Lamp MIL and 25% engine derate after three (3) hours of a continuous open circuit.

2.3 ENGINE OVERVIEW

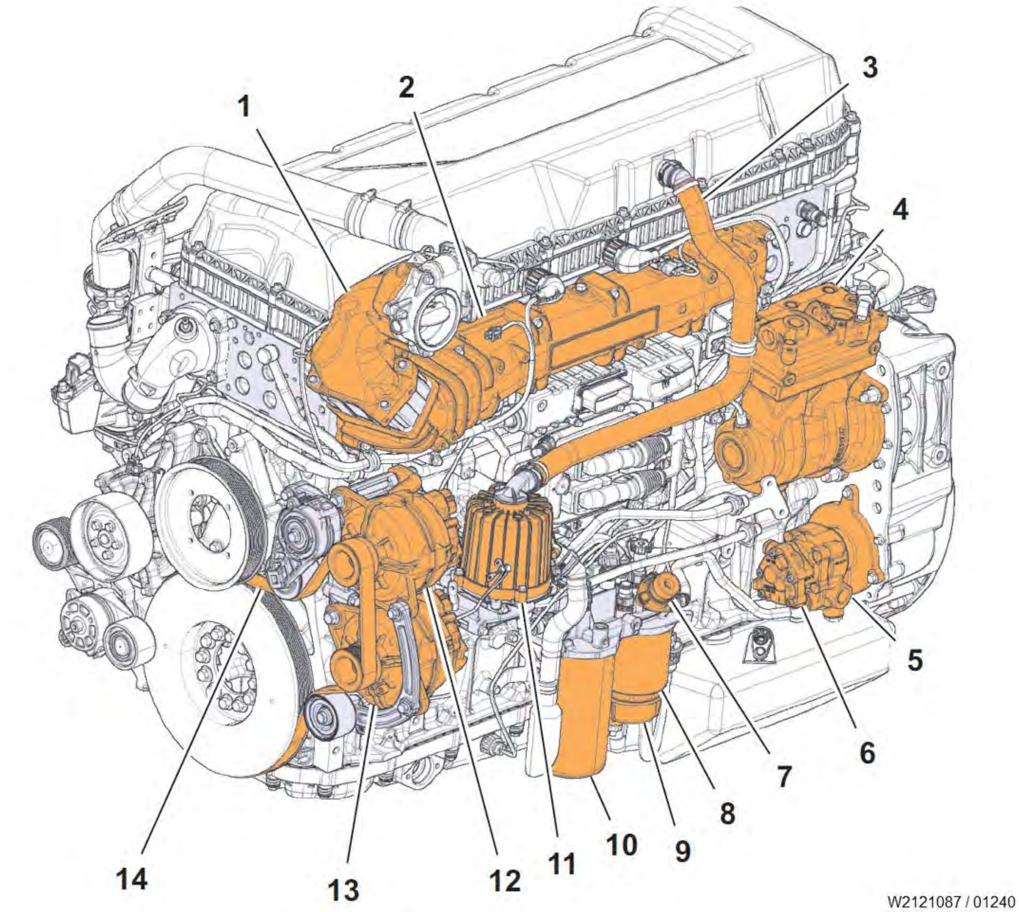


FIGURE 3: D13 ENGINE OVERVIEW, CURB SIDE

1. Mixing Chamber	8. Fuel filter (Primary)
2. Intake Manifold	9. Fuel/Water separator bowl
3. CCV Breather Pipe	10. Fuel Filter (Secondary)
4. Air Compressor	11. Crankcase Ventilator
5. Power steering pump	12. Alternator
6. Fuel pump	13. Alternator
7. Hand-priming Pump	14. Alternator Belt

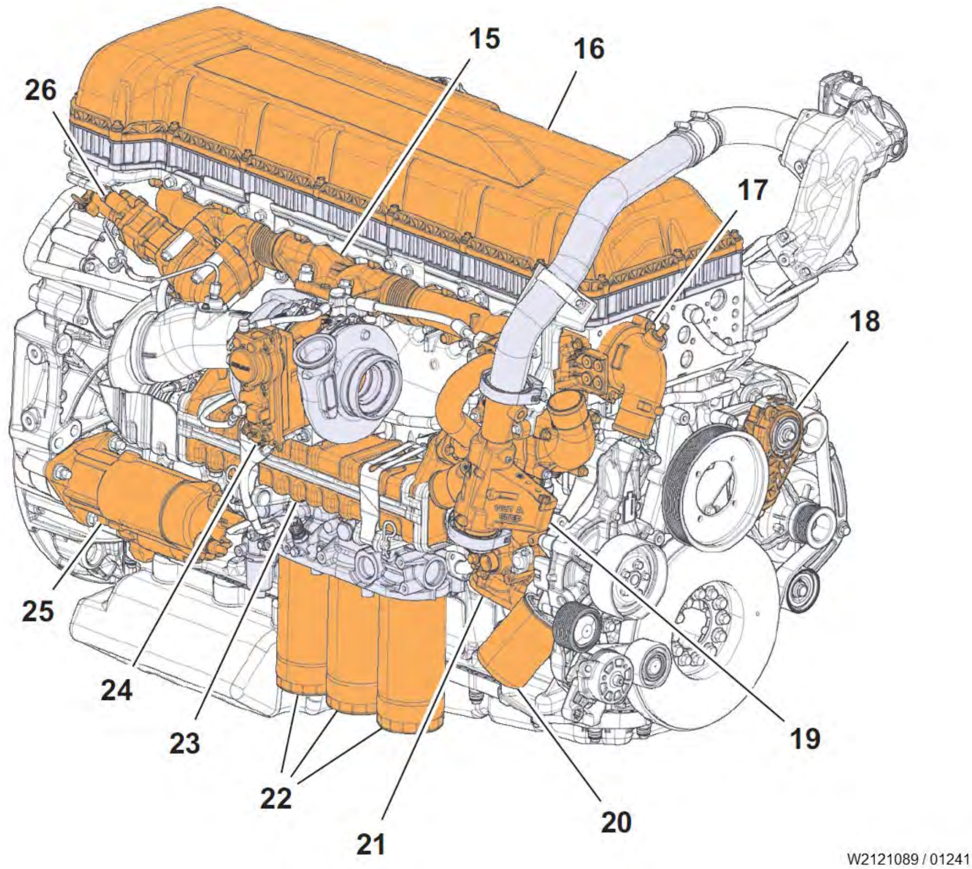


FIGURE 4: D13 ENGINE OVERVIEW, ROAD SIDE

15. Exhaust Manifold	21. Coolant Inlet Pipe
16. Valve Cover	22. Oil Filters (full flow)
17. Thermostat Cover	23. EGR Cooler
18. Belt Tensioner	24. Turbocharger Actuator
19. Venturi	25. Starter
20. Coolant Filter	26. EGR Valve

2.4 ENGINE & EXHAUST AFTERTREATMENT SYSTEM DIAGRAM

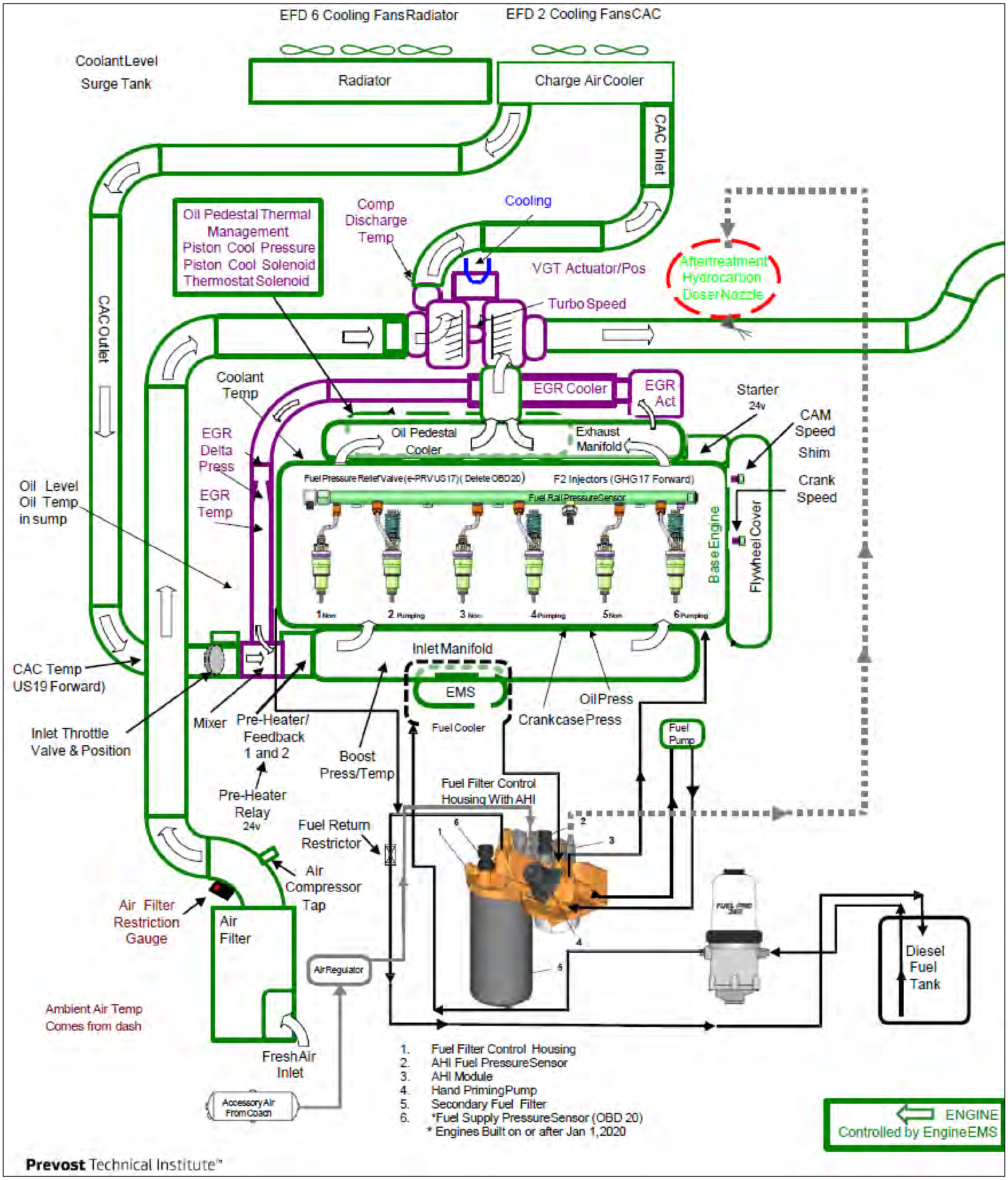


FIGURE 5: 2017 AND LATER ENGINE & EXHAUST AFTERTREATMENT SYSTEM DIAGRAM (1 OF 2) 01222

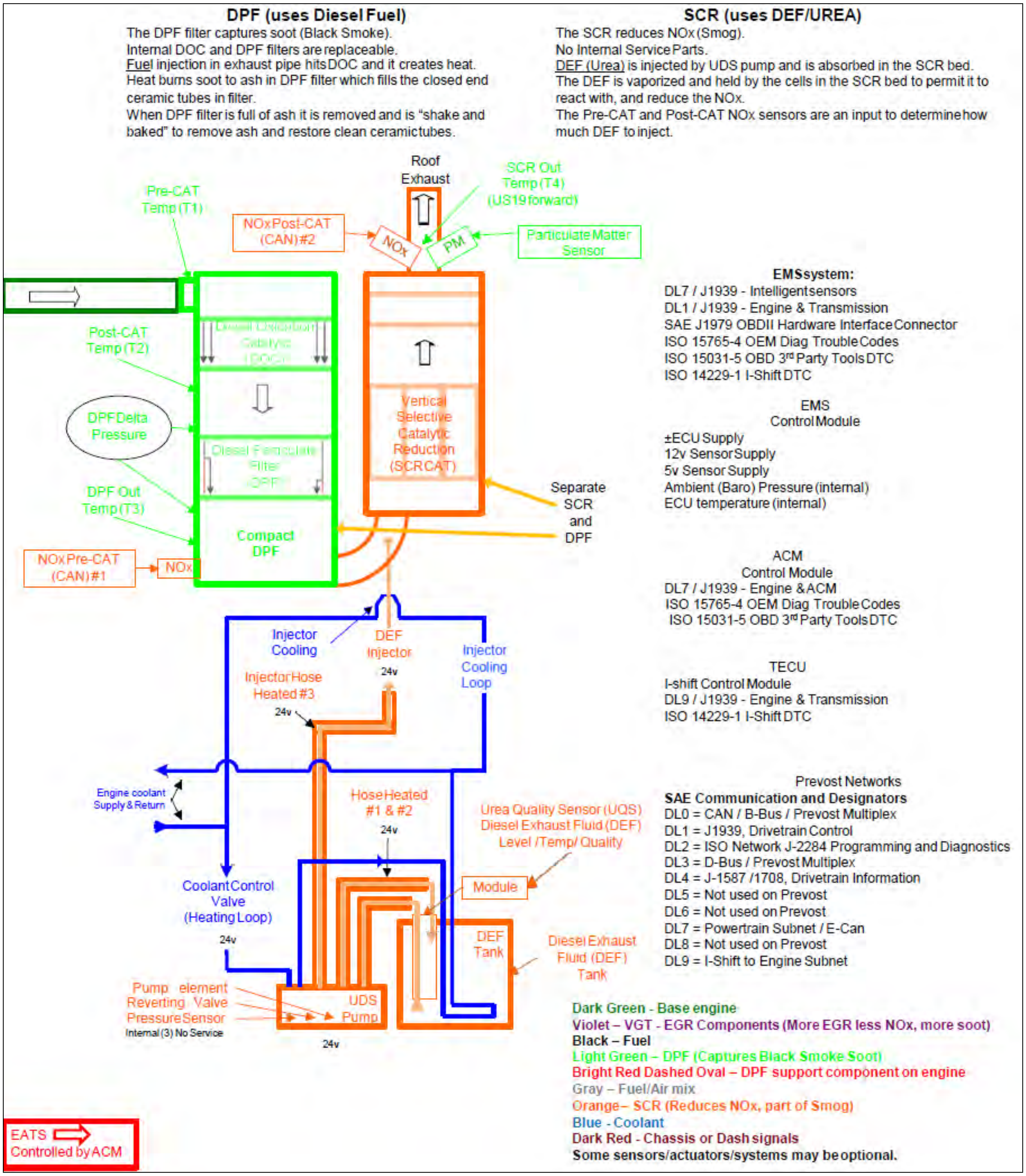


FIGURE 6: 2017 AND LATER ENGINE & EXHAUST AFTERTREATMENT SYSTEM DIAGRAM (2 OF 2) 01222

2.5 ENGINE OIL

2.5.1 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.

2.5.2 Oil Quality

Approved VDS-5 and VDS-4.5 diesel engine oils are mandatory for use in all OBD20 emission compliant Volvo engines. VDS-5 oils exceed the new API service category FA-4. VDS-4.5 oils exceed the API service category CK-4. Take note that **VDS-5 oil is not backward compatible, thus cannot be used on older engines.**

Recommended oil for EOBD-U20 (OBD20) engine:

- Oil meeting Volvo specification VDS-5 or API FA-4.

Minimum requirement for EOBD-U20 (OBD20) engine:

- Oil meeting Volvo specification VDS-4.5 or API CK-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.

2.5.3 OBD20 Emission Compliant Volvo Engines Oil Viscosity

SAE Viscosity Grade 15W-40 oil meeting Volvo specification VDS-4.5 or API CK-4.

Other possible oils:

- 5W-30 oil meeting Volvo specification VDS-5 or API FA-4.
  Remarque: 5W-30 oil can only be used on the 2-oil filter D13N OBD20. 5W-30 cannot ever go into a 3-oil filter engine

- 10W-30 oil meeting Volvo specification VDS-4.5 or API CK-4.

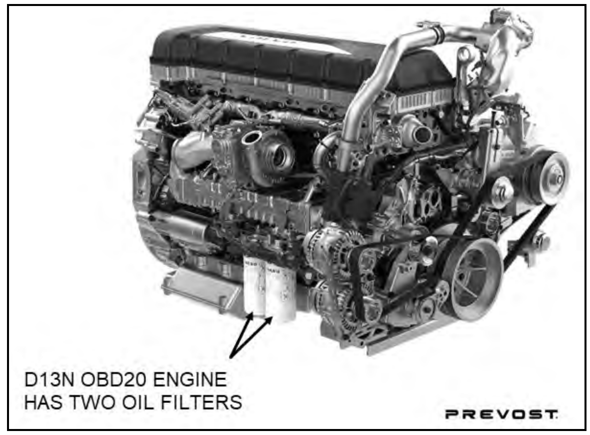
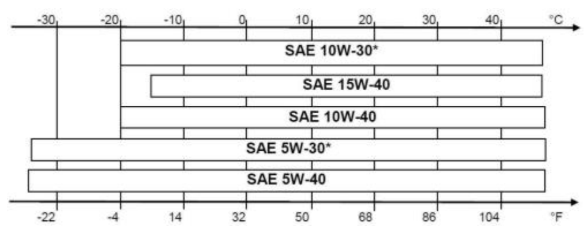


FIGURE 7: D13 OBD20 OIL FILTER CONFIGURATION

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



2.5.4 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.

2.5.5 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 levels of the traditional, petroleum based oils for engines and provided they meet the quality level VDS-4.5 (API CK-4) or VDS-5 (API FA-4).

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

2.5.6 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.

2.5.7 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	
	liters	quarts
Oil pan low/high mark	24 – 32	25 – 34
Refill volume including filter change	38	40

NOTE

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

2.5.8 Oil Change Intervals

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

MAINTENANCE

Engine oil and filters change

Change engine oil and filters at the intervals specified by the Lubrication And Servicing Schedule in Section 24A: LUBRICATION & SERVICING SCHEDULE.

NOTE

Oil filters must always be changed when changing the oil.

2.5.9 Oil Filters

There are two Extra Long Life full-flow oil filters on theD13 OBD20 engine.

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.

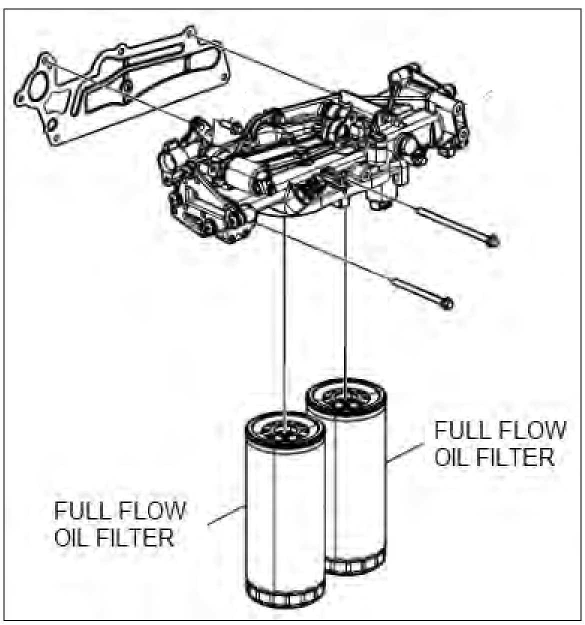


FIGURE 8: D13 OBD20 OIL FILTERS

2.5.10 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.
- Prefill the new oil filters with approved engine oil. Refer to Figure 9. Also, lubricate the filter gaskets with engine oil (1). Hand tightens the oil filters until they contact the sealing surface of the oil filter housing (2). Manually tighten the oil filters an additional ¾ to 1 full turn (3).

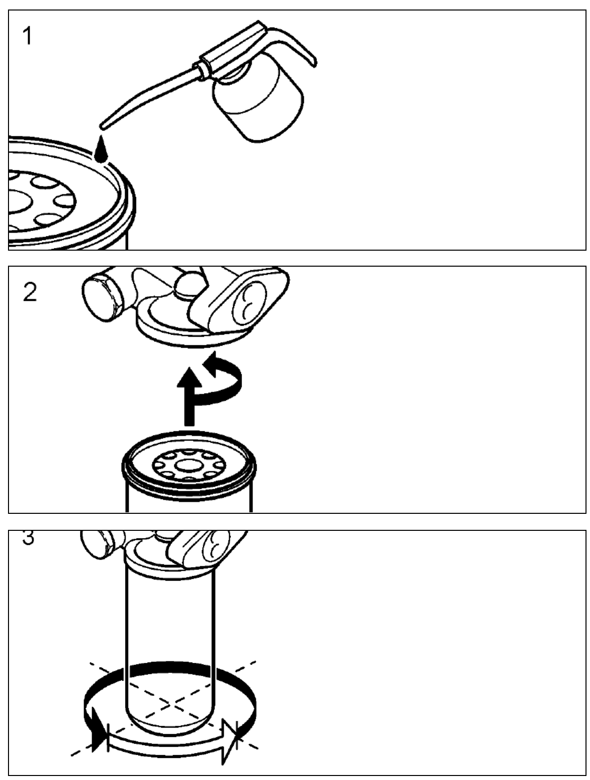


FIGURE 9: OIL FILTER REPLACEMENT

- 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.

2.5.11 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.

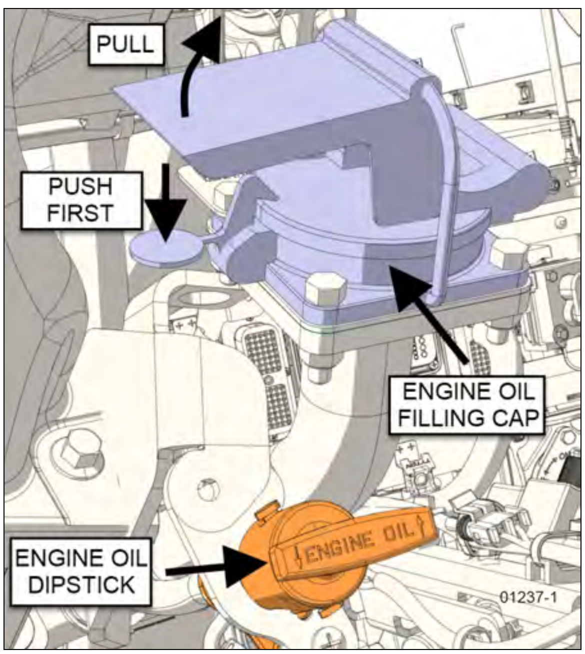


FIGURE 10: ENGINE OIL FILLING COMPONENTS

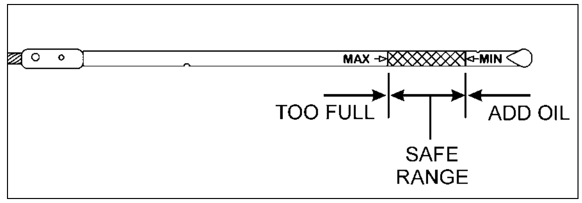


FIGURE 11: ENGINE OIL LEVEL DIPSTICK

2.6 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), 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.

- **First**

1. Close the heater line shut-off valves.
2. Disconnect batteries from the starting system by removing battery cables. 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 complete with hitch if applicable from the vehicle. Refer to Section 18, BODY, under "REAR BUMPER REMOVAL".
4. Using the quick-connect drain hose, drain the engine cooling system. Refer to Section 05, COOLING under "DRAINING COOLING SYSTEM".

- **Begin With Vehicle Raised**

1. Using a vehicle lift or jack, raise vehicle to access transmission fasteners and wire harness.
2. From under the vehicle, disconnect the propeller shaft as detailed in Section 09, under heading "Propeller Shaft Removal".
3. Partially remove L.H. side transmission protective panel to access connectors.
4. Disconnect transmission harness from transmission housing.
5. Disconnect steel-braided airline from pressure regulator output. The pressure regulator is mounted in the upper section of the engine compartment backwall and is accessible through the engine compartment R.H. side door.
6. Locate the transmission oil cooler beside the transmission on the driver side. Untighten bolts A, B, C and D and pivot the transmission oil cooler towards the transmission.

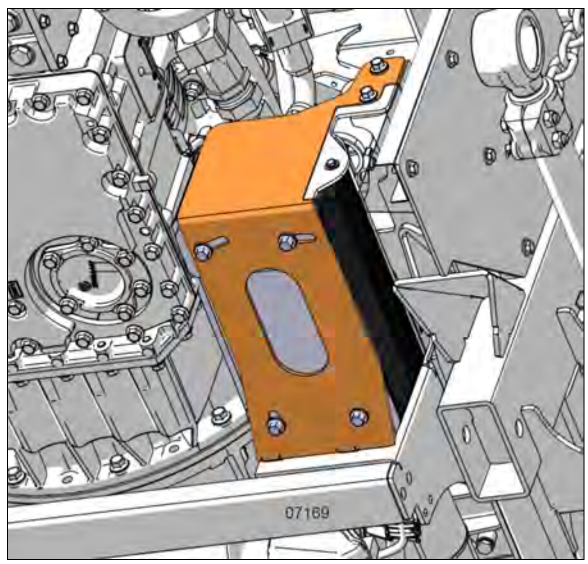


FIGURE 12: COOLER POSITION DURING ENGINE CRADLE INSERTION OR REMOVAL

7. Remove the retaining bolts, washers and nuts securing the power plant cradle to the vehicle rear subframe.
8. Disconnect the engine coolant hose near the starter.
9. Disconnect air compressor suction and discharge hoses.

- **Continuous With Vehicle Lowered**

Lower the vehicle enough to access all components.

➢ Engine Compartment R.H. side

1. Disconnect cables from chassis grounds.
2. Inside the engine compartment, disconnect starter, alternators and heater cables. Also disconnect AFSS cable.
3. Disconnect from engine, connector C397 and vehicle interface harness connector located above EECU connectors. Also disconnect DPF cable.
4. Disconnect power steering pump hoses.
5. Close engine fuel supply shut-off valve on fuel filter. Disconnect the fuel line located above fuel filters and connected to the inlet port.
6. Disconnect fuel return line from bulkhead fixed on the engine cylinder head end.
7. Loosen nut ''A''.
8. Loosen nut ''B'' then use screw ''C'' to remove tension in belts. Remove belt.

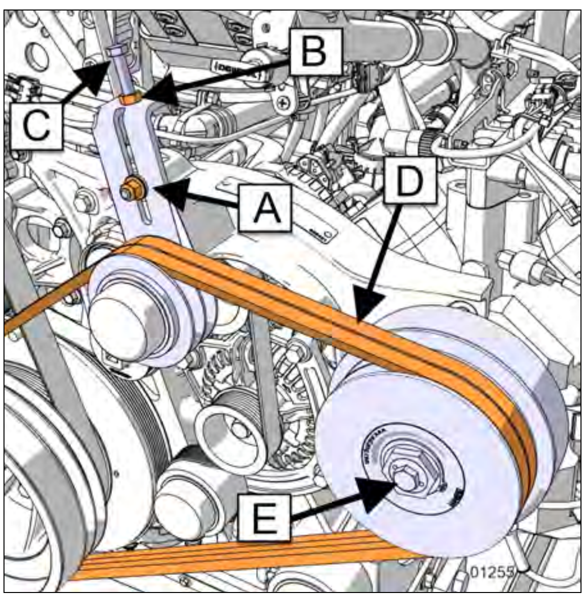


FIGURE 13: BELT REMOVING

9. Remove the A/C compressor clutch assembly (item A in Figure 14), refer to MI18-37 at the end of section 22 Heating and air conditioning for the procedure How to remove and install the A/C compressor clutch assembly.

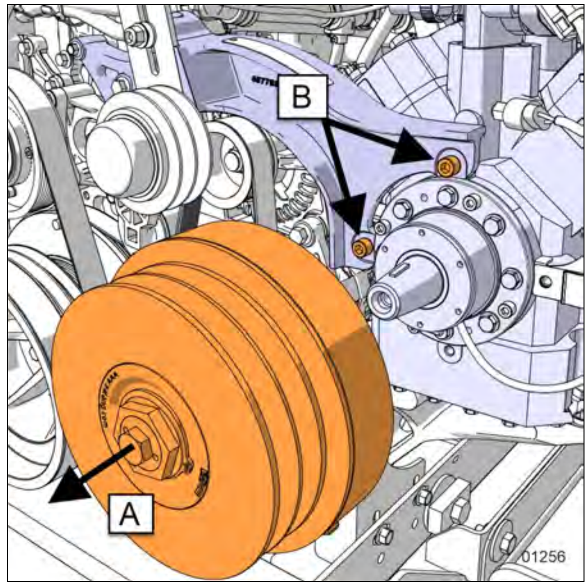


FIGURE 14: CLUTCH ASSEMBLY REMOVAL

10. Remove both nuts ''B''.
11. Remove the compressor mounting bolts (4) then move the compressor out. Do not unplug connectors, hoses or pipes.

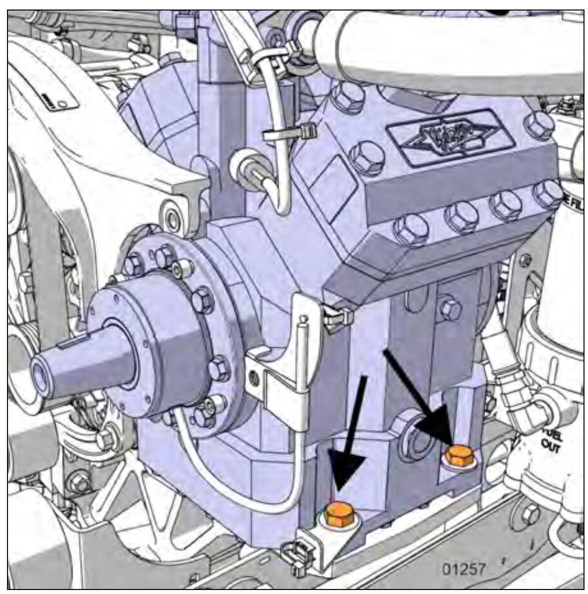


FIGURE 15: COMPRESSOR MOUNTING BOLTS

12. At the back of the air cleaner, disconnect the engine-air intake duct

mounted between air cleaner housing and turbocharger inlet.

CAUTION

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

13. Disconnect and remove the exhaust pipe mounted between the flexible coupling and the pipe going to the Diesel Oxidation Catalyst (DOC) and Diesel Particulate Filter (DPF) assembly. If necessary, refer to Section 4: EXHAUST SYSTEM under “EXHAUST AFTERTREATMENT SYSTEM OVERVIEW".

14. Disconnect and remove the air intake duct mounted between the charge air cooler outlet and the engine intake.

➢ Engine Compartment L.H. side

1. At the turbocharger inlet, disconnect and remove the engine-air intake duct mounted between air cleaner housing and turbocharger inlet.
2. Disconnect and remove section of coolant pipe assembly mounted between the radiator outlet and the water pump inlet.
3. Disconnect and remove a section of coolant pipe assembly mounted between the thermostat housing and the radiator inlet.
4. Disconnect and remove surge tank hose connected to pump inlet pipe and hose connected to engine.
5. Disconnect and remove the air intake duct mounted between the turbocharger outlet and the air cooler inlet.
6. Unfasten and put aside engine compartment lighting fixture and turbocharger fire suppression nozzle.
7. Disconnect Exhaust Aftertreatment System control cable.

- **Last**

1. Inspect the power plant assembly to ensure that nothing will interfere when sliding out the cradle. Check for connections or hoses not mentioned in the above list.
2. Make sure the ten retaining bolts, washers and nuts securing the power plant cradle to the vehicle rear subframe are removed.

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.

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

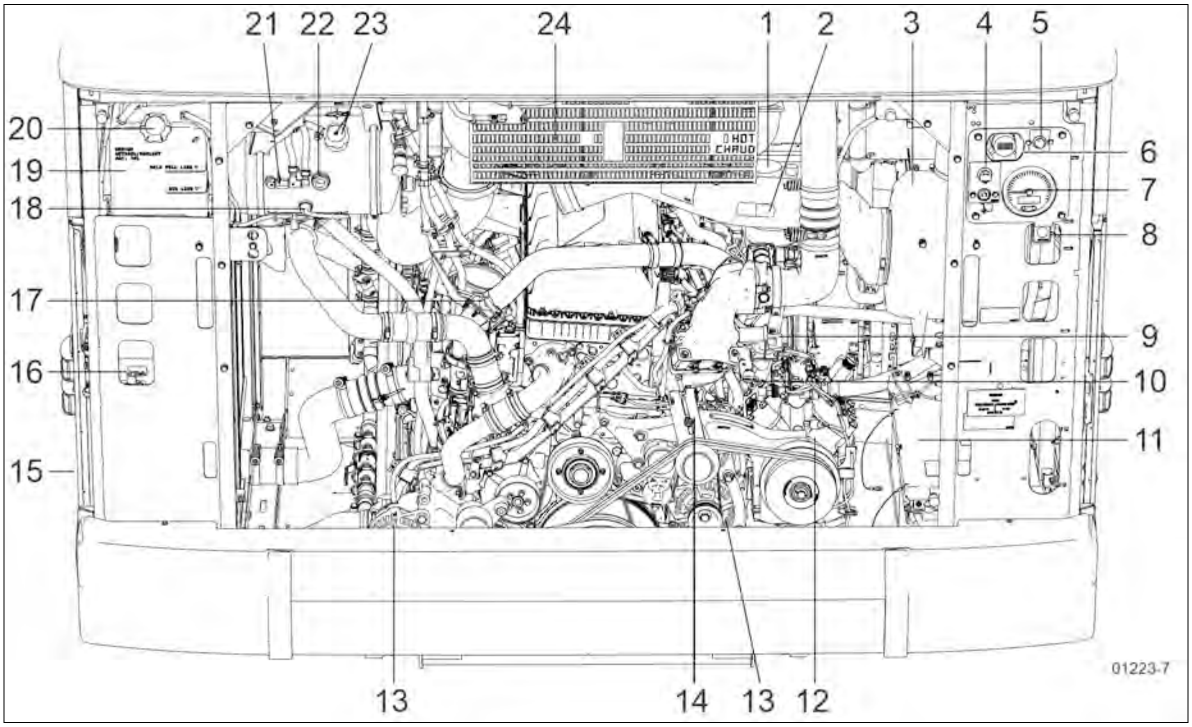


FIGURE 16: ENGINE COMPARTMENT

1. Power steering fluid reservoir (hidden);
2. Engine air filter restriction indicator;
3. Engine air filter;
4. Emergency engine stop push-button & rear start push-button;
5. Engine compartment light switch;
6. Backup alarm;
7. Engine compartment rear gauge;
8. Air system drain valve push-button;
9. Engine oil filler tube;
10. Engine oil dipstick;
11. Battery bank;
12. A/C compressor;
13. Alternators;
14. Compressor belt tensioner;
15. Cooling pack;
16. Radiator door catch lever;
17. Transmission fluid dipstick;
18. Coolant surge tank "critically low" level sensor;
19. Coolant recovery tank;
20. Coolant recovery tank filler cap;
21. Coolant surge tank pressure relief valve
22. Coolant surge tank sight glass;
23. Coolant surge tank filler cap;
24. Diesel Particulate Filter (DPF) assembly (behind heat shield).

2.7 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.

TORQUE: 190 lb-ft (258 Nm)

2. Reposition the oil filter as shown in Figure 17.

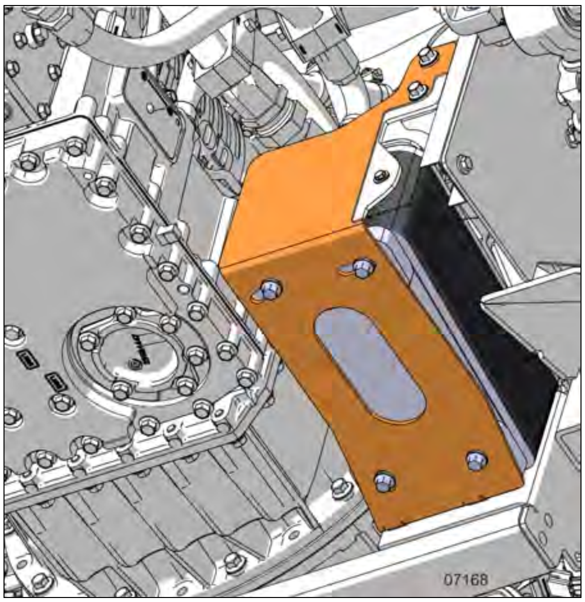


FIGURE 17: NORMAL OIL COOLER POSITION

3. Reinstall compressor mounting bolts (4).
4. Reinstall both screws ''A''.
5. Reinstall the A/C compressor clutch assembly.
6. Reinstall both screws ''A''.
7. Reinstall the A/C compressor clutch assembly.

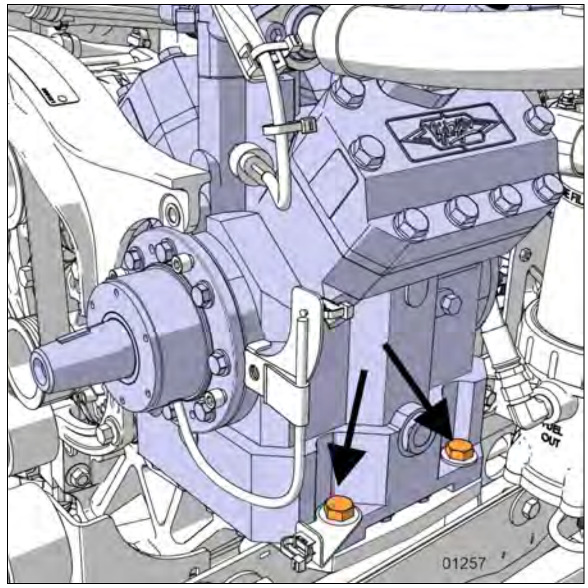


FIGURE 18: COMPRESSOR MOUNTING BOLTS

NOTE
Refer at the beginning section 22 Heating and air conditioning for torque values. Refer to MI18-37 at the end of section 22 Heating and air conditioning for the procedure of the clutch assembly removal and installation. Also refer to that document for the compressor belts tension values.

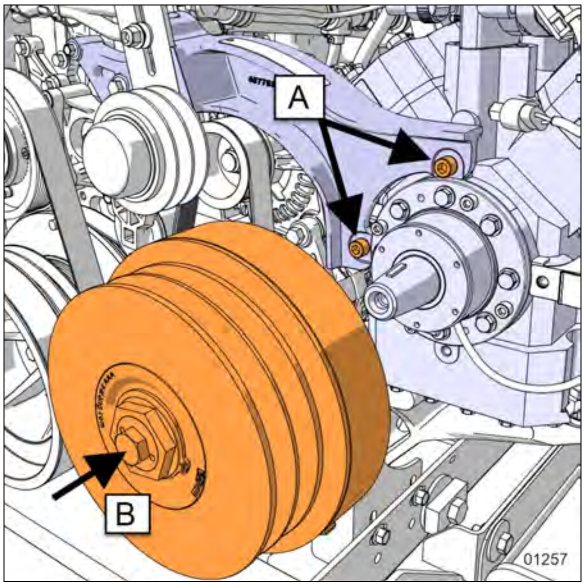


FIGURE 19: CLUTCH ASSEMBLY REINSTALLATION

8. Reinstall belts.
9. Apply specific tension to the belt.

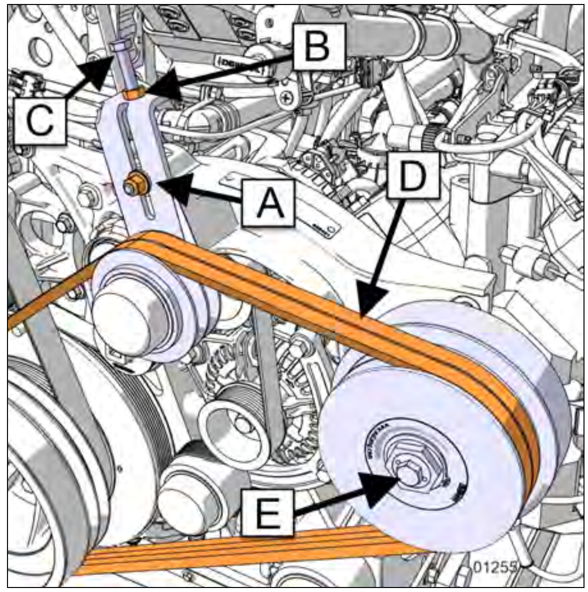


FIGURE 20: BELTS REINSALLATION

10. Refill cooling system with saved fluid (refer to Section 05 coolant system).
11. 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).
12. Start engine for a visual check. Check fuel, oil, cooling, pneumatic and hydraulic system connections for leakage. Test operation of engine controls and accessories.

2.8 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 at the back of the engine.

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

3. 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 (Figure 21). 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.

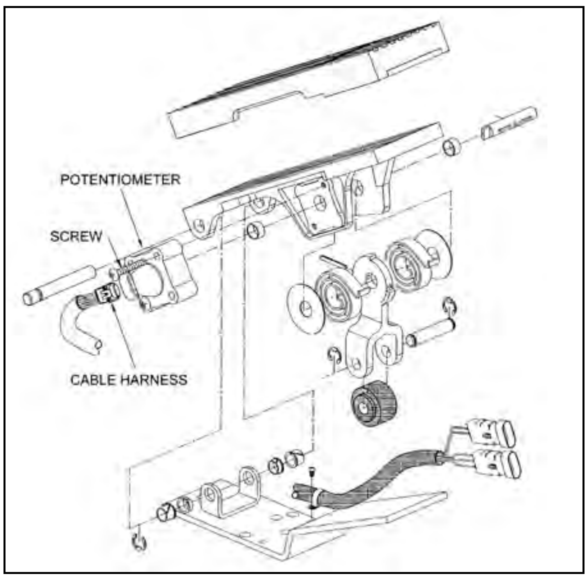


FIGURE 21: ELECTRONIC FOOT PEDAL ASSEMBLY 3035

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.

4. AUTOMATIC BELT TENSIONERS AND IDLER PULLEY INSPECTION

With the engine running, if noise is coming from the tensioners or drive system, an inspection with the engine off is necessary.

MAINTENANCE

Remove belts and inspect automatic belt tensioners, idler pulley bearings at the intervals specified by the Lubrication And Servicing Schedule in Section 24A: LUBRICATION & SERVICING SCHEDULE.

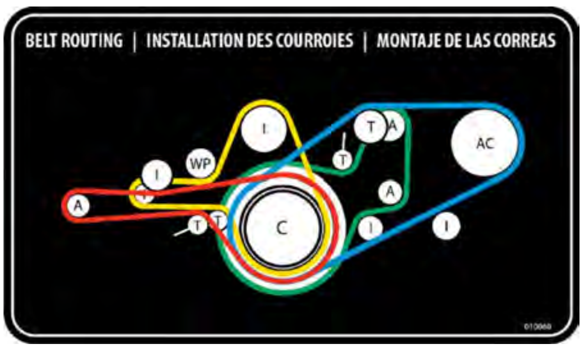


FIGURE 22: COACH BELT ROUTING

A=alternator
C=crank pulley
I=dler
WP=water pump
T=tensioner
AC=air conditioning compressor

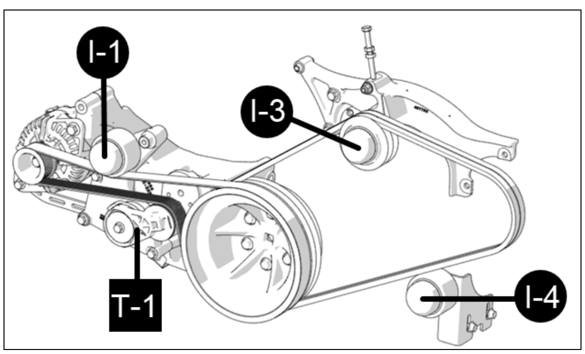


FIGURE 23: IDLER PULLEYS & AUTOMATIC BELT TENSIONERS

I= IDLER
T= TENSIONER

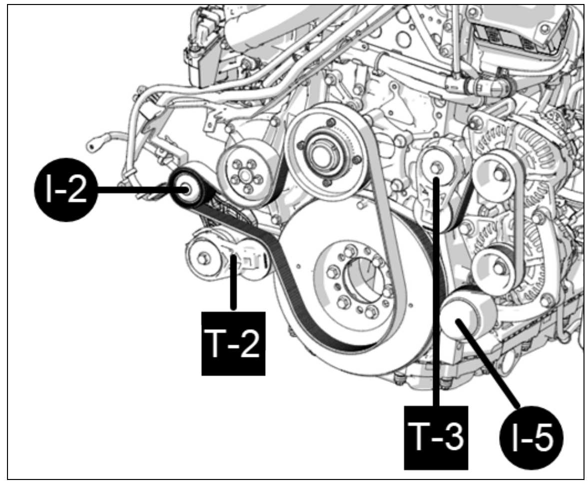


FIGURE 24: IDLER PULLEYS & AUTOMATIC BELT TENSIONERS

I= IDLER
T= TENSIONER

IDLERS	
REF	SYSTEM
I-1	L.H. SIDE ALTERNATOR
I-2	WATER PUMP DRIVE
I-3	A/C COMPRESSOR DRIVE
I-4	A/C COMPRESSOR DRIVE
I-5	R.H. SIDE ALTERNATOR DRIVE

AUTOMATIC BELT TENSIONERS	
REF	SYSTEM
T-1	L.H. SIDE ALTERNATOR
T-2	WATER PUMP DRIVE
T-3	R.H. SIDE ALTERNATOR DRIVE

4.1 BEARING INSPECTION

1. First, set parking brake, turn the ignition OFF and set the rear start selector switch to the OFF position.
2. Remove all belts on left hand alternator, water pump drive, A/C compressor drive and alternator drive.
3. Spin all idler pulleys, I-1 thru I-5, plus the idlers that are part of the automatic belt tensioners T-1 thru T-3.
4. Listen if some idlers are noisy and check for play in the bearings by hand.

5. Replace noisy idlers or if a play is found. Replace the automatic belt tensioner as a complete unit.
6. Record the results of the inspection.

4.2 AUTOMATIC BELT TENSIONER BUSHING WEAR

Automatic belt tensioner bushing wear may result in belt misalignment.

1. Check the automatic belt tensioner T-1 thru T-3.
2. Pry the automatic belt tensioner arm and check for a play between the arm and the spring case (**FIGURE 25**).

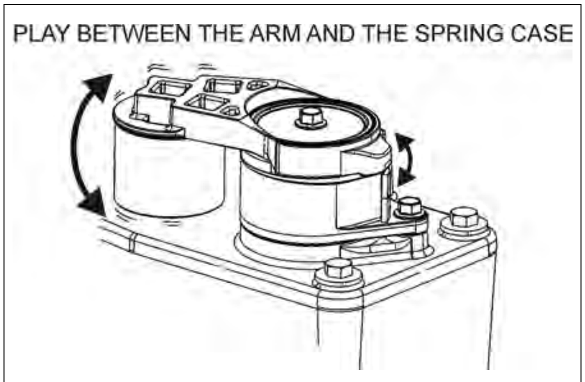


FIGURE 25: CHECKING BUSHING WEAR

3. If bushing wear is suspected, remove the tensioner. Inspect the tensioner for any signs of wear. Check for bearing noise as well as metal to metal contact between the arm and spring case which is a sign of bushing wear. Check for cracks in the tensioner body.
4. Replace the automatic belt tensioner if found defective.
5. Record the results of the inspection.

4.3 BELTS AND IDLERS VISUAL INSPECTION

1. Inspect drive belts for cracks, frayed material, missing chunks in the belt, abrasion and peeling. Replace belts if damaged.
2. Visually inspect all idlers for signs of deterioration, loose fasteners, etc.
3. Record the results of the inspection.

MAINTENANCE

Visually inspect belts and idlers for signs of deterioration, cracks, frayed material at the intervals specified by the Lubrication And Servicing Schedule in Section 24A: LUBRICATION & SERVICING SCHEDULE.

5. ENGINE PROTECTION STRATEGY

The engine protection system will automatically derate or derate and stop the engine when certain engine conditions reach a critical stage.

In the event of a serious fault, the red STOP telltale light comes on and an audible alarm will sound if the engine is running.

Prior to an actual automatic shutdown, the engine will automatically derate, go to idle, and then stop in 30 seconds.

ENGINE PROTECTION LOGIC (with yellow CHECK or red STOP telltale light)	
High engine coolant temperature	Shutdown
High engine oil temperature	Shutdown
Low engine oil pressure	Shutdown
High crankcase pressure (rate of change)	Shutdown
Low coolant level	Derate only
High intake manifold air temperature	Derate only
High transmission oil temperature	Derate only
High temperature of cooled exhaust gas (EGR) - after EGR cooler	Derate only
EGR valve and position error	Derate only
Variable Geometry Turbo (VGT) valve and position error	Derate only
High VGT actuator temperature	Derate only
High pre-Diesel Oxidation Catalyst (DOC) temperature	Derate only
High Compressor Discharge Temperature (CDT – measured)	Derate only
High soot load	Derate only
High Diesel Particulate Filter (DPF) pressure differential (DP)	Derate only

OUTSIDE ENGINE PROTECTION LOGIC (no yellow CHECK or red STOP telltale light)	
High altitude (ensures that high compressor discharge temp. is never reached)	Derate only
Turbo over-speed	Derate only
Low coolant temperature	Derate only
Crank sensor failure	Derate only
High crankcase pressure - Absolute Pressure	Shutdown

6. SPECIFICATIONS

Volvo D13N EOBD-U20 (OBD20) Engine

Make .... Volvo

Emission EM-USA21

Vehicle OBD EOBD-U20 (OBD20)

Generation .... N

Type .... Diesel four cycle/in-line direct injection engine

Description .... Turbo/Air to air charge cooled

No. of cylinders 6

Operating range .... 1000-1800 RPM

X3-45 and H345 Coaches Peak Power Rating .... 435 HP

Peak Torque Rating .... 1665 Ft-lb

Low Idle .... 600 rpm

Fast Idle .... 1000 rpm

Maximum full load revolutions .... 2000 rpm

Engine oil level quantity

Oil Pan Capacity, Low Limit .... 25 quarts/24 liters

Oil Pan Capacity, High Limit .... 34 quarts/32 liters

Refill volume including filter change .... 40 quarts/38 liters

Oil filter Type (full flow) .... Extra Long Life P/N 23151592

Recommended engine oil 5W-30 VDS-5

Minimum requirement engine oil 10W-30 VDS-4.5

Torque specification

Engine oil filter .... Tighten ¾ of a turn to 1 full turn after gasket contact.

MAINTENANCE INFORMATION

MI16-16

DATE : FEBRUARY 2016	SECTION : 01 - Engine
SUBJECT :	**VOLVO D13 ENGINE – STARTER REMOVAL AND INSTALLATION**

DESCRIPTION

This procedure applies to current Melco 105P70 starter part number #21212425.

REQUIRED TOOLS

RATCHET EXTENSION BAR 	**RATCHET AND SOCKET SET – METRIC** 
CORDLESS DRILL 	**BRASS WIRE CUP BRUSH** 
TORQUE WRENCH 	**CUTTING PLIERS** 
VOLTMETER / MULTIMETER 	**METRIC OPEN END WRENCH SET** 

PROCEDURE – STARTER REMOVAL AND INSTALLATION

DANGER

Park vehicle safely, apply parking brake, stop the engine. Prior to working on the vehicle, **set the ignition switch to the OFF position,** the battery master switch to the OFF position and trip the main circuit breakers equipped with a trip button.

RISK OF ELECTRICAL SHOCK

1. The starter is connected to the batteries through master relay R1. If the ignition switch is in the OFF position and the battery master switch (master cut-out) is set to the OFF position, there should not be electrical power to the starter **B** (batt) terminal. However, a faulty master relay R1 could eventually leave the battery power circuit closed, thus electrical power would be present at the starter **B** terminal.
2. Using a voltmeter or multimeter, probe the starter **B** terminal and the **ground** terminal. Make sure that the voltage reading is 0 volt prior disconnecting the starter cables (FIGURE 2).

STARTER REMOVAL

3. While proceeding from under the vehicle, gain access to the starter (item 29 on FIGURE 1) on the turbocharger side (street side).

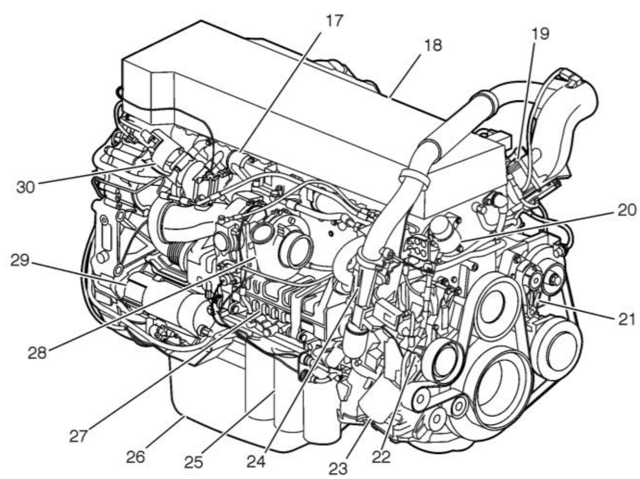


FIGURE 1: D13H ENGINE OVERVIEW, TURBO SIDE

4. On the starter, disconnect circuits **0C**, **101** and **101B** (see FIGURE 2). Properly clean cable lugs as applicable using a brass wire cup brush, a Scotch-Brite pad or an emery cloth. Remove old Color Guard Rubber Coating as much as possible.

   IMPORTANT: keep hardware for later use

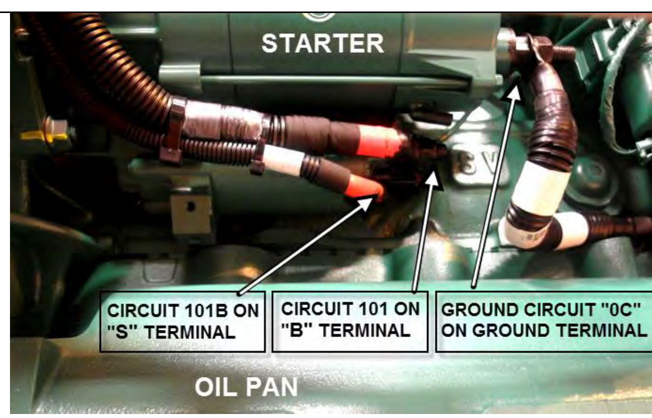


FIGURE 2

5. Using a 18mm socket, unscrew three bolts fastening the starter to the flywheel housing (FIGURE 3).
6. Detach the starter from the flywheel housing.

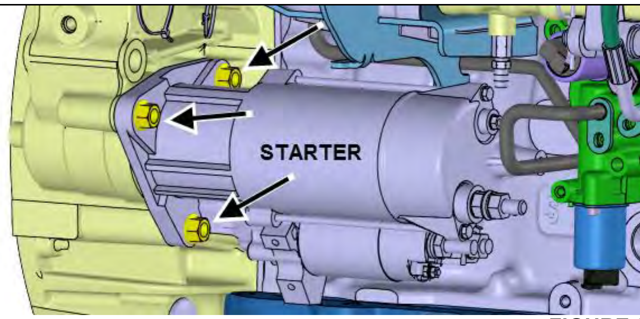


FIGURE 3

STARTER INSTALLATION

1. If the starter is replaced with a brand new starter, prepare the new starter as follows (refer to FIGURE 5).
   a) Remove the second nut on the ground terminal (FIGURE 5). Keep for later use.
   b) Remove the jumper cable connected to the ground terminal (FIGURE 5).
   c) Make sure that the three nuts identified on FIGURE 5 are tightened to a torque of **22 lbf-ft**.
   d) Reinstall the jumper cable to the ground terminal.
   e) Install a nylon tie mount p/n 504013 on the starter. Refer to FIGURE 6 for proper location. Secure the nylon tie mount with one screw *p/n 502817* (FIGURE 7).

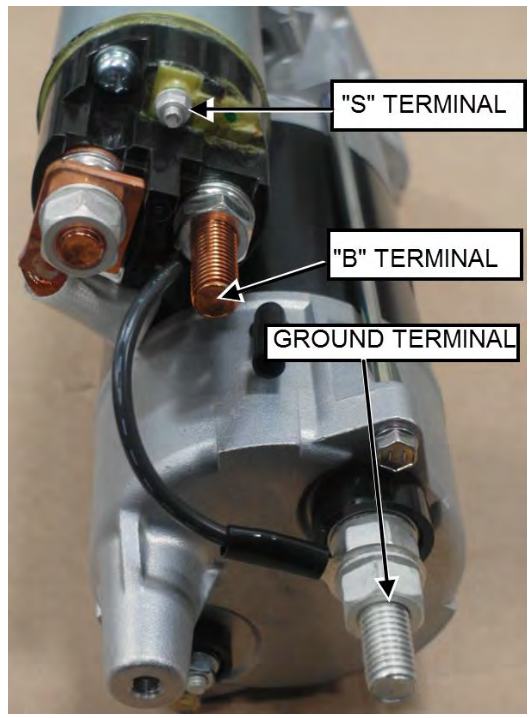


FIGURE 4 : TERMINAL IDENTIFICATION

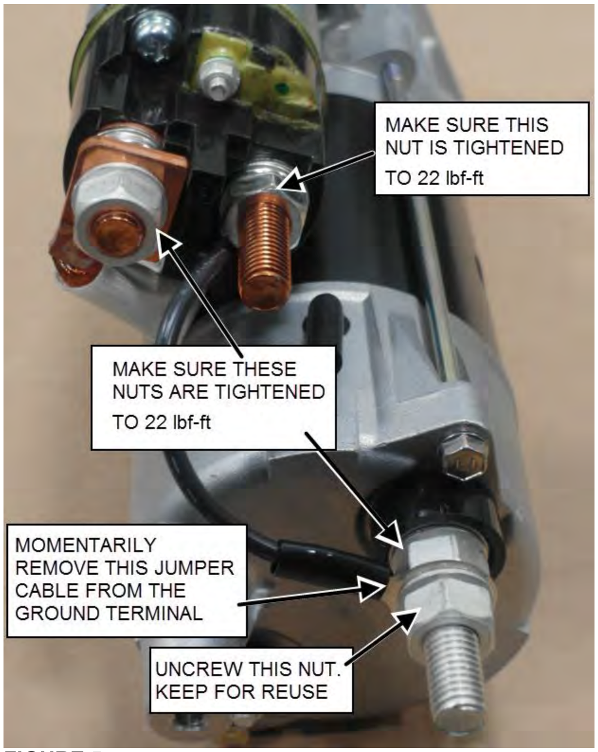


FIGURE 5

FIGURE 6

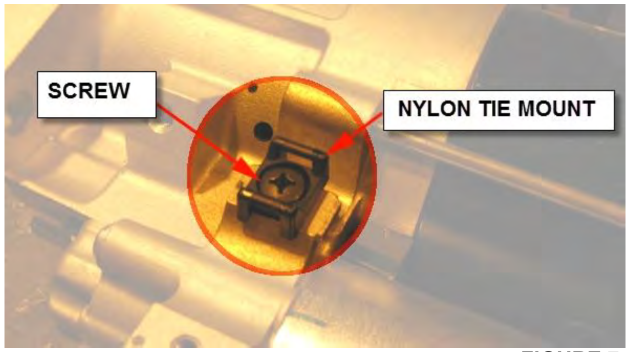


FIGURE 7

2. Install the replacement starter with the solenoid located on the underside of the starter motor as shown on **FIGURE 8**.
3. Hand tighten the three mounting nut.

   Flange nut M12 p/n 990942 qty: 3

4. Once the starter is properly seated on the flywheel housing, torque the three mounting nuts to al torque of **44 lbf-ft**.

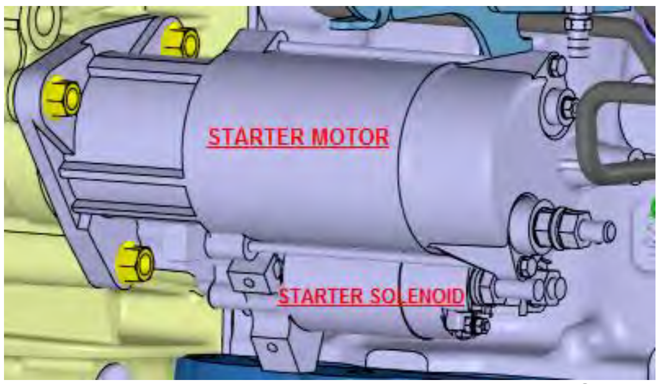


FIGURE 8

INSTALLATION OF CIRCUIT 0C

5. Connect the ground cable (circuit 0C) to the ground terminal first. Make sure the ground cable extends vertically downward from the terminal as shown on **FIGURE 9**.
6. Secure the ground cable lug with the nut previously removed at step 1-a. Tighten to a torque of **22 lbf-ft**.

   M12 hex nut p/n 983717

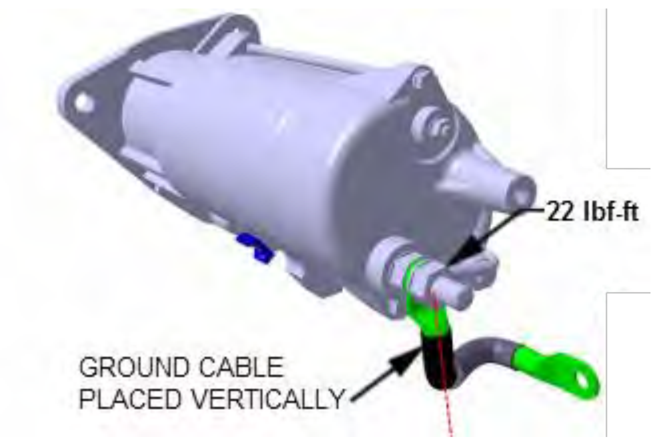


FIGURE 9

INSTALLATION OF CIRCUIT 101

7. Connect circuit **101** to **B** terminal (FIGURE 4 & FIGURE 5). Position circuit **101** cable to be in line with the nylon tie mount on the starter.
8. Place the washer against circuit **101** cable lug and secure cable lug and washer with the nut. Tighten the nut to a torque of **22 lbf-ft**.

   washer p/n 500958 qty:1

   nut p/n 5001761 qty:1

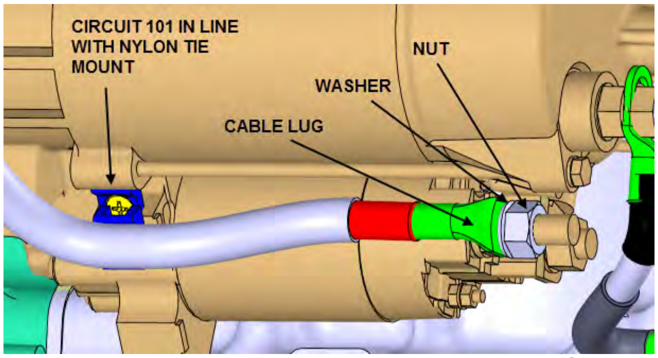


FIGURE 10

INSTALLATION OF CIRCUIT 101B

9. If not already done, remove the nut and washer provided with the brand new starter on **S** terminal (FIGURE 4).
10. Connect circuit **101B** to **S** terminal. Position circuit **101B** cable to be in line with the nylon tie mount on the starter.
11. Place the provided washer against circuit **101** cable lug and then secure cable lug and washer with the nut provided. Tighten the nut to **35 lbf-in**.

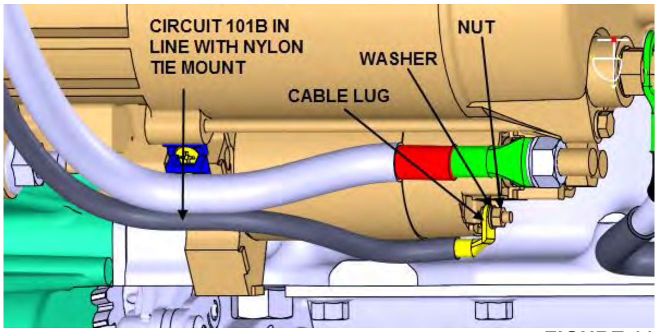


FIGURE 11

12. Secure circuit **101** and **101B** to the tie mount using one nylon tie *p/n 504016*.
13. Tie circuit **101** and **101B** together using one nylon tie *p/n 504637* as shown on FIGURE 12.

FIGURE 12

14. Apply anti-corrosion compound or **Color Guard Rubber Coating** (Prevost p/n 684013) on starter terminals, cable lugs and nuts (see FIGURE 13 to FIGURE 15).

FIGURE 13

FIGURE 14

FIGURE 15

FUNCTIONAL TEST

1. Reset main circuit breakers if applicable. Set the battery master switch (master cut-out) to the ON position and start the engine.

PARTS / WASTE DISPOSAL

Discard according to applicable environmental regulations (Municipal/State[Prov.]/ Federal)

Access all our Service Bulletins on https://secureus5.volvo.com/technicalpublications/en/pub.asp
Or scan the QR-Code with your smart phone.

*E-mail us at **technicalpublications_prev@volvo.com** and type "ADD" in the subject to receive our warranty bulletins by e-mail.*

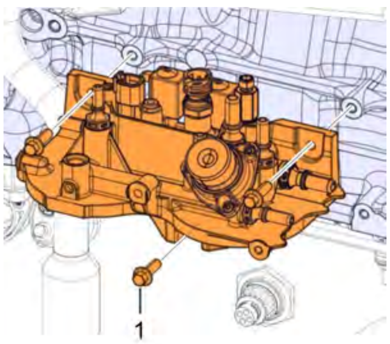
CONTENTS

SECTION CHANGE LOG

	DESCRIPTION	DATE
1	Introduction of Davco Fuel Pro 386 primary fuel filter	08/31/2022
2		
3		
4		
5		
6		

1. TORQUE TABLES

1.1 FUEL SYSTEM



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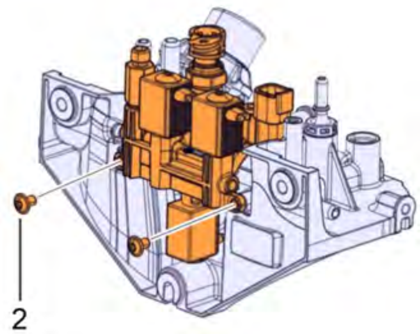

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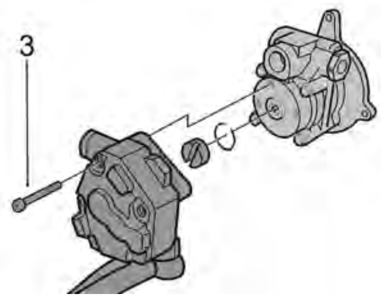
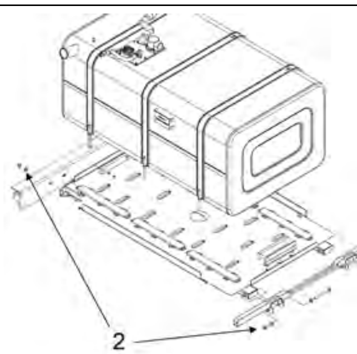
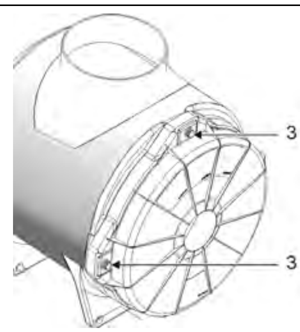
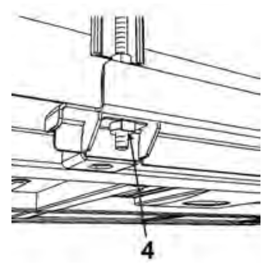


FUEL FILTER / PUMP HOUSING – VOLVO D13 ENGINE		
No	DESCRIPTION	TORQUE
1	Fuel filter housing assembly screws	15-21 lb-ft (20-28 Nm)
2	Dosing module mounting screws	7.5 lb-ft (10 Nm)
3	Fuel pump housing mounting screws	6-7 lb-ft (8-9 Nm)

1.2 MISCELLANEOUS TORQUE







MISCELLANEOUS TORQUE		
No	DESCRIPTION	TORQUE
1	Brake pedal potentiometer holding screws	10-20 lb-in (1.13-2.26 Nm)
2	Fuel tank support to frame	55 lb-ft (75 Nm)
3	Air filter cover plastic screws (4)	10-15 lb-ft (14-20 Nm)
4	Steel fuel tank retaining straps	20 lb-ft (27 Nm)

2. FUEL SYSTEM

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 part replacement, repair and maintenance.

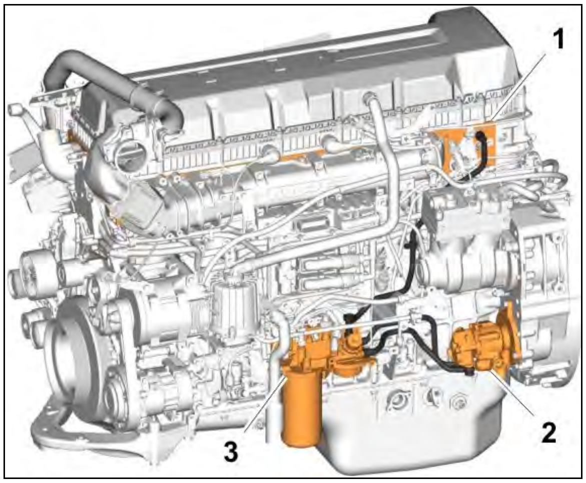


FIGURE 1: FUEL SYSTEM – LOW PRESSURE SYSTEM

1	Cylinder head
2	Tandem pump (fuel pump is front part)
3	Secondary fuel filter housing

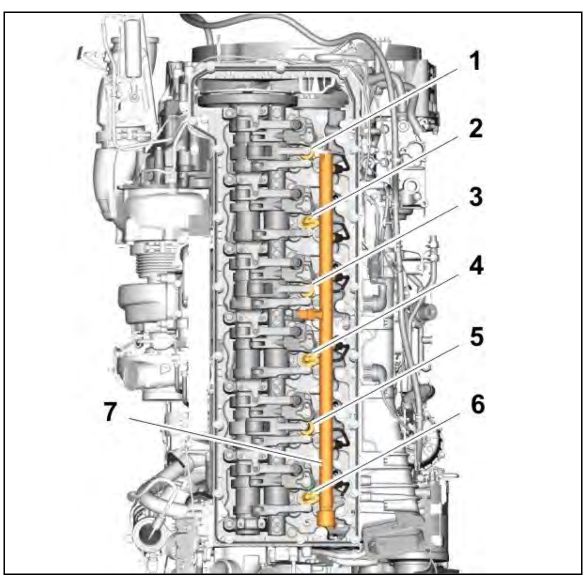


FIGURE 2: FUEL SYSTEM – HIGH PRESSURE SYSTEM

1	Pumping injector (cylinder 6)
2	Non-pumping injector (cylinder 5)
3	Pumping injector (cylinder 4)
4	Non-pumping injector (cylinder 3)
5	Pumping injector (cylinder 2)
6	Non-pumping injector (cylinder 1)
7	Common rail

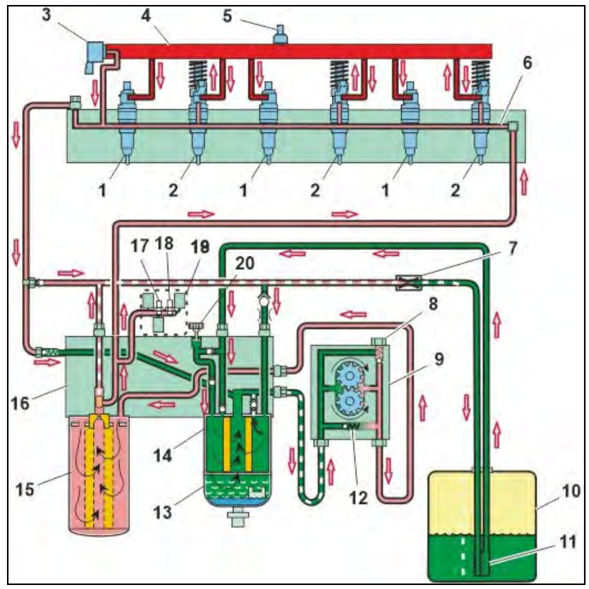


FIGURE 3: FUEL SYSTEM SCHEMATIC (VOLVO D13 ENGINE)

1	Non-pumping injector
2	Pumping injector
3	Fuel pressure relief valve
4	Common rail
5	Rail pressure sensor
6	Fuel channel (gallery)
7	Restrictor
8	Overpressure relief valve
9	Fuel pump
10	Fuel tank
12	Check valve
13	Bowl (fuel / water separator)
14	Primary Filter or Fuel Pro 382/386

15 Secondary filter

16 Fuel filter housing

17 Fuel pressure sensor (low pressure system)

18 Aftertreatment hydrocarbon injector module

19 Hand pump (fuel primer pump)

2.1 FUEL VALVE

The manual shut-off valve is located on the inlet side of Davco Fuel Pro 382/386 primary fuel filter.

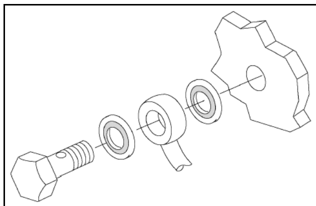


FIGURE 4: FUEL LINE COMPRESSION FITTING

⚠ 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.

2.2 DAVCO FUEL PRO 382/386 PRIMARY FUEL FILTER

The Fuel Pro 382 (Figure 5) and Fuel Pro 386 (Figure 6) fuel processor is installed between the fuel tank and the secondary fuel filter and is used as the primary fuel filter. This system also serves as a water separator and is equipped with heating for winter conditions. Davco Technical Manual F1387 is available on Prevost technical Publications site.

Fuel Pro 382: 25 microns filter element

From L-7751 (DOB 1300) up to N-7977 (DOB 1417)

Fuel Pro 386: 10 microns filter element

From N-7978 (DOB 1418)

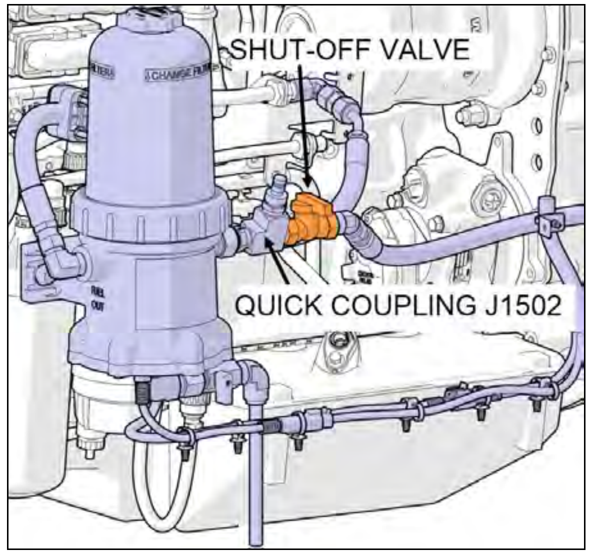


FIGURE 5: DAVCO FUEL PRO 382 WITH MANUAL SHUT-OFF VALVE

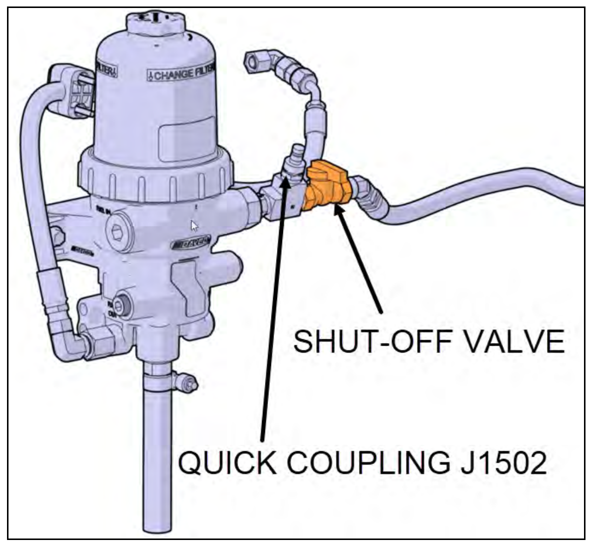


FIGURE 6: DAVCO FUEL PRO 386 WITH MANUAL SHUT-OFF VALVE

The filter fibers used in the Davco Fuel Pro 382/386 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 382/386 filter element when the fuel level in the see-thru filter cover reaches the “CHANGE FILTER” lettering on the clear cover.

Water drains

1.Turn off the engine and remove the vent cap.

2. Place a suitable container under the Fuel Pro and open the drain valve.
3. Collected water will flow into the container. When fuel begins to flow out the drain, close the drain valve. Drain the least amount of fuel as possible.
4. Install the vent cap and tighten it by hand until it clicks.
5. Start the engine and raise the RPM for one minute to purge the air from the system.

2.2.1 Priming fuel system

To prime the fuel system, turn the engine off and then proceed as follows:

Close the shut-off valve on the “fuel in” side of the Fuel Pro unit and then pump fuel into the engine through the quick coupling J1502. When completed, open the shut-off valve and keep on pumping fuel about ten seconds to fill the fuel line located between the Fuel Pro unit and the fuel tank.

2.2.2 Filter replacement

1. Turn off the engine. Place a suitable container under the fuel processor.
2. Close the shut-off valve on the “fuel in” side of the fuel filter (Figure 5).
3. Remove the vent cap & vent cap O-ring (B) and open the drain valve (I) at the base of the Fuel Pro body and drain the fuel until it is below the collar (A) level.
4. Close the drain valve.
5. Untighten the collar (A), remove clear cover, filter spring (F), filter element and cover O-ring (E).

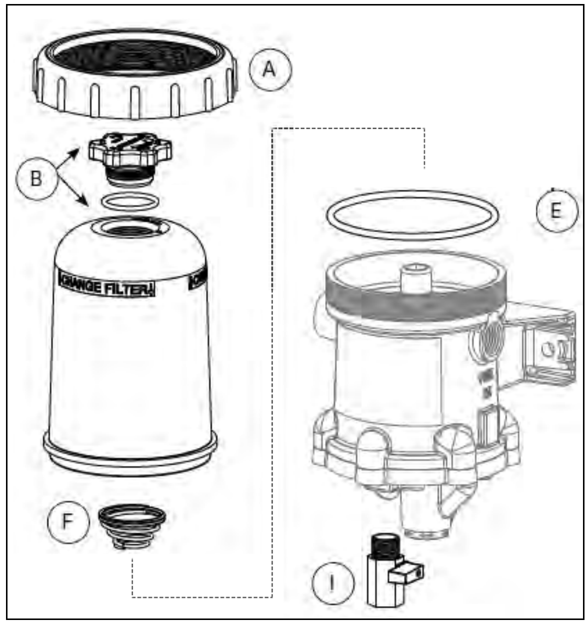


FIGURE 7: DAVCO FUEL PRO FUEL PROCESSOR

6. Dispose of used filter element, cover O-ring and vent cap O-ring.
7. Using a clean shop rag, clean the cover, the collar, the vent cap, and threads on the Fuel Pro body.
8. Install the new filter element.
   - FUEL PRO 382: Install the new filter element onto the center stud.
   - FUEL PRO 386: Position the filter element so the key is lined up with the keyway on the separator plate of the housing (Figure 8). Use the arrow on the top of the endplate to align the filter. Ensure the filter element is fully seated by firmly pushing on the endplate. The filter should not rotate freely.

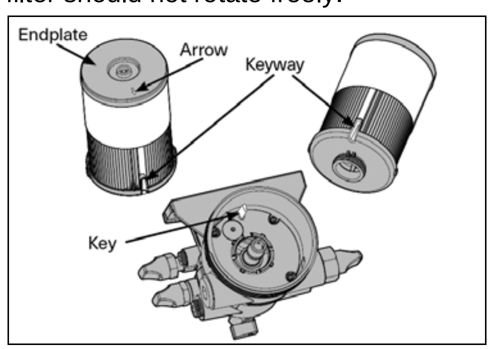


FIGURE 8: KEYWAY ON FUEL PRO 386 FILTER ONLY

9. Ensure the filter spring is installed at the top of the clear cover. If missing, the spring must be replaced to insure proper filter operation.

10. After ensuring a new O-ring is properly positioned at the base of the clear cover, install the clear cover with the collar onto the fuel processor. Apply downward pressure to the top of the clear cover and then tighten the collar by hand until secured.

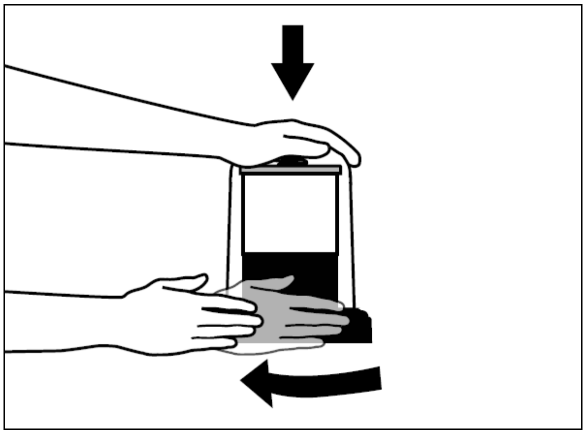


FIGURE 9

11. Use a Davco collar wrench (if necessary) to tighten the collar three additional ribs.

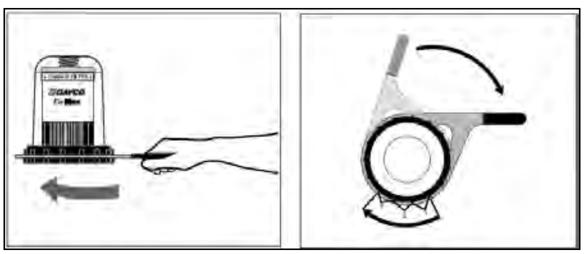


FIGURE 10

12. Fill the clear cover with clean diesel fuel until it reaches the top of the filter through spin off vent cap located on top of clear cover.

13. Install the vent cap with new O-ring and tighten it by hand until it clicks.

14. Open the shut-off valve.

15. Start the engine. When the lubrication system reaches its normal operating pressure increase the engine RPM to high idle for 1-2 minutes.

16. After the air is purged and while the engine is at idle, loosen the vent cap and let the fuel level drop to just above the collar, then tighten the vent cap by hand until it clicks.

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

NOTE
Diesel fuel is an environmentally hazardous product. Dispose according to applicable environmental regulations.

2.3 SECONDARY FUEL FILTER

A secondary fuel filter is installed on the engine. This filter consists of a spin-on filter cartridge.

2.3.1 Secondary Fuel Filter Replacement

CAUTION

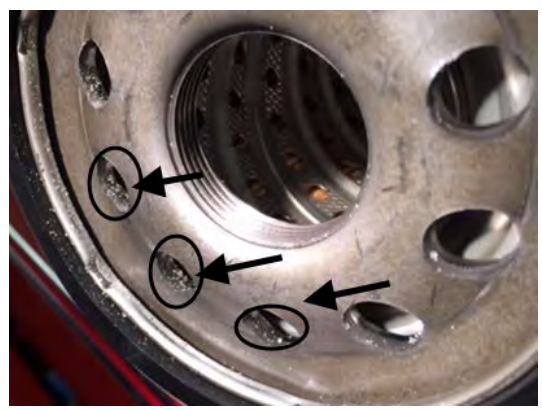
Secondary fuel filters on GHG17 engines

Do not install pre-GHG17 fuel filters on GHG17+ engines (including this vehicle OBD20 engine).

Although the thread pitch is the same, these filters do not fit and may cause serious issues with the fuel system.

Refer to Impact for the appropriate fuel filter part numbers.

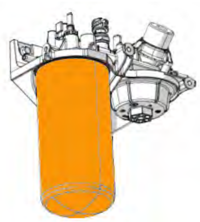
ALUMINUM PARTICLES ON THE FILTER RESTRICTOR (FUEL FILTER HOUSING)



ALUMINUM PARTICLES FOUND ON A PRE-GHG17 FILTER CAUSED BY GRINDING OF THE TOP OF THE FILTER INTO THE FILTER RESTRICTOR

Difference between secondary fuel filter end caps	
	
PRE-GHG17 END CAP DESIGN	**GHG17 END CAP DESIGN WITH DEEP GROOVE**

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. On the new filter, apply clean engine oil to the inner & outer seals. **Do not install pre-GHG17 fuel filters on GHG17 engines.**

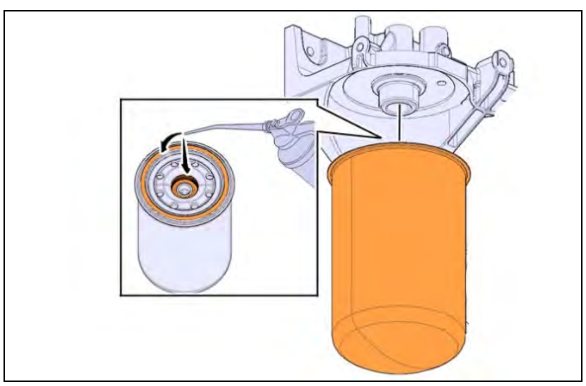


FIGURE 11: SECONDARY FUEL FILTER

5. Screw the new fuel filter in place. Rotate clockwise until the seal contacts the base. Then rotate clockwise another 1/2 - 3/4 turn.

⚠ **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.

6. 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.
7. 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.

2.4 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.

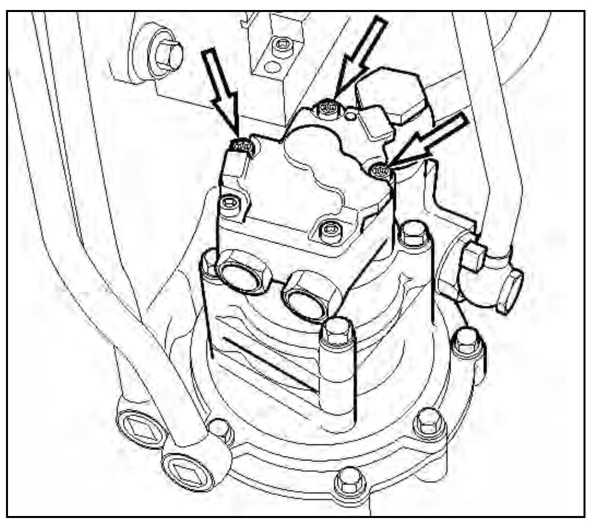


FIGURE 12: FUEL PUMP REMOVAL

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.

TORQUE: 6-7 lb-ft (8-9 Nm)

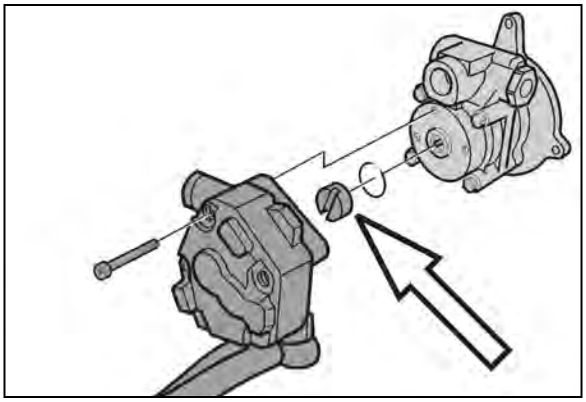


FIGURE 13: FUEL PUMP DRIVE AXLE

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.

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.

MAINTENANCE

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.

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.

CAUTION

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

4. FUEL TANK (STEEL)

This vehicle is equipped with a steel fuel tank with a legal capacity (corresponding to 95% of gross capacity) of 180 US gallons (681 liters).

The fuel filling access door is located on the R.H. side of vehicle providing easy fuel filling.

The tank is also equipped with a Emco-Wheaton posi-lock fuel filler neck and a Level Control Valve (LCV) on the fuel tank connection panel to relieves pressure buildup and allows offset air in the tank to escape during filling. A whistle mounted at the LCV outlet can be heard as air escapes. During fueling, the LCV will close when the fuel reaches the level in the tank corresponding to 95% of the tank volume, permitting a small build-up of pressure in the tank. When the back pressure reaches between 1.1 and 1.5 psig it forces the filling nozzle to close automatically.

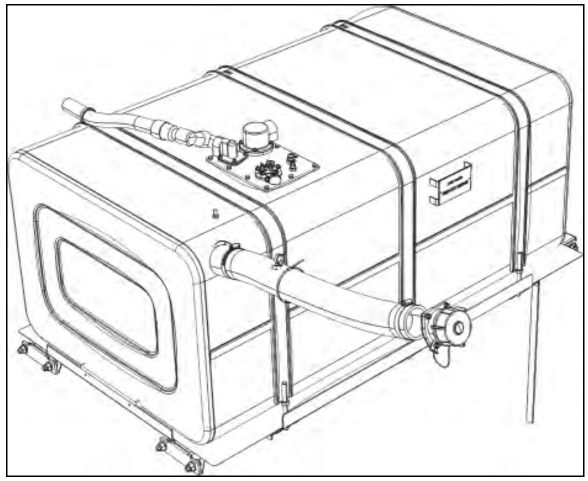


FIGURE 14: STEEL FUEL TANK ASSEMBLY

5% of tank inside space is kept filled with air, allowing for a fuel expansion safety margin. A drain plug, accessible from under the vehicle, is fitted at the bottom of the tank.

4.1 DRAIN PLUG

NOTE

For faster emptying, it is recommended to siphon fuel through the opening left on the connection panel once the pressure relief valve is removed.

Apply **Loctite 567 Thread Sealant** on drain plug. With any sealant, the first one or two threads should be left uncovered to avoid system contamination.

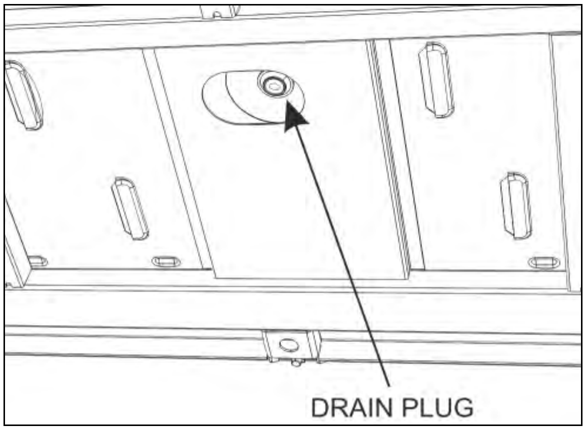


FIGURE 15: FUEL TANK DRAIN PLUG

The proper method of assembling this tapered threaded drain plug is to screw it to the finger tight position and then wrench tighten further 2-3 turns. If leakage persists, check for damaged threads.

4.2 REMOVAL

DANGER

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

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

NOTE

Before removal, the fuel tank should be completely emptied by unscrewing the drain plug. For faster emptying, it is recommended to siphon fuel through the opening left on the connection panel once the pressure relief valve is removed.

Ensure that the container used has a capacity equal to the amount of fuel remaining in the tank.

1. Open the condenser door.
2. Unscrew clamps retaining R.H. side filler tube to fuel tank and filler neck. Disconnect tube and remove it.
3. Unscrew engine fuel supply and return lines from fuel tank connection panel.
4. Disconnect the fuel level sender electrical wires (3 wires). Prior disconnecting, identify the wires and proper terminal on the fuel level sender as reference for reinstallation (Figure 16).
5. Using mobile column lifts, raise the vehicle to gain access to the fuel tank support from underneath.
6. Before removing the bolts securing the tank support to the chassis, lower the vehicle and make sure the tank support is adequately supported with jack stands or wood blocks. Failure to do so could result in injury as well as damage to the tank.

DANGER

Before removing the bolts securing the tank cradle to the frame, make sure the tank cradle is adequately supported with jack stands. Failure to do so could result in injury as well as damage to the tank.

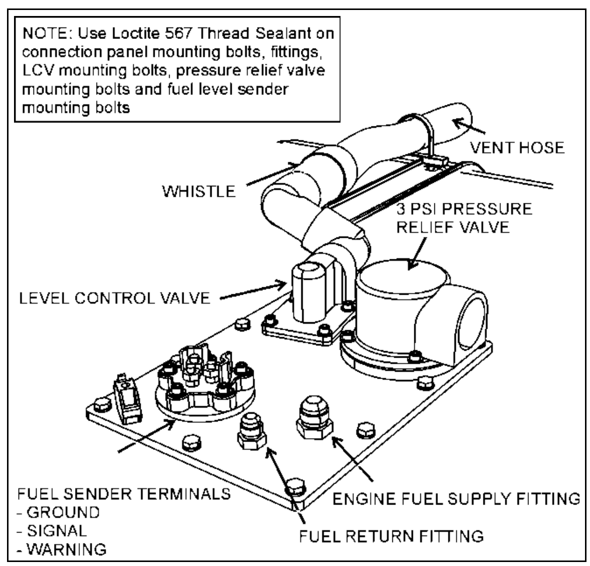


FIGURE 16: FUEL TANK CONNECTION PANEL

7. Once properly supported, unscrew the bolts (6) holding the fuel tank support to the vehicle chassis.

8. Lift the coach until it is high enough to clear the fuel tank. The fuel tank will rest on the floor.

4.3 INSTALLATION

To install tank, simply reverse the "Tank Removal" procedure. Apply Valvoline anti-corrosion compound on retainer strap studs, nuts and fuel tank cradle mounting bolts.

Fasten tank to cradle (tank straps).

TORQUE: 20 lb-ft (27 Nm)

Fasten tank support to vehicle.

TORQUE: 82 lb-ft (111 Nm)

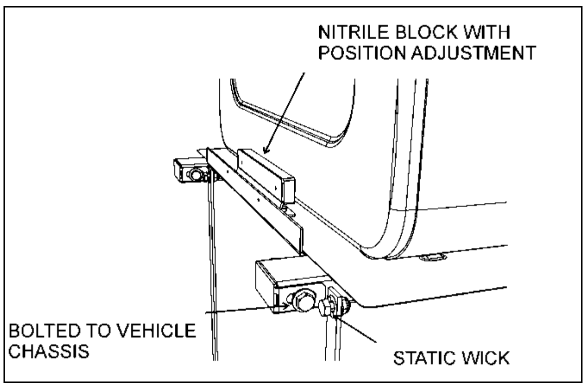


FIGURE 17: FUEL TANK SUPPORT MOUNTING BOLTS

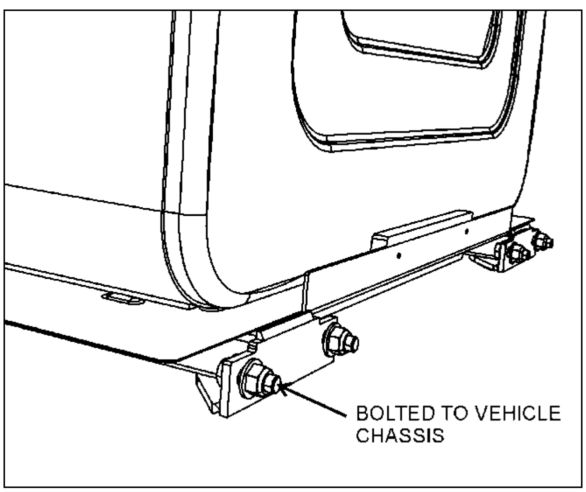


FIGURE 18: FUEL TANK SUPPORT MOUNTING BOLTS

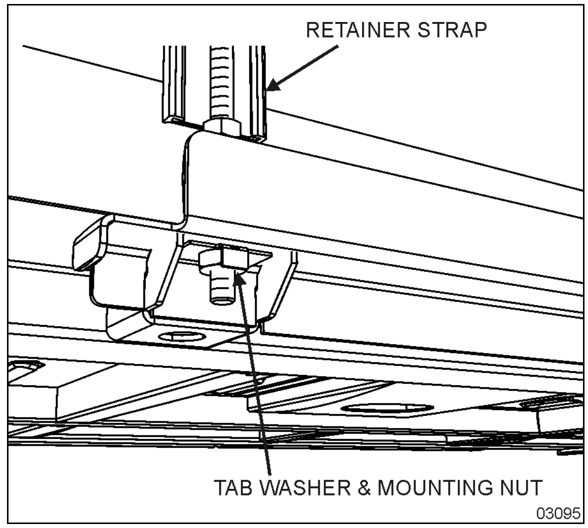


FIGURE 19: FUEL TANK STRAP MOUNTING

4.4 FUEL TANK INSPECTION

MAINTENANCE

Perform fuel tank inspection at the intervals specified by the Lubrication And Servicing Schedule in Section 24: LUBRICATION & SERVICING.

Perform an external visual inspection of the fuel tank from under the vehicle to detect fuel traces or leaks.

Perform a visual inspection of the fuel tank connection panel. Make sure there are no loose connections. Investigate and correct the cause of any fuel leaks.

Inspect fuel tank cradle specific attachment points as described below.

1. Raise the vehicle with safe lifting equipment and procedures.

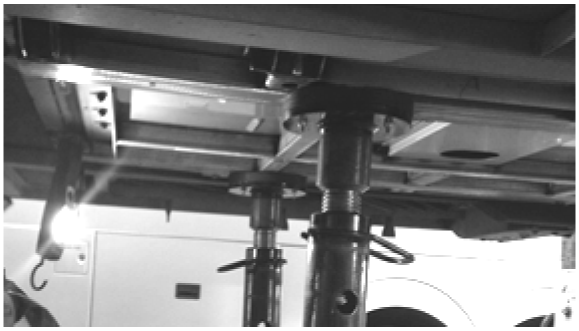


FIGURE 20: JACK STANDS UNDER THE FUEL TANK CRADLE

2. Carefully inspect fuel cradle mounting bolts, 2 bolts (Figure 21).

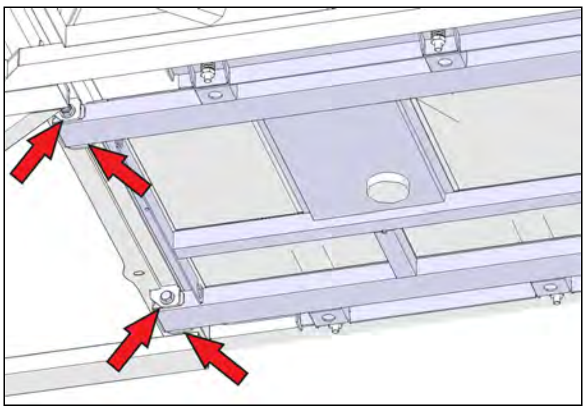


FIGURE 21: SPECIFIC MOUNTING POINTS TO BE INSPECTED

3. On the transversal screw joints (Figure 22) any visible gap between cradle support tubing and vehicle frame mounting lugs **is not acceptable**.

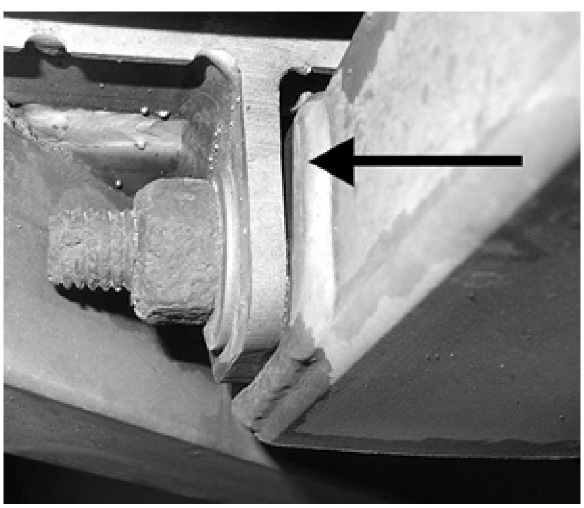


FIGURE 22: VISIBLE GAP ON TRANSVERSAL SCREW JOINT

4. If there is no gap, the inspection is completed. Else, perform the following **Fuel Tank cradle Corrective Measures**.

4.4.1 Fuel Tank Cradle Corrective Measures

Visible gap should be shimmed using U-shims #030082 (3.175 mm / 0.125 in) and/or #030083 (0.953 mm / 0.037 in) as required.

1. Place jack stands under the fuel tank cradle.
2. While processing with one side at a time, unscrew and remove the bolt.

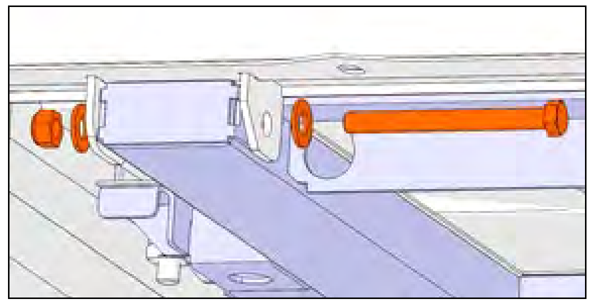


FIGURE 23: TRANSVERSE SCREWS, 2 LOCATIONS

3. On the transversal screw joints (Figure 22) any visible gap between cradle support tubing and vehicle frame mounting lugs is not acceptable.
4. The visible gap should be shimmed using U-shims #030082 and/or #030083 as required.
5. Shim arrangement may vary and may be stacked on both sides (Figure 24).

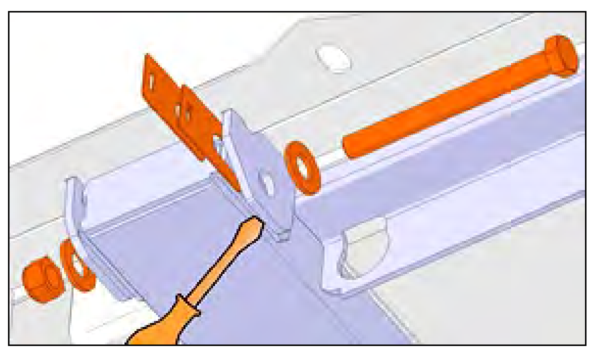


FIGURE 24: SHIM INSTALLATION, TRANSVERSE SCREW. ARRANGEMENT MAY VARY

6. Replace any bolt showing **signs of wear** by new hardware. **DO NOT REUSE NUTS**. Perform replacement one screw location at a time with appropriate support**.** Apply torque seal mark.

Torque: 82 lb-ft (111 Nm)

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 of 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.

4.5 FUEL TYPE

EPA-10 and later 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.

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

*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.*

4.6 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.

4.7 BIODIESEL FUELS

Biodiesel up to a maximum of 5% blend (B5) may be used and will not affect the manufacturers' mechanical warranty as to engine and emissions system related components, provided the biofuel used in the blend conforms to ASTM D6751, B1 to B5 blends conform to ASTM D975. Also, any engine performance problem related to the use of biodiesel fuel would not be recognized nor considered as Volvo or Prevost's responsibility.

However, Volvo engines are certified to comply with U.S. EPA and California emissions standards based upon the use of *test fuels* with specifications established by these regulatory agencies.

Alternative fuels, including biodiesel, that are not substantially similar to the required *test fuels* may adversely affect engine emissions compliance. As a result, Volvo does not warrant the engine will conform to applicable Federal or California emissions limits when operated on biodiesel or other alternative fuels that are not substantially similar to specified test fuels used for certification.

Additional maintenance care must be carried-out for the following systems:

4.7.1 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.

5. 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).

5.1 AIR CLEANER SERVICING

Replacing the air filter cartridge is important to ensure clean air and good flow. Neglecting this servicing could lead to an efficiency loss and eventual engine problems. Follow these steps to replace the filter cartridge:

MAINTENANCE

Air cleaner

Change the filter element when indicated by the restriction indicator or at the intervals specified by the Lubrication And Servicing Schedule in Section 24: LUBRICATION & SERVICING.

5.1.1 Checking restriction indicator

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

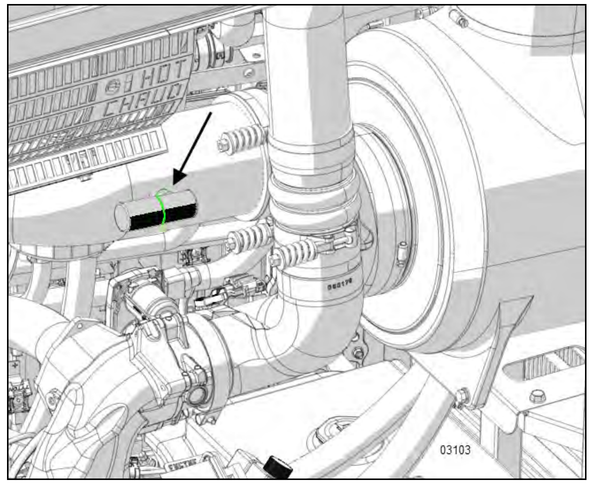


FIGURE 25 RESTRICTION INDICATOR LOCATION

Indication of a need to replace the filter will be apparent once its line turns red. Proper operation will be indicated by a green line. Consult the servicing schedule for time intervals between each regular filter change.

5.1.2 Replacing the Filter

- Remove the four filter cover plastic bolts. The filter itself can be removed by pulling it with gentle movements from left to right and up/down. A residual suction may occur, creating additional resistance.
- Empty the drain rubber valve located under the filter housing; if damaged this part can be ordered and changed.

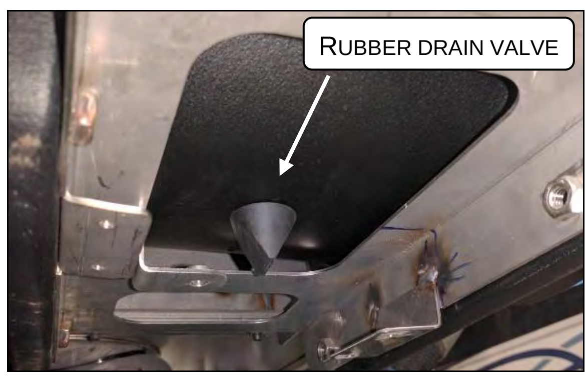


FIGURE 26 RUBBER DRAIN VALVE UNDER FILTER

- Using a clean damp cloth, wipe the sealing flange and the inside of the outlet tube.

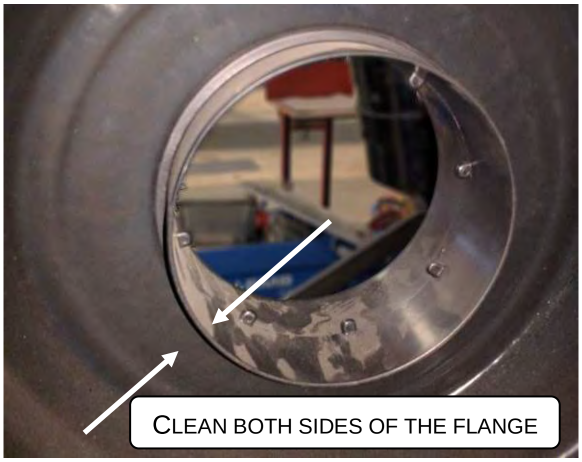


FIGURE 27FILTER FLANGE

- Look for traces of dirt and particles on the outer surface of the old filter, indicating possible leakage. If so, the leakage cause should be investigated and solved.
- Unbox the new filter, inspect the inner sealing surface for potential non-conformities; Do not wipe the surface as it is factory sprayed with a dry lubricant for an easier mounting.

Insert new filter by gently pushing it inside the filter housing.

⚠ **CAUTION**
Avoid pushing it by its center; use both hands and push on its outer rim until it is well seated. (It should be exceeding the housing by around 2-1/2 inches as shown)

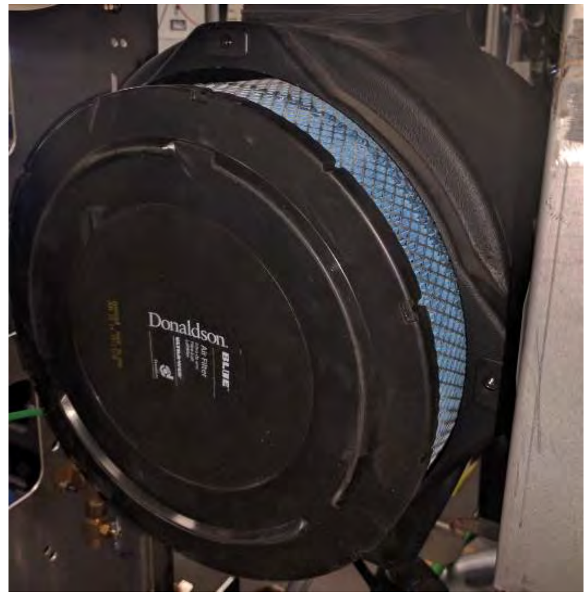


FIGURE 28 AIR FILTER

- Replace the filter cover and tighten the 4 plastic bolts using recommended torque settings (as displayed on filter cover).

TORQUE: 10-15 lb-ft (14-20 Nm)

FIGURE 29 FILTER COVER SCREWS

WARNING: The cover is not supposed to apply pressure on the filter. If so, the filter needs to be pushed further in the housing.

- Reset the restriction gage by pushing on the right-hand side button.

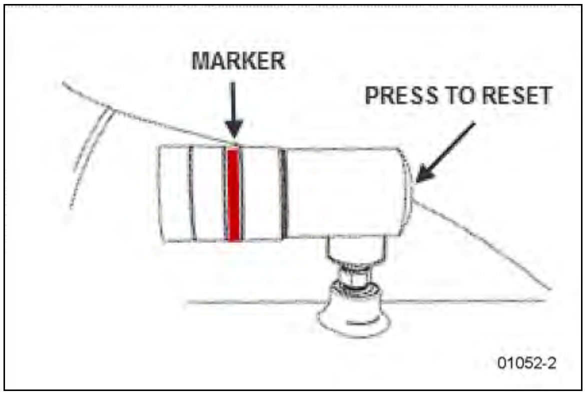


FIGURE 30: RESTRICTION INDICATOR

5.2 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.

6. ACCELERATOR PEDAL

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

6.1 PEDAL ADJUSTMENT

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

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

6.2 POTENTIOMETER REPLACEMENT

1. Disconnect cable harness connector.
2. Loosen the two screws and remove potentiometer. Retain for re-assembly.
3. Discard potentiometer (Figure 31).

> **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.

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 (Figure 31) and tighten just enough to secure potentiometer lightly.

TORQUE: 10-20 lb-in (1.13-2.26 Nm)

5. Reconnect electronic foot pedal assembly's cable harness to the ECM connector. If potentiometer calibration is necessary (see *"FUEL PEDAL ADJUSTMENT"* in this section).

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

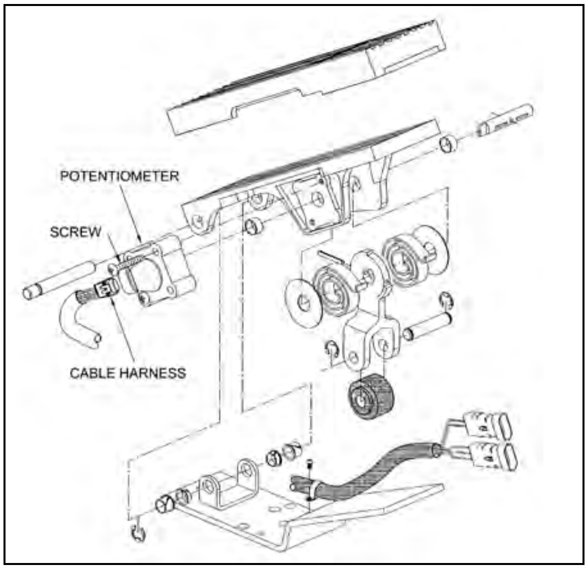


FIGURE 31: ELECTRONIC FOOT PEDAL ASSEMBLY 03035

7. SPECIFICATIONS

Davco Fuel Pro 382/386 Fuel Filter / Water Separator Element

Max Fuel Flow .... 180 US gal/h (681 l/h)

Secondary Fuel Filter

Filter type .... Spin-on cartridge

Filter torque.. 1/2 to 3/4 of a turn after gasket contact

Fuel tank Capacity

Tank capacity (95% of total volume) .... 180 US gallons (681 liters)

Air Cleaner

Filter type .... Dry-type replaceable element

Filter change interval.. Red marker on restriction indicator

CONTENTS

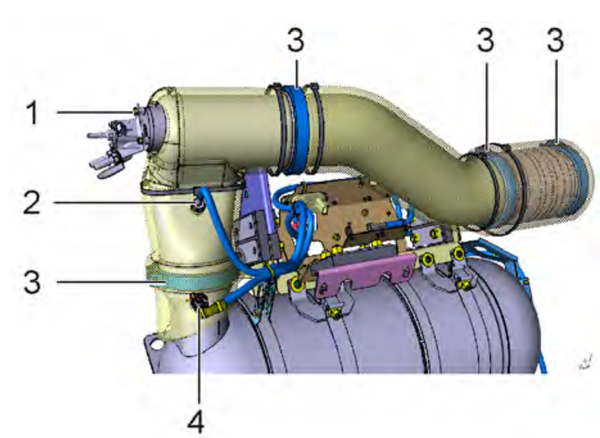
SECTION CHANGE LOG

DESCRIPTION		DATE
1		
2		
3		
4		
5		
6		

1. TORQUE TABLES

The following tables show specific torque values for the DPF assembly. *In the absence of a torque specification for a given item, standard torque applies.* See table in Section 00: General Information.

1.1. EXHAUST SYSTEM



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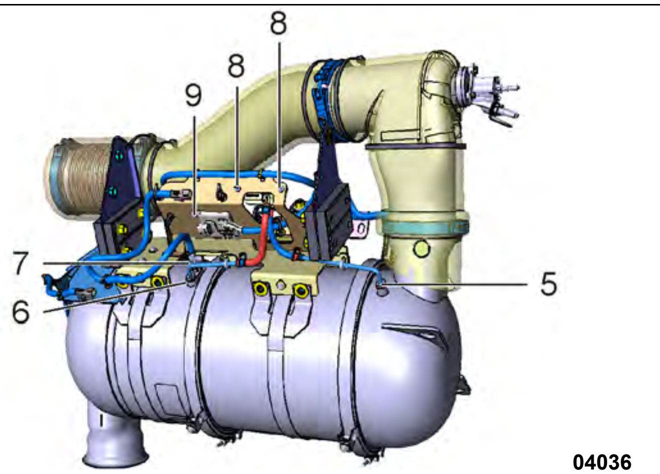

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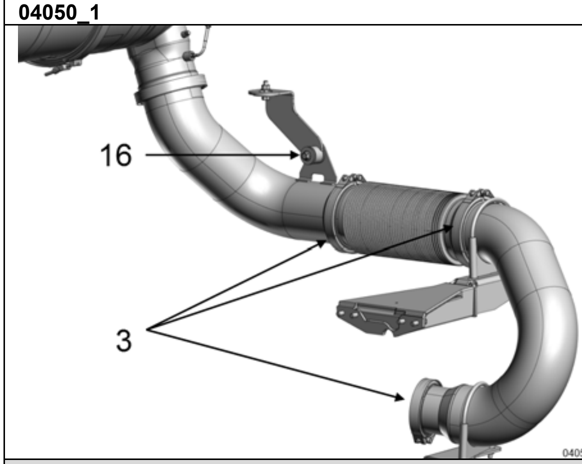
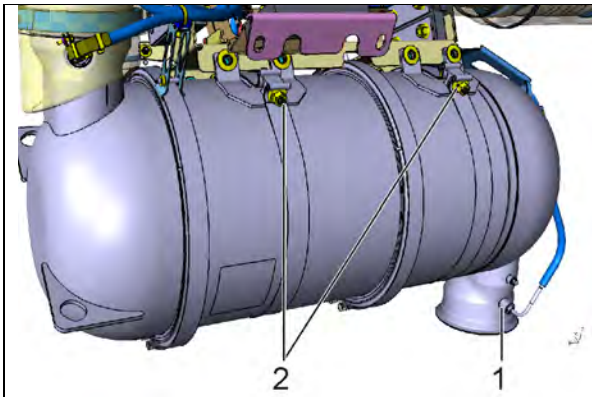


TORQUE SPECIFICATIONS		
No	DESCRIPTION	TORQUE
1	DEF injection nozzle mounting bolt	6.3-8.5 lb-ft (9-12 Nm)
2	DPF outlet temperature sensor (T3)	30-37 lb-ft (41-50 Nm) *
3	V-band clamp 4-inch & 5-inch	6.5-9.5 lb-ft (9-13 Nm)
4	NOx sensor 1	30-44 lb-ft (41-60 Nm)
5	DPF filter outlet pressure sensor	3.7-4.6 lb-ft (5.02-6.24 Nm) *
6	DPF filter inlet pressure sensor	3.7-4.6 lb-ft (5.02-6.24 Nm) *
7	Diesel Oxidation Catalyst (DOC) temperature sensor (T2)	30-37 lb-ft (41-50 Nm) *
8	Cap screw	3.8-5.1 lb-ft (5.15-6.91 Nm)
9	Module mounting bolt	5.9-8.8 lb-ft (8-11.93 Nm)
16	Vibration damper screw downstream from turbo	4.5-5.5 lb-ft (6-7 Nm)

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



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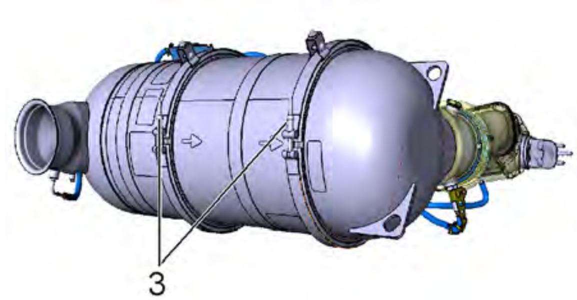

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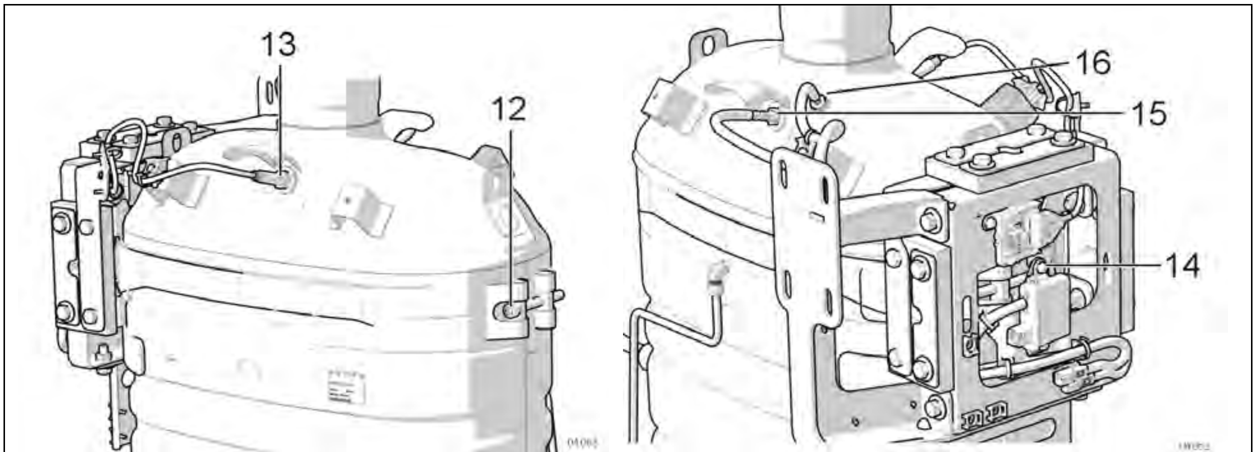
TORQUE SPECIFICATIONS		
No	DESCRIPTION	TORQUE
1	DPF inlet temperature sensor (T1)	30-37 lb-ft (41-50 Nm)*
2	DPF tank strap	17-23 lb-ft (23-31 Nm)
3	DPF tank V-band clamp	17-23 lb-ft (23-31 Nm)

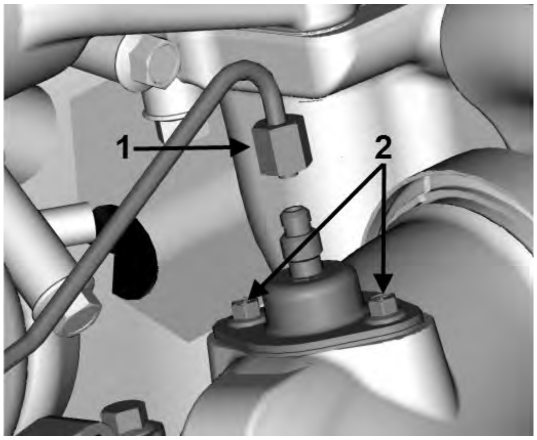
* Use Permatex 454G anti-seize lubricant or Loctite 76764 silver grade anti-seize

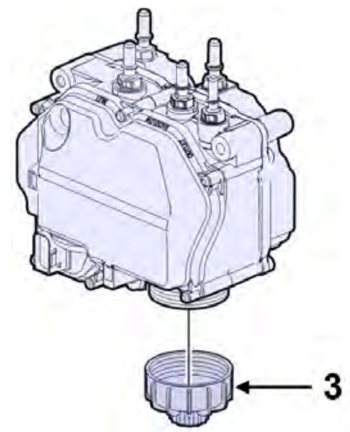


TORQUE SPECIFICATIONS		
No	DESCRIPTION	TORQUE
12	SCR tank strap bolts	30-37 lb-ft (41-50 Nm)
13	NOx sensor 2 (outlet)	30-44 lb-ft (41-60 Nm)
14	Module mounting bolts	5.9-8.8 lb-ft (8-11.93 Nm)
15	SCR tank particulate matter sensor	33-40.5 lb-ft (45-55 Nm)
16	SCR tank temperature sensor (T4)	30-37 lb-ft (41-50 Nm)*

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

1.2. MISCELLANEOUS TORQUES





MISCELLANEOUS TORQUES		
No	DESCRIPTION	TORQUE
1	Aftertreatment hydrocarbon doser fuel line fitting	177-213 lb-in (20-24 Nm)
2	Aftertreatment hydrocarbon doser mounting bolts	120-130 lb-in (14-15 Nm)
3	DEF pump filter cover	16.5 lb-ft (22 Nm)

2. EXHAUST AFTERTREATMENT SYSTEM (EATS) OVERVIEW

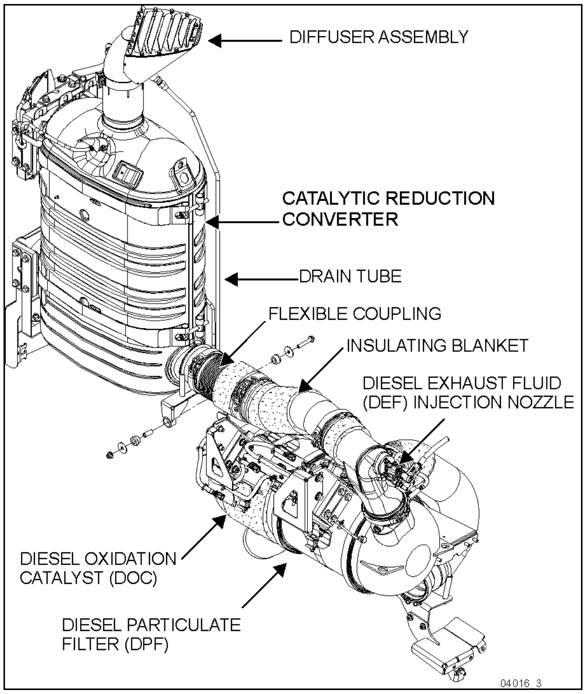


FIGURE 1: EXHAUST SYSTEM

The technology behind clean emissions is through the immediate aftertreatment of engine exhaust. The process for reducing NOx 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 NOx 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 NOx. To achieve this goal, the exhaust aftertreatment system (EATS) 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 NOx to minimum level. Through constant monitoring of the exhaust gas temperature and the system back pressure, the Engine management System (EMS) is able to manage regeneration.

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

IMPORTANT NOTE

Exhaust Aftertreatment System (EATS) components must not be removed, altered or modified in any way. In order to protect the emission control system from tampering, inducement measures will occur if the following states are detected:

- Disconnection of DEF tank level sensor
- Blocked DEF line or dosing valve
- Disconnection of NOx sensor
- Disconnected exhaust temperature sensor
- Disconnected DEF temperature sensor
- Disconnected DEF quality sensor
- Disconnection of DEF dosing valve
- Disconnection of DEF pump
- Disconnection of SCR wiring harness

Auxiliary Emission Control Device (EACD) defines as any element of design which senses temperature, vehicle speed, engine RPM, transmission gear, manifold vacuum, or any other parameter for the purpose of activating, modulating, delaying, or deactivating the operation of any part of the emission control system.
Disconnection of the following EACD produces immediate activation of the Malfunction Indicator Lamp MIL and 25% engine derate after three (3) hours of a continuous open circuit.

- Intake throttle position sensor;
- Ambient air temperature sensor;
- Vehicle speed;
- Engine oil pressure sensor;
- Exhaust back pressure sensor;
- Camshaft speed sensor;
- EGR delta pressure;
- Fuel rail pressure
- Engine timing sensor;
- Engine coolant temperature;
- EGR temperature sensor.

2.1. 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 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.

2.2. FLEXIBLE COUPLING INSTALLATION

The flexible coupling contains a rigid interior pipe (Figure 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.

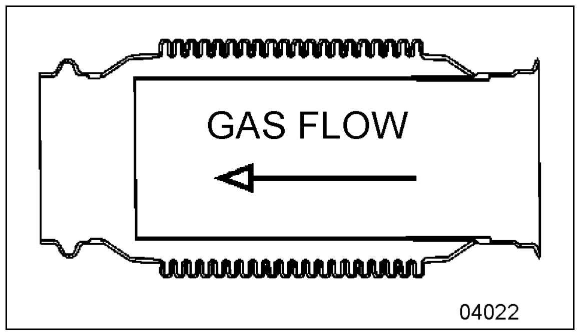


FIGURE 2: FLEXIBLE COUPLING

3. 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 Prevost on an exchange basis. For Commuter vehicle applications and severe duty cycle, this will occur after approximately 4500 hours 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.

MAINTENANCE

DPF (Diesel Particulate Filter)

Either clean or replace filter cartridge at the intervals specified by the Lubrication And Servicing Schedule in Section 24A: LUBRICATION & SERVICING SCHEDULE.

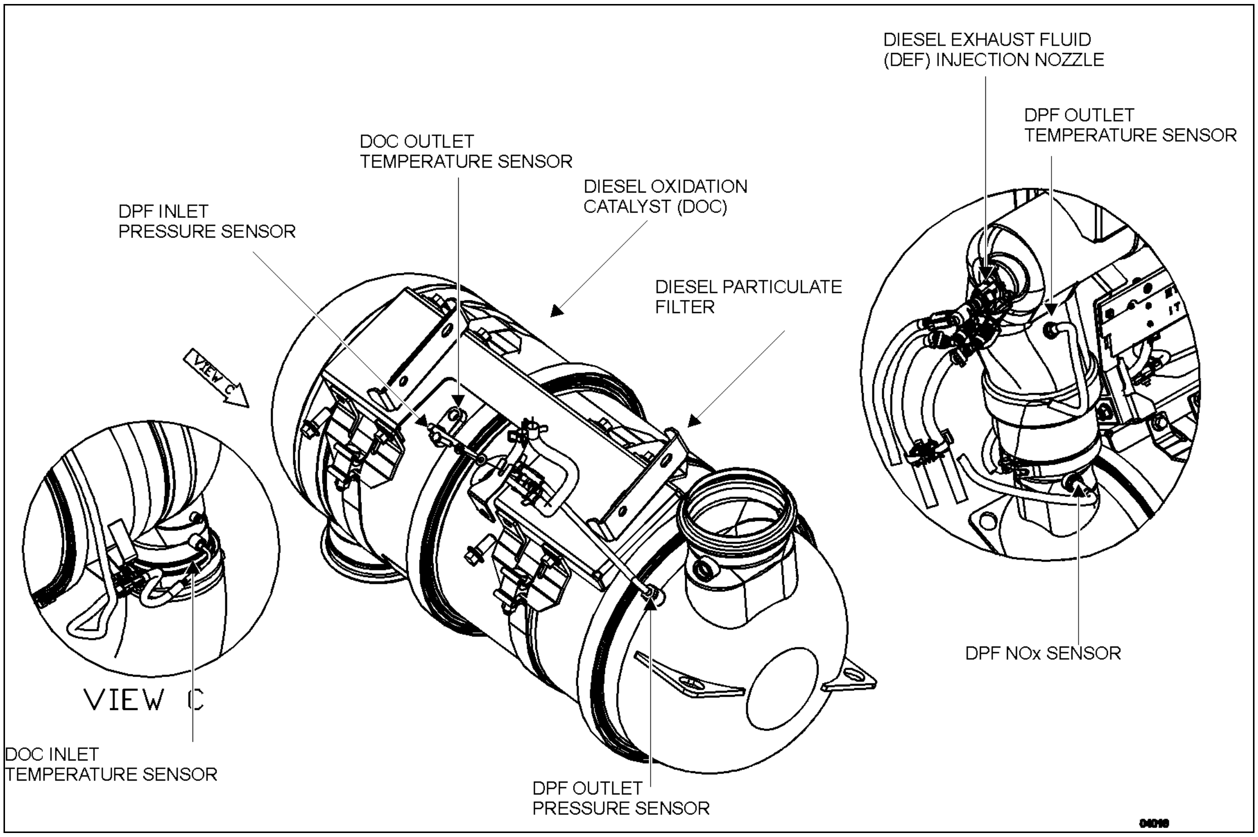


FIGURE 3: DIESEL OXIDATION CATALYST (DOC) & DIESEL PARTICULATE FILTER (DPF) ASSEMBLY

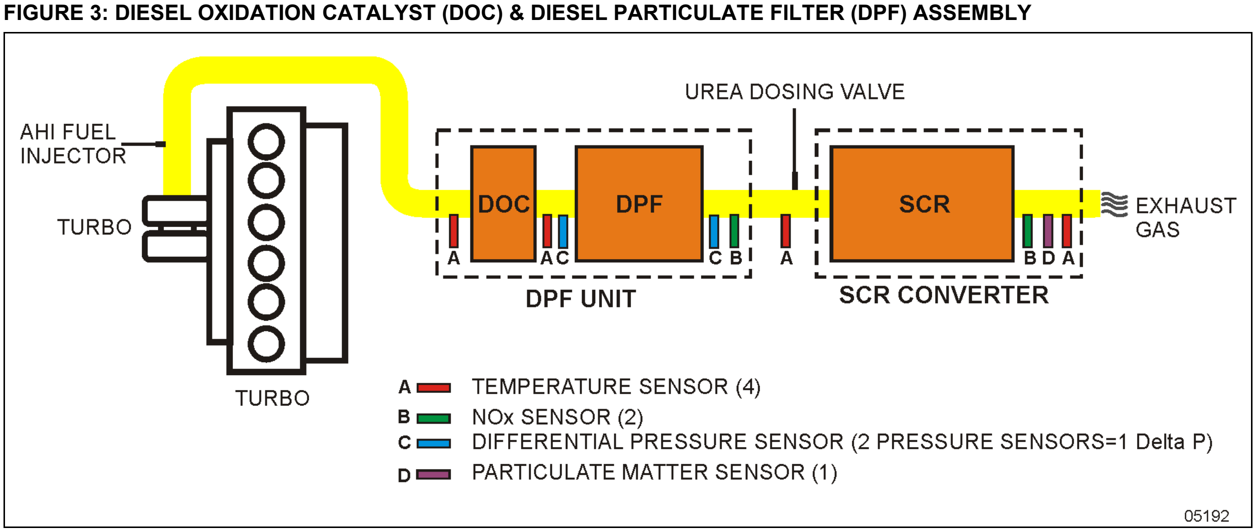


FIGURE 4: EATS SENSORS LOCATION – OBD20 VERSION

WARNING

HOT EXHAUST

During stationary regeneration, exhaust gas 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.**

3.1. 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 EATS to cool before handling. Wear protective clothing and gloves while servicing.

1. First, Access the engine compartment
2. Put insulating blanket aside;
3. Remove the heat shield;

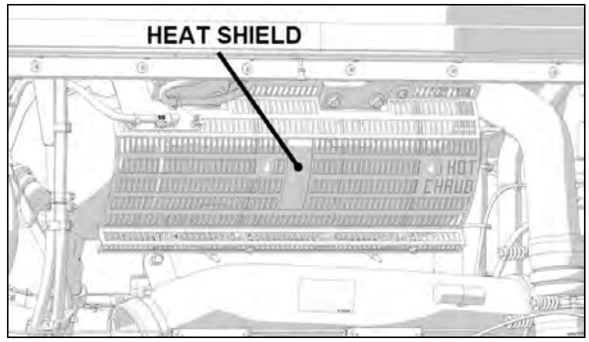


FIGURE 5: DPF HEAT SHIELD

4. Disconnect pressure, NOx and temperature sensors;
5. Support Diesel Oxidation Catalyst (DOC) and Diesel Particulate Filter (DPF) assembly;

CAUTION

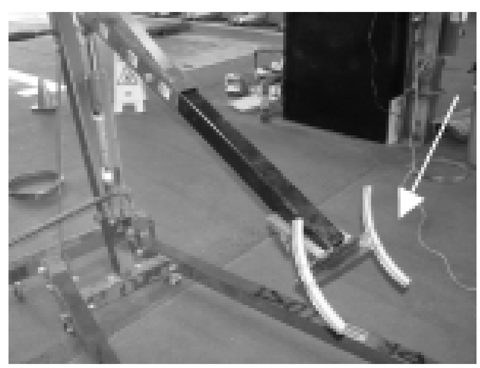
HEAVY DEVICE

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.

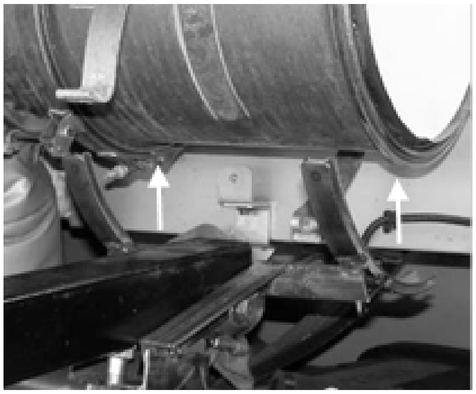
NOTE

PREVOST # 35606 SUPPORT TOOL USE & INSTALLATION

- Install tool to a suitable engine crane.

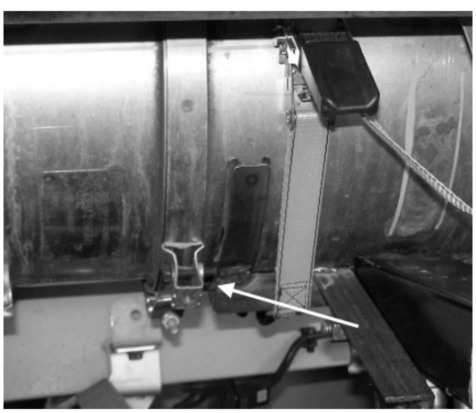


- Position crane and support tool under DPF assembly.

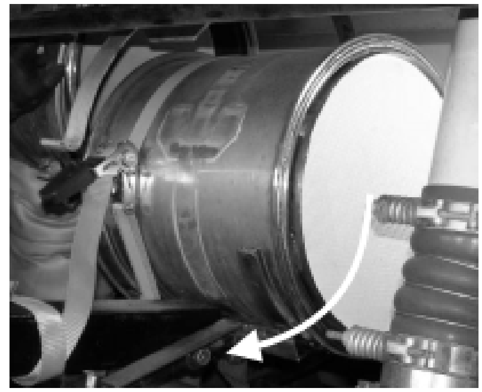


- Secure DPF to support tool using appropriate tie-down type strap.

- Loosen V-band clamp holding DOP to DPF.



- Lower and pull back to remove DPF from bus.



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

CAUTION

FRAGILE - HANDLE WITH CARE

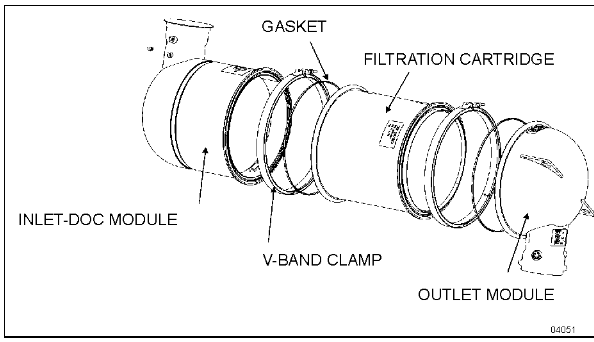
Use extreme care when handling DPF cartridge as it could be damaged or destroyed by dropping or sudden impact.

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.

9. 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.



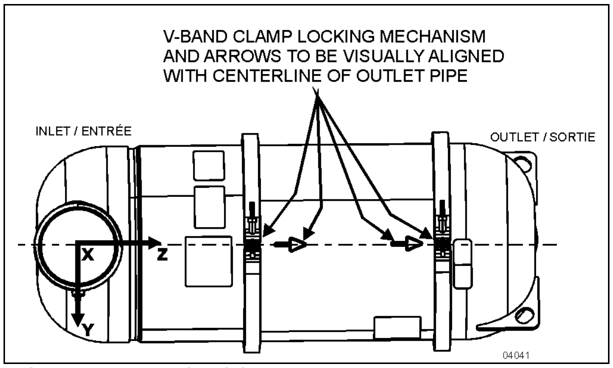


FIGURE 6: TAKING DOC AND DPF APART

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

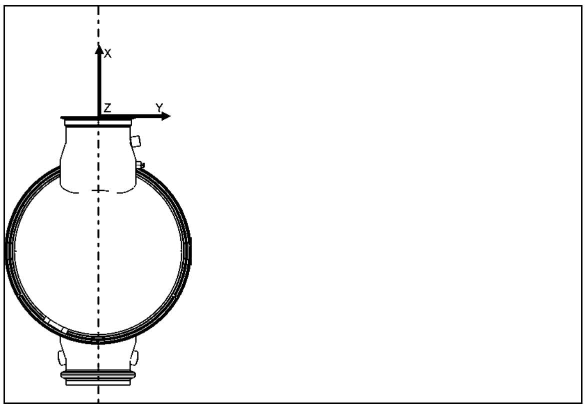


FIGURE 7

11. Tighten V-band clamps.

TORQUE: 20 lb-ft (27 Nm)

⚠ **CAUTION**
Always torque clamps by hand.

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

4. SELECTIVE CATALYTIC REDUCTION 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:

4.1. REMOVAL

Procedure # 1

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

1. Set the starter selector switch to the *OFF* position.
2. Shut off the heater line shut-off valves.
3. 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 to facilitate re-installation. Plug all openings to prevent dirt from entering the system.

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

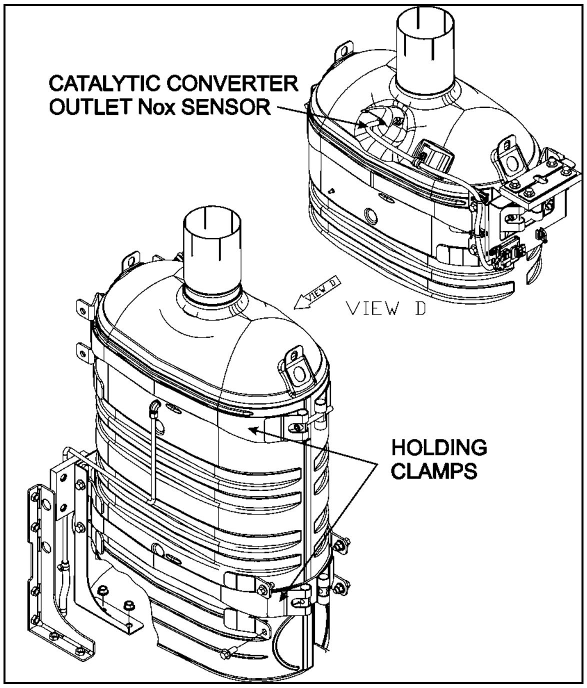


FIGURE 8: CATALYTIC CONVERTER

5. Disconnect and remove a section of coolant pipe assembly mounted between the thermostat housing and the radiator inlet.
6. Disconnect and remove the air intake duct mounted between the turbocharger outlet and the air cooler inlet.
7. Open radiator door. Unfasten bolts and screws fixing radiator sealing frame.
8. 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.

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

Alternate Procedure

In this alternate procedure, the radiator remains in place. Rather, it is the coolant tank that is removed to lower the catalytic converter for replacement.

1. Set the starter selector switch to the *OFF* position.
2. Shut off the heater line shut-off valves.
3. Remove DOC and DPF assembly (Refer to paragraph 2.1 in this Section).
4. Remove pipe connecting DOC & DPF assembly to catalytic converter.
5. 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.

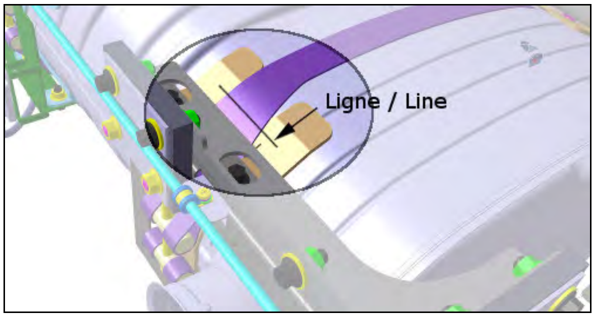
6. Disconnect and remove section of coolant pipe assembly mounted between the radiator outlet and the water pump inlet.
7. Disconnect and remove a section of coolant pipe assembly mounted between the thermostat housing and the radiator inlet.
8. Disconnect and remove the air intake duct mounted between the turbocharger outlet and the air cooler inlet.
9. Remove coolant surge tank.
10. Release tension from drive belt (Refer to paragraph 12.1 and 15.1 in Section 05: Cooling System).
11. Safely support catalytic converter from the top.
12. Disconnect catalytic converter outlet NOx sensor.
13. Remove clamps holding catalytic converter then lower.
14. Remove or disconnect any piece of equipment or component that might be in the way or that might prevent removing the catalytic converter.

5. ASSEMBLING CATALYTIC CONVERTER

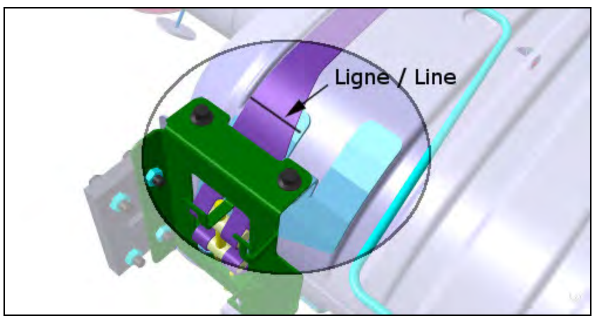
Before removing

1. 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

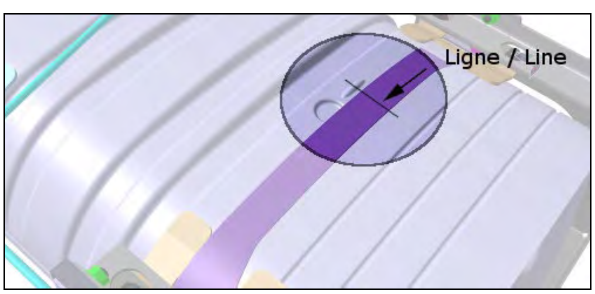


Upper

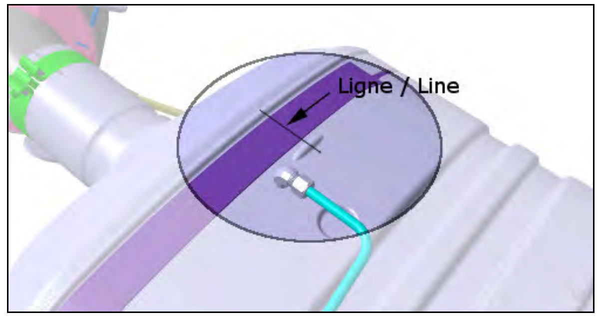


2. Mark, with a vertical line the central position of the lower and upper clamps with regard to the emboss located at the bottom and at the top of the catalytic converter.

Lower



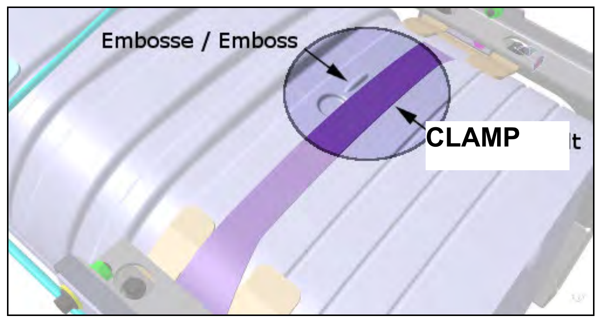
Upper



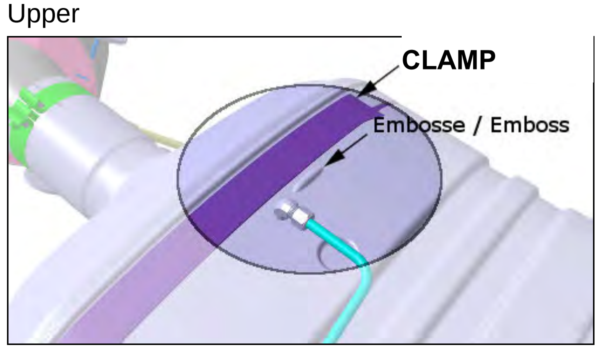
Assembling

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

Lower

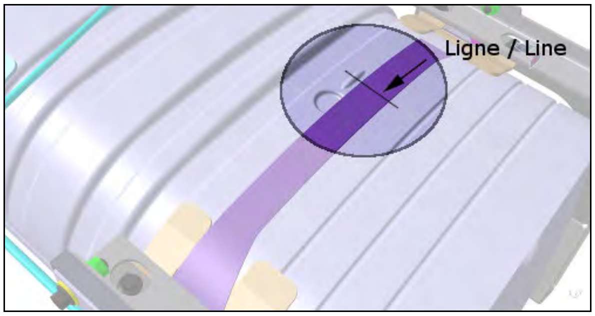


Upper

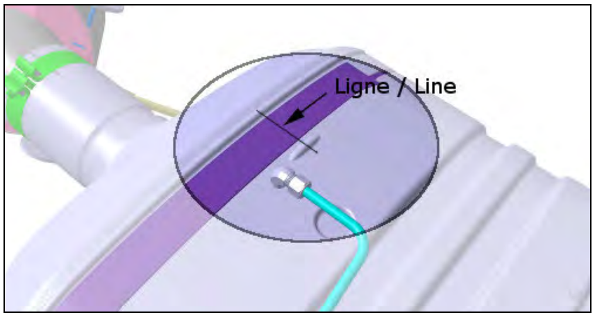


4. Using the lines made earlier, line up the lower and upper clamps with regard to the emboss of the converter and afterward, line up the lines made earlier on the clamps with regard to the clamp supports on the catalytic converter.

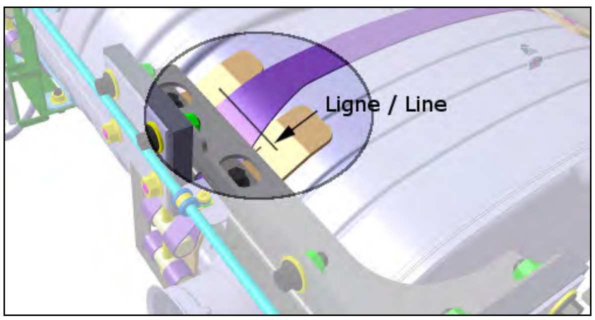
Lower



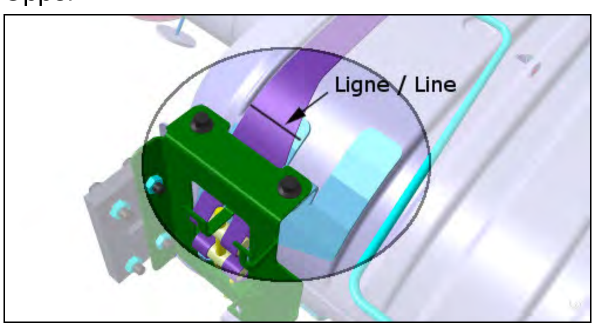
Upper



Lower



Upper



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

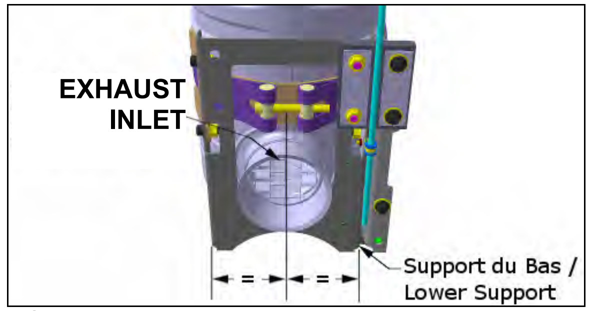


FIGURE 9

6. 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.

6. DIFFUSER ASSEMBLY

During stationary regeneration, exhaust gas temperature may get very hot at the outlet. The diffuser decreases the exhaust gas temperature by about half 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.

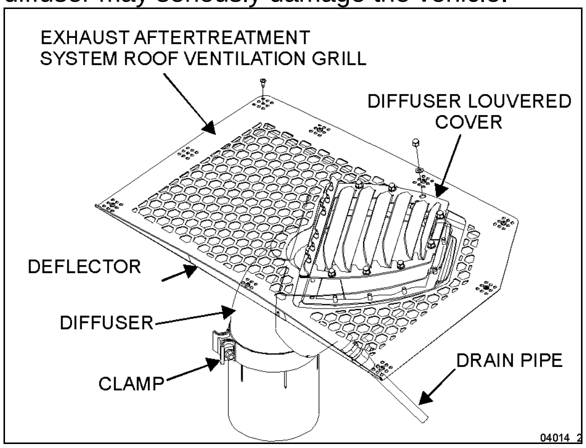


FIGURE 10: DIFFUSER ASSEMBLY

6.1. 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 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.

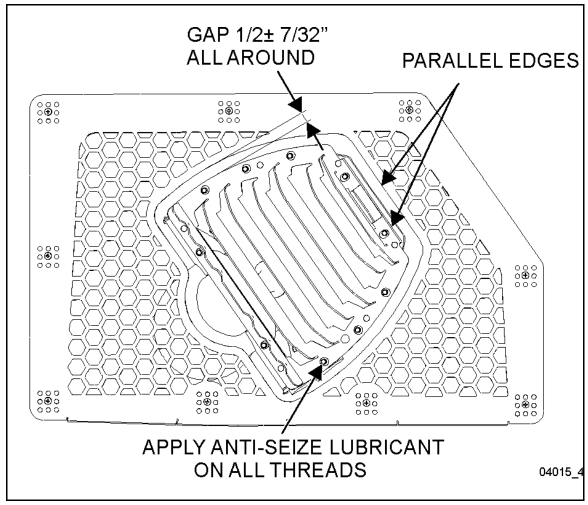


FIGURE 11: DIFFUSER POSITION ADJUSTMENT

2. For proper angular position, make sure that the two edges shown on Figure 11 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 EATS roof ventilation grill and deflector.

6.2. 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.

MAINTENANCE

Diffuser assembly

Inspect the diffuser assembly at the intervals specified by the Lubrication And Servicing Schedule in Section 24A.

7. 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 curb side, in the condenser compartment.

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

A heating coil inside the tank uses 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.

7.1. 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!

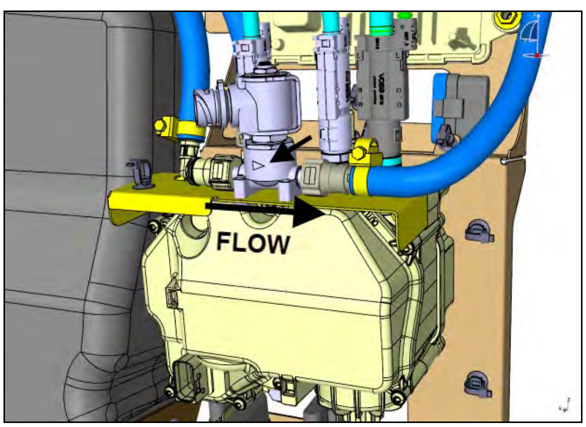


FIGURE 12

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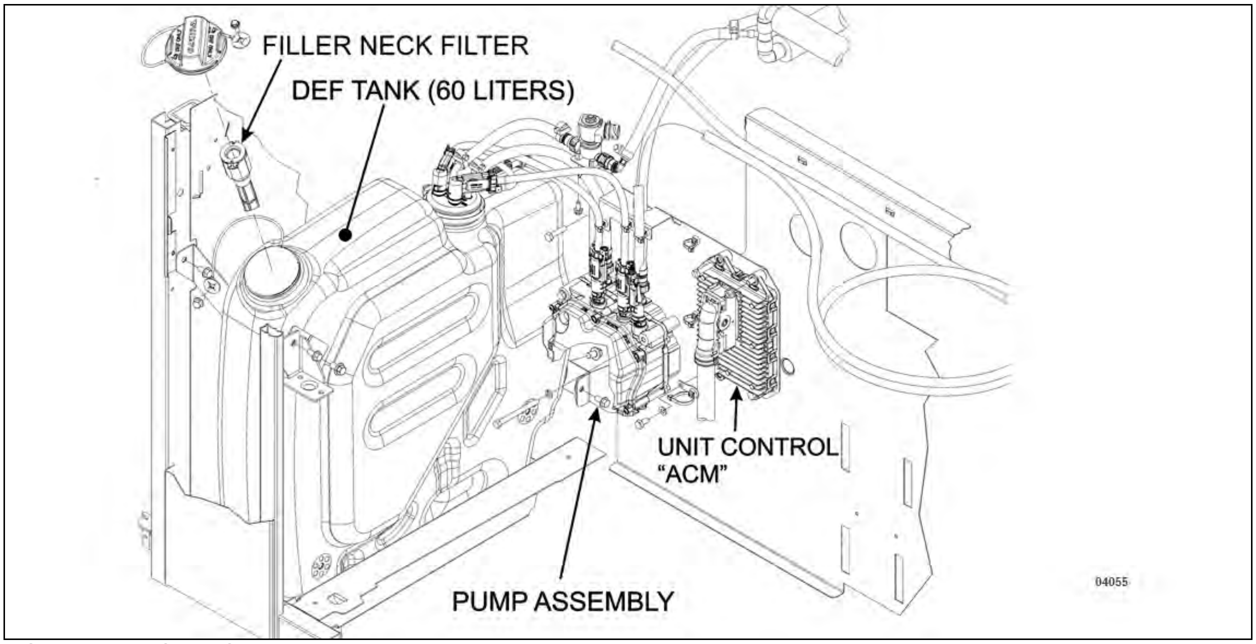


FIGURE 13: X3 SERIES DEF TANK AND PUMP

7.2. FILLER NECK STRAINER

If the DEF tank filler neck strainer (Figure 13) 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.

7.3. 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.

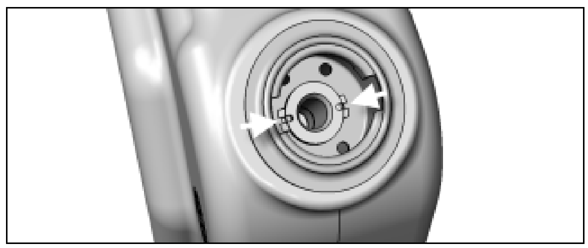


FIGURE 14

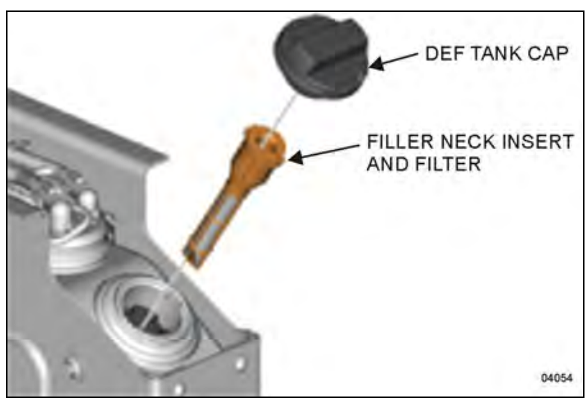


FIGURE 15

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 at the intervals specified by the Lubrication And Servicing Schedule in Section 24A: LUBRICATION & SERVICING SCHEDULE.

7.4. 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. Clean the area around filter cover. Loosen and remove filter cover.

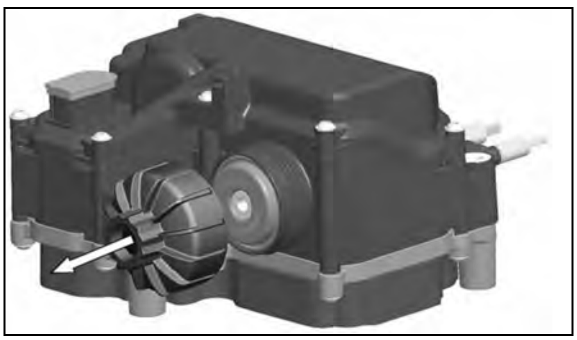


FIGURE 16

CAUTION

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

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

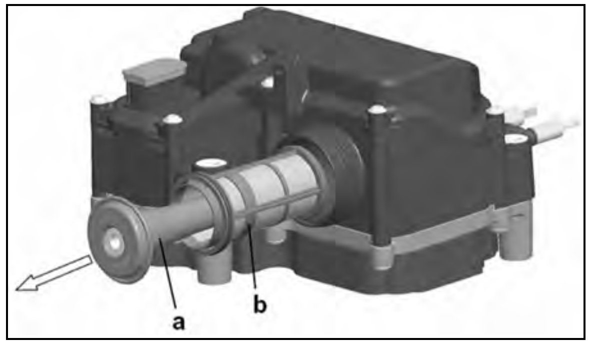


FIGURE 17

a) Equalizer

b) Filter element

5. Use the special tool included in the filter replacement kit to remove the filter element.

   Note: Two different filters are used in the DEF pump. Use the end of the special tool that matches the color of the filter element.

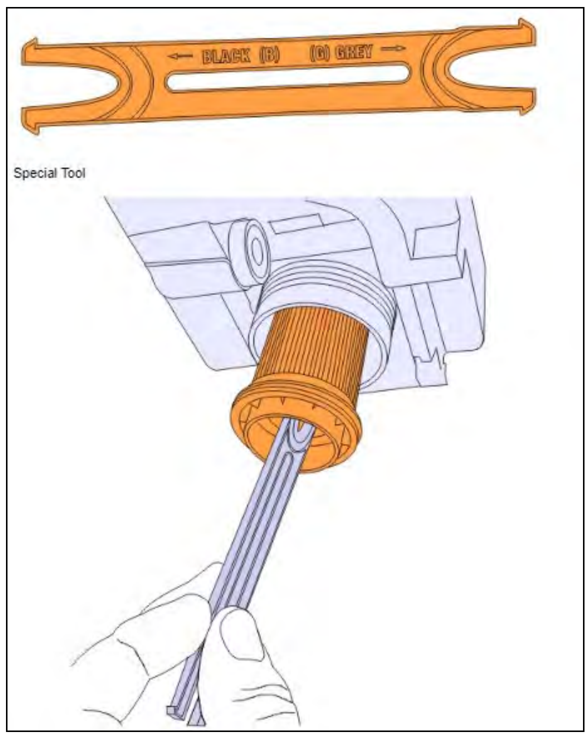


FIGURE 18

6. 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.

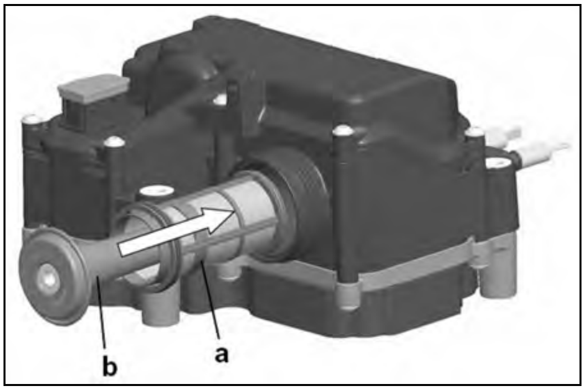


FIGURE 19

7. Install filter cover. Torque to prescribed torque.

   TORQUE: 16.5 lb-ft (22 Nm)

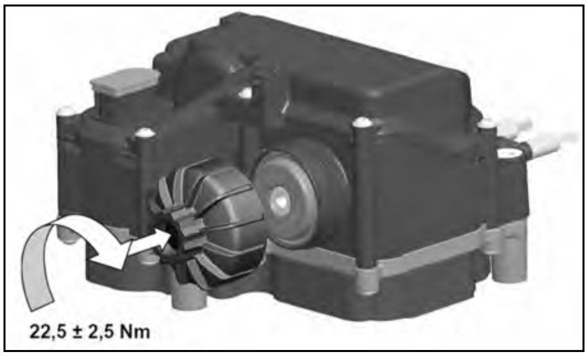


FIGURE 20

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 at the intervals specified by the Lubrication & Servicing Schedule in Section 24A.

8. AFTERTREATMENT HYDROCARBON DOSER

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

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 hydrocarbon doser. 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.

MAINTENANCE

Aftertreatment hydrocarbon doser

Replace the aftertreatment hydrocarbon doser at the intervals specified in Section 24A: LUBRICATION & SERVICING SCHEDULE.

8.1. 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.

Remove the aftertreatment hydrocarbon injector mounting fasteners. Remove the aftertreatment hydrocarbon injector from the diffuser pipe (which attaches to the turbocharger outlet).

Clean the sealing surface on the diffuser pipe before mounting the aftertreatment hydrocarbon injector.

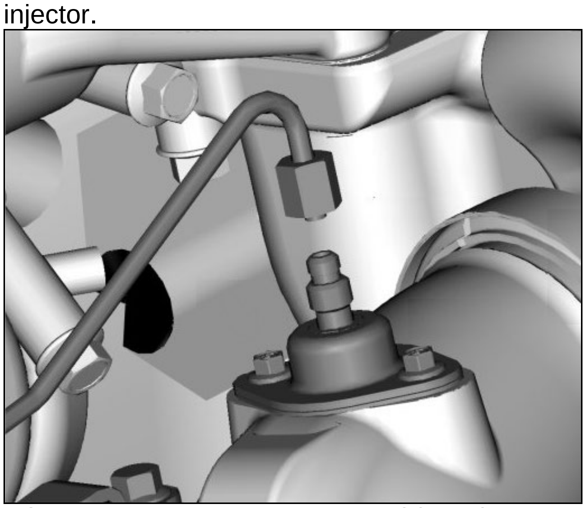


FIGURE 21: AFTERTREATMENT HYDROCARBON DOSER

Install the new aftertreatment hydrocarbon injector and new gasket onto the diffuser pipe (which attaches to the turbocharger outlet) and tighten the fasteners.

TORQUE: 120-130 lb-in (14-15 Nm)

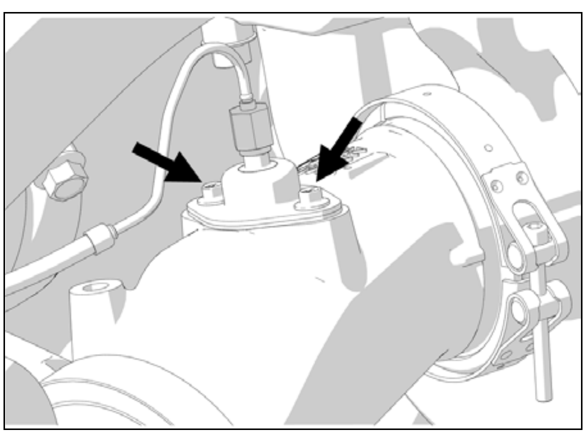


FIGURE 22

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

3. Connect the line to the aftertreatment hydrocarbon injector. Tighten the line fitting.

TORQUE: 177-213 lb-in (20-24 Nm)

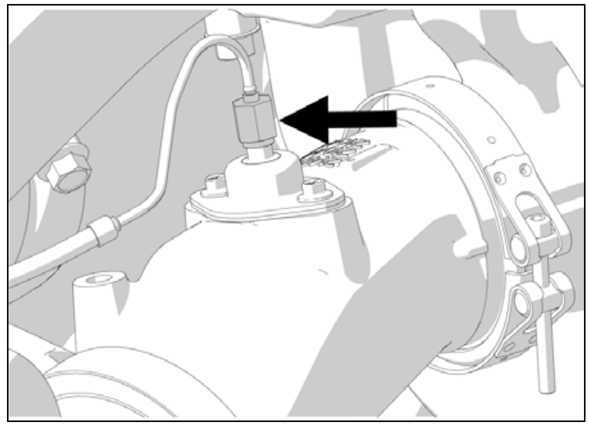


FIGURE 23

4. Install the P-clamp and fasteners to secure the line to the mounting bracket on the diffuser pipe.
5. Start the engine, build air to operating pressure. 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.

PREVOST

MAINTENANCE INFORMATION

MI23-44

DATE :	December 2023 SECTION : 04 EXHAUST
SUBJECT :	**INJECTOR, AHI NOZZLE IDENTIFICATION – AFTERTREATMENT SYSTEM**

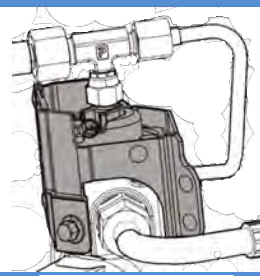
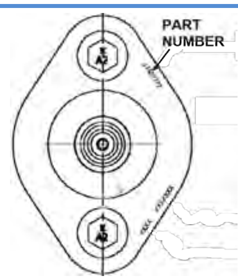
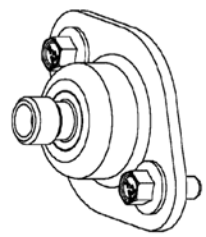
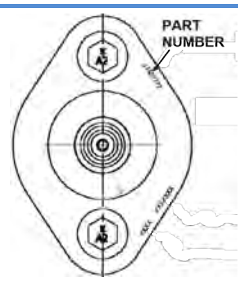
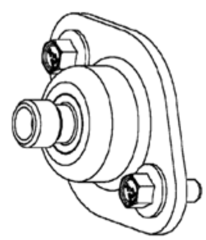
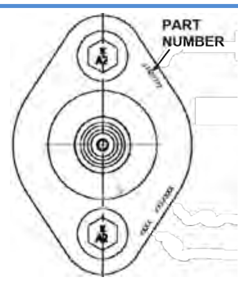
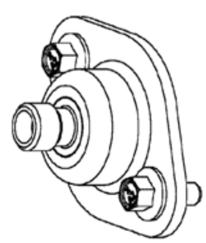
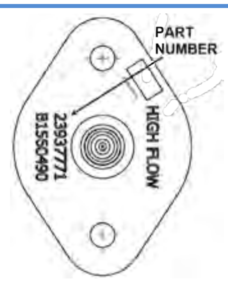
First Release 12-07-2023

APPLICATION

Model	VIN 
PREVOST VEHICLES EQUIPPED WITH VOLVO D13 ENGINE	

DESCRIPTION

Since the introduction of diesel particulate filter (DPF), several types of aftertreatment hydrocarbon injectors (AHI) have been installed. Use the following table to identify the different types of injectors. The maintenance required for these injectors can be cleaning or systematic replacement based on the interval prescribed in the lubrication & servicing schedule. Note that for the latest AHI injector version, no maintenance is required.

Part number	Emission level	OBD level	Top view	Side view	Nozzle side	Required servicing
21089234	US07 US10					**Clean** as per lubrication and servicing schedule
21407621 **LOW FLOW NOZZLE** **From D13 serial 961636**	US14	OBD13 OBD16				**Replace** as per lubrication and servicing schedule
23923337 **HIGH FLOW NOZZLE (alternate)**						**Replace** as per lubrication and servicing schedule
21407772 **HIGH FLOW NOZZLE TYPE 1**	US17	OBD17 OBD18				**Replace** as per lubrication and servicing schedule
23937771[1] **HIGH FLOW NOZZLE TYPE 2**	US21	OBD21				**No** maintenance required

[1] Can be used as replacement for 21407772 (US17 up)

CONTENTS

SECTION CHANGE LOG

	DESCRIPTION	DATE
1		
2		
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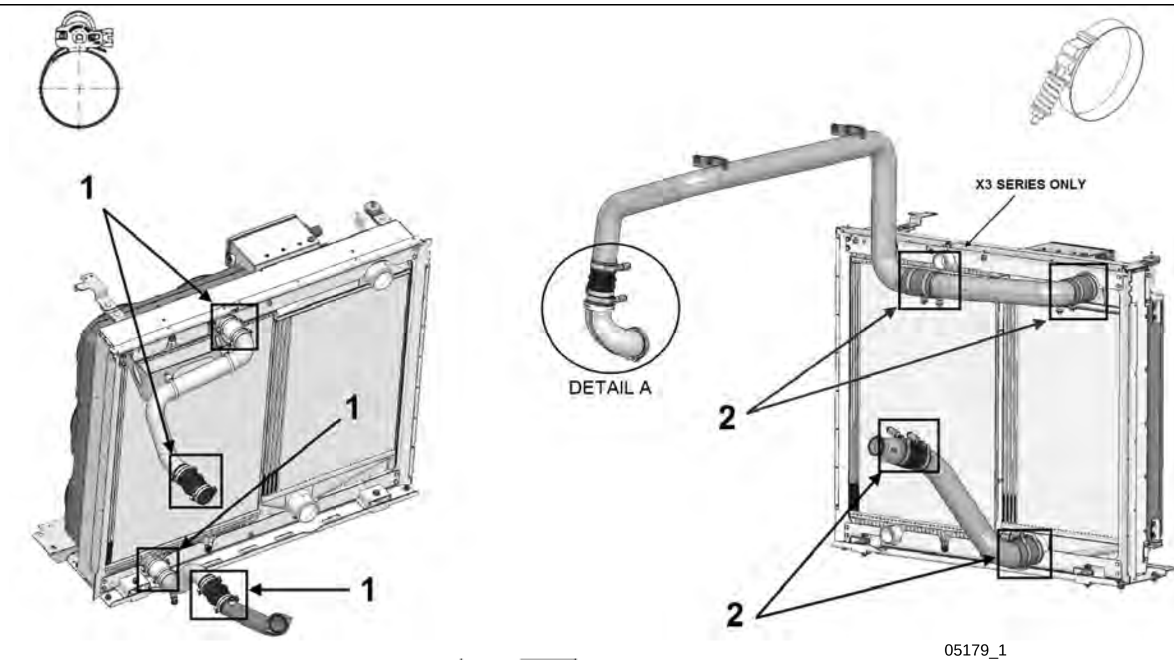
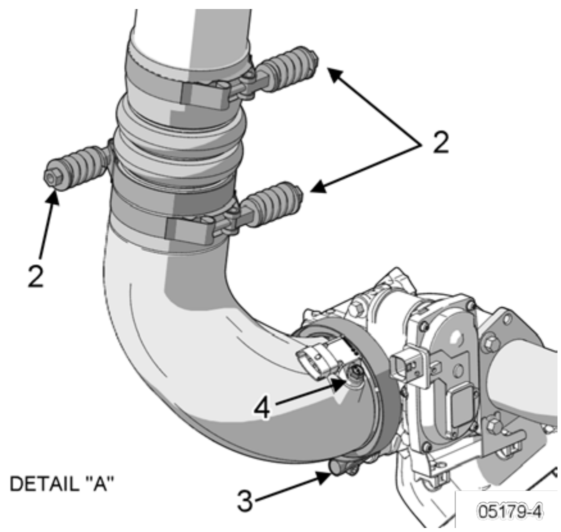
4		
5		
6		

1. TORQUE TABLES

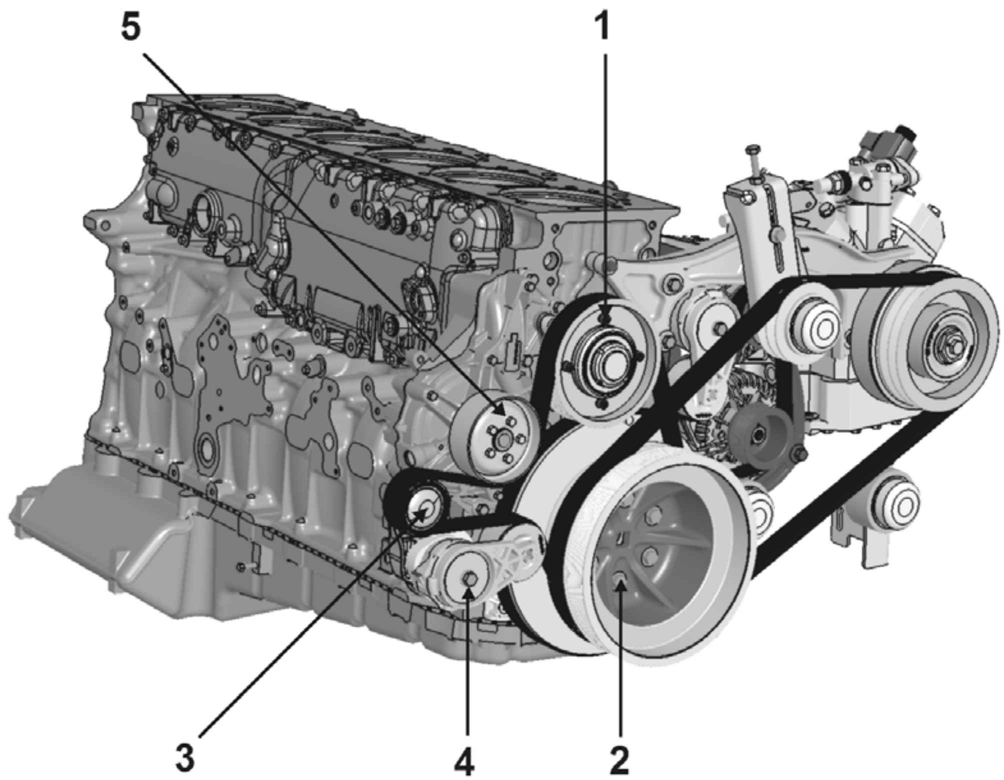
1.1 HOSE CLAMPS





HOSE CLAMPS		
No	DESCRIPTION	TORQUE
1	Hose clamps - coolant lines (2.5 in O.D)	30 lb-in (3.39 Nm)
2	Constant-torque hose clamps - charge air cooler (CAC)	4.5-5.5 lb-ft (6.1-7.46 Nm)
3	Intake elbow - V-clamps (both)	4.5-6 lb-ft (6.1-8.13 Nm)
4	Screw, CAC air temperature sensor	5.3-6.5 lb-ft (7-9 Nm)

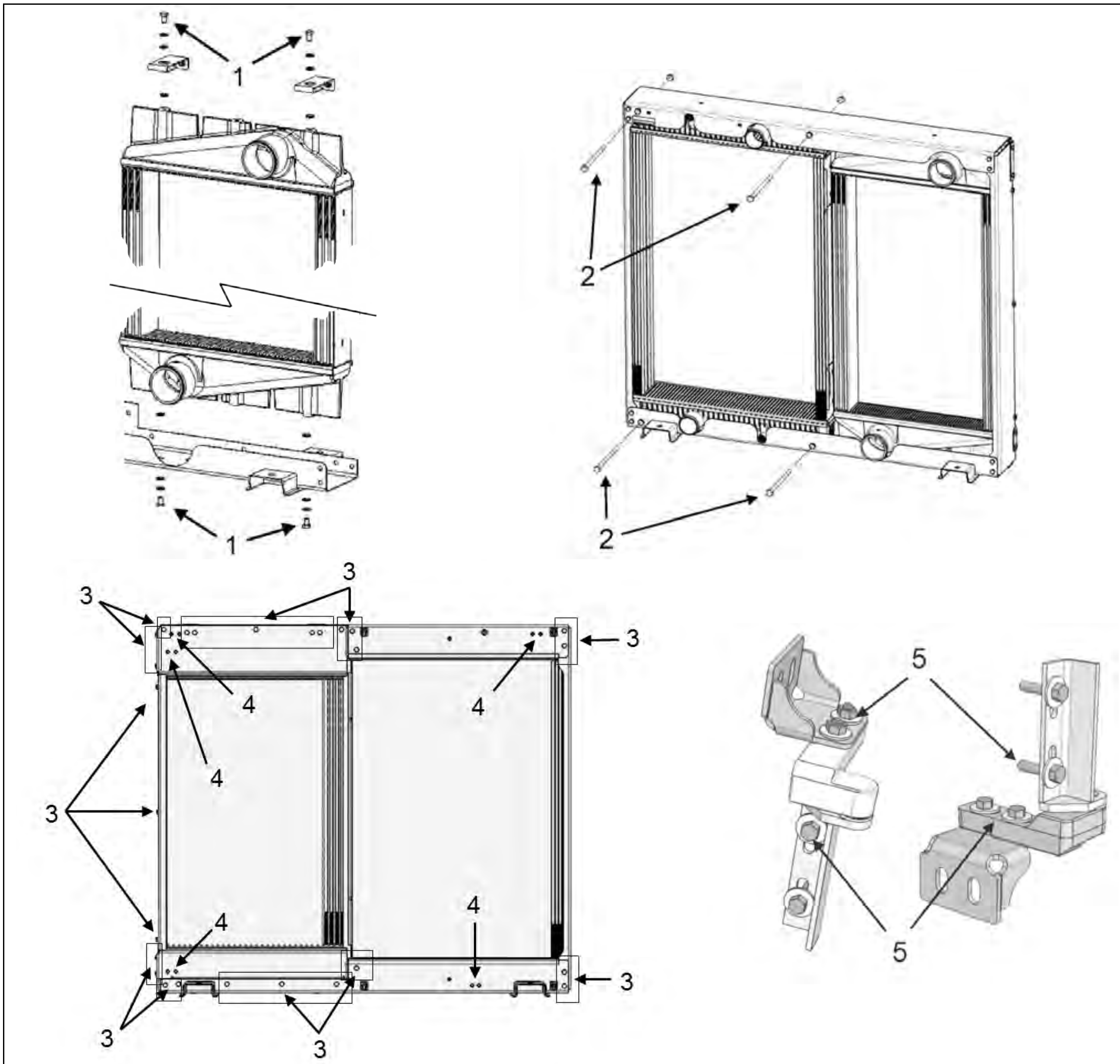
1.2 PULLEYS, IDLERS & TENSIONERS



01225_3

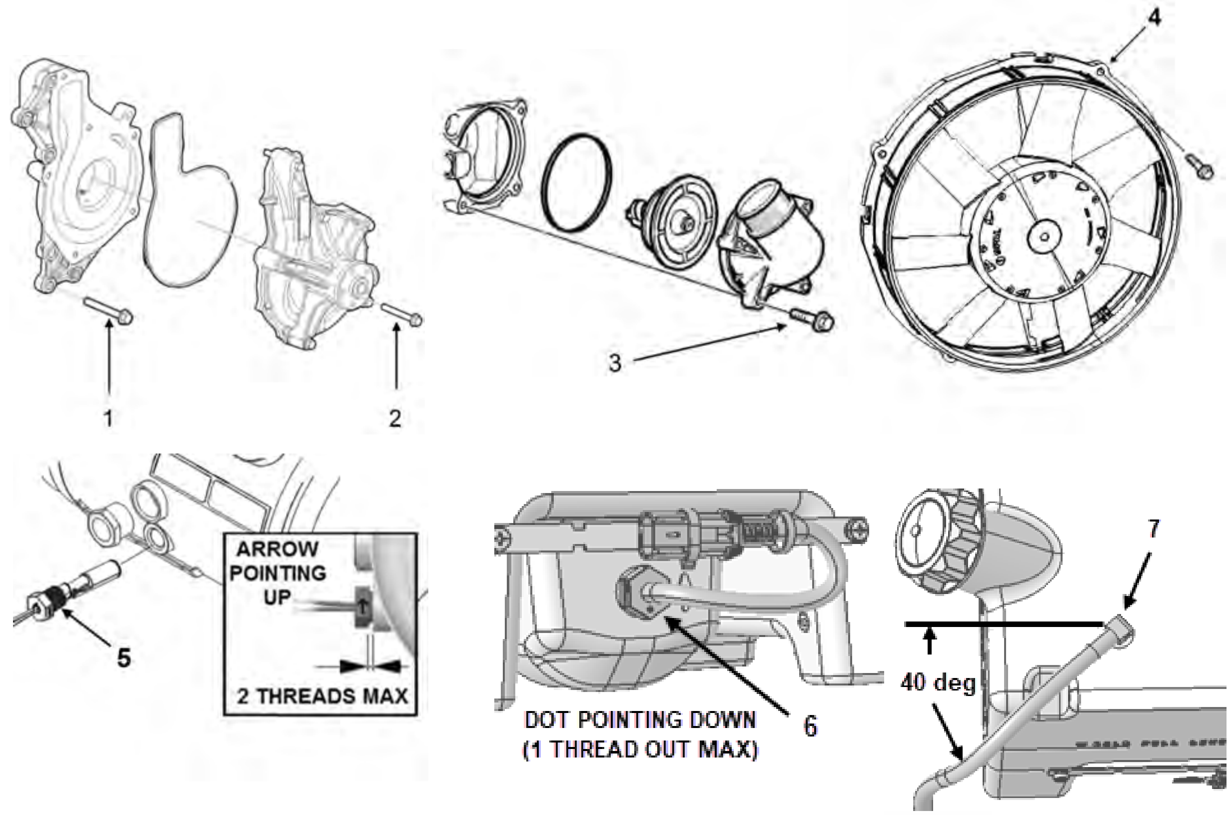
PULLEYS, IDLERS & TENSIONERS		
No	**DESCRIPTION**	**TORQUE**
1	Water pump idler pulley bolts	16 lb-ft (22 Nm)
2	Crank pulley bolts	22 lb-ft (30 Nm)
3	Idler bolt – water pump	43 lb-ft (58 Nm)
4	Automatic belt tensioner bolt – water pump	48 lb-ft (65 Nm)
5	Water pump pulley	18 lb-ft (24 Nm)

1.3 COOLING ASSEMBLY



COOLING ASSEMBLY		
No	DESCRIPTION	TORQUE
1	CAC upper & lower mounting bolts (with plastic bushings)	9 lb-ft (12 Nm)
2	Radiator to cooling pack frame mounting bolts (pass through)	9 lb-ft (12 Nm)
3	Cooling pack frame bolts (all 8mm bolts – both sides)	9 lb-ft (12 Nm)
4	Brackets, fan shroud hinge, shroud support & upper support	9 lb-ft (12 Nm)
5	Fan shroud hinge bolts (upper & lower)	68 lb-in (8 Nm)

1.4 MISCELLANEOUS



MISCELLANEOUS		
No	DESCRIPTION	TORQUE
1	Water pump - Back cover to engine	29-41 lb-ft (39-56 Nm)
2	Water pump - body to back cover	15-21 lb-ft (20-28 Nm)
3	Thermostat housing bolts	15-21 lb-ft (20-28 Nm)
4	Electric cooling fan mounting bolts	30 lb-in (3 Nm)
5	Surge tank coolant level sensor (arrow on side must point up)	2 Threads out MAX*
6	Recovery tank coolant level sensor (dot must point down)	1 Threads out MAX**
7	Recovery tank threaded fitting (top of tank)	1 Threads out MAX**

* Add Teflon – PTFE sealant to threads

** Add Loctite MR 5438 Plastic Pipe sealant to threads (DO NOT use PTFE sealant)

2. DESCRIPTION

A radiator and variable speed electric cooling fans are used to effectively dissipate the heat generated by the engine. A charge air cooler (CAC) mounted next to the radiator is also used to cool the compressed air flow coming from the turbocharger before it reaches the engine intake. All components, along with the fans circuit breaker box, are grouped together and mounted on the L.H. side of the engine compartment to form an easy to access and service “cooling assembly” (Figure 1).

> **WARNING**
>
> **WHEN THE ENGINE IS RUNNING**
>
> Cooling fans may activate at any moment.
>
> Keep hands away from cooling fans or keep the radiator door closed.

> **WARNING**
>
> **Cooling fans may be running when the engine is shut down in the following conditions:**
>
> - If a High Exhaust Temperature condition exists (e.g. following regeneration).
> - During "Motor Test" sequence.

An engine mounted centrifugal water pump is used to circulate the engine coolant in the cooling circuit. The pump works in conjunction with a full blocking-type thermostat positioned in the water outlet passage, controlling the coolant flow and providing fast engine warm-up and regulated coolant temperature.

The engine coolant is drawn from the lower portion of the radiator by the water pump and is forced through the transmission cooler before going through the oil cooler and into the cylinder block.

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 airstreams created by the revolving fans and the motion of the vehicle.

Upon starting a cold engine or when the coolant is below normal operating temperature, the closed thermostat directs 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 thermostat is completely open, all of the coolant flow is directed to the radiator inlet.

The system fill cap is on the top of a plastic recovery tank located next to the surge tank (Figure 2), a cap is also present on the metal surge tank to act as a pressure cap, The thermostat is located in the housing bolted to the engine on the L.H. side.

> **WARNING**
>
> *Do not open the surge tank pressure cap unless a large amount of liquid must be added*. Always use the recovery tank fill cap to add coolant to the vehicle during normal operation (level check).

> **WARNING**
>
> The system pressure must be relieved using the pressure relief valve.
>
> **Never open the surge tank pressure cap without making sure first that the system is completely depressurized. Coolant under pressure (hot or not) may cause serious injuries and eyes damages.**

> *NOTE*
>
> *Close the valve after releasing the pressure.*

The engine cooling system also provides hot coolant for the vehicle heating system. Refer to section 22, *"HEATING AND AIR CONDITIONING"* in this manual for information relating to heating system water circulation.

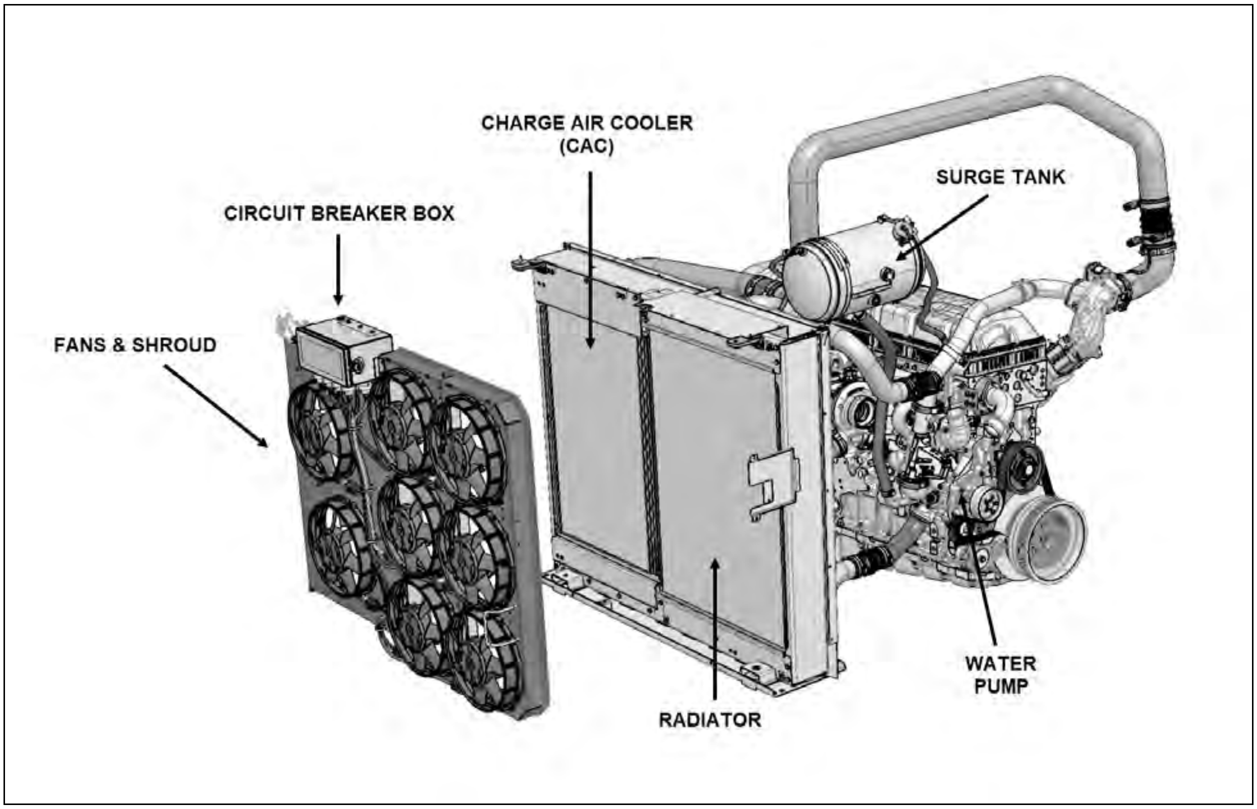


FIGURE 1: COOLING SYSTEM & RELATED COMPONENTS

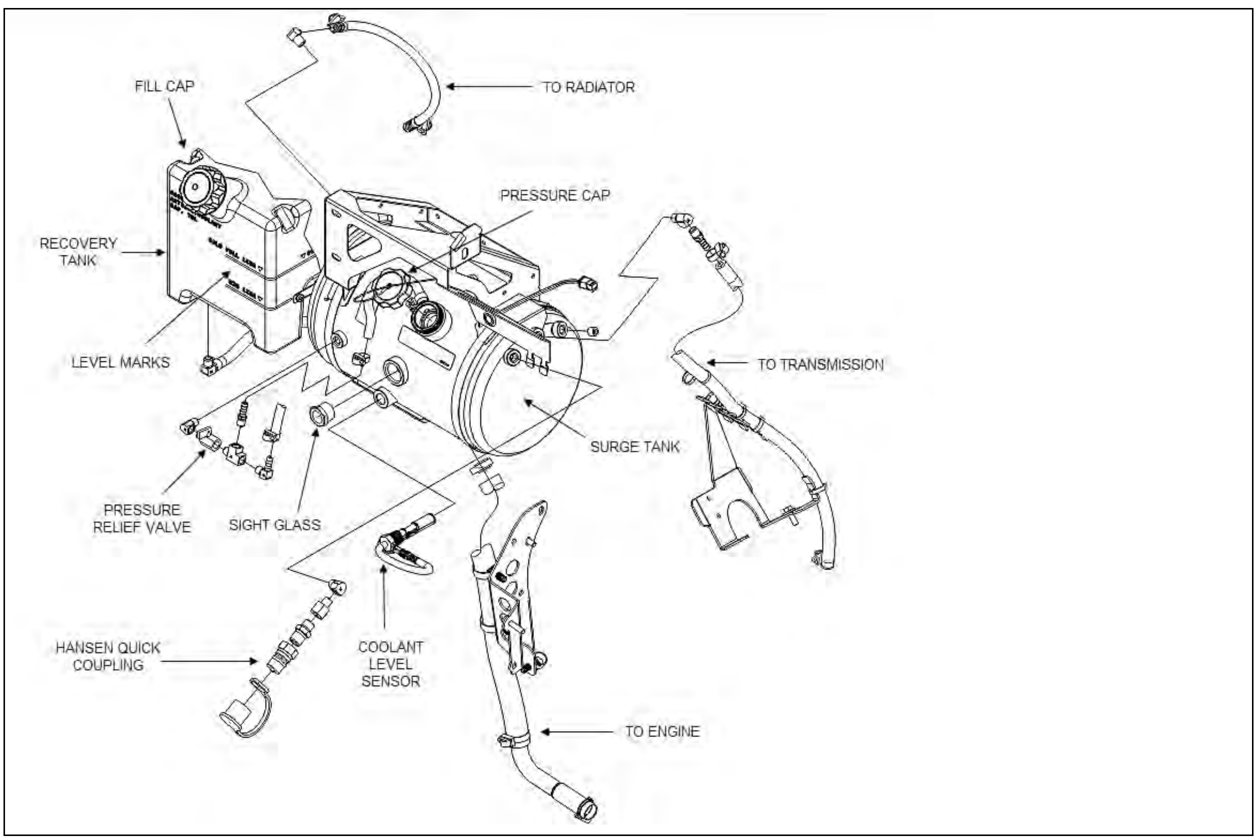


FIGURE 2: COOLANT SURGE TANK AND RECOVERY TANK

3. MAINTENANCE

3.1 GENERAL RECOMMANDATIONS

A systematic routine inspection of cooling system components is essential to ensure maximum engine and heating system efficiency.

- Check coolant level in the surge/recovery tank daily, and correct if required. Test antifreeze strength.
- Check water pump belt and replace if frayed or badly worn.
- 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 thermostat regularly.
- Pressurize system periodically using Hansen Quick Coupling (Figure 3).

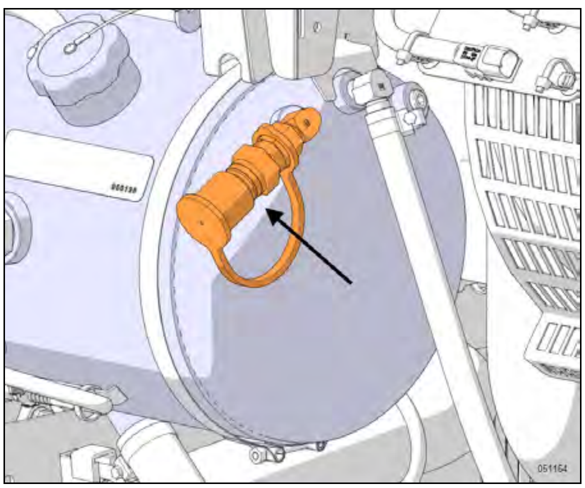


FIGURE 3: HANSEN QUICK COUPLING

> *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 10-15 psi using Hansen Quick Coupling. Do not exceed 15 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.*

> **CAUTION**
>
> Hoses and hose connections should be clean and free of oil and grease before hose clamp installation. **Do not use** soap, lubricant or sealing compound on hose connections.

> *NOTE*
>
> *For additional information concerning Volvo D13 engine components or engine-related components, consult 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.*

3.2 COOLANT FILTER HOUSING SHUT-OFF VALVE – SPINDLE SERVICING

Seizing of the spindle in the coolant filter housing (Figure 4) could prevent proper operation of the valve. With proper cleaning, the application of a silicone-based lubricant to the groove in the spindle, and cycling the valve at regular intervals will prevent the buildup of corrosion in the coolant filter housing. Follow this spindle servicing and repair procedure.

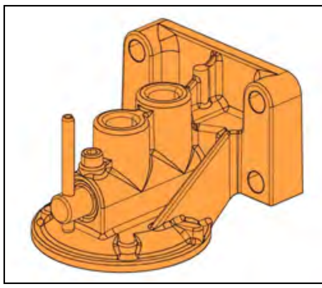


FIGURE 4: COOLANT FILTER HOUSING

1. Park the vehicle on a level surface. Apply the parking brake and place the transmission in neutral.
2. Turn the ignition switch to the OFF position.
3. On the engine compartment rear start panel (Figure 5), push the **engine stop/ignition interlock** button to prevent the engine from being started.

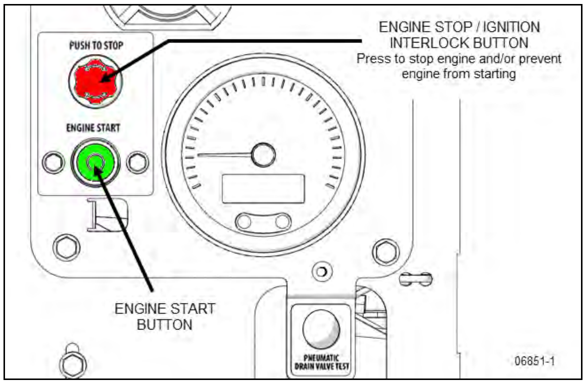


FIGURE 5: REAR START PANEL

4. Drain the coolant from the engine. Refer to DRAINING COOLING SYSTEM in this section.

<u>Shut-off valve corrosion repair procedure</u>

5. Place a spill container under the engine coolant filter housing.
6. Loosen the M5 hex socket screw (1) in the coolant filter housing (3) until it clears the groove in the spindle (2) (Figure 6).

Note: This is the groove the M5 hex socket screw sets in when the coolant filter hosing is fully assembled.

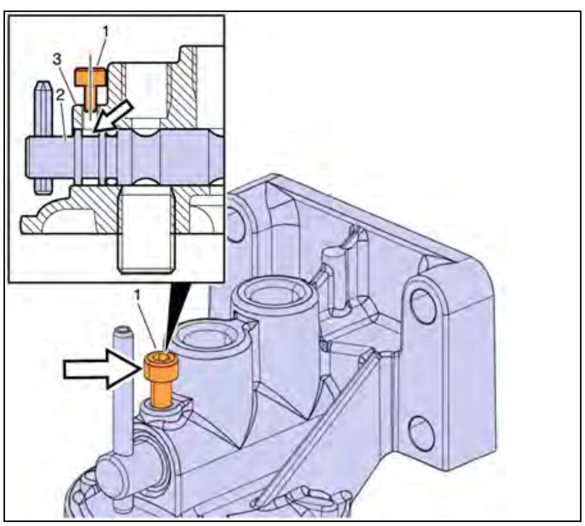


FIGURE 6: M5 HEX SOCKET SCREW

7. Extract the spindle (2) from the coolant filter housing (3) (Figure 7).

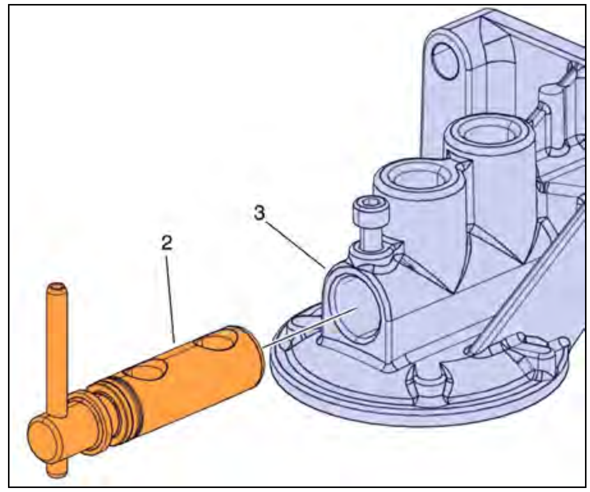


FIGURE 7: SPINDLE

8. Gently scrape by hand and remove any loose debris or corrosion from the spindle and coolant filter housing using an abrasive cleaning pad (Figure 8).

Note: *Do not allow any corrosion or solid contaminants to fall into the filter housing.*

Note: *When cleaning is required* ***DO NOT*** *use power tools or grinders to clean the areas covered with corrosion. This could damage the parts beyond repair.*

Note: *Inspect the O-ring (4) in the spindle (2) for damaged due to corrosion or during removal. Replace the O-ring using part number 968725 if needed. Replace the spindle using part number 3979940 if needed.*

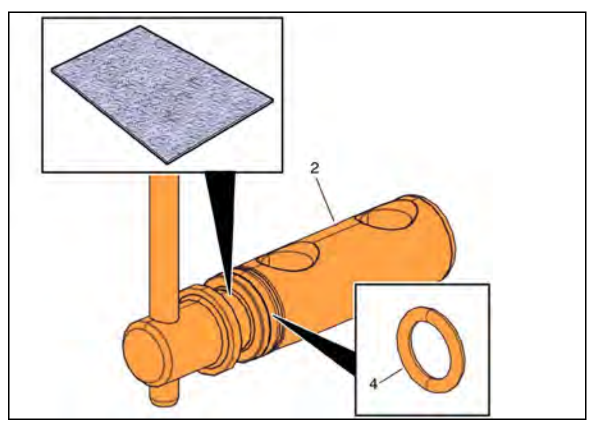


FIGURE 8: INSPECT THE O-RING (4) IN THE SPINDLE (2)

9. If the area containing corrosion cannot be reliably cleaned or there is damage to the sealing surface for the O-ring, the coolant filter housing must be replaced.

10. Apply grade NLGI No.2 silicone-based grease to the grooved area of the spindle. Ensure the grooved area of the spindle is filled as completely as possible (Figure 9).

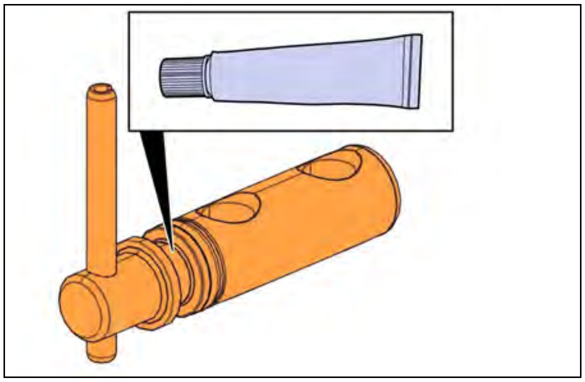


FIGURE 9: APPLY GRADE NLGI NO.2 SILICONE-BASED GREASE TO THE GROOVED AREA

11. Reinsert the spindle (2) into the coolant filter housing (3) and tighten the M5 hex socket screw (1) (Figure 10).
12. To prevent reoccurrences, at a minimum, the grease should be repacked in this area when the coolant is changed, and the valve should be rotated periodically.

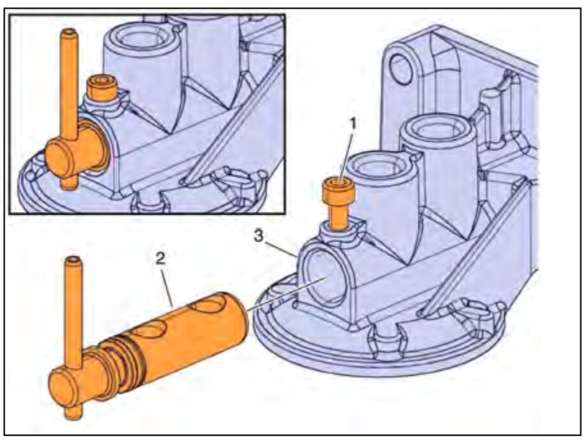


FIGURE 10: INSERTING THE SPINDLE

13. Fill the cooling system with the recommended coolant.
14. Set the engine stop/ignition interlock back to the normal position.
15. Start the engine, check for leaks and proper operation.
16. After shutdown, replenish coolant as necessary.

4. 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.

4.1 HOSE CLAMPS ON COOLANT LINES

All hose clamps used for the heating and cooling systems have a spring function (spring in the housing) to compensate for the normal expansion/contraction of hose and metal connection that occurs during vehicle operation and shutdown. These clamps are worm-driven and made of stainless steel (Figure 11).

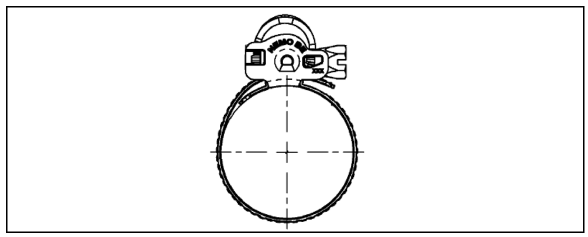


FIGURE 11: CLAMP TYPE USED ON HEATING & COOLING SYSTEMS

All connections equal or greater than 2 inches OD have doubled clamps (two clamps, side by side) with screw housing separated from at least 90°. A torque wrench should be used for proper installation (Figure 12 & Figure 13).

TORQUE: 30 lb-in (3.39 Nm)

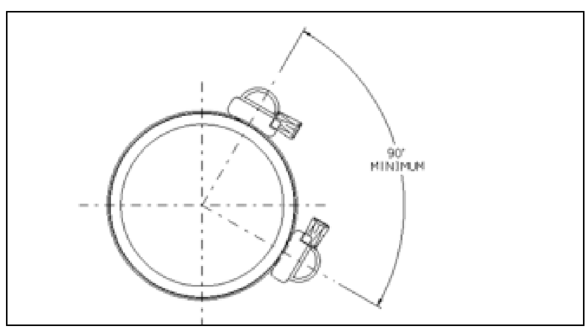


FIGURE 12: DUAL CLAMP MINIMUM SPREAD ANGLE

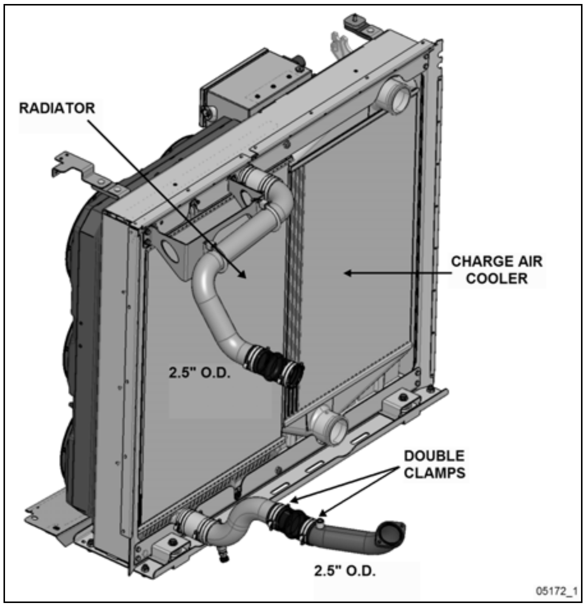


FIGURE 13: COOLANT DOUBLE CLAMPS

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

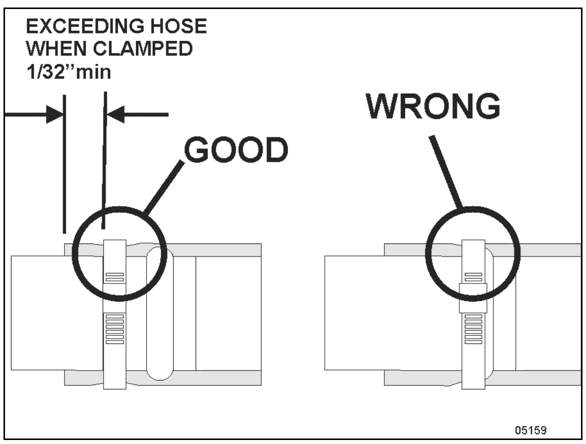


FIGURE 14: PROPER HOSE CLAMP INSTALLATION

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

If for any reason hose clamps need to be replaced; install and tighten hose clamps to specified torque (dry) (Figure 15).

TORQUE: 4.5-5.5 lb-ft (6.1-7.46 Nm)

Elbow V-clamps must also be torqued to specification.

TORQUE: 4.5-6 lb-ft (6.1-8.13 Nm)

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

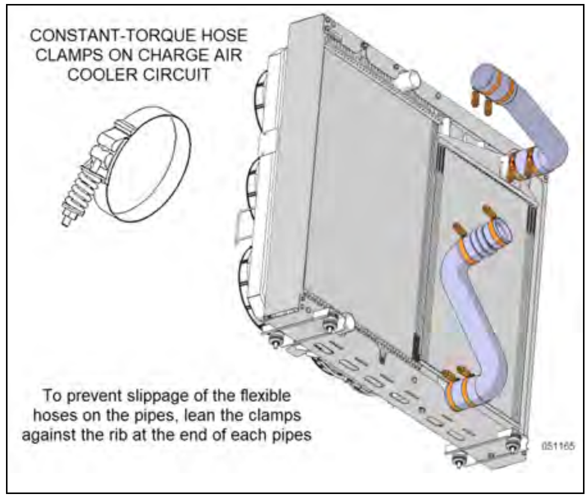


FIGURE 15: CHARGE AIR COOLER HOSE CLAMPS

4.2.1 Maintenance

Since the constant-torque clamp automatically adjusts to keep a consistent sealing pressure, there is no need to 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.

5. THERMOSTAT OPERATION

5.1 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 16).

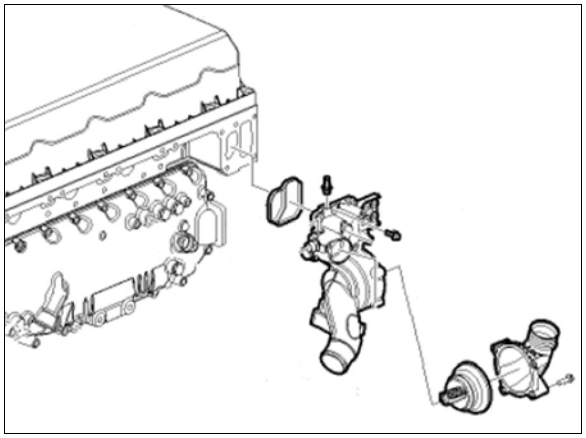


FIGURE 16: VOLVO D13 THERMOSTAT HOUSING

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 tighten.

TORQUE: 15-21 lb-ft (20-28 Nm)

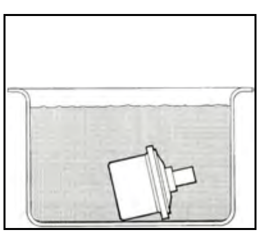
5. Install the rubber radiator hose to the thermostat housing. Position the clamp and tighten to secure.
6. Fill the system with the recommended coolant.
7. Start the engine, check for leaks and proper operation. After shutdown, add fluids as necessary.

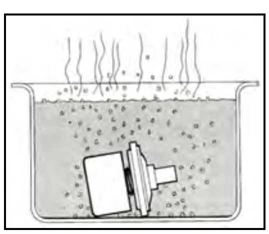
5.2 CHECKING NEW THERMOSTAT

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

NOTE
Check to be sure that the new 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 167°F (75°C) 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 212°F (100°C). After at least 30 seconds at the boiling point, check that the thermostat has opened at least 9/32in (7mm). If the thermostat has not opened, it must be replaced. A good thermostat starts to close at 203°F (95°C) and is fully closed at approximately 185°F (85°C).

6. COOLANT

6.1 COOLANT LEVEL VERIFICATION

Cold engine coolant level is correct when coolant level is visible between the two level marks on the recovery tank (Figure 2 & Figure 17). If coolant level is low, fill cooling system.

6.2 COOLANT LEVEL SENSOR

This warning device consists of 2 fluid level sensors. The first sensor is mounted at the bottom of the plastic recovery tank and warns the driver that the engine coolant level as reached the *low level*. Add coolant whenever possible up to the recovery tank top fill line.

The second probe is mounted on the front of the metal surge tank and warns the driver that the engine coolant as reached the *critically low level*. Stop the vehicle and add coolant to the recovery tank (not surge tank).

NOTE
If the critically low coolant level is reached, the "STOP ENGINE" lamp will illuminate, an alarm will be heard and the engine will switch to derate mode (50% torque reduction).

Special care must be taken to ensure proper installation of these sensor (tank or sensor replacement).

Recovery tank sensor, make sure that:

- Dot on the sensor body is pointing down.
- *Loctite MR 5438* Plastic Pipe sealant is applied to the threads.
- A maximum of one thread is visible once tightened.

Surge tank sensor, make sure that:

- Arrow on the sensor body is pointing up.
- PTFE sealant (Teflon) is applied to the threads
- A maximum of two threads are visible once tightened.

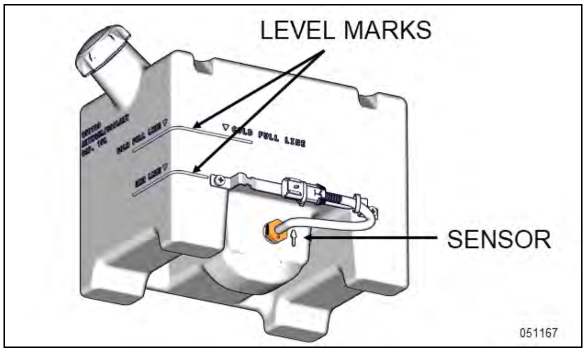


FIGURE 17: RECOVERY TANK SENSOR & LEVEL MARKS

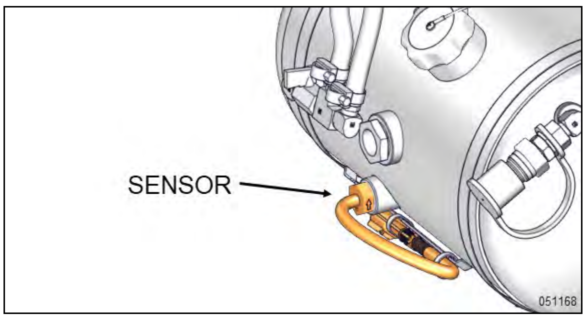


FIGURE 18: COOLANT SURGE TANK SENSOR

6.3 THAWING COOLING SYSTEM

If the cooling system becomes frozen solid, place the coach in a warm area until the ice is completely thawed.

CAUTION

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 it is thawed, check engine, radiator and related components for damage caused by expansion of frozen coolant fluid.

6.4 COOLANT RECOMMENDATIONS FOR VOLVO D13 ENGINE

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.

To function properly, the cooling system must be pressurized to prevent localized boiling of coolant. The system must be kept clean and leak-free. The pressure cap must be checked periodically for proper operation.

Always maintain cooling system at the proper coolant level. Check daily, use recommended *Final Charge Global Extended Life Coolant premix* (*50/50 antifreeze and water mixture ratio).* This ratio should be used year-round to provide freeze and boil-over protection as well as providing a stable environment for seals and hoses.

Freeze protection	Boiling protection	antifreeze in mixture
-34°F (-38°C)	*265°F (129°C)*	*50%*

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 located on the surge tank provides information on recommended coolants.

CAUTION

Use only *Final Charge Global Extended Life Coolant (pre-diluted 50/50 mixture)*.

Use a Long-Life filter *without* supplemental additives (SCA).

MAINTENANCE

Coolant & filter

Replace the coolant & the filter cartridge at the intervals specified by the Lubrication And Servicing Schedule in Section 24: LUBRICATION & SERVICING.

Do not exceed recommended service intervals.

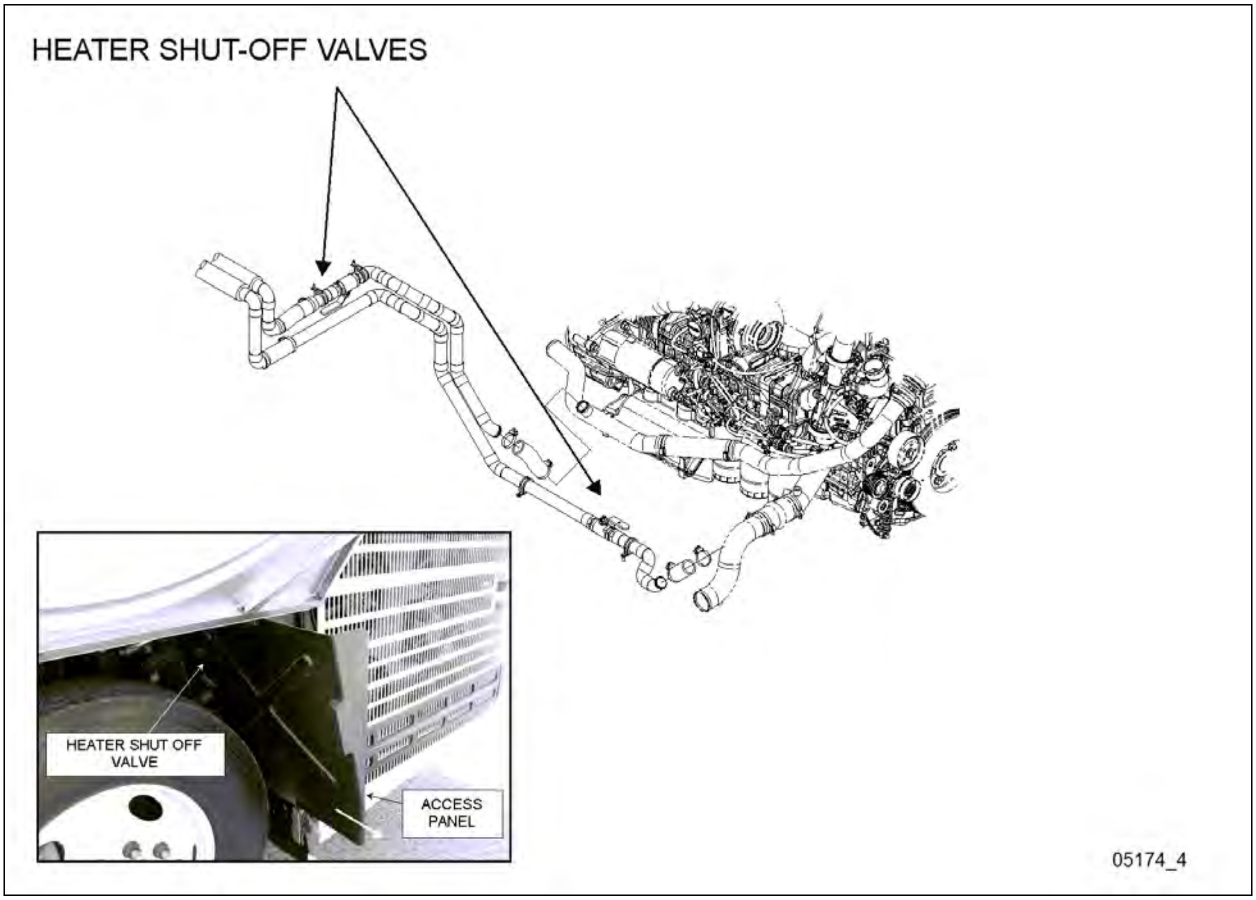


FIGURE 19: LOCATION OF HEATER LINE SHUT-OFF VALVES IN ENGINE COMPARTMENT

6.5 COOLANT SAMPLING

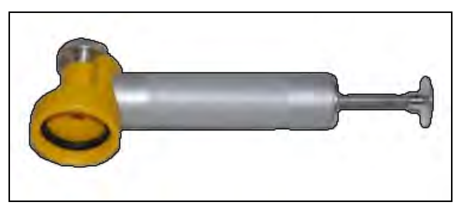
NOTE
The following procedure is provided for reference only. *Instructions coming with the laboratory test kit take precedence over this procedure.*

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. Sampling should be performed on a *cold engine*.

Providing a sample of coolant for lab analysis may be required at some point in the life of the vehicle.

Typical material required:

- Hand Vacuum Pump w/ bottle provision



- Sample bottle
- Plastic tube (1/4 “refrigerator” tube)
- Nitrile gloves
- Safety glasses
- Shop Towels

NOTE
Watch out for accidental contamination! *Hand vacuum pump should be used for* coolant sampling only *to prevent cross-contamination.* *Also, ensure cleanliness throughout this procedure to make sure the coolant sample is not contaminated accidentally.*

Sampling should be performed on the surge tank, on a cold engine.

If the vehicle has been standing still for a significant period, drive it around 30 min up to normal operating temperature. Then let it cool down.

1. Release the surge tank pressure using the pressure relief valve (Figure 2).
2. Pull the pressure cap off the surge tank.
3. Thread the sample bottle to the pump. Hand tightens.
4. Slide the plastic tubing in the fitting on the pump until it exceeds about 1/2 inch into pump cavity.
5. Insert tube in the surge tank about half way to the bottom. (Do not draw sample in the bottom of the surge tank.)
6. Pump until sample bottle is about 2/3 full. Do not overfill.
7. Loosen pump fitting to remove tube from pump. Allow any coolant in the tube to flow in the bottle.
8. Remove sample bottle and install cap.
9. Throw plastic tube away. (Not to be re-used)
10. Complete any forms required by the laboratory.

7. DRAINING COOLING SYSTEM

Use the following procedures to drain the cooling system partially or completely.

To drain engine and related components:

1. Stop engine and allow engine to cool. Close both heater line shutoff valves.

The valves are located in the engine compartment. One is located under the turbocharger inlet pipe in the lower L.H side of the engine compartment; another valve is located behind the L.H. tag axle wheel and is accessible by lifting the hinged rear wheel fender and removing the access panel behind it (Figure 19).

MAINTENANCE
Cooling system Drain, flush, thoroughly clean and refill the system at the intervals specified by the Lubrication And Servicing Schedule in Section 24: LUBRICATION & SERVICING.

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. Release the pressure using the pressure relief valve and remove the pressure cap.

CAUTION
***Never open the surge tank pressure cap without making sure first that the system is completely depressurized.* Coolant under pressure (hot or not) may cause serious injuries and eyes damages.**

5. Connect coolant extractor (Figure 20). 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.

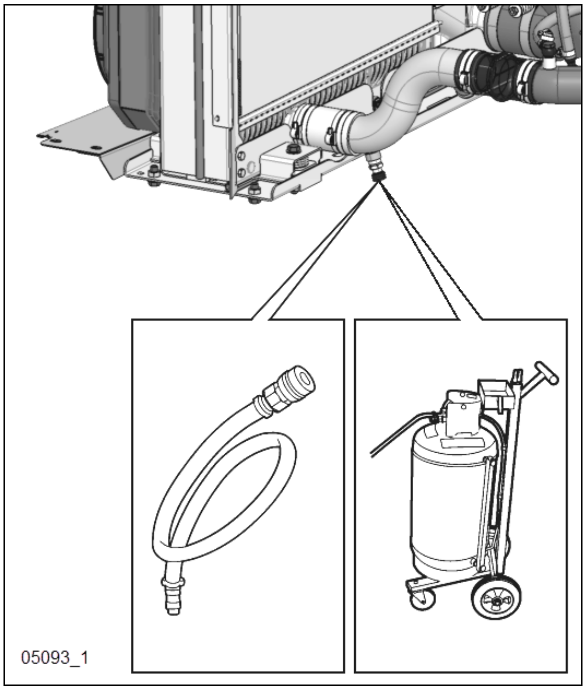


FIGURE 20: EXTRACTING COOLANT

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

If freezing weather is anticipated and the engine is not protected with antifreeze, drain the cooling system completely when the 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; follow procedure under *"Draining Heating System"* in Section 22.

8. 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 tank filler neck.

4. Install the 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 critically low 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 and add as required.

CAUTION

Never pour cold coolant into a hot engine. The sudden change in temperature may crack the cylinder head or block.

If the entire system has been drained, redo the previous steps while maintaining the two heater line shutoff valves in the "Open" position. With engine running, activate the driver's and central heating systems to permit coolant circulation. Complete the procedure by bleeding the heater cores as explained in Section 22, under *"Bleeding Heating System".*

9. 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.
8. Refill 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.

> **MAINTENANCE**
>
> COOLING SYSTEM CAPACITY Including heating system (approximation):
>
> **27.5 US gal (104 liters).**

9.1 COOLING SYSTEM DESCALERS

If the engine overheats and the water pump, coolant level and thermostat operation have been found to be satisfactory, it may be necessary to flush and de-scale the cooling system.

1. Drain the coolant from the engine.
2. Fill system with clean water.
3. Add the required amount of a reputable commercially available de-scaling product (aluminum & copper compatible). It is important that product directions be thoroughly read and followed regarding duration of the treatment, temperature and product mix ratio.

> **CAUTION**
>
> Only use de-scaling products sold by a reputable manufacturer, product must be aluminum and copper compatible and must be safe for rubber hoses and gaskets.
>
> *Some de-scaling products will require the use of a neutralizing agent before coolant system refill*
>
> Carefully follow manufacturer's directions to avoid cooling system damage when using descaling products.
>
> Never use "home-brewed" descaling solution containing caustic or acid products not intended for cooling system descaling or having unknown active product concentration.

4. Drain descaling solution from the cooling system.
5. Refill with clean water and carefully rinse the cooling system to completely evacuate all remaining descaling solution.
6. On heavily contaminated system, reverse flush the cooling system to prevent remaining dirt and scale deposits from clogging the radiator tubes or being forced through the water pump (refer to paragraph 9.2 *Reverse Flushing* below).
7. Flush the system.
8. Refill system with appropriate coolant.

9.2 REVERSE FLUSHING

After the engine and radiator have been thoroughly de-scaled, they should be reverse-flushed. The water pump should be removed and the radiator and engine reverse-flushed separately to prevent dirt and scale deposits from clogging the radiator tubes or being forced through the pump. Reverse flushing is accomplished by hot water, under pressure, being forced through the cooling system in a direction opposite to the normal flow of coolant, loosening and forcing deposits out.

The radiator is reverse flushed as follows:

1. Remove the radiator inlet and outlet hoses and replace existing radiator cap with a new one.
2. Attach a hose to the top of the radiator to lead water away from the engine.
3. Attach a hose at the bottom of the radiator and insert a flushing gun in the hose.
4. Connect the water hose of the gun to the water outlet and the air hose to the compressed air outlet.
5. Turn on the water and when the radiator is full, turn on the air in short blasts, allowing the radiator to fill between blasts.

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

6. Continue flushing until only clean water is expelled from the radiator.

The cylinder block and cylinder head water passages are reverse flushed as follows:

1. Remove the thermostats and the water pump.
2. Attach a hose to the water inlet of oil cooler housing to drain water away from engine.
3. Attach a hose to the water outlet at the top of the cylinder head (thermostat housing) and insert the flushing gun in the hose.
4. Turn on the water until the jackets are filled, and then turn on the air in short blasts. Allow jackets to fill with water between air blasts.
5. Continue flushing until the water from the engine runs clean.

10. SPIN-ON COOLANT FILTER

The engine cooling system filter is used to filter out impurities such as scale or sand from the coolant. The filter is mounted on the frame below the turbocharger inlet tube (Figure 21).

To replace a filter:

1. Close the filter shutoff cock 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 shutoff cock.
6. Start engine and check for leaks.

MAINTENANCE
Coolant filter Replace the coolant filter cartridge at the intervals specified by the Lubrication And Servicing Schedule in Section 24: LUBRICATION & SERVICING. Do not exceed recommended service intervals.

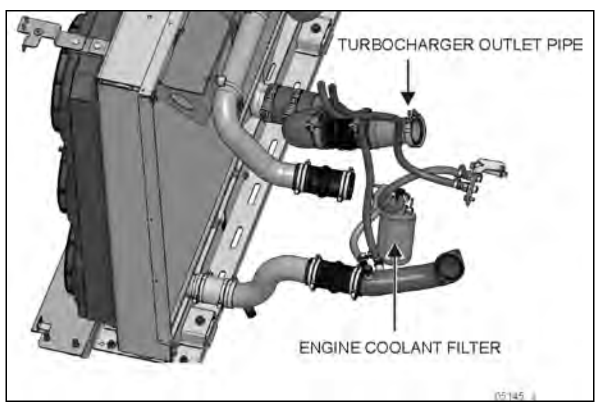


FIGURE 21: COOLANT FILTER

11. COOLING ASSEMBLY

The cooling assembly uses a total of 8 identical 12 inches (305mm) brushless (24V) electric cooling fans to dissipate the heat generated by the engine. The first two fans are used by the charge air cooler (CAC) to cool the hot compressed air coming from the turbocharger; the remaining 6 fans are used by the radiator (Figure 22 & Figure 23).

Each fan is fixed to a shroud by 4 hex screws and is individually connected to the circuit breaker box through a main wiring harness (*refer to section 06 ELECTRICAL for more information regarding breaker box components and harness*).

The shroud assists in directing the air flow generated by the fans through the radiator/CAC assembly with maximum efficiency and is sealed to the radiator/CAC assembly (cooling pack) with rubber seals. The shroud is hinged and can be "pivoted" out of the way to inspect or clean the radiator/CAC fins and tanks.

CAUTION

The fan shroud is an essential component used to achieve maximum air flow capacity through the cooling assembly. To prevent overheating, inspect rubber seal regularly to ensure proper sealing.

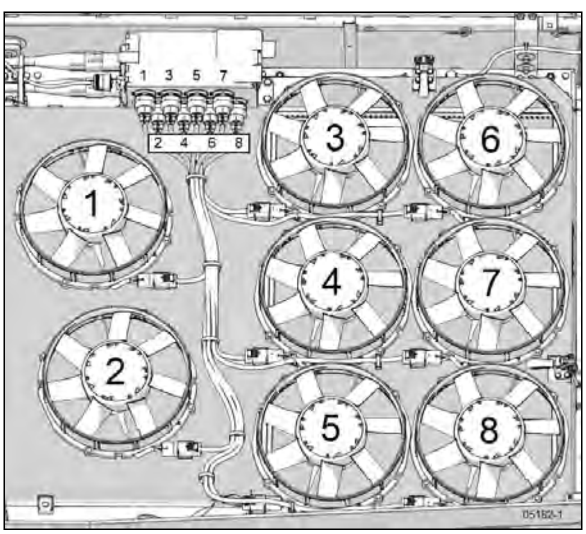


FIGURE 22: FAN ORDER AND CONNECTOR NUMBER AT CIRCUIT BREAKER BOX

11.1 MAINTENANCE

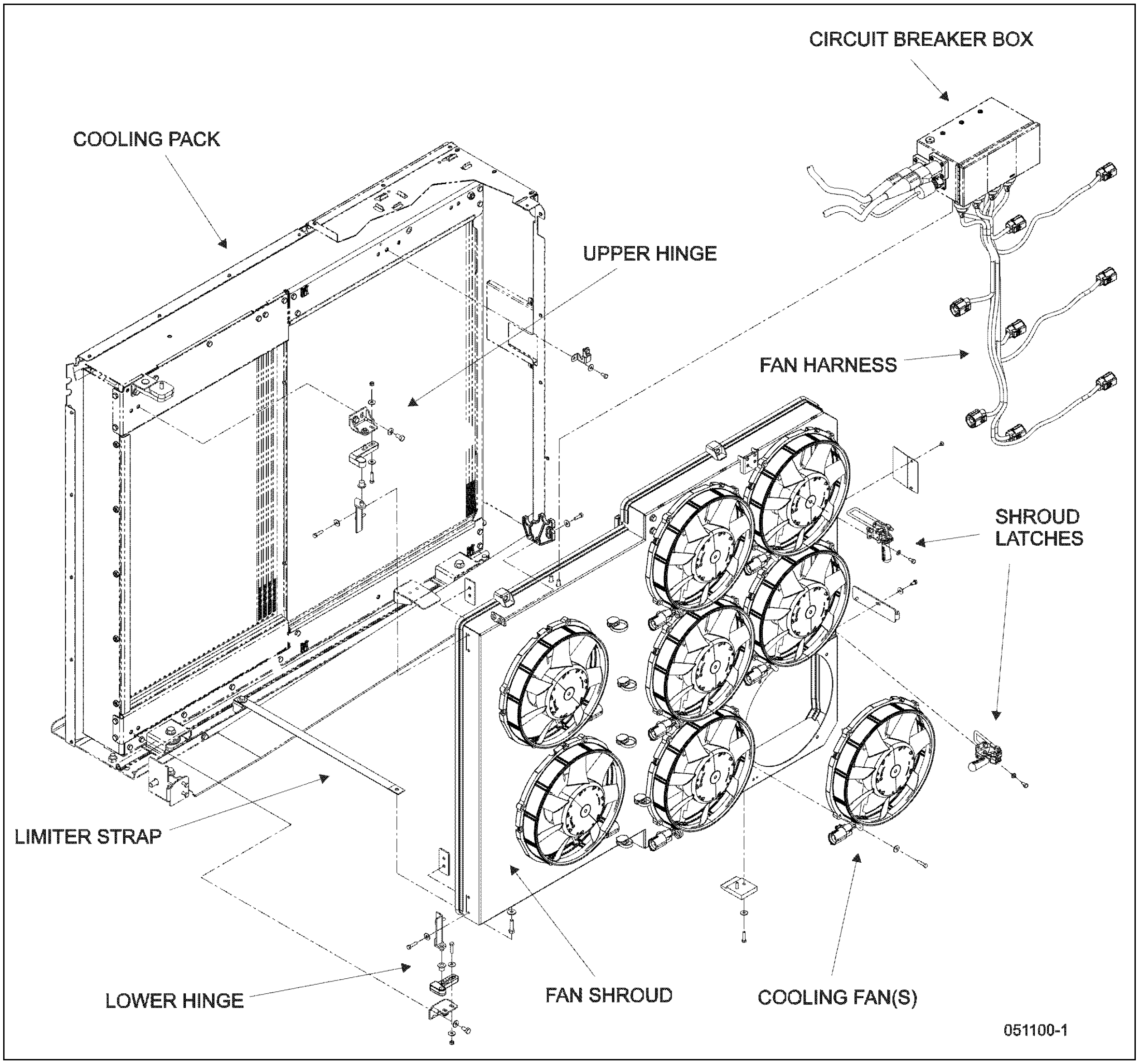


FIGURE 23: COOLING ASSEMBLY MAIN COMPONENTS

WARNING

Cooling fans may start when the engine is shut down in the following conditions:

- If a High Exhaust Temperature condition exists (e.g. following regeneration).
- During "Motor Test" sequence.

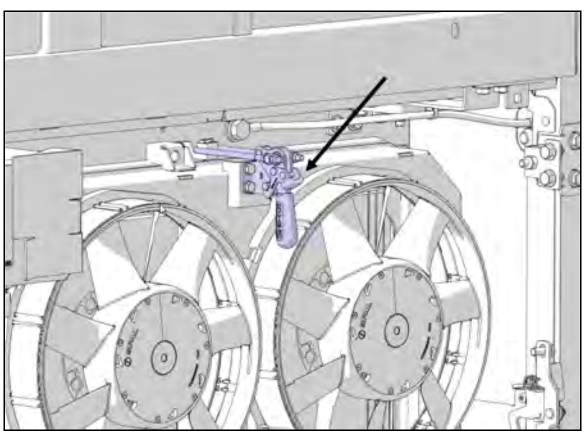
MAINTENANCE

Inspect fan blades regularly, check for dirt or grime accumulations on the blade that could cause vibrations, clean as necessary using water and regular strength degreaser.

Check for cracks and signs of abrasion on the blades that could indicate contact with debris or obstruction during operation.

Check the bottom of the shroud cover and remove debris that could have accumulated. In sub-zero winter area, also check for snow and ice accumulation that could block the fan blades rotation.

Unlatch (two latches, upper shown) and open the fan shroud as necessary to facilitate cleaning and debris removal.



NOTE

Electric cooling fan motors are sealed and certified IP6K9K and IP68.They can therefore be safely power/pressure washed.

NOTE

To prevent a situation where debris would stick to the radiator door (due to fans suction force) and prevent full cooling performance, all fans are forced to stop for a period of 25 sec. every 30 minutes.

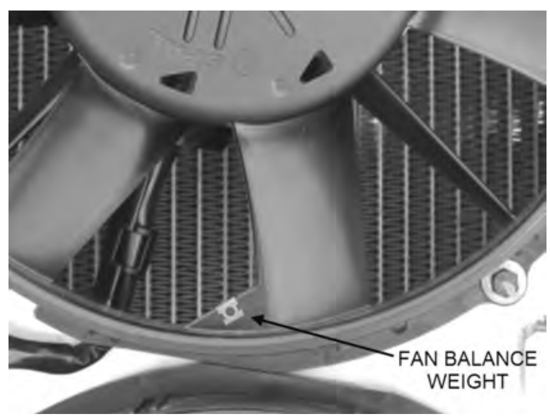
NOTE

To keep area between fans and shroud cover clean and, in winter, prevent snow and ice accumulation, a cleaning sequence, where the fans will run at full reverse speed for 30 sec. will take place the first time the vehicle reaches 19 mph (30 km/h) after start-up.

A winter cleaning mode will also take place if exterior temperature drops below 32°F (0°C) and will activate the fans at full reverse speed for 30 sec every 30 min.

CAUTION

Fans are factory balanced by the use of small metal weight clipped to the fan blades, to avoid damaging vibrations during fan operation, do not remove, shift or interchange balancing weights.



11.2 COOLING FAN REPLACEMENT

Proceed as follow to remove one (or more) individual fan from the shroud (Figure 24).

1. Unplug the fan from the main fan harness (blue connector).
2. Remove the 4 hex screws holding the fan body to the shroud.

3. Remove the fan.
4. Reverse removal procedure to reinstall the fan and apply specified torque to the fan frame mounting screws.

TORQUE: 30 lb-in (3 Nm)

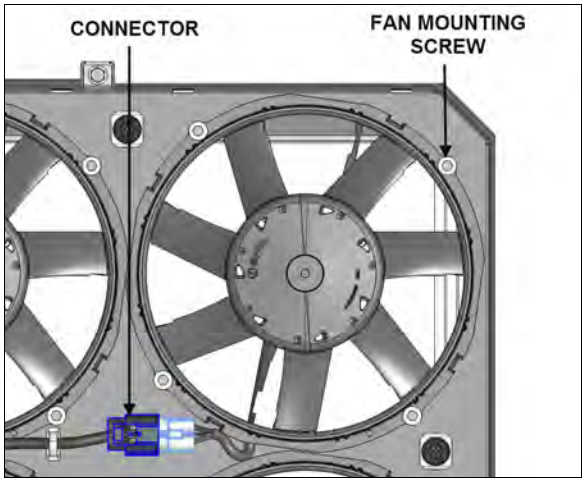


FIGURE 24: CONNECTOR & MOUNTING SCREW LOCATION

11.3 COOLING FAN SHROUD REMOVAL & INSTALLATION

1. Open rear engine door and set engine stop button to the OFF position (push).
2. Open the radiator door and disconnect the door support arm to allow full door opening (optional).

NOTE
If fan shroud is removed in preparation for the removal of the complete cooling assembly (see 11.4 in this section); the radiator door must be removed from the vehicle. - *Open and support door.* - *Disconnect side marker lights.* - *Remove light harness from door.* - *Unscrew lower hinge from vehicle.* - *Lift and remove door.* *See section 18 BODY for more information.*

3. Disconnect the cooling fans circuit breaker box (Figure 25).

- Turn the two main harness (black and red) connectors half a turn counterclockwise and pull.
- Turn the smaller wiring connector 1/3 turn counterclockwise.
- Remove the wires from the wire separator and move them out of the way.

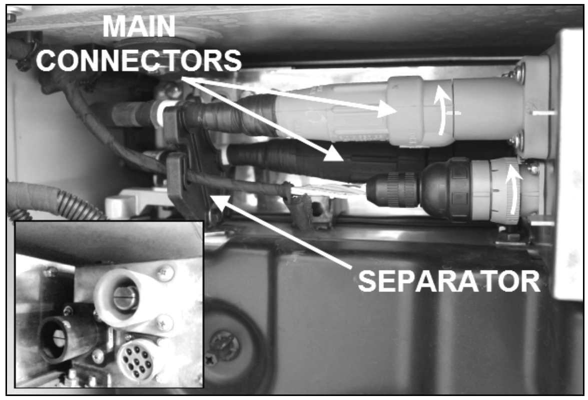


FIGURE 25: CIRCUIT BREAKER BOX CONNECTIONS

4. Unlatch the two shroud hold down latches and open the shroud assembly (yellow handle Figure 26).

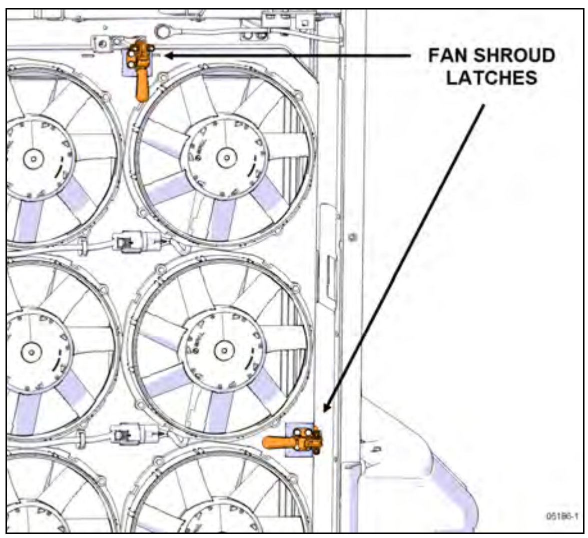
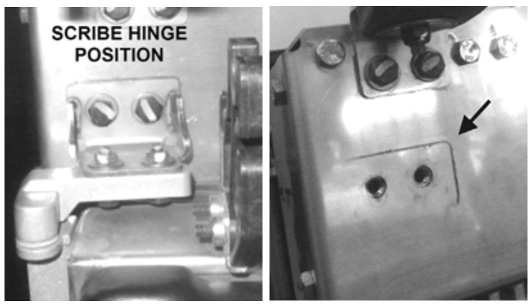


FIGURE 26: SHROUD HOLD DOWN LATCHES

5. Unfasten the limiter strap at the bottom of the shroud assembly.
6. Support the bottom of the shroud assembly with a lift table or other suitable equipment.
7. Unscrew the shroud upper hinge at the vehicle structure and remove the hinge.

NOTE

It is good practice to scribe the hinge position on the vehicle structure to use as a reference point upon reinstallation. This will minimize the need for hinge adjustment.



8. Slightly lift the door with the lift table to disengage the lower hinge pin and allow shroud removal from the vehicle.

NOTE

Do not lose the plastic bushings installed at the pivot point of both lower and upper hinges.

9. Reverse removal procedure to reinstall the fan shroud assembly making sure that;

   - The bushings are installed at the hinges pivot point.
   - There is no gap at both hinges between the bushing and the hinge pivot.
   - Main connectors are fully engaged (paint mark are aligned Figure 27).

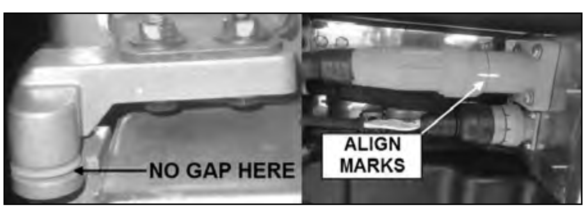


FIGURE 27: INSTALLED HINGE & MAIN CONNECTOR

11.4 COOLING PACK (RADIATOR & CAC) REMOVAL & INSTALLATION

NOTE

For CAC only replacement, removal of the entire cooling pack is not necessary. Refer to paragraph 11.5 in this section for "in vehicle" CAC replacement instructions.

WARNING

GALVANIC CORROSION PREVENTION

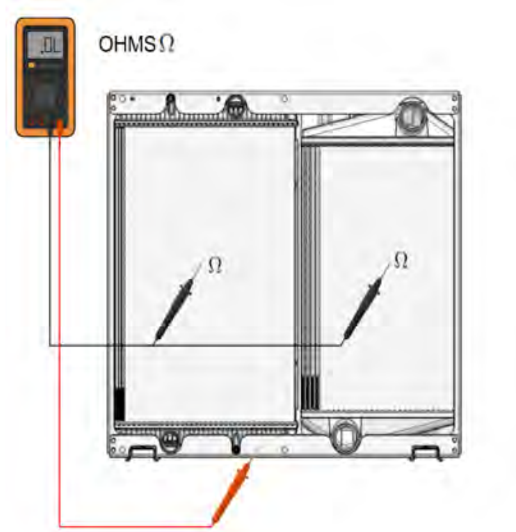
Galvanic corrosion (also called bimetallic corrosion or contact corrosion) is an electrochemical process in which one metal corrodes preferentially to another when both metals are in electrical contact.

To avoid galvanic corrosion problems, the aluminum CAC and radiator have been electrically isolated from the cooling pack stainless frame.

When replacing the entire cooling pack with a new unit, make sure before installation that :

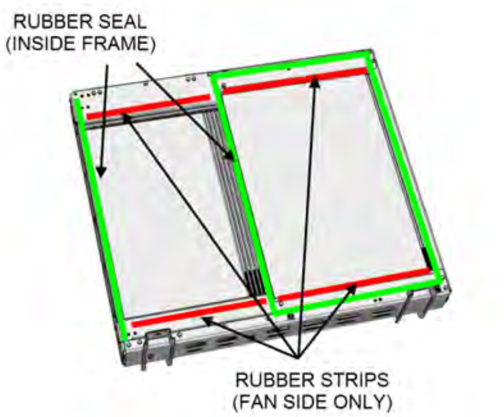
- There is no conductivity between the frame and both CAC and radiator core using a suitable ohmmeter or continuity (buzzer) tester.

Note: If using ohmmeter, a minimum of 100 000 (100K) ohms must be observed to be considered acceptable for installation.

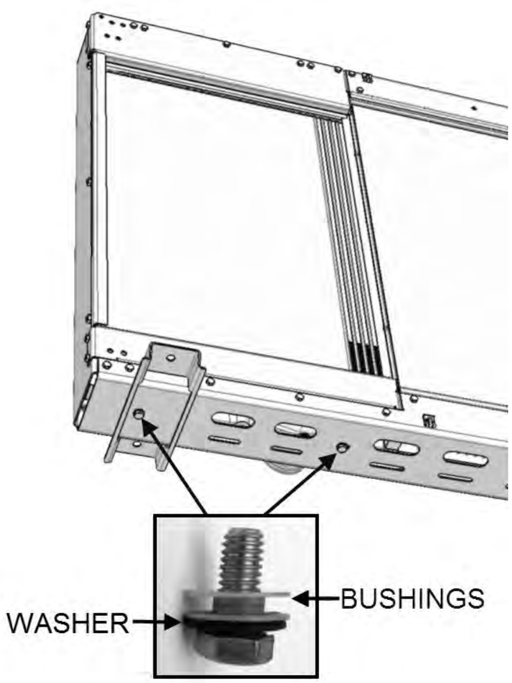


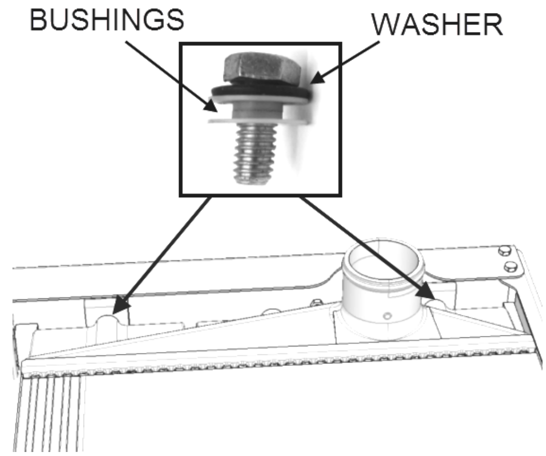
When replacing the CAC or radiator unit only, ensure that:

- The rubber seal is present all around the radiator perimeter and that it is in good condition (replace as necessary).
- Both rubber strips (upper & lower) are present and in good shape at the edge of the upper and lower support section (fan side only).

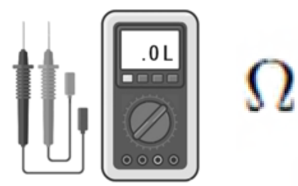


- Both uppers and lowers CAC insulating bushings & washers are present and in good condition at the CAC mounting points (replace as necessary).





After all the frame sections have been reassembled, check for conductivity between CAC/radiator core and frame *(min 100 000 ohms must be observed).*



1. Open rear engine compartment door.
2. Open rear engine door and set engine stop button to the OFF position (push).
3. Raise L.H. side hinged rear fender (Figure 28).

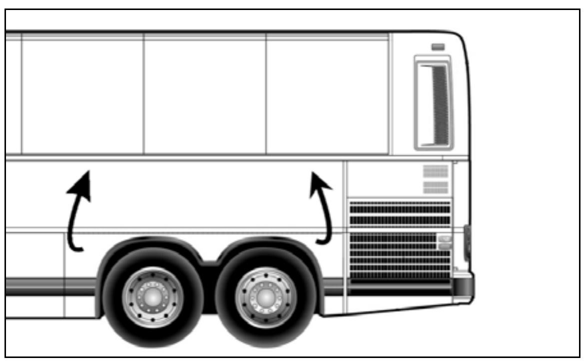


FIGURE 28: RAISING REAR FENDER

4. Remove access panel located behind L.H tag axle wheel.
5. Access the heater shut-off valve located behind the access panel and set it to the closed position (Figure 29).

6. Set the second heater shut-off valve, located in the engine compartment below the turbocharger outlet to CAC pipe, at the closed position.

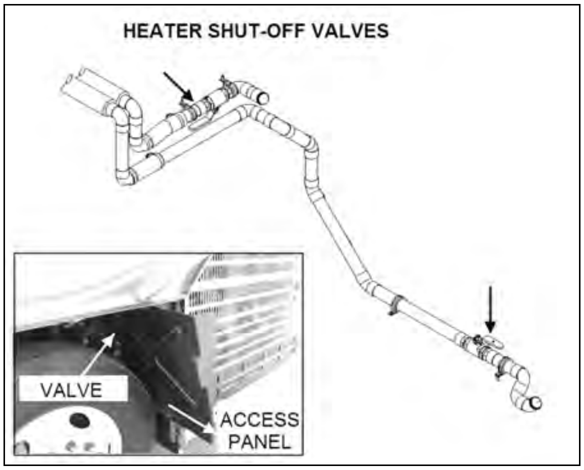


FIGURE 29: HEATER SHUT-OFF VALVES POSITION

7. Connect coolant extractor (Figure 30) to the radiator drain cock and drain the coolant system as per *Draining cooling system in paragraph 7 of this section.*

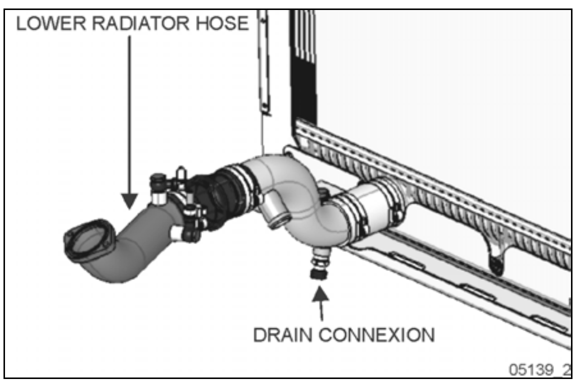


FIGURE 30: COOLANT DRAIN EXTRACTOR CONNECTION

DANGER

Risk of poisoning. Do not drink coolant. Use proper hand protection when handling. Keep coolant out of reach of children and animals.

8. Disconnect the upper radiator pipe *at the pipe junction* between the radiator and the engine (Figure 31).

9. Also disconnect the upper CAC pipe at the *mid-pipe junction*.

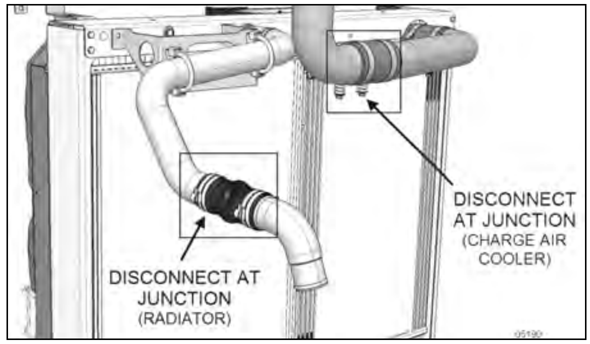


FIGURE 31: RADIATOR & CAC UPPER CONNECTION

10. Disconnect the radiator lower pipe directly at the radiator outlet (Figure 32).

11. Disconnect the lower CAC pipe (turbo outlet).

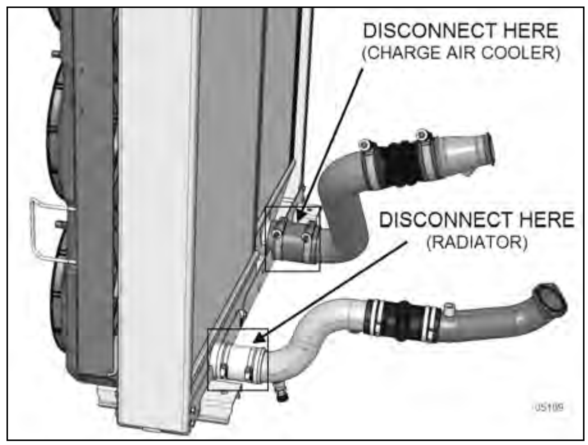


FIGURE 32: RADIATOR & CAC LOWER CONNECTION

12. Proceed to the cooling fan shroud removal following *paragraph 11.3* of this section (radiator door must be removed).

13. Disconnect the ground connection at the upper right corner of the cooling assembly (Figure 33).

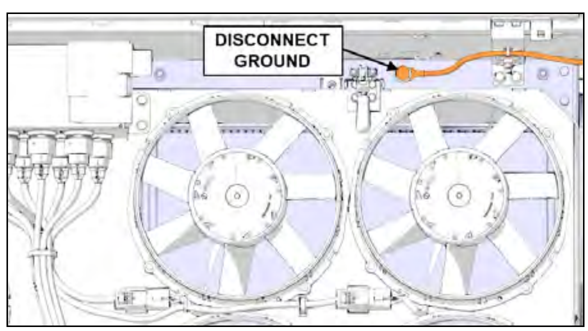


FIGURE 33: COOLING ASSEMBLY GROUND

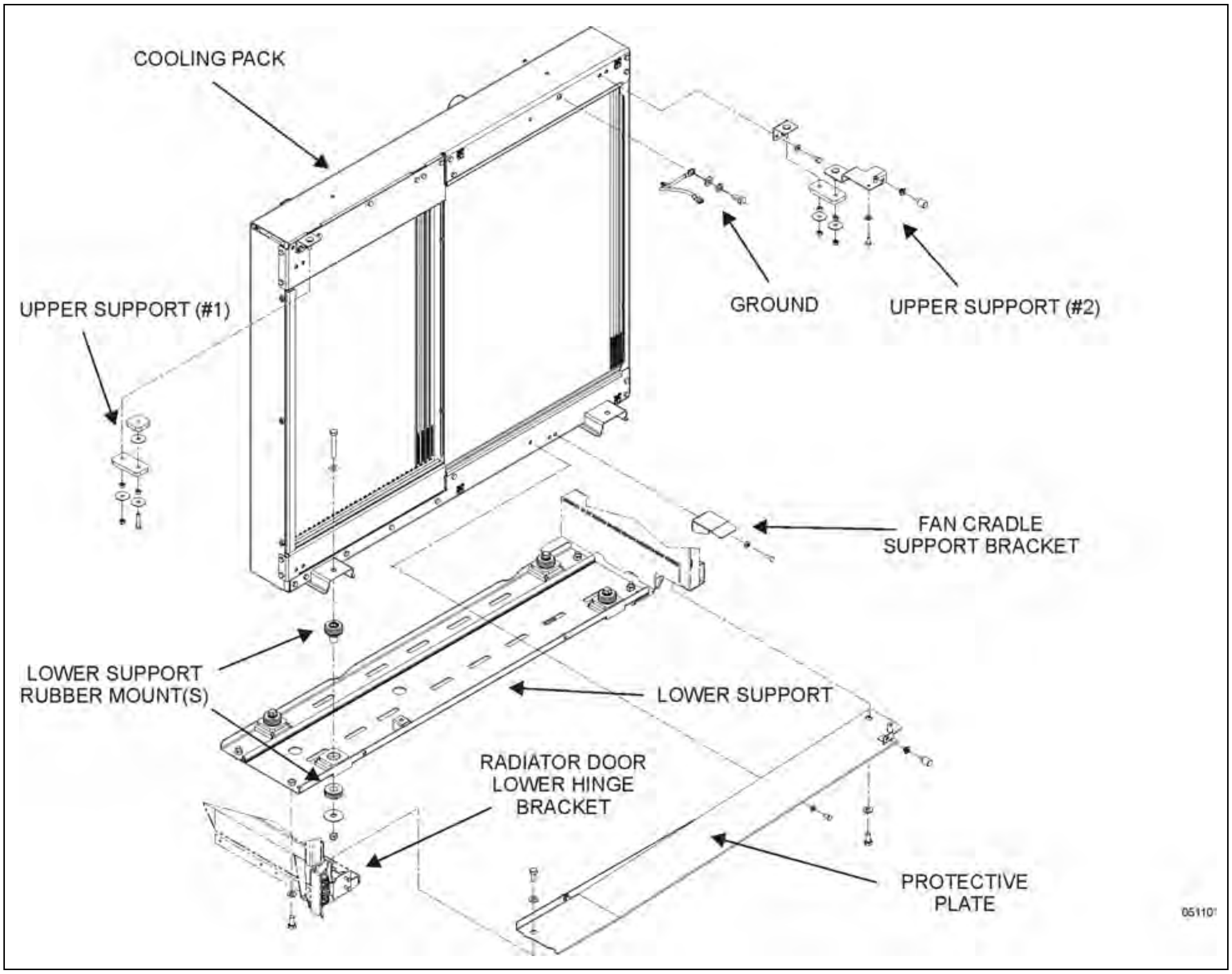


FIGURE 34: COOLING PACK SUPPORTS AND COMPONENTS

14. Remove the radiator door lower hinge bracket (Figure 35).

15. Remove the protective (splash) plate fixed to the cooling pack lower support (Figure 36).

FIGURE 35: RADIATOR DOOR LOWER HINGE BRACKET

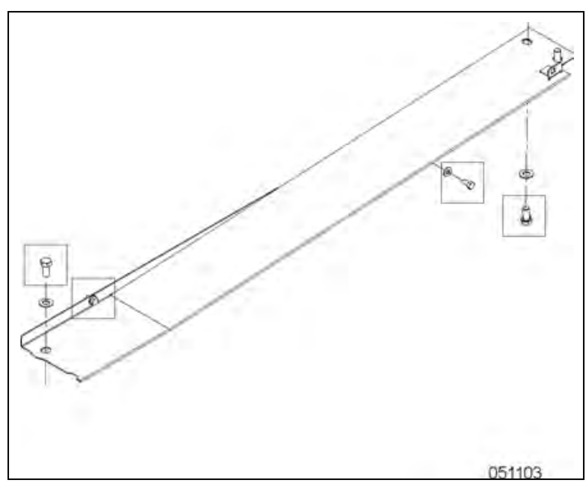


FIGURE 36: PROTECTIVE PLATE MOUNTING BOLTS

16. Support the cooling assembly with a lift table positioned under the lower support.

17. Unscrew the lower support from the vehicle (two hex bolts at each end of the support Figure 37).

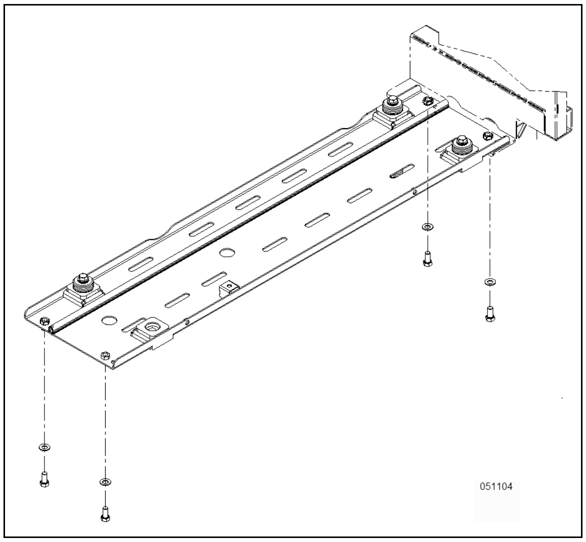


FIGURE 37: LOWER SUPPORT MOUNTING BOLTS

18. Unscrew the two upper supports from the vehicle structure so they will be removed with the cooling assembly (Figure 38).

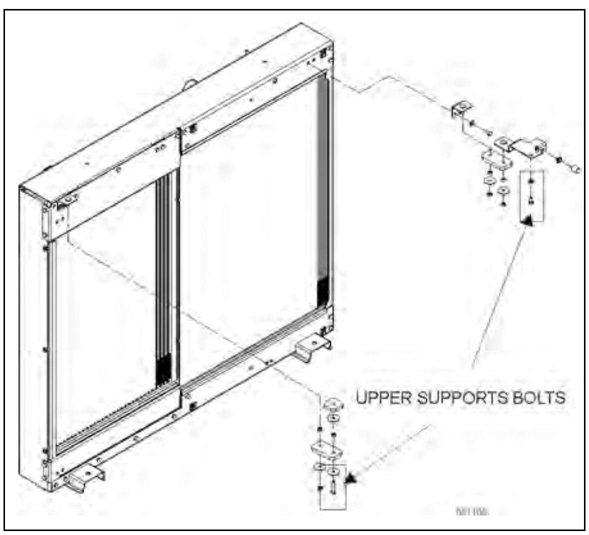


FIGURE 38: UPPER SUPPORTS MOUNTING BOLTS

19. Slightly lift the assembly and slide it out of the vehicles.
   - Check interference at the back of the assembly with the pipe sections still attached to the assembly and the vehicle structure (slack hose clamps and turn down tubes as necessary).

20. To proceed to the *radiator replacement*, remove radiator upper pipe section, bracket and hardware, unbolt the four support bolts passing through the radiator and holding it to the frame (upper & lower) also unbolt the cooling pack frame upper and lateral sections and slide the old radiator out (Figure 39).

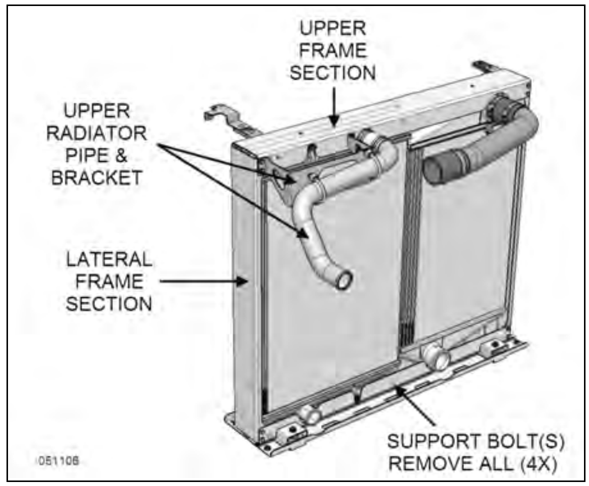


FIGURE 39: COOLING PACK PARTS TO BE REMOVED FOR RADIATOR REPLACEMENT

21. Insert a new radiator in the lower support making sure that insulating foam is installed all around the radiator body.

22. Reinstall the four support bolts and the upper and lateral frame sections only (*go to step 24 below*) Torque all support bolts and frame bolts to specified torque below.

TORQUE: 9 lb-ft (12 Nm)

23. To proceed to the *complete cooling pack replacement*, ignore steps 20 to 22 above and remove and transfer to the new assembly:
   - Both upper supports & brackets
   - Lower support & rubber mounts
   - Shroud support bracket
   - Lower hinge & hinge bracket

Torque all brackets to specified torque.

TORQUE: 9 lb-ft (12 Nm)

NOTE
Reinstallation of the cooling components as a complete assembly is recommended. *- Install fan shroud on the cooling pack frame then install complete assembly to vehicle structure.*

24. Lay the cooling pack horizontally at working height (use large workbench or sawhorses) exterior face pointing up.

25. Install fan shroud in position over the cooling pack (make sure the lower hinge is correctly assembled with plastic bushing in place) (Figure 40).

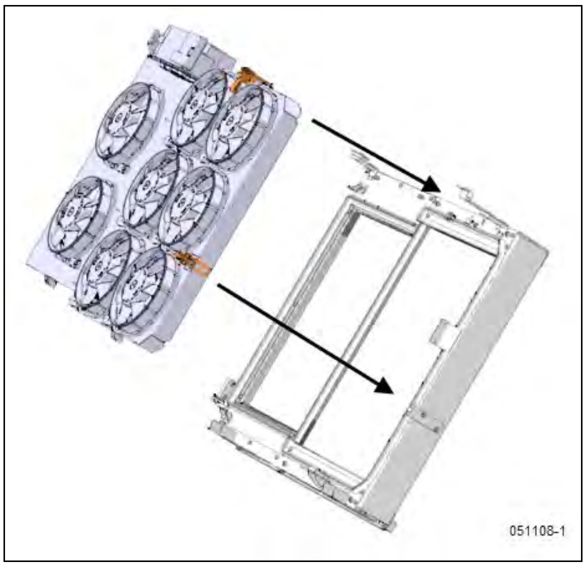


FIGURE 40: FAN SHROUD POSITIONING

26. Loosely install the hinges.

27. Lock the shroud in place using the two latches.

28. Adjust the shroud in its final position (release tension on the latches as required).

- There should be no gaps between the hinge pivot point and the plastic bushing (upper & lower hinges Figure 41).

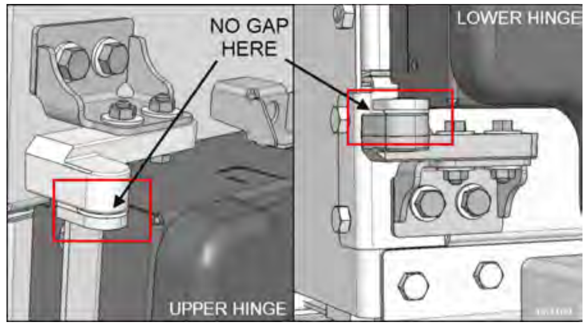


FIGURE 41: SHROUD HINGES INSTALLATION

- The bottom of the shroud should fit flat (parallel) against the shroud lower support (Figure 42).

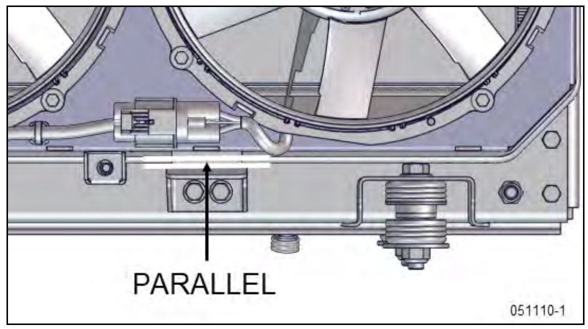


FIGURE 42: FAN SHROUD PARALLEL TO SUPPORT

29. Tighten hinges and hold down bolts.

TORQUE: 68 lb-in (8 Nm)

30. Put back the cooling assembly in its vertical position on a small lift table.

31. Reinstall the upper CAC and radiator pipe sections (including bracket and hardware Figure 43).

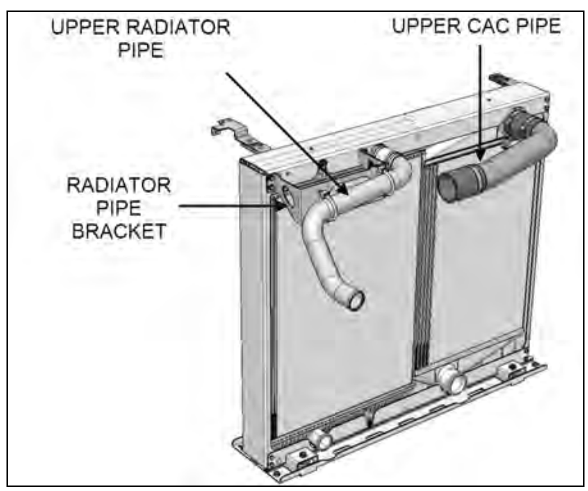


FIGURE 43: RADIATOR & CAC UPPER PIPES

32. Slide back the cooling assembly into position and reverse removal procedure to reinstall in vehicle.

33. Make sure that there is no conductivity between the CAC/radiator units and the cooling pack frame (*see note at the beginning of paragraph 11.4)*.

34. Fill the vehicle cooling system.

35. Set engine stop button to the ON position (depressed), start the engine and check for coolant leaks.

11.5 CHARGE AIR COOLER (CAC) IN VEHICLE REMOVAL

In the event that the charge air cooler (CAC) would require replacement or in cases where access to the engine hot side and/or turbocharger would be required. It is possible to remove the CAC from the vehicle without removing the complete cooling pack thereby eliminating the need to drain and refill the vehicle cooling system.

NOTE
Spec for CAC acceptable leakage: *The CAC is considered acceptable if it can hold 30 psi (206 kPa) gauge pressure with less than 1 psi (6.9 kPa) loss in 60 seconds.*   *This spec does not apply if there is any evidence that the leak was caused by a foreign object impact.*

1. Open rear engine compartment door.

2. Set engine stop button to the OFF position (push).

3. Proceed to the cooling fan shroud removal following *paragraph 11.3* of this section.

4. Disconnect the lower CAC pipe (directly at the CAC connection or at the turbo connection).

5. Disconnect the upper CAC pipe: It is possible to disconnect the pipe middle section junction and loosen the hose clamps at the CAC connection to pivot down the pipe and clear the radiator (Figure 44).

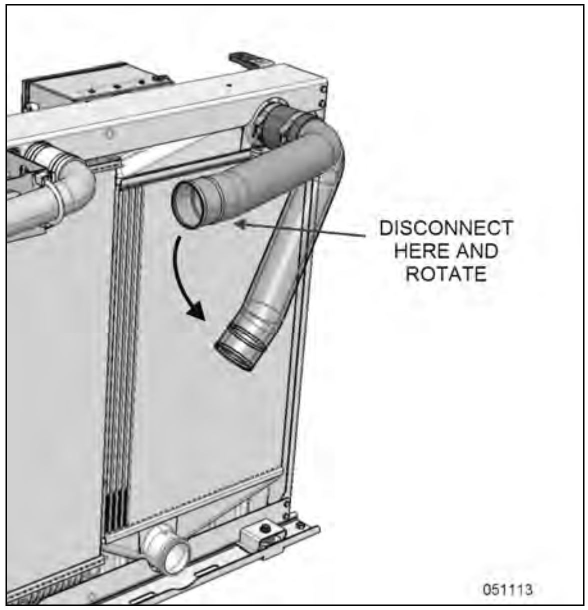


FIGURE 44: ROTATE CAC UPPER PIPE

6. Unscrew the upper cooling pack support from the vehicle structure (CAC side support only Figure 45).

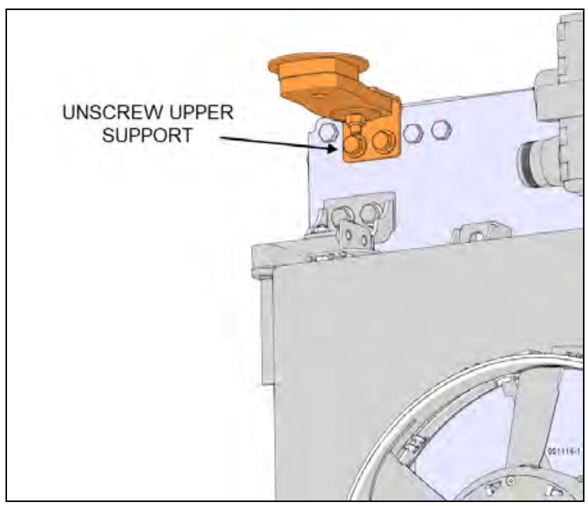


FIGURE 45: UPPER SUPPORT (CAC SIDE)

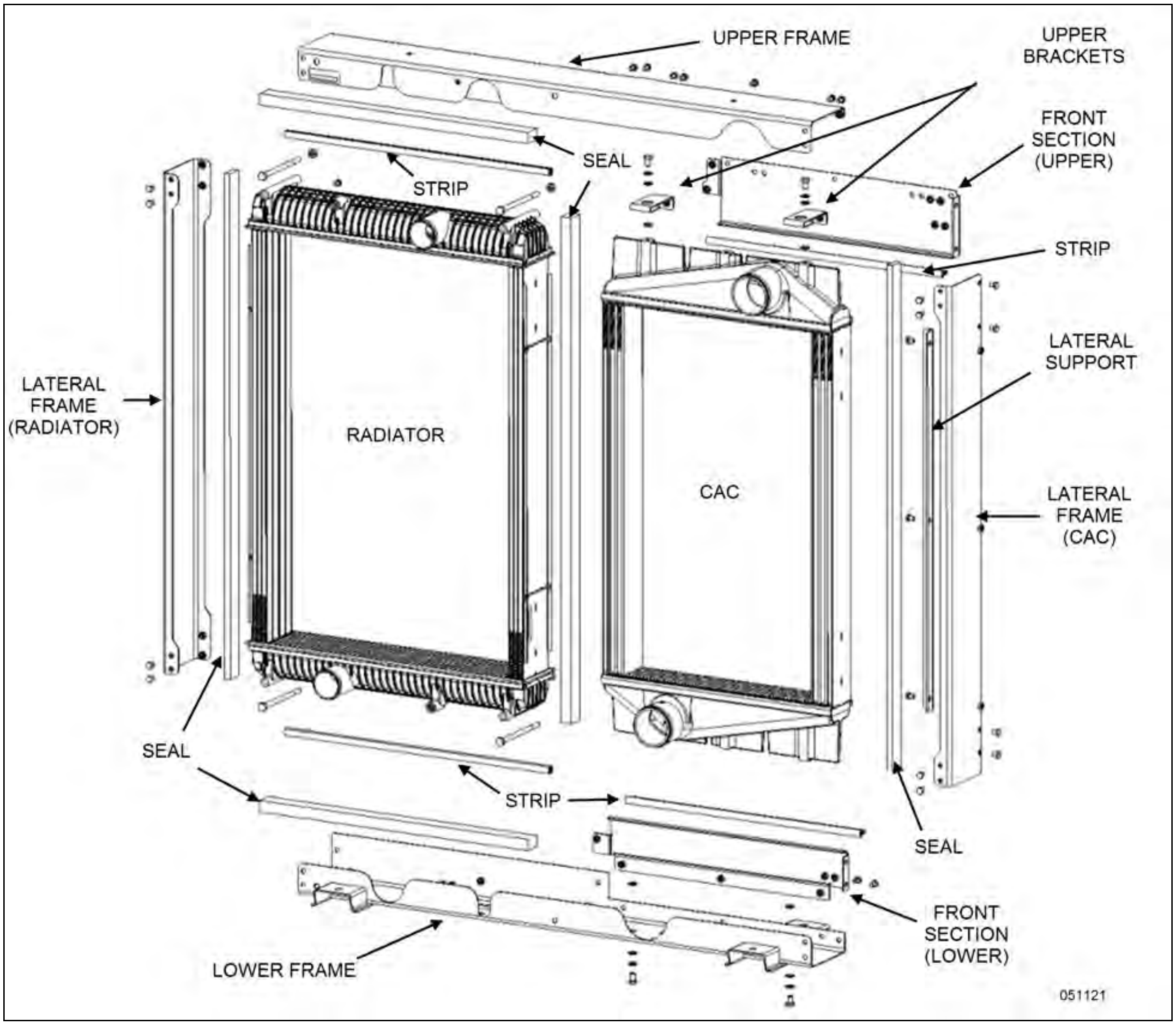


FIGURE 46: COOLING PACK EXPLODED VIEW

7. Remove CAC upper front frame structure by unscrewing the 11 hex bolts holding it (Figure 47).

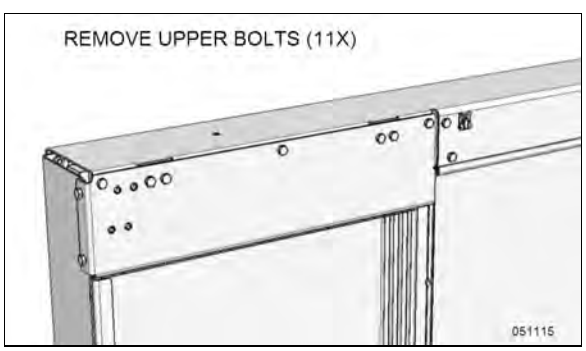


FIGURE 47: UPPER FRAME BOLTS

8. Remove the CAC lower front frame structure by unscrewing the 8 hex bolts holding it (Figure 48).

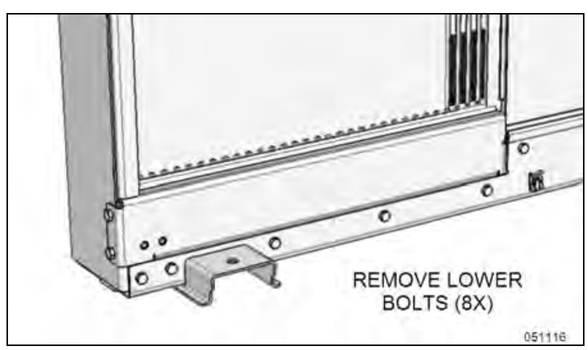


FIGURE 48: LOWER FRAME BOLTS

9. Also remove the CAC lateral support (3 hex bolts Figure 49).

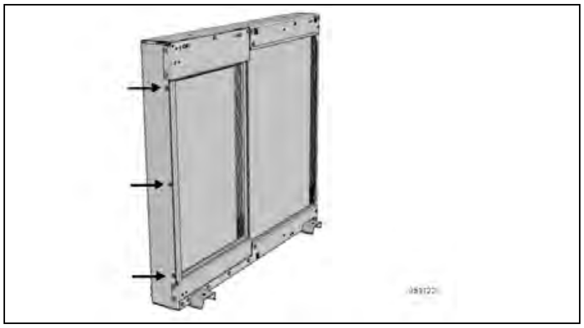


FIGURE 49: CAC LATERAL SUPPORT BOLTS

10. From under the vehicle, unscrew the CAC from the lower support (two hex bolts with plastic insulating bushings Figure 50).

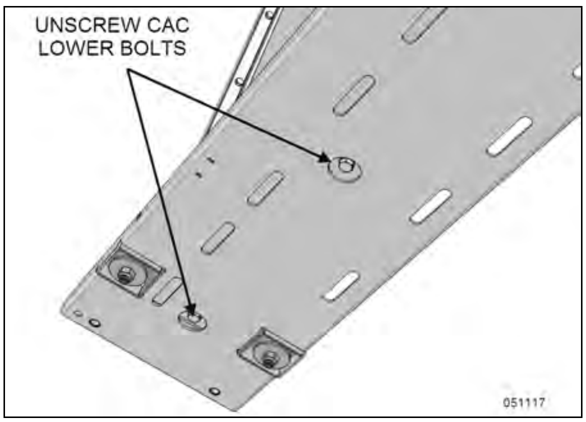


FIGURE 50: LOWER CAC INSULATED BOLTS

11. Remove CAC (and two upper brackets) from the vehicle.

12. If a new CAC is to be installed, transfer the upper CAC pipe and upper brackets to the new unit. Torque upper brackets with plastic bushings & washers to specified torque (Figure 51). Also reinstall the lower CAC pipe if it was previously removed with the CAC unit.

TORQUE: 9 lb-ft (12 Nm)

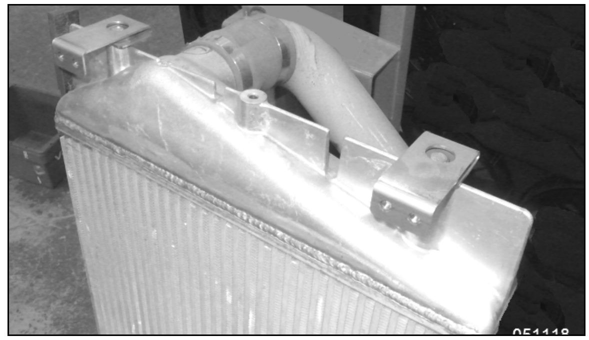


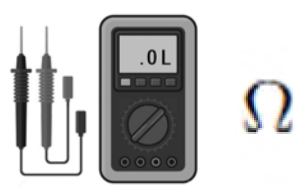
FIGURE 51: CAC UPPER BRACKETS & PIPE

WARNING

To prevent galvanic corrosion, the CAC upper brackets need to be electrically insulated from the CAC body.

When reinstalling brackets, make sure the plastic insulating bushings (two per bracket) & washers (one per bracket) are present and in good condition (replace as necessary).

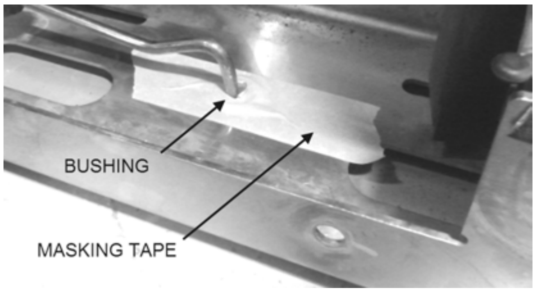
After installation, check for proper insulation (lack of conductivity) between brackets and CAC body with a suitable ohmmeter or continuity tester (buzzer).



13. In preparation for reinstallation of the CAC, install the inner insulating bushings in their location (lower support).

NOTE

To ease installation and ensure that the bushings will not move during reinstallation, use masking tape to hold the inner bushings to the lower support.



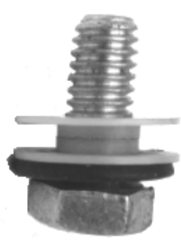
14. Install CAC on the vehicle and secure to the lower support using both lower hex bolts, washers and remaining plastic insulating bushings.

TORQUE: 9 lb-ft (12 Nm)

WARNING

To prevent galvanic corrosion, the CAC is electrically insulated from the support by the use of plastic insulating bushings.

When reinstalling brackets, make sure the plastic insulating bushings (two per bracket) & washers (one per bracket) are present and in good condition (replace as necessary).



After installation, check for proper insulation (lack of conductivity) between support and CAC body with a suitable ohmmeter or continuity tester (buzzer).

15. Reinstall both (upper and lower) front frame sections (Figure 52).

TORQUE: 9 lb-ft (12 Nm)

16. Secure upper support to the vehicle structure.

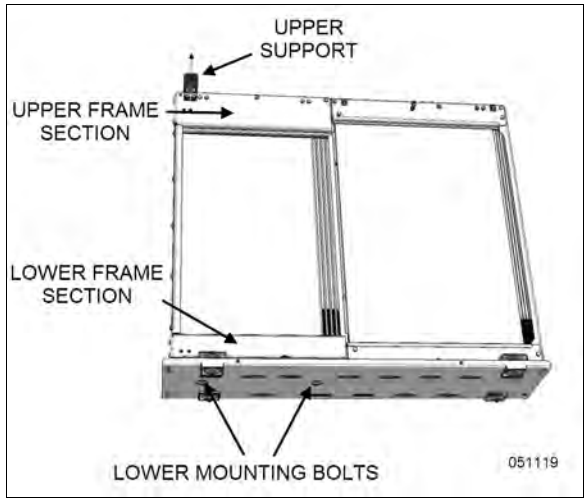


FIGURE 52: CAC FRAME SECTIONS

17. Double check for lack of continuity between CAC body and vehicle structure (*see note at the beginning of paragraph 11.4 for reference).*

18. Reconnect upper CAC pipe and tighten hose clamps at both ends.

19. Reconnect lower CAC pipe.

20. Proceed to the fan shroud reinstallation (*refer to paragraph 11.3 earlier in this section*).

21. Set engine stop button to the ON position (depressed) and start the vehicle.

22. Check for CAC leakage at the pipe connections.

12. SPECIFICATIONS

Cooling System Capacity

Including heating system .... 27.5 US gal (104 liters)

Cooling System Fans

Number used 8
Diameter .... 12 in (30.5 cm)
Power 850W
Voltage (nominal) .... 24 Volts
Voltage (operating range) .... 16-32 Volts
Maximum speed .... 4760 rpm
Sealing .... SAE J1455 IP67 / IP69K
Operating temperature range .... -40 to 138°F (-40 to 59°C)

Thermostat

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

Coolant

Type .... Final Charge Global Extended Life Coolant
Ratio .... pre-diluted 50/50 mixture

Coolant Filter Cartridge

Number used 1
Type .... Spin-on
Long-Life without Coolant Additives (SCA) .... Yes

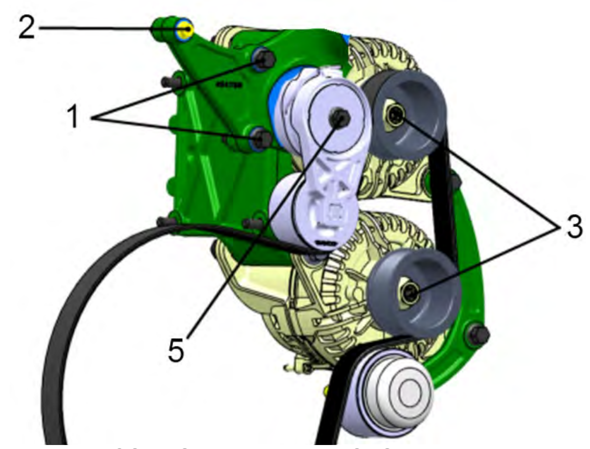
CONTENTS

SECTION CHANGE LOG

	DESCRIPTION	DATE
1	Headlamps disassembly procedure updated	March 2021
2	Limp-homes, available functions modified	Oct 2021

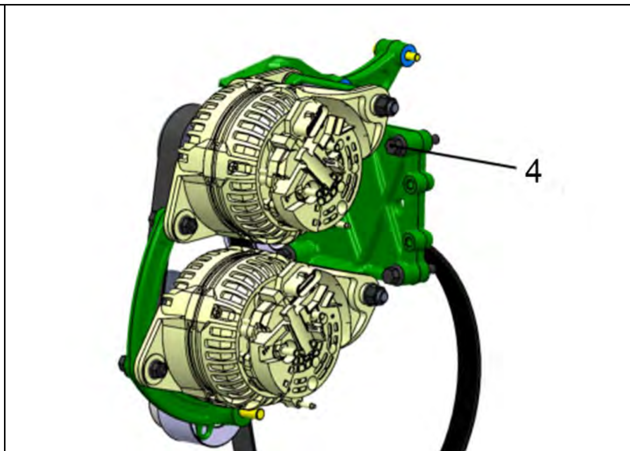
1. TORQUE TABLES

1.1 ALTERNATORS AND SURROUNDING COMPONENTS



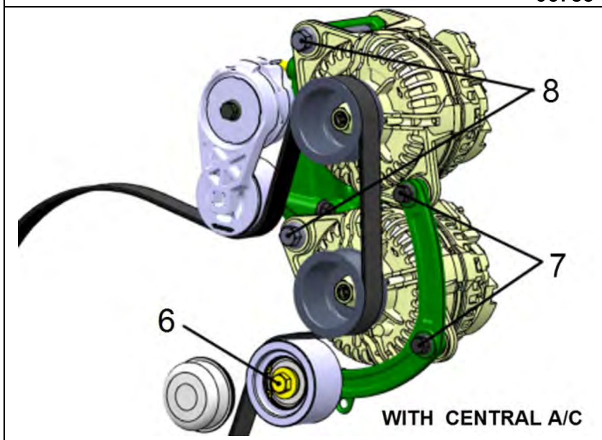
COLD SIDE ALTERNATORS

06783



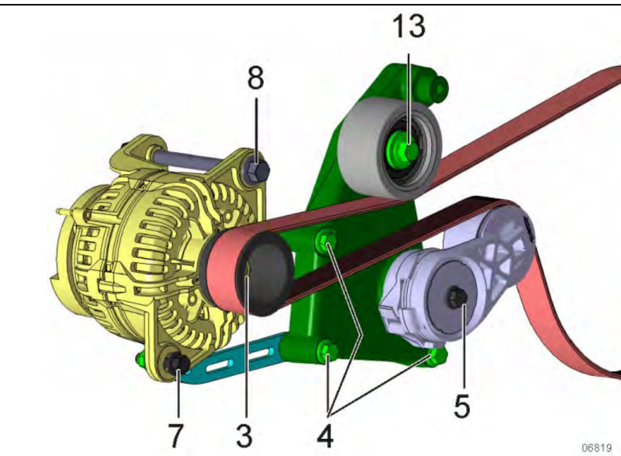
COLD SIDE ALTERNATORS

06784



COLD SIDE ALTERNATORS

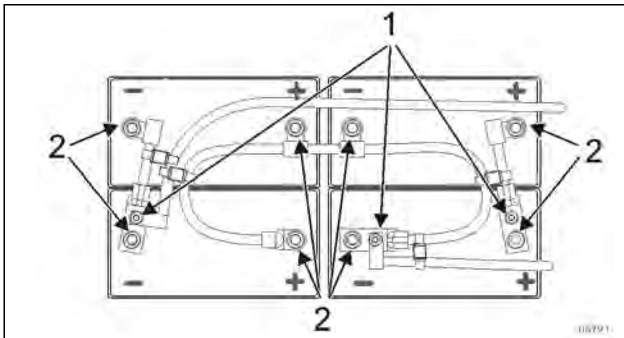
06785

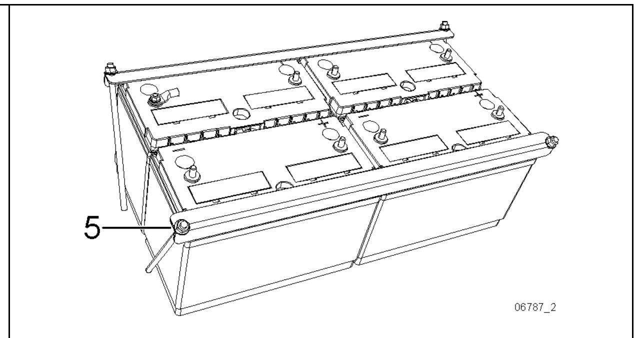


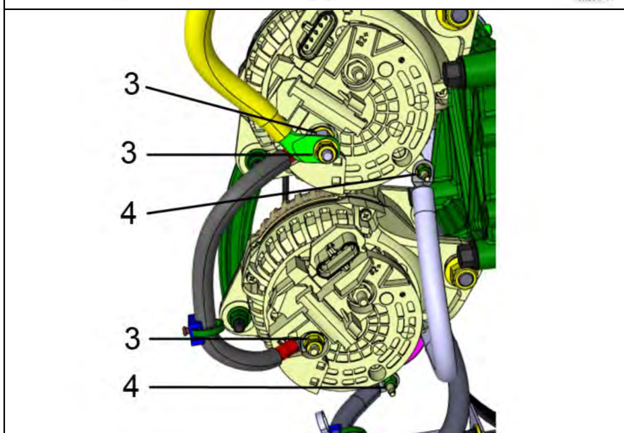
HOT SIDE ALTERNATOR, LOW LH (coaches)

BOSCH HD10 ALTERNATORS		
No	DESCRIPTION	TORQUE
1	A/C tensioner / idler bracket mounting bolts (2)	43 lb-ft (58 Nm)
2	A/C tensioner / idler bracket mounting bolt (1)	22 lb-ft (30 Nm)
3	Alternator pulley (2) LH threads	70-80 lb-ft (95-108 Nm)
4	Alternator mounting bracket mounting bolts	48 lb-ft (65 Nm)
5	Alternator belt tensioner mounting bolt	48 lb-ft (65 Nm)
6	Alternator belt idler mounting bolt (central A/C config.)	82 lb-ft (111 Nm)
7	Alternator mounting bolts, short	48 lb-ft (65 Nm)
8	Alternator mounting bolts, long	82 lb-ft (111 Nm)
13	Alternator belt idler mounting bolt (hot side)	59 lb-ft (80 Nm)

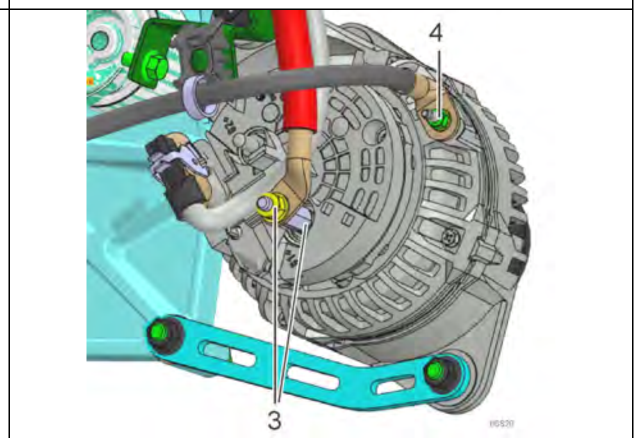
1.2 ELECTRICAL CONNECTIONS – BATTERIES, MISCELLANEOUS



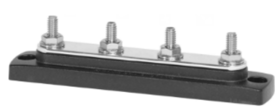




COLD SIDE ALTERNATORS



HOT SIDE ALTERNATOR, LOW LH (single)



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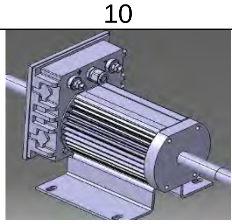

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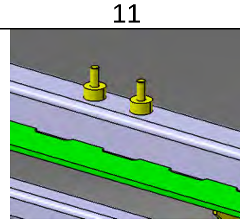

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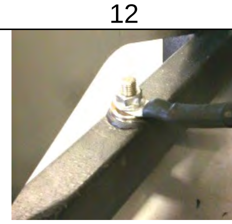

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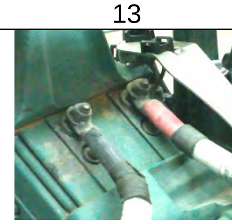

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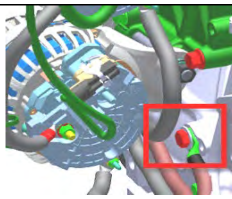
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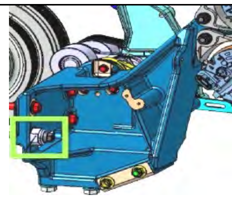
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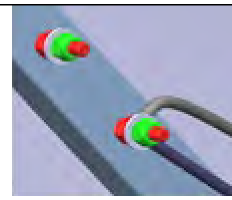

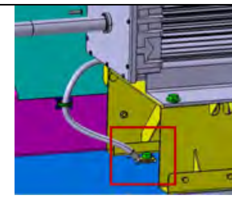
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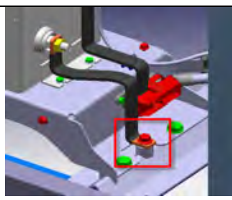
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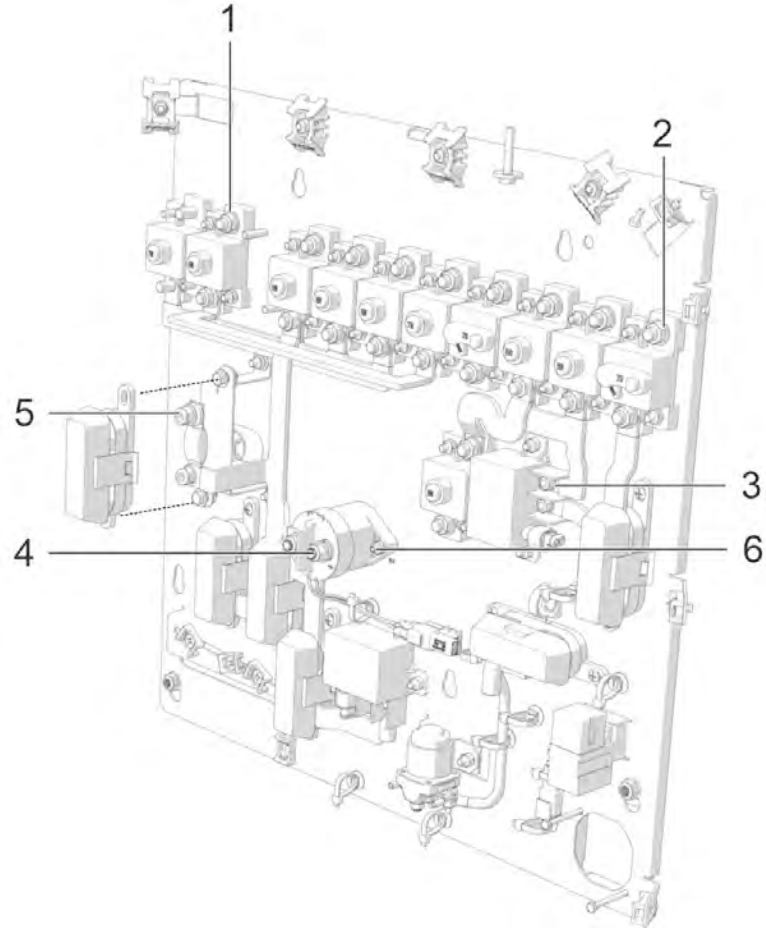
ELECTRICAL CONNECTIONS - BATTERIES, MISC.

No	DESCRIPTION	TORQUE
1	AGM battery Ground, 12VD & 24VD terminal nut	170 lb-in (19 Nm)
2	AGM battery connections, cap nut	170 lb-in (19 Nm)
3	Alternator power connection – nut & adaptor	11 lb-ft (15 Nm)
4	Alternator ground connection – nut	6 lb-ft (8 Nm)
5	Battery tie-down	45-55 lb-in (5-6 Nm)
6	Electronic ground bus bar ¼-20 stud (front & rear electric cmpt)	60 lb-in (7 Nm)
7	Junction block – 1 stud 3/8-16	114-126 lb-in (13-14 Nm)
8	Junction block – 4, 6, 8, 10 studs #10-32 brass	20 lb-in (2 Nm)
9	Booster block – 3/8-16 studs	119-131 lb-in (13-15 Nm)
10	ATC type fuse box – #8-32 screw terminal	15 lb-in (2 Nm)
11	Battery equalizer – 5/16-18 stud	91-101 lb-in (10-11 Nm)
12	VECR/F – M8-1.5 studs	164-181 lb-in (19-20 Nm)
13	24-V Inverter– M8-1.25 studs	104-115 lb-in (12-13 Nm)
14	Evaporator fan motor – 5/16-18 stud	48-50 lb-in (5-6 Nm)
15	Chassis ground studs – 1/2-13 stud stainless steel	170 lb-in (19 Nm)
16	Chassis battery ground studs – 1/2-13 stud stainless steel	170 lb-in (19 Nm)
17	Engine air preheater – M8-1.25 stud	84-108 lb-in (9-12 Nm)
18	Engine ground studs – M10-1. 5 stud	240 lb-in (27 Nm)
19	Alternator ground cable stud (hot side) – M10-1. 5 stud	240 lb-in (27 Nm)

20	On chassis welded ground stud – M6-1 stud	106 lb-in (12 Nm)
	On chassis welded ground stud – M10-1.5 stud	170 lb-in (19 Nm)
21	Evaporator fan motor ground cable stud – M8-1.25 stud	170 lb-in (19 Nm)
22	Main electrical shut-off switch (Kissling type) – M12-1.75 stud	166-183 lb-in (19-21 Nm)
23	Circuit breaker (manual reset) 1/4-28 stud nut	58 lb-in (7 Nm)
24	Circuit breaker (switchable, manual reset) 1/4-24 stud nut	58 lb-in (7 Nm)
25	Ultracapacitor starting module 1/2-13 power studs	180 lb-in (20 Nm)
	Ultracapacitor starting module 3/8-16 12V power stud	212 lb-in (24 Nm)
26	Bus bar, chassis ground stud, M10-1.5, ultracap starting module	240 lb-in (27 Nm)

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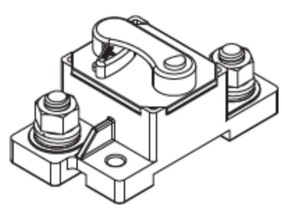
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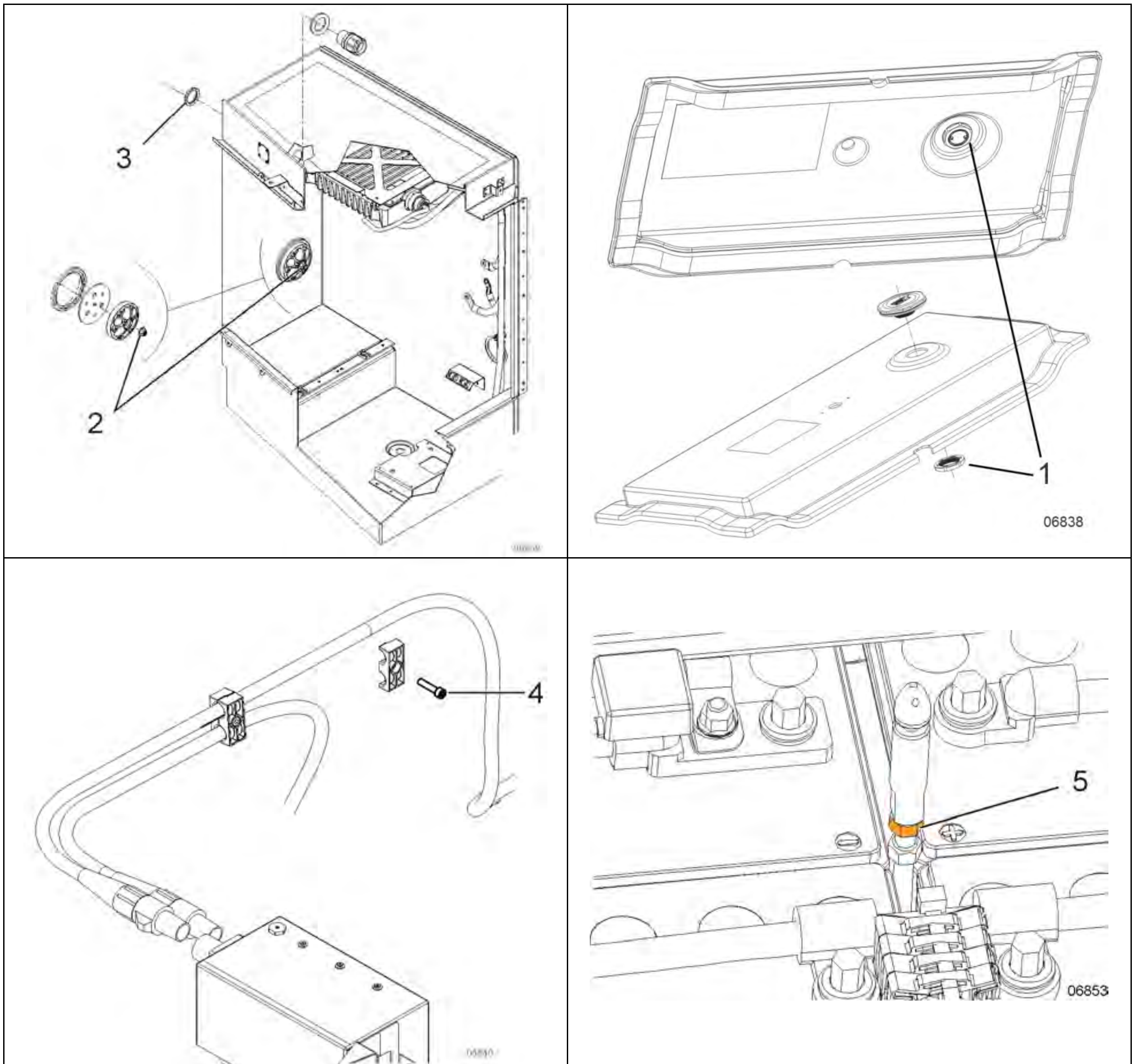
ELECTRICAL CONNECTIONS – MAIN POWER COMPARTMENT

No	DESCRIPTION	TORQUE
1	Main circuit breaker 3/8-16 stud nut	135 lb-in (15 Nm)
2	Main circuit breaker (switchable, manual reset) 3/8-16 stud nut	135 lb-in (15 Nm)
3	Power relay stud nut	44 lb-in (5 Nm)
4	Battery master relay – M8-1.25 buss bar connection stud nut 100 lb-in	100 lb-in (11 Nm)
5	Fuse holder M8-1.25 stud nut	96 lb-in (11 Nm)
6	Battery master relay mounting nut M5 15-35 lb-in	15-35 lb-in (2-4 Nm)



MISCELLANEOUS COMPONENTS		
No	DESCRIPTION	TORQUE
1	Battery cover vent mounting nut	40-48 lb-in (4.5-5.4 Nm)
2	Cable pass-through assembly nut	90-110 lb-in (10-12 Nm)
3	Strain relief mounting lock nut	90-110 lb-in (10-12 Nm)
4	Screw - power cable support- electrical cooling fans	50-60 lb-in (5.6-6.8 Nm)
5	Battery cover stud nut	86-106 lb-in (10-12 Nm)

2. GENERAL DESCRIPTION

This vehicle uses a dual voltage system to obtain two different voltages (12-volts and 24-volts) for various electrical controls and accessories. The main power source incorporates four batteries connected in series-parallel. 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 12V and 24V systems are controlled through individual main battery relays. Base configuration uses three 24V self-regulated alternators, belt driven from the engine, and can be reached through the engine compartment doors.

This vehicle is equipped with PRIME energy management system, which features AGM batteries and a Vanner Vann-Bus 80 Series battery equalizer.

2.1 WIRING DIAGRAMS

A paper copy of the 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.

2.1.1 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 CB5 is released (open circuit) and you don't know which circuit is affected.

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

b) At item CB5, 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 CB5, 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 35.2 the components as well as the electric wiring, thus providing you with a complete understanding of this circuit.

Situation: Using the Driver's Info Display (DID), you check on arrival if there are active errors in the vehicle electrical system. With the DIAGNOSTICS menu, highlight VIEW ACTIVE FAULTS, highlight ELECTRICAL 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 arrow to see all the fault messages.

Problem: DID displays the fault "Elec. Horn SW63; shorted to ground" as being active.

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

b) In first column DEVICE ID, look for device SW63.

c) At device SW63, find the fault message, the minimum condition to activate, other inputs involved in logic, the multiplex module related to switch 63, the connector and pin number on the module and the page on which to find the corresponding diagram.

d) Once the problem corrected, the DID still shows the fault as being active. You have to leave the VIEW ACTIVE FAULTS menu, wait approximately 20 to 30 seconds and then return to VIEW ACTIVE FAULTS to request a new diagnostic of the electrical system from the MCM. The DID should display the fault as being inactive.

2.2 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.

2.3 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	Data link High
Green	Data link Low
Orange	Connected to multiplex outputs
White	Connected to multiplex inputs
Red	24 volt system
Yellow	12 volt system
Black	grounded wire
Orange	speakers (+) (**Coaches Only)**
Brown	speakers (-) (**Coaches Only)**
Grey	spare wire

Black convolute tube with orange tape containing:

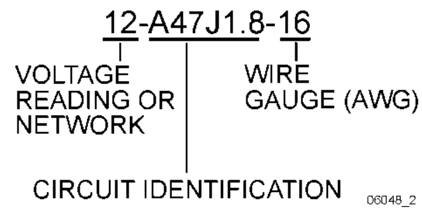
Black	120V ac system (live)
White	120V ac system (neutral)
Green	120V ac system (ground)

NOTE

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

2.4 WIRE IDENTIFICATION

Each wire on a diagram is patterned to assist in tracing and testing circuits. The wire identification identifies the voltage reading or network, the circuit identification and the basic wire gauge.



VOLTAGE READING OR NETWORK

0	120	J1939
5	ANA	J2284
0/12	BBUS	LIN
0/24	DATA	PWM
12	DBUS	GND
24	J1587	…other

CIRCUIT IDENTIFICATION

Ground circuits

Electronic: I/O module number followed by an R, followed by the connector number and pin number (cavity) (ex: A47RJ1.8, A54 RJ2.14).

Electronic ground studs: Number 00 followed with the stud location[1] and sequential number (ex: 00R1, 00F4).

Chassis ground studs: Number 0 followed with the stud location and sequential number (ex: 0EV1, 0FH2).

Power & voltage carrying circuits

Power distribution: Uphill component identification as circuit number (ex.: F96, CB22).

Multiplex outputs: Output module number and connector and pin number (cavity) (ex: A55J1.4, A49J2.9)

Relays, diodes, resistors and any other component output: Component number and pin number as circuit name (ex: SW55A, R30.87, D12.B).

NETWORKS

J1939
- DL0 (Bbus Mux)
- DL1 (drivetrain control network)
  - DL3 (Dbus Mux)
  - DL7 (engine subnet)
- DL9 (engine transmission/I-Shift subnet)

J2284
- DL2

J1587
- DL4 (powertrain subnet 900/901)

WIRE GAUGE (AWG)

0000	3	14
000	4	16
00	6	18
0	8	20
1	10	22
2	12	24

[1] For stud location, refer to page 2.1 of wiring diagram

2.5 SPARE WIRES

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

⚠ CAUTION

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

NOTE

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

2.6 CIRCUIT BREAKERS

The electric circuits are protected by manual reset type circuit breakers. The main circuit breakers (Figure 2), as well as those protecting the A/C system, are located in the main power compartment.

This type of circuit breaker de-energizes the circuit without disconnecting any wire.

Some circuit breakers such as CB2 & CB6 are different in the fact that you may open the circuit manually, to do so simply press the blue button on breaker to open the circuit, repair defective circuit, and afterwards swing red reset lever of breaker to close the circuit.

FIGURE 1: BREAKER WITH MANUAL TRIP BUTTON AND RESET LEVER SUCH AS CB2 & CB6

2.6.1 Main Circuit Breakers On Coaches

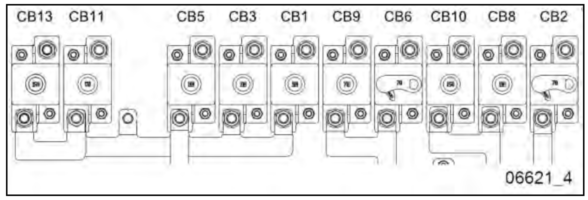


FIGURE 2: MAIN CIRCUIT BREAKERS ON COACHES

MAIN CIRCUIT BREAKERS ON COACHES		
CB1	**24 WUP** front distribution rear junction box	90 A
CB2	**12VD** & 12 ECU front distribution – ignition & engine start rear junction box rear junction box	70 A
CB3	**24 WUP** HVAC evaporator rear junction box	90 A
CB5	**24 WUP** rear distribution-rear junction box	90 A
CB6	**24VD** rear distribution & WCL rear junction box	70 A
CB8	**12 WUP** rear distribution-rear junction box	90 A
CB9	**24VD** preheater rear junction box	70 A
CB10	**12 WUP** front distribution – VECF power rear junction box	150 A
CB11	**24 WUP** Sound system-rear junction box	50 A
CB13	**24 WUP** Inverter 120 VAC outlets rear junction box	150 A
VD= volts direct. The electrical components connected to these circuit breakers are direct-connected to the battery.		

2.6.2 VECR/VECF Circuit Breakers

Smaller circuit breakers are located in the VECF and VECR in front and rear electrical compartment respectively. Refer to Figure 18 and Figure 20

2.6.3 Electric Cooling Fan Circuit Breakers

<u>MAXI 50 Amp manual reset CB</u>

Each radiator or Charge Air Cooler electric fan may be protected by a MAXI 50 amp single pole thermal type breaker with manual reset. If tripped, the circuit breaker remains open until it is reset by pressing the reset button.

This type of circuit breaker inserts in MAXI fuse blades mounting style. Simply pull the circuit breaker off the blade type mount to replace.

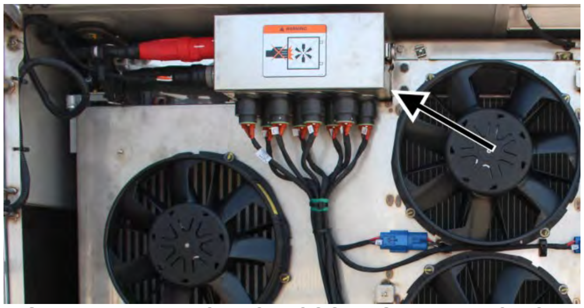


FIGURE 3: ELECTRIC COOLING FAN CIRCUIT BREAKER BOX

ELECTRIC FAN DRIVE 50 Amps CIRCUIT BREAKERS		
ID	Description	connector
CB201	Charge Air Cooler fan #1 - Mo65	1
CB202	Charge Air Cooler fan #2 - Mo67	2
CB203	Radiator fan #3 - Mo68	3
CB204	Radiator fan #4 - Mo69	4
CB205	Radiator fan #5 - Mo70	5
CB206	Radiator fan #6 - Mo71	6
CB207	Radiator fan #7 - Mo72	7
CB208	Radiator fan #8 - Mo73	8

2.7 MULTIPLEX FUSES

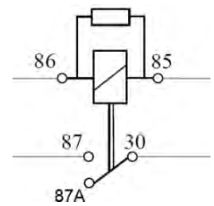
The multiplex outputs are protected in current by an internal “soft-fuse”. Each output has programmed specific maximum amperage. When an output is shorted, the current gets above the limit and the soft-fuse intervenes to turn the output OFF. The output stays OFF until the "soft-fuse" is reset.

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

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

2.8 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.



86 coil
85 coil
30 common feed
87 normally open contact NO
87A normally closed contact NC

FIGURE 4: SINGLE POLE DOUBLE THROW RELAY

NOTE

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

CAUTION

The Multiplex vehicle uses a VF4 relay specially designed 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.

2.9 COOLING FAN CONNECTIONS

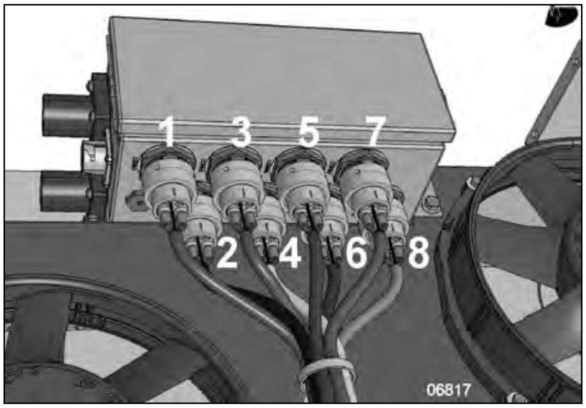


FIGURE 5: COOLING FANS CIRCUIT BREAKER BOX - CONNECTOR NUMBER

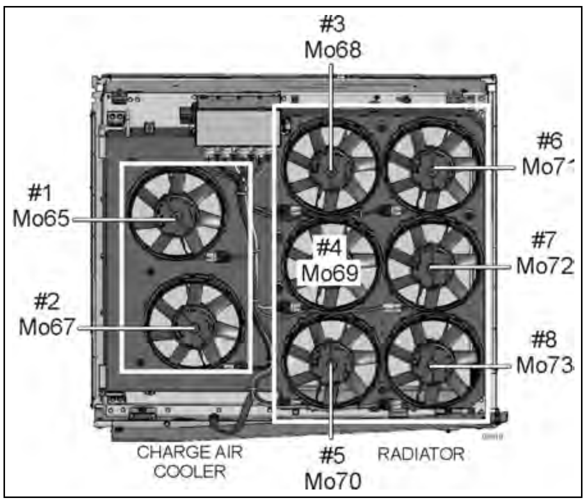


FIGURE 6: COOLING FAN IDENTIFICATION

⚠ WARNING

WHEN THE ENGINE IS RUNNING…

Cooling fans may start running at any moment.

Keep hands away from cooling fans or keep the radiator door closed.

⚠ WARNING

Cooling fans may be running when the engine is shut down in the following conditions:

- If a High Exhaust Temperature condition exists (e.g. following regeneration). The CAC fans will keep running for a maximum of 15 minutes.
- During the **Electric Motors Test Sequence**, the cooling fans will start running briefly.

The CAC fans and the radiator fans are controlled by two multiplex modules, i.e. AE49 & AE52. Each module controls one (1) CAC fan and three (3) radiator fans. For this reason, if one module fails, sufficient cooling will still be available for the CAC and the radiator through the second module.

Module AE49: Fans 1, 4, 6, 8

Module AE54: Fans 2 3, 5, 7

If one fan doesn't function, diagnose the probable causes of failure for this particular fan. If one CAC fan and three radiator fans are not functioning, then you should suspect that one of the multiplex modules (AE49 or AE52) is defective.

2.10 ELECTRONIC GROUND

All the electronic modules installed on this vehicle are grounded to the electronic ground stud located in the main power compartment, using separate and protected circuits.

All the loads fed by a particular electronic module are grounded to that same module. However, a load can be grounded to another module in the situation when the load can be powered by two different modules for redundancy need.

2.11 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, engine ECU, transmission ECU, instrument cluster module, the battery equalizer, the preheater system, AFSS, the wheelchair lift system and some Multiplex modules which remain 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 main electrical shut-off switch located above the batteries, on the exterior wall of 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 main circuit breakers CB2 & CB6 located on the rear junction panel 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.

2.12 CORROSION INHIBITOR

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.

CAUTION

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

DANGER

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

3. ELECTRONIC MODULES

3.1 MCM

The MCM (Master Control Module) plays the role of interface between the engine ECM, the transmission ECU, the telltale panel module and other I/O-EA, I/O-EB 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 keeps the back-up program of the vehicle specific multiplex program. So, a specific MCM cannot be removed from a vehicle and be installed on another vehicle.

3.1.1 Replacing the MCM

If the MCM must be replaced, a new MCM, pre-programmed at the factory specifically for the vehicle must be ordered. The actual vehicle identification number (V.I.N) will be needed at the time of ordering.

1. The vehicle should be connected to a battery charger.
2. Turn the hazards ON. Doing this will prevent the vehicle to fall in “sleep” mode after the normal 15 minutes delay.
3. Set the ignition key to the ON position and leave it in that position at all time while performing this procedure.
4. On rear electrical junction panel, trip circuit breaker CB6.
5. Replace the MCM.
6. Reset circuit breaker CB6.
7. The DID indicates "MUX AUTOPROGRAMMING I/O MODULE PLEASE WAIT" until the reprogramming of

the I/O modules 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.

8. The previous message displayed on the DID may disappear event if the programming is not completed. For this reason, wait another 5 minutes before proceeding to the next step.
9. Trip and reset circuit breaker CB6.
10. Check the DIAGNOSTICS menu of the Driver Information Display (DID). Select VIEW ACTIVE FAULTS and ELECTRICAL. 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).

3.1.2 Uploading a multiplex program update into the MCM

An updated vehicle multiplex program saved on a laptop computer can be uploaded into the MCM. A laptop computer running Windows XP or Windows 7 must be connected to the RS232 serial port DB9 connector (identified C226) found on the front service compartment electrical panel. Please contact your Prevost Service Representative in order to get the vehicle specific multiplex program and upload procedure. Save the specific multiplex program on your laptop computer.

⚠ WARNING

WHEN UPLOADING A NEW MUX SOFTWARE INTO THE MCM …

Cooling fans WILL start running for a short while.

Keep hands away from cooling fans or keep the radiator door closed.

3.2 I/O-EA AND I/O-EB MODULES

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

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

3.2.1 Replacing I/O-EA or I/O-EB Modules

I/O-EA, I/O-EB modules can be replaced and reprogrammed without having to connect a computer to the vehicle.

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

1. On rear electrical junction panel, trip circuit breaker CB6.
2. Replace the defective module.
3. Reset circuit breaker CB6. Doing so will initiate the I/O auto programming.
4. 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.
5. The previous message displayed on the DID may disappear event if the programming is not completed. For this reason, wait another 5 minutes before proceeding to the next step.
6. Trip and reset circuit breaker CB6.
7. Check the **Diagnostics** menu of the Driver Information Display (DID). Select VIEW ACTIVE FAULTS and. 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).

3.3 ELECTRONIC MODULES CONNECTOR PIN-OUT

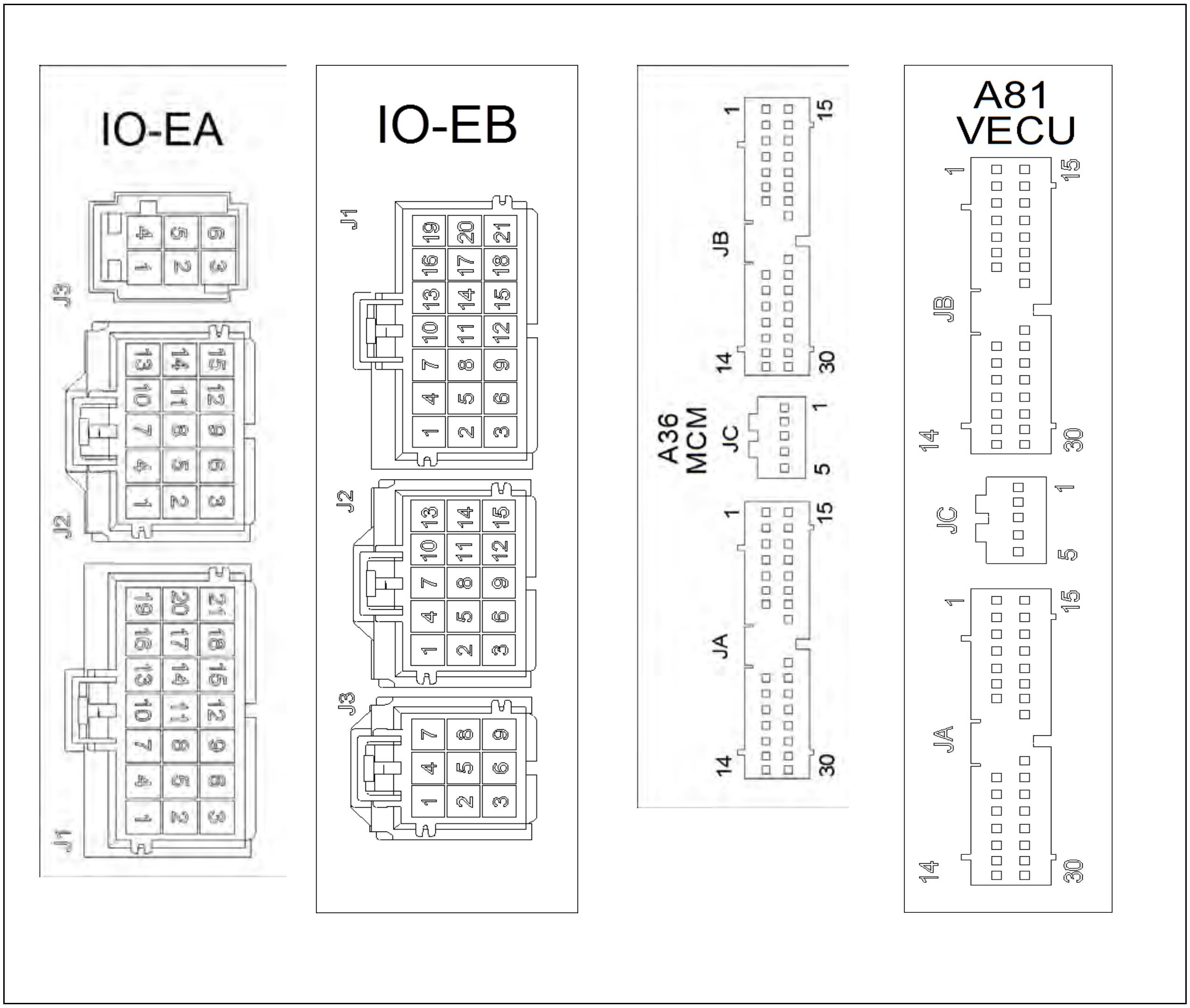


FIGURE 7: ELECTRONIC MODULES CONNECTOR PIN-OUT - BACK PROBING VIEW

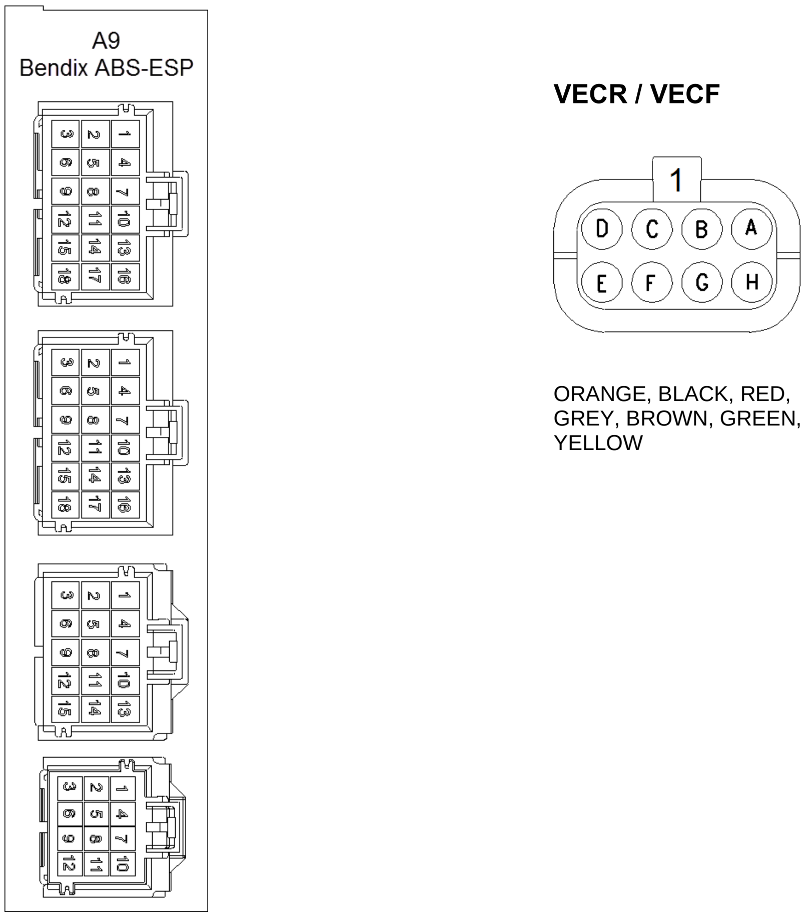


FIGURE 8: ELECTRONIC MODULES CONNECTORS PIN-OUT - BACK PROBING VIEW

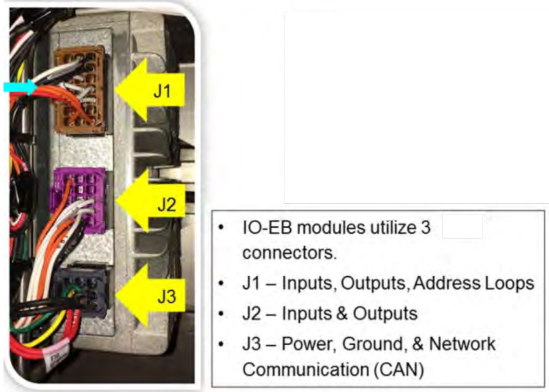
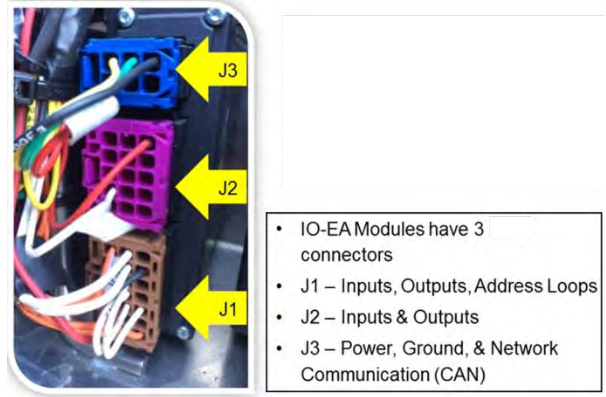
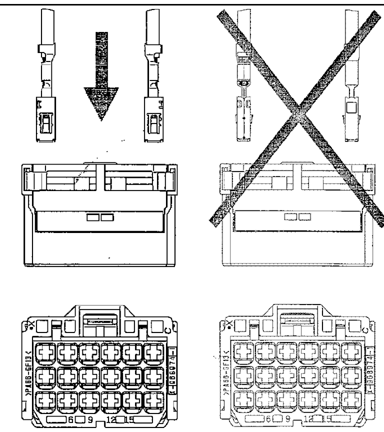
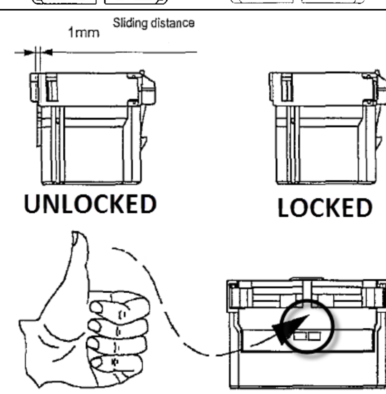
	

FIGURE 9: I/O-EB MODULE	**FIGURE 10: I/O-EA MODULE**

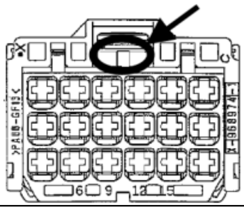
I/O-EA & I/O-EB MUX modules

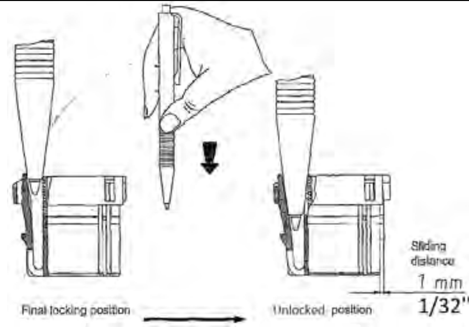
Connector: AMP MCP 2.8

Contact loading of housings Loading the contacts is only possible if the secondary lock is in the unlock position. Proper orientation of the contact is important. If the orientation is incorrect, the contact stops too early in the region of the secondary lock and the whole crimp stands out from the housing. With correct orientation the secondary lock stops with a metallic "click" sound.	
Locking the secondary lock Delivery state of the secondary lock is the open position. In this position the AMP MCP2.8 contacts can be loaded. After that the secondary lock is moved into the final locking position by hand. At a sufficient large surface a perpendicular force is initiated by (preferably) the thumb of one hand. Proper final position is reached a click noise can be heard. Make sure that both sides are locked.	

Unlocking the secondary lock

To unlock the secondary lock on these housings, a simple solid commercial ball pen is sufficient. The ball pen has to be inserted perpendicularly according the image, between the locking latch of the housing and the secondary lock block. Then it will be pushed with care until the opening is felt (a “click” sound can be heard).

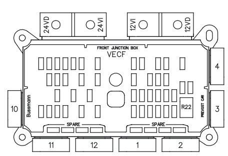
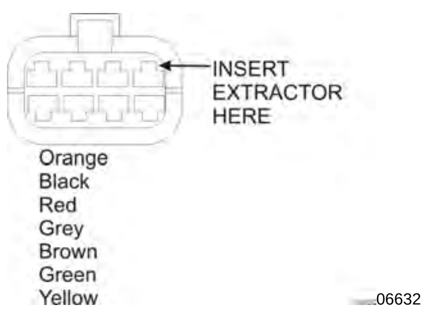




Extracting the contacts from housings

To extract contacts, the secondary lock has to be in the unlock position. The tool has to be inserted from connection side into the cavity of housing up to the stop; the contact will be unlocked thereby. Keep the tool in that position and then take the contact out by pulling on the cable. Note: Do not pull the cable before unlocking the contact; on the other hand by pressing the cable gently against the cable outlet direction the unlocking procedure will be facilitated.

EXTRACTOR/TOOL: Prevost 568103

Multiplex modules	Connector type	Contact removal
 **VECR / VECF** 06627	 06632 **BUSSMAN**	EXTRACTOR/TOOL: Prevost #682256 (Packard 12094429) Remove the terminal by disengaging the flexible lock tab on the terminal. Gently remove the terminal from the connector by pulling on the wire.

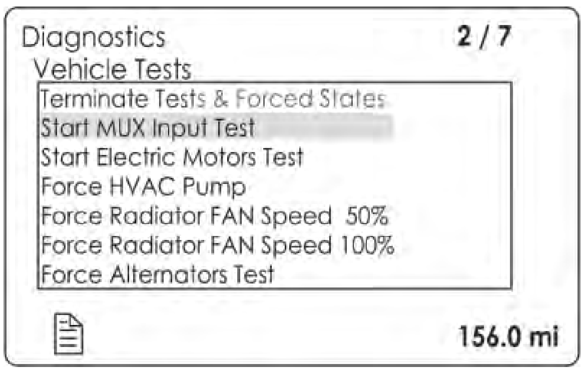
4. AVAILABLE TEST MODES

The available test modes are the followings:

1. MUX (multiplex) Input test;
2. Electric motors test sequence;
3. Alternator test.

4.1 MULTIPLEX INPUT TEST

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



To initiate the test, use the Driver Information Display (DID) DIAGNOSTICS menu. Select VEHICLE TESTS submenu and then START 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 TERMINATE TESTS & FORCED STATES 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
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
Headlamps switch, 2 positions
Multi-function lever headlamps 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,
- 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.

4.2 Electric Motor Test Sequence

This test mode allows testing of the electric motors, the A/C compressor clutch and unloader and the HVAC system solenoid valves without the need to have the engine running. Note that while in test mode, the engine cannot be started.

Prerequisite conditions for the motor test mode:

A. A battery charger must be connected. If not, the test will be interrupted when the voltage drops below 24.4 volts,

B. Engine not running,

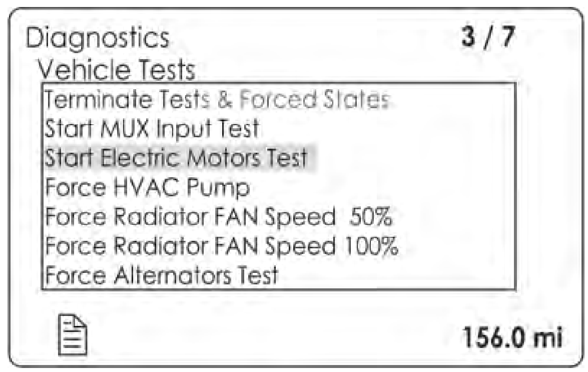
C. Parking brake applied,

DANGER

Before starting the test sequence, make sure that no one is doing maintenance in the evaporator compartment, the condenser compartment or close to the CAC & radiator electric cooling fans.

NOTE

The back-up alarm will sound (beep) ten (10) times prior the test starts to warn the persons who do work on the vehicle. Moreover, the alarm will beep to tell the person conducting the electric motors test sequence to move to the next test location 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 START ELECTRIC MOTORS TEST 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 telltale panel audible alarm gives a signal each second to remind that the motor test mode is underway.

4.2.1 Test Sequence – Coaches

Test Sequence – Coaches	
Go to the condenser compartment	• The condenser fans start. Speed will gradually increase to maximum speed. • The passenger's unit refrigerant solenoid valve activates. The refrigerant solenoid valve of the overhead compartment A/C system 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	• The main power compartment fan activates for 3 seconds. • Toilet fan motor starts. • A/C compressor clutch activates 3 times. • The compressor unloader activates 3 times. • The electric cooling fans start running for 20 seconds.

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

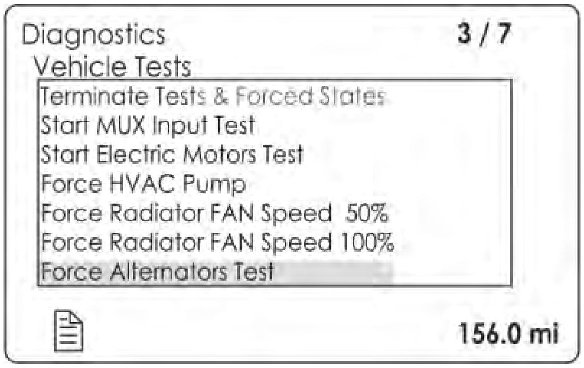
In the evaporator compartment	• Evaporator fan motor runs at speed 1 for 3 seconds then runs at speed 2 for 2 seconds. • Hot water pump starts running for 5 seconds and hot water pneumatic valve cycles 3 times.

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

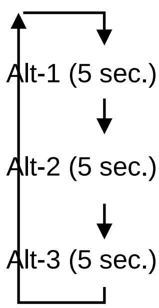
Inside the vehicle	• The driver's HVAC unit refrigerant solenoid valve cycles 3 times and the hot water pneumatic valve cycles 3 times also. • Left and right overhead compartment fans start running one after the other for 5 seconds. • The upper windshield defroster (optional) starts running.
To exit the electric motors test sequence, press ESCAPE button, select TERMINATE TESTS & FORCED STATES submenu and then press ENTER button twice.	

4.3 ALTERNATOR TEST

Anytime an alternator is suspected of being defective, this test will help you when performing your own alternator power output test, without the need to disconnect the alternator power cable. A clamp-on current meter is required.



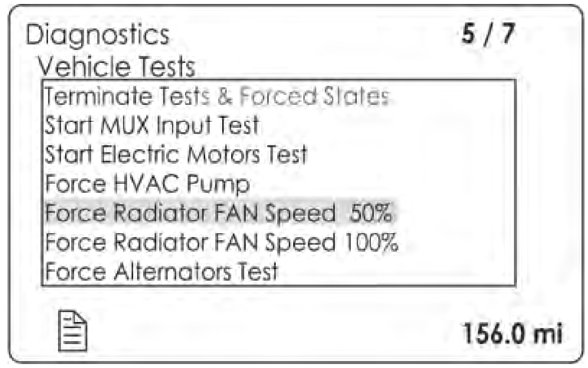
To initiate the test, use the Driver Information Display (DID) DIAGNOSTICS menu. Select VEHICLE TESTS submenu and then FORCE ALTERNATORS TEST. Press ENTER button to start the test. This feature will activate one alternator at a time during 5 seconds, cycling between alternator 1, 2 & 3.



To exit test, press ESCAPE button, select TERMINATE TESTS & FORCED STATES submenu and then press ENTER button twice.

4.4 FORCED ACTIVATION OF THE COOLING FANS

To allow the technicians to visually check if all the cooling fans are in working conditions or to prevent the engine from overheating in case of malfunction of the cooling fans activation system, it is possible to force activation of the CAC & radiator fans.



Prerequisite condition: The engine is running (fast idle if at stand still).

1. On the Driver Information Display, select DIAGNOSTICS menu. Select VEHICLE TESTS submenu and then FORCE RADIATOR FAN SPEED 50% or FORCE RADIATOR FAN SPEED100% 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 TERMINATE TESTS & FORCED STATES submenu and then press ENTER button twice. TEST will disappear from the DID status line.

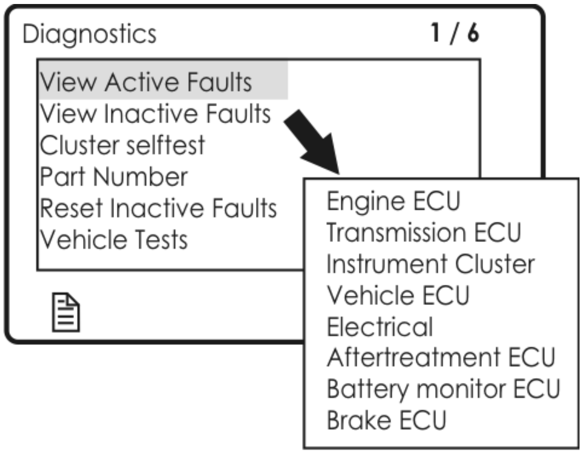
⚠ WARNING
Keep hands away from the cooling fans as they may start running at any moment.

4.4.1 Cooling Fans Cleaning Mode Validation

In order to make sure the cleaning mode is working, the following steps should be taken:

1. From the instrument panel DID, look for any fault codes related to cooling fans in the ELECTRICAL section.

Select: Diagnostics > View Active Faults > Electrical



2. From the dash cluster DID, look at the cooling fans status under the fans status gauge. While in cleaning mode, the status will show CLEANING.

Fan run in reverse mode once per drive cycle when the vehicle reaches for the first time a speed between 31 mph and 43 mph. Note that no cooling request should be present in order for the cleaning mode to start. The sequence will last 10 seconds at full speed.

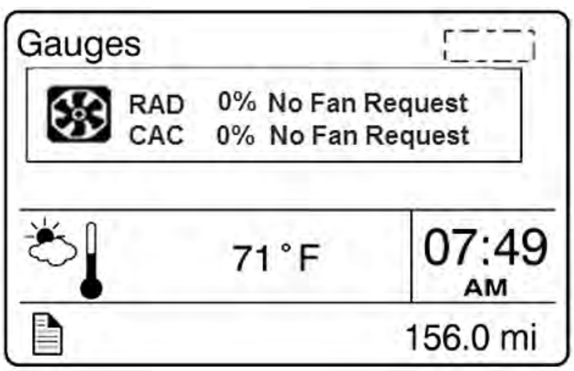


FIGURE 11: DURING THE NORMAL OPERATION OF THE VEHICLE, DISPLAYS THE SPEED AND THE STATE OF BOTH CHARGE AIR COOLER AND RADIATOR COOLING FANS, EXPRESSED IN PERCENTAGE FROM 0 TO 100%

5. LIMP-HOME MODES

5.1 DRIVER INFORMATION DISPLAY LIMP-HOME MODE

In case of malfunction of unavailability of the steering wheel UP, DOWN, ENTER & ESCAPE buttons, it is still possible to scroll through the DID menus using the multi-function lever.

To activate the DID limp-home mode, press and hold the courtesy blinkers button for 3 seconds.

The limp-home mode will cancel if no switch is pressed before a 1 minute delay after activation.

Limp-home mode action	
Activate RH flasher	UP
Activate LH flasher	DOWN
Activate headlamps call switch	ENTER
Press courtesy blinkers button	ESCAPE

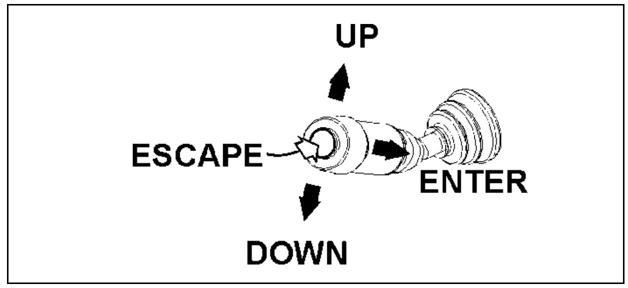


FIGURE 12: MULTIFUNCTION LEVER

5.2 LOWER PRIORITY I/O-EA & I/O-EB MODULES FOR BREAKDOWN SERVICE

Modules AE42 (I/O-EA) and AE43 (I/O-EB) affect lower priority functions. These modules can therefore be used as spare parts for breakdown service while on the road.

Functions lost if AE42 is removed and used as spare part:

- Kneeling system,

Functions lost if AE43 is removed and used as spare part:

- Cruise control & ACB,
- Baggage compartment door luck,
- Door ajar,
- Tire Pressure Monitoring System,

5.3 ESSENTIAL FUNCTIONS TO OPERATE THE VEHICLE

Even with a defective MCM (Chassis Control Module) or a DL0 (BBUS MUX) 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 DL0 (BBUS MUX) 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.

5.3.1 Available Functions

- Startup: Turn on the ignition in the driver's area and rear start the vehicle from the engine compartment,
- Headlamps: Low beams only,
- Stoplights: 2 upper stoplights + high-mounted stoplight are functional,
- HVAC: Defroster fixed at medium speed.

6. NETWORKS

Networks identification

NETWORKS	
J1939	- DL0 (Bbus Mux) - DL1 (drivetrain control network) - DL3 (Dbus Mux) - DL7 (engine subnet) - DL9 (engine transmission/I-Shift subnet)
J2284	- DL2
J1587	- DL4 (powertrain subnet 900/901)

6.1 DL0 (BBUS MUX) NETWORK

The DL0 (BBUS MUX) network wiring is separated in sections and uses the following connectors that are not shared with other circuits: C1, C3, C5, C13, C100. These connectors allow sections of the network to be isolated to help locate short-circuit on the DL0 (BBUS MUX).

In case of a short-circuit on the DL0 (BBUS MUX) network, this affects all the modules and they all act as “No response” in the error messages of the VIEW ACTIVE FAULTS/ELECTRICAL menu. To locate a short-circuit, proceed by disconnecting one module zone at a time while verifying if this makes inactive the errors in the modules still connected. Connector C1 (front electrical & service compartment) disconnects all the modules at the rear of the vehicle from the network. Connector C5 (front electrical & service compartment) disconnects all the modules from the entrance door & wiper control panel. Connector C3 (rear electrical panel) disconnects all the modules at the rear of the vehicle from the network.

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

6.2 DL0 (BBUS MUX) CONNECTION ON THE TELLTALE PANEL AND THE HVAC CONTROL UNIT

The telltale panel module and HVAC module are linked to the MCM by a DL0 (BBUS MUX) connection. In case of a connection default, the telltale panel LCD display shows "CAN", and on the HVAC control unit, the temperature display indicates "---". To confirm a connection default, check that the fan speed on the driver's section HVAC control unit cannot be adjusted.

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

NOTE

While downloading a new vehicle program in the MCM from a computer, the DL0 (BBUS MUX) network is temporarily interrupted and therefore a DL0 (BBUS MUX) reference appears in the telltale panel LCD display.

6.3 SPARE DL0 (BBUS MUX)

A spare DL0 (BBUS MUX) 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 DL0 (BBUS MUX) network to the spare DL0 (BBUS MUX) network. Refer to the vehicle wiring diagram and section 4.6 for more information.

7. TROUBLESHOOTING

7.1 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.

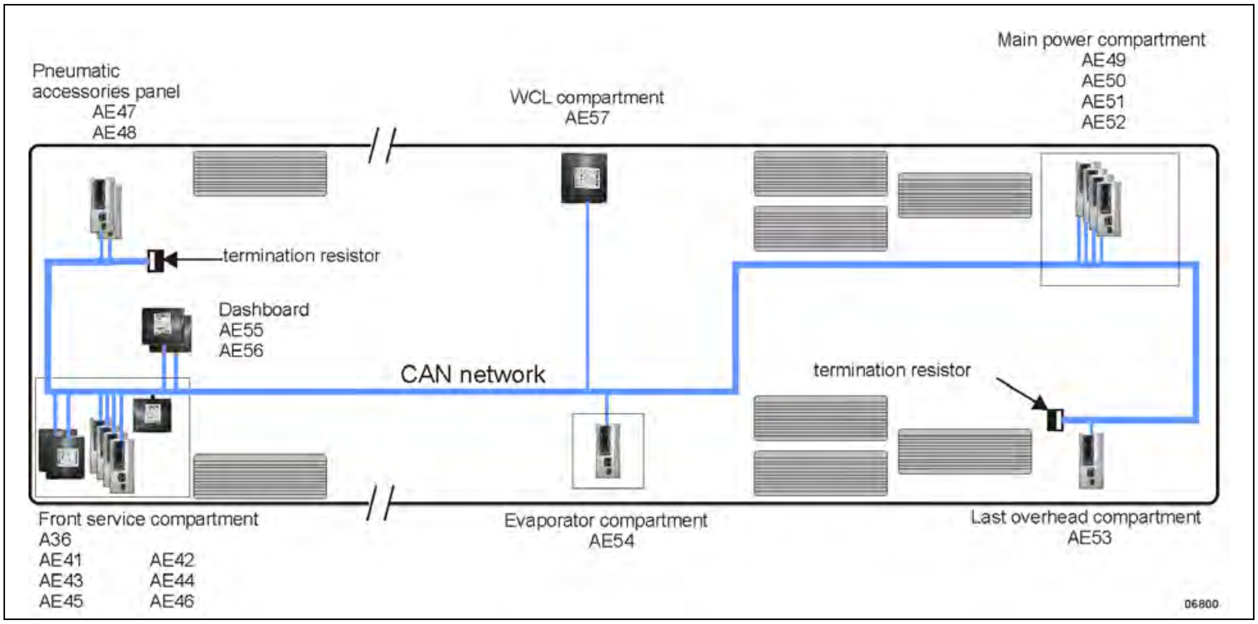
Inactive Multiplex output = Residual voltage of 18% to 33% of supply voltage.

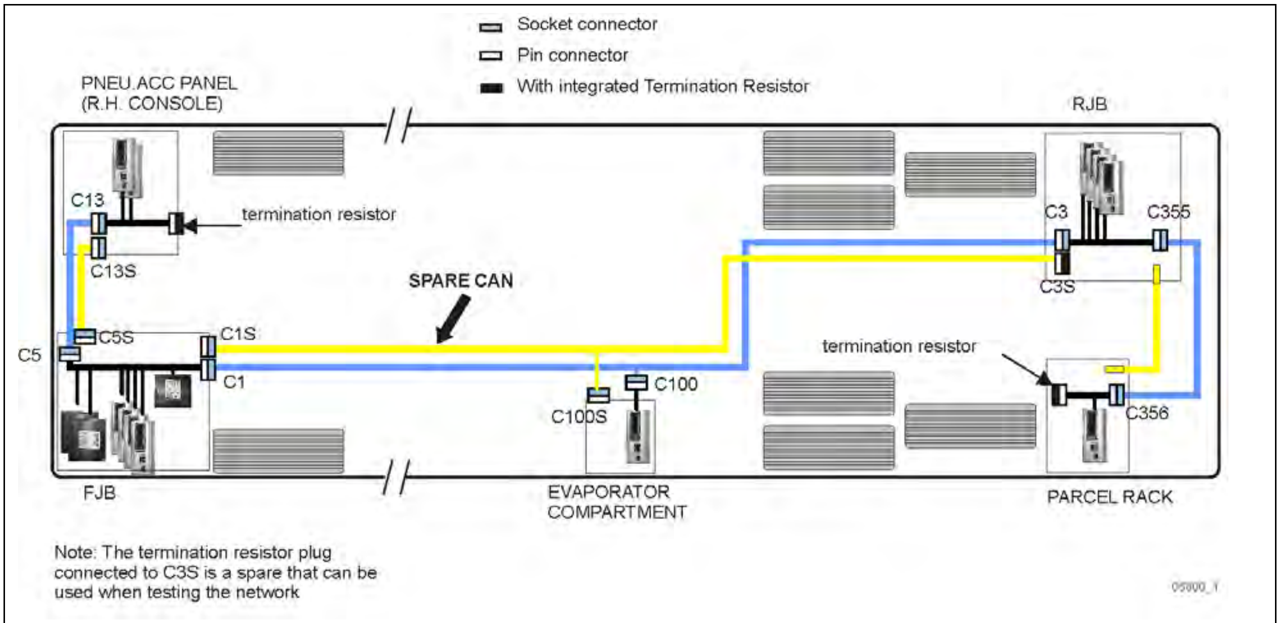
Inactive Multiplex input = Residual voltage of 50% of supply voltage.

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

7.2 DL0 (BBUS MUX) NETWORK LAYOUT AND TROUBLESHOOTING

MUX MODULE IDENTIFICATION	MODULE TYPE	LOCATION
A36	MCM	FJB
AE41	I/O-EA	FJB
AE42	I/O-EA	FJB
AE43	I/O-EB	FJB
AE44	I/O-EB	FJB
AE45	I/O-EB	FJB
AE46	I/O-EB	FJB
AE47	I/O-EB	R.H. CONSOLE
AE48	I/O-EB	R.H. CONSOLE
AE49	I/O-EB	MAIN POWER COMPARTMENT
AE50	I/O-EB	MAIN POWER COMPARTMENT
AE51	I/O-EB	MAIN POWER COMPARTMENT
AE52	I/O-EB	MAIN POWER COMPARTMENT
AE53	I/O-EB	LAST OVERHEAD COMPARTMENT, L.H. SIDE
AE54	I/O-EB	EVAPORATOR CMPT
AE55	I/O-EA	DASHBOARD
AE56	I/O-EA	DASHBOARD
AE57	I/O-EA	WCL CMPT, ABOVE WHEELCHAIR LIFT

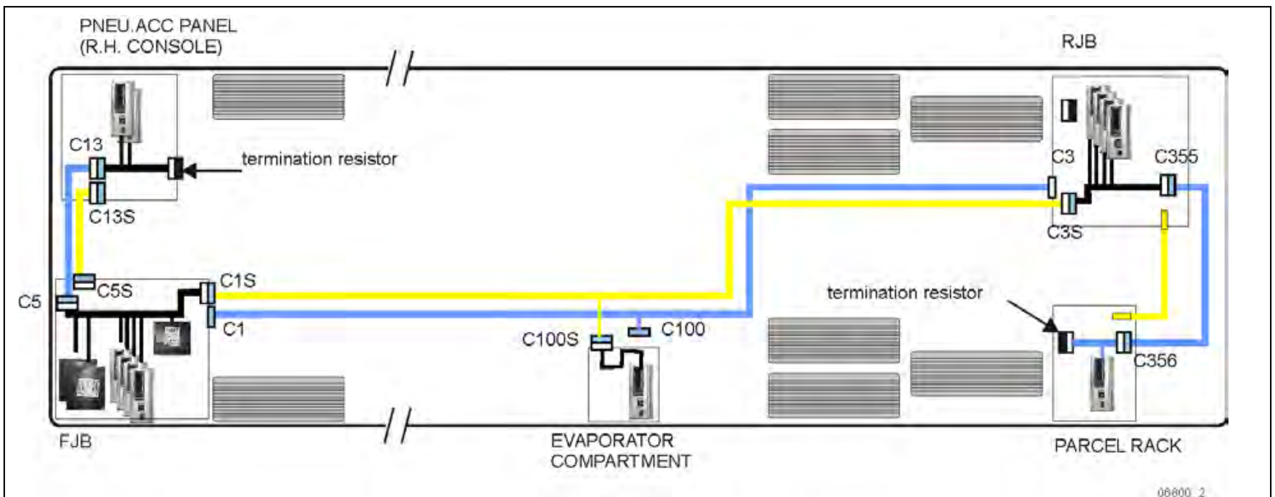




If all 17 modules (AE41 to AE57) are showed as Not Responding and Active Fault, the problem could be:

- A short circuit somewhere on the DL0H, DL0L (BBUS MUX) 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.



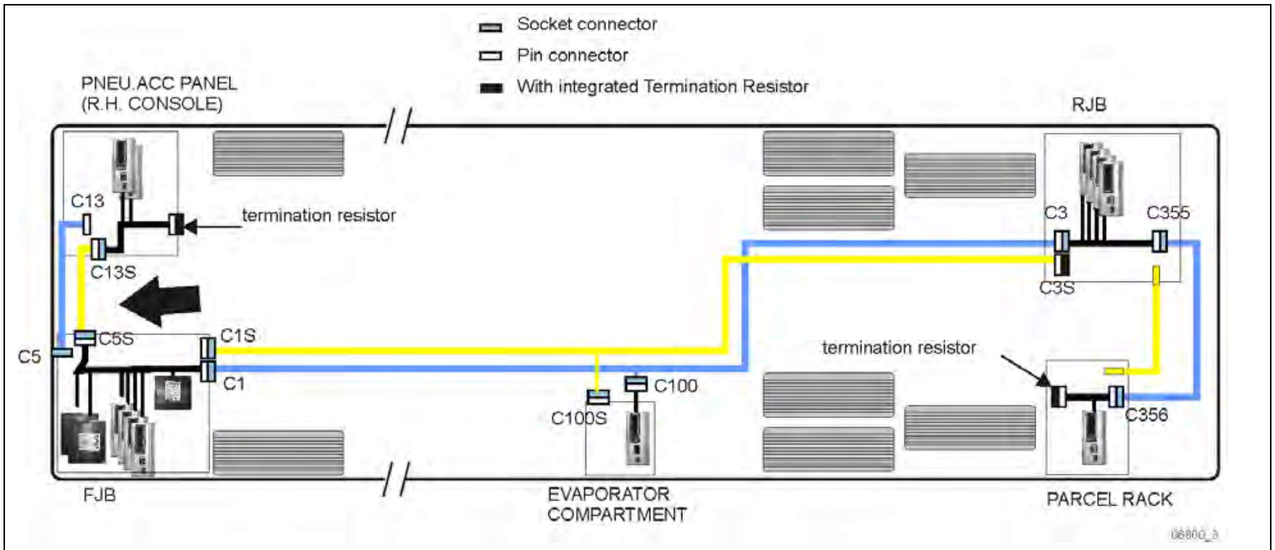
Use the spare "FRONT ELECTRICAL COMPARTMENT to MAIN POWER COMPARTMENT" CAN

FRONT ELECTRICAL COMPARTMENT: disconnect C1 and connect C1 pin housing to C1S socket housing.

RJB: disconnect C3 and connect C3 socket housing to C3S pin housing.

5th baggage compartment: disconnect C100 and connect C100 pin housing to C100S socket housing.

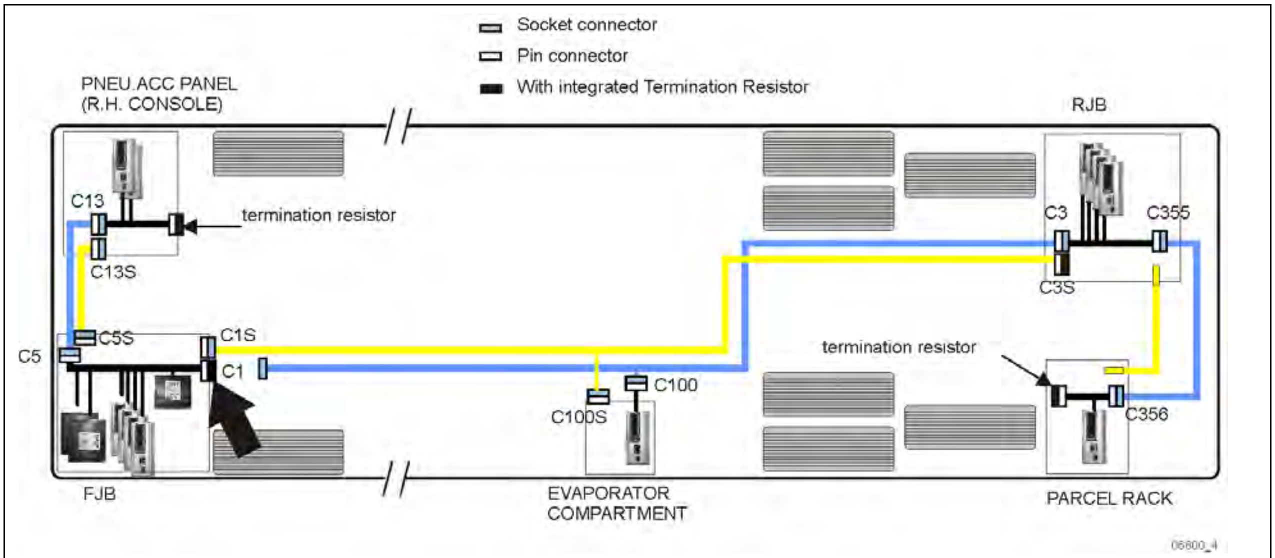
NOTE
All modules including Wake-up modules and MCM have to be powered OFF prior to probe the DL0 (BBUS MUX) lines with an ohmmeter. Probing the resistance between the DL0H and DL0L wire is a useful method to localize short circuits or open circuit on the DL0 (BBUS MUX) network. However, when doing so, make sure none of the modules connected to the DL0 (BBUS MUX) 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 DL0 (BBUS MUX) lines and this is fooling the ohmmeter. Proceed as follow when probing the DL0 (BBUS MUX) line with an ohmmeter in order to get a valid reading: • Turn ignition key to the OFF position. • Set the main electrical shut-off switch to the OFF position to turn all Wake-up modules power to OFF. Trip circuit breakers CB2 and CB6 to remove direct battery power from the MCM.



Use the spare "FRONT ELECTRICAL COMPARTMENT to pneumatic accessories panel" CAN

Pneumatic accessories panel: disconnect C13 and connect C13S pin housing to C13 socket.

FRONT ELECTRICAL COMPARTMENT: Disconnect C5 and connect C5S socket housing to C5 pin housing.

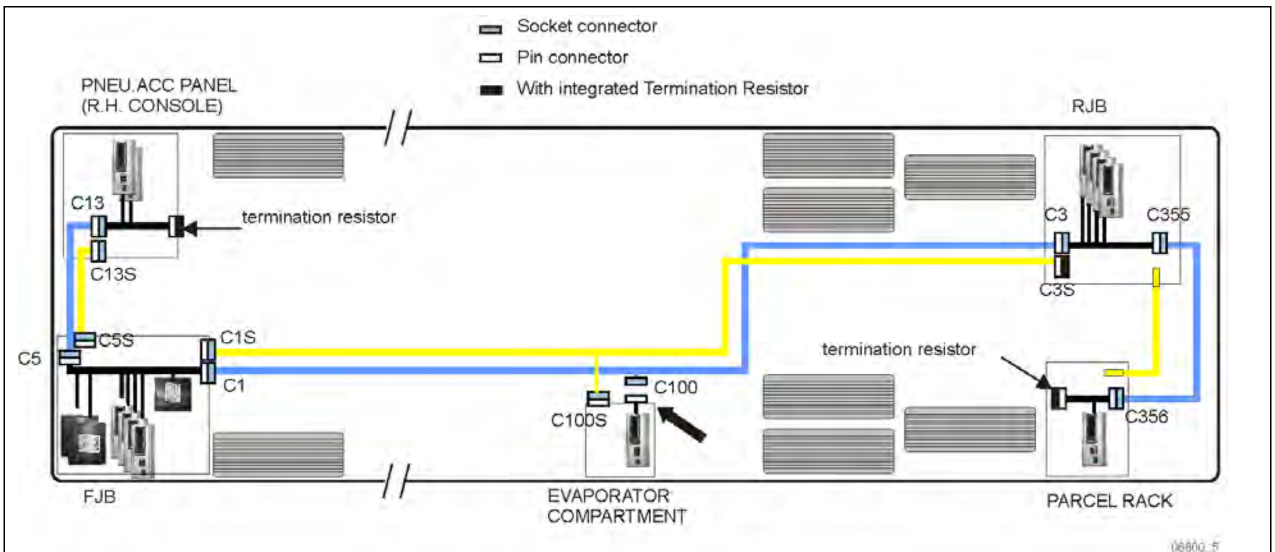


Isolate the front from the rear

Take one of the termination resistors in the MAIN POWER COMPARTMENT.

Disconnect C1 and connect the termination resistor to C1 pin housing.

If all the front modules respond normally, the short circuit is in the rear portion.

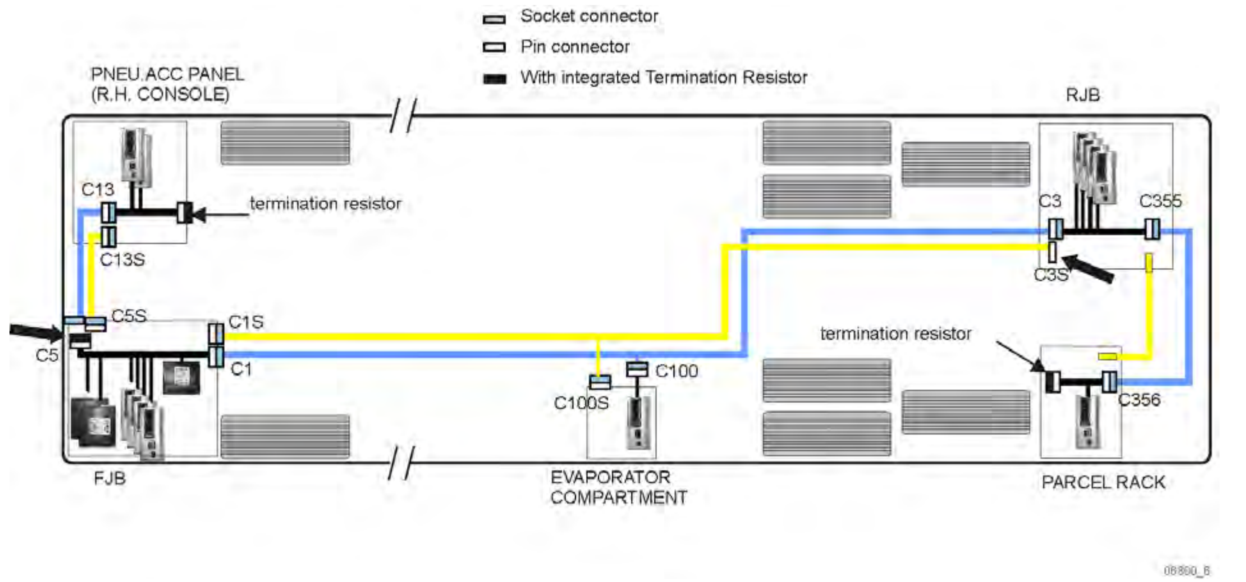


Isolate the evaporator module from the network

Disconnect C100.

No need to connect a termination resistor there since C100 is a stub connection.

If the short circuit problem is in the evaporator panel, all modules except AE54 will respond normally.

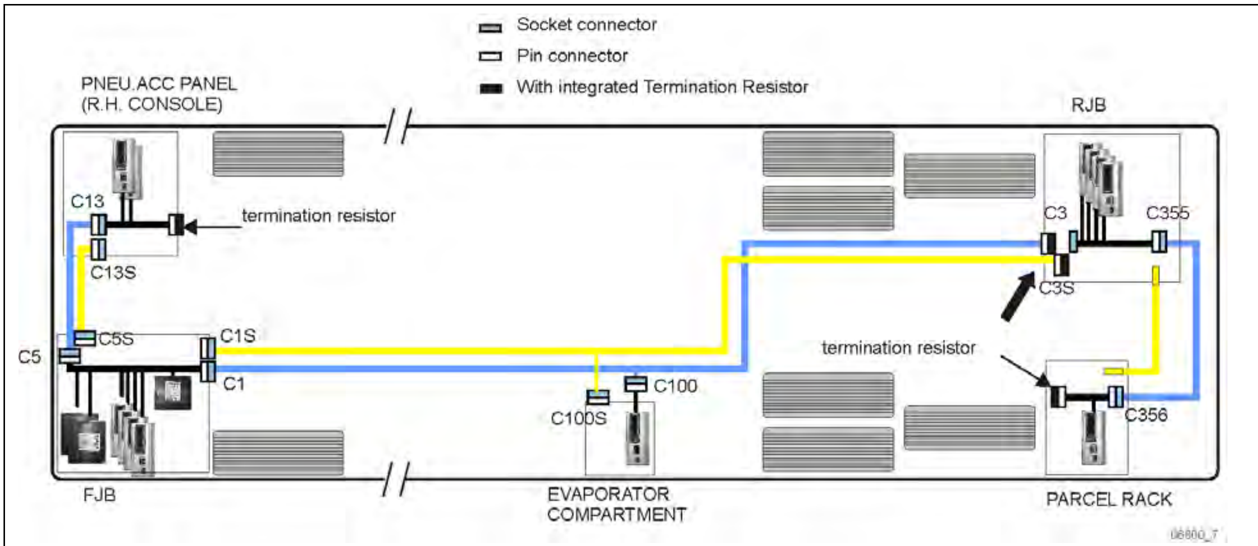


Isolate the pneumatic accessories panel modules from the network

In the FRONT ELECTRICAL COMPARTMENT, disconnect C5.

Take the spare termination resistor on C3S in the MAIN POWER COMPARTMENT and connect it to C5 pin housing.

If the short circuit problem is in the pneumatic accessories panel all modules except AE47 and AE48 located into the pneumatic accessories panel will respond normally.



Isolate the MAIN POWER COMPARTMENT from the network

Disconnect C3 Plug and connect the termination resistor into C3 pin housing.

If the short circuit problem is in the MAIN POWER COMPARTMENT or downstream, all front modules + the evaporator module will respond normally.

The same process can be for the overhead compartment module.

DL0 (BBUS MUX) 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 DL0 (BBUS MUX) harnesses instead of trying to repair them.

7.3 MULTIPLEX TROUBLESHOOTING TABLE

Problem/Symptom	Probable Causes	Actions
Vehicle does not Start	The Engine Stop pushbutton located on the rear start panel is depressed Main electrical shut-off switch is in the OFF position	1. Twist and pull the Engine Stop pushbutton to place it in normal operating position, check that the main electrical shut-off switch is in the ON position and retry cranking from the ignition switch 2. Start the vehicle from the engine compartment using the rear start button
	DL0 (BBUS MUX) network problem (Multiplex) Module AE52 not powered or is defective Engine ECM does not receive the ignition signal Engine ECM is not powered	If the vehicle does not start from the rear: 1. Verify that module AE52 is powered: a) Check the DIAGNOSTICS menu of Driver Information Display (DID). Select VIEW ACTIVE FAULTS and ELECTRICAL. The message "No Response ModA52, Active", indicates a power problem on the module or a DL0 (BBUS MUX) network problem. b) Check / reset circuit breaker CB5 c) Check / reset CB134V d) Probe gray connector on module to see if it is powered. 2. Verify that the engine ECM is powered and gets the ignition signal a) Check / reset circuit breaker CB8 Check / reset CB91V b) Check / reset circuit breaker CB2 Check / reset CB99V

Problem/Symptom	Probable Causes	Actions
None of the Multiplexed functions are operating, including the basic limp-home functions (door opening, flashers, wipers in speed 1) “FLIP REAR BREAKER TO INITIATE I/O MODULES PROGRAMMING” pop-up message appears in the DID *Note: The sunshades are still functioning since these are not multiplexed*	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	1. Engage the auto-programming of the I/O modules: Turn the ignition key to the ON position, trip and reset circuit breaker CB6. 2. The DID indicates "MUX AUTOPROGRAMMING I/O MODULE PLEASE WAIT" until the reprogramming is complete.
Many secondary functions (not essential for driving) not functioning (interior lighting, driver's area lighting, wiper speed 2 and intermittent). Marker lights and clearance lights are turned ON when setting ignition to the ON position.	The MCM module does not receive 24 V power. The DL0 (BBUS MUX) 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.	1. Check / reset circuit breaker CB6. Check / replace fuse F1 2. Operate in limp-home mode by starting the vehicle from the engine compartment (REAR START). All functions essential to drive are available To close and lock the door, pull the door manually up to its closed position and it will lock by itself. The door opening button is still functioning
No temperature control in the passenger area Passenger temperature display indicates two dashes "--"	Problem with the temperature sensor located in the evaporator compartment air intake or the sensor wiring	Instruct the driver to manually control the temperature by playing with the passenger set point. Set above 22°C (72°F) to heat and below 22° C (72°F) to cool

Problem/Symptom	Probable Causes	Actions
Entrance door does not open nor close using the control buttons Defroster fan not functioning Windshield wipers not functioning in speed 1 or intermittent	Module AE47 is not powered or is faulty	1. Check the DIAGNOSTICS menu of Driver Information Display (DID). Select VIEW ACTIVE FAULTS and ELECTRICAL. The message “No Response ModA47, Active” indicates a power problem on the module. (A DL0 (BBUS MUX) network problem would show the same message but doesn't produce these symptoms). 2. Check / reset circuit breaker CB1 3. Check / reset CB45V 4. Probe gray connector on module to see if it is powered. 5. Use the air release valves near the entrance door and in the front service compartment to lock / unlock the door
Windshield wipers not functioning in speed 1 or intermittent	No power on R27	Check CB48 (VECF)
HVAC condenser fans not oprerating	Module AE54 is not powered or is faulty	Check / reset circuit breaker CB135V
Windshield washer not functioning Windshield upper section de-icing system not functioning	Module AE44 is not powered or is faulty	1. Check the DIAGNOSTICS menu of Driver Information Display (DID). Select VIEW ACTIVE FAULTS and ELECTRICAL. The message “No Response ModA44, Active” indicates a power problem on the module. (A DL0 (BBUS MUX) network problem would show the same message but doesn't produce these symptoms). 2. Check / reset circuit breaker CB1 3. Check / reset CB44V 4. Probe gray connector on module to see if it is powered.

Problem/Symptom	Probable Causes	Actions
Defroster fan is functioning but no heat or cooling available in the driver area.	Module AE47 is not powered or is faulty	1. Check the DIAGNOSTICS menu of Driver Information Display (DID). Select VIEW ACTIVE FAULTS and ELECTRICAL. The message “No Response ModA47, Active” indicates a power problem on the module. (A DL0 (BBUS MUX) network problem would show the same message but doesn't produce these symptoms). 2. Check / reset circuit breaker CB1 3. Check / reset CB45V 4. Probe gray connector on module to see if it is powered.
Low beam headlamps and front flasher on left side not functioning Electric horn not functioning	Module AE46 is not powered or is faulty	1. Check the DIAGNOSTICS menu of Driver Information Display (DID). Select VIEW ACTIVE FAULTS and ELECTRICAL. The message “No Response ModA46, Active” indicates a power problem on the module. (A DL0 (BBUS MUX) network problem would show the same message but doesn't produce these symptoms). 2. Check / reset circuit breaker CB10 3. Check / reset CB19V 4. Probe gray connector on module to see if it is powered.
Low beam headlamps and flasher on right side not functioning	Module AE48 is not powered or is faulty	1. Check the DIAGNOSTICS menu of Driver Information Display (DID). Select VIEW ACTIVE FAULTS and ELECTRICAL. The message “No Response ModA48, Active” indicates a power problem on the module. (A DL0 (BBUS MUX) network problem would show the same message but doesn't produce these symptoms). 2. Check / reset circuit breaker CB10 3. Check / reset CB21V 4. Probe gray connector on module to see if it is powered.

Problem/Symptom	Probable Causes	Actions
Rear flashers not functioning Stoplights and center stoplights not functioning	Module AE51 is not powered or is faulty	1. Check the DIAGNOSTICS menu of Driver Information Display (DID). Select VIEW ACTIVE FAULTS and ELECTRICAL. The message “No Response ModA51, Active” indicates a power problem on the module. (A DL0 (BBUS MUX) network problem would show the same message but doesn't produce this symptom). 2. Check / reset circuit breaker CB8 3. Check / reset CB107V 4. Probe gray connector on module to see if it is powered.
Engine is overheating and radiator fans do not engage	Module AE52 or AE49 is not powered or is faulty	1. Check the DIAGNOSTICS menu of Driver Information Display (DID). Select VIEW ACTIVE FAULTS and ELECTRICAL. The message “No Response ModA52/ ModA49, Active” indicates a power problem on the module. (A DL0 (BBUS MUX) network problem would show the same message but doesn't produce this symptom). 2. Check circuit breaker CB5 3. Check / reset CB133V, CB134V 4. CB201-CB208
The A/C compressor clutch does not engage	Module AE54 (or AE52) is not powered or is faulty	5. Check the DIAGNOSTICS menu of Driver Information Display (DID). Select VIEW ACTIVE FAULTS and ELECTRICAL. The message “No Response ModA54, Active” indicates a power problem on the module. (A DL0 (BBUS MUX) network problem would show the same message but doesn't produce this symptom). 6. Check / reset circuit breaker CB5 7. Check / reset CB135V 8. Probe gray connector on module to see if it is powered.

Problem/Symptom	Probable Causes	Actions
Evaporator fan not functioning	Circuit breaker CB3 tripped Module AE54 is not powered or is faulty	1. Check circuit breaker CB3 2. Check relay R12 3. Check the DIAGNOSTICS menu of Driver Information Display (DID). Select VIEW ACTIVE FAULTS and ELECTRICAL. The message “No Response ModA54, Active” indicates a power problem on the module. (A DL0 (BBUS MUX) network problem would show the same message but doesn't produce this symptom). 4. Check / reset circuit breaker CB5 5. Check / reset CB135V 6. Probe gray connector on module to see if it is powered.
HVAC condenser fans not functioning in speed 1	Module AE54 is not powered or is faulty	1. Check the DIAGNOSTICS menu of Driver Information Display (DID). Select VIEW ACTIVE FAULTS and ELECTRICAL. The message “No Response ModA54, Active” indicates a power problem on the module. (A DL0 (BBUS MUX) network problem would show the same message but doesn't produce this symptom). 2. Check / reset circuit breaker CB5 3. Check / reset CB135V 4. Check /reset CB141V-CB144V 5. Probe gray connector on module to see if it is powered.
Parcel rack equipment not functioning	Circuit breaker CB11 CB13 tripped	1. Check CB11, CB13 2. Check / reset CB148V
Fire alarm telltale light and audible alarm always ON and there is no fire or high temperature in the engine compartment	Short-circuited fire sensor or defective sensor	Prior to start the vehicle, cycle the ignition key to the ON position, OFF position and then ON position again and then start the vehicle. This will deactivate the fire alarm function. This has to be repeated each time the vehicle is re-started
The vehicle is parked and the electrical horn is acti-vated to indicate a fire in the engine compartment but there is no fire	Short-circuited fire sensor or defective sensor	Cycle the ignition key between the ON and OFF position twice within 3 seconds. This will deactivate the fire alarm function. This has to be repeated each time the vehicle is parked

Problem/Symptom	Probable Causes	Actions
A single light, a group of LED lights or another function of the vehicle is not functioning	The multiplex outputs are protected in current by an internal “soft-fuse”. When an output is shorted, it turns OFF and stays OFF until the "soft-fuse" is reset	Turn the ignition key to the OFF position and turn to the ON position again. This resets all "soft –fuses"
No backlighting in the instrument cluster	Circuit breaker CB6 is tripped or CB128V, CB37V tripped	Check circuit breaker CB6 Check / reset CB128V, CB37V Check / replace relay R22, R23
The radiator/CAC fans do not function and the engine is overheating		You can manually engage the radiator/CAC fans half speed (50%) or full speed (100%). 1. On the Driver Information Display, select DIAGNOSTICS menu. Select VEHICLE TESTS submenu and then ACTIVATE RADIATOR FAN SPEED 50% or ACTIVATE RADIATOR FAN SPEED 100%. 2. The DID status line will show TEST to confirm the forced activation of the radiator fans. To cancel, turn the ignition switch to the OFF position or press ESCAPE button, select TERMINATE TESTS & FORCED STATES submenu and then press ENTER button twice. TEST will disappear from the DID status line.

7.4 ELECTRICAL SYSTEM DIAGNOSTIC THROUGH THE DID

Using the Driver's Info Display (DID), check if there are active errors in the vehicle electrical system. With the DIAGNOSTICS menu, highlight VIEW ACTIVE FAULTS and then highlight ELECTRICAL to request a diagnostic of the electrical system from the MCM. 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 VIEW ACTIVE FAULTS menu, wait approximately 20 to 30 seconds and then return to VIEW ACTIVE FAULTS to request a new diagnostic of the electrical system from the MCM. 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 DL0 (BBUS MUX) 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 J3 connector. If it is, then you can conclude that there is a DL0 (BBUS MUX) link problem. Refer to DL0 (BBUS MUX) NETWORK LAYOUT AND TROUBLESHOOTING in this section.

8. ELECTRICAL COMPARTMENTS

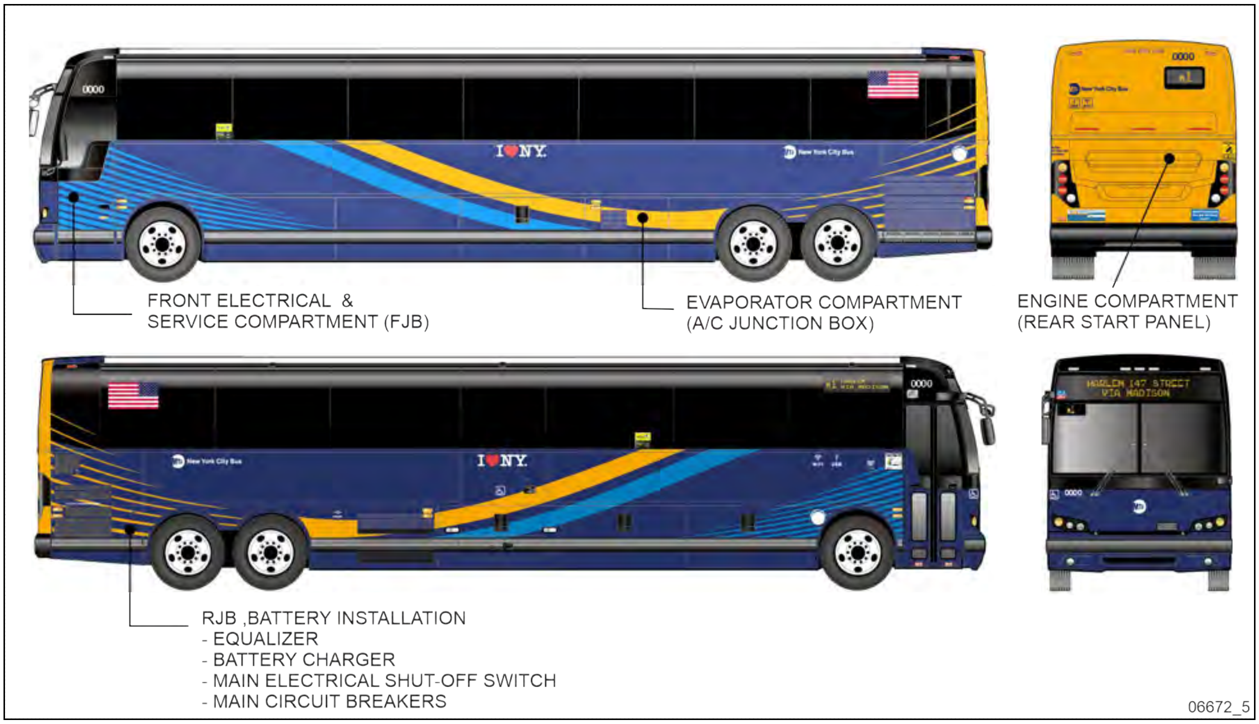


FIGURE 13: ELECTRICAL COMPARTMENTS

8.1 MAIN POWER COMPARTMENT (RJB)

The main power compartment (a.k.a. rear junction box) and battery installation (Figure 14) are accessible from the engine compartment curb-side door.

The batteries are housed and secured on the engine R.H side deck. The battery posts and connections are protected by a watertight cover. The cover is fitted with a built-in vent. The cover can be unlocked and then removed with the use of the same type of hardware that allows opening and closing of the rear fender. Refer to paragraph *9.5 Battery Removal and Installation* for the battery removal procedure.

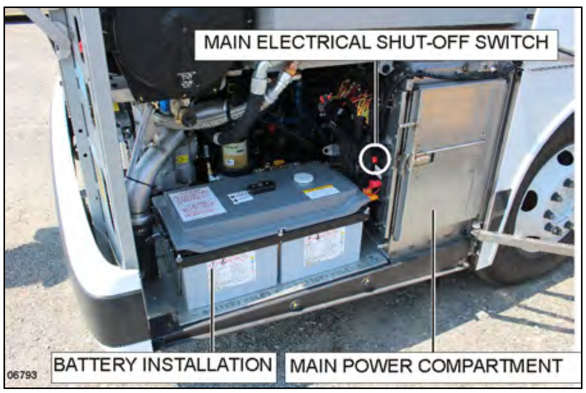


FIGURE 14: ENGINE R.H. SIDE COMPARTMENT

The main power compartment panel provides access to the following:

- Rear 12VD, 24VD junction blocks;
- Main circuit breakers;
- AE49, AE50, AE51, AE52 I/O-EB Multiplex modules;
- Vehicle Electrical Center Rear (VECR);
- Master relay R1;
- 12V ignition relay R3;
- Starter relay;
- Relays and fuses;
- Battery equalizer;
- 12VD & 24 VD current sensors;

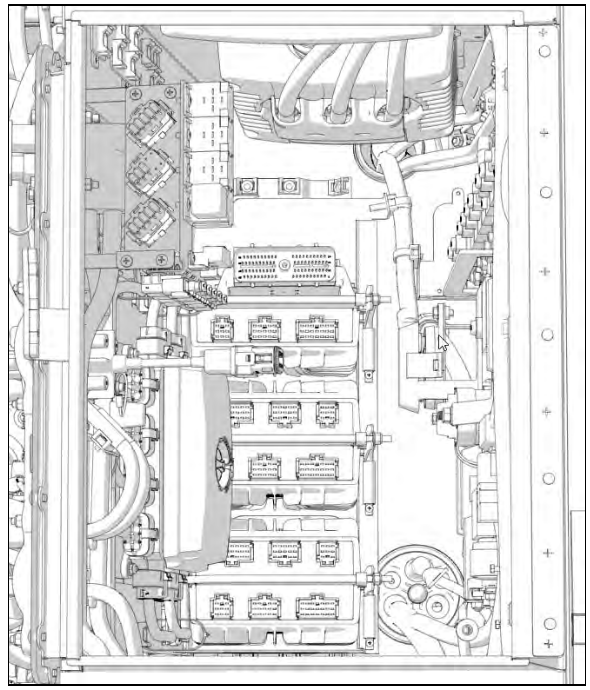


FIGURE 15: MAIN POWER COMPARTMENT

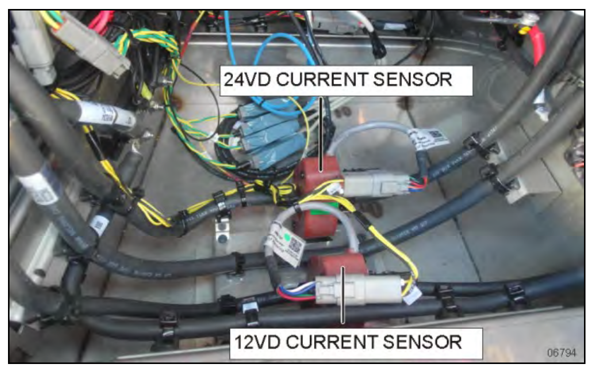


FIGURE 16: 12VD / 24VD CURRENT SENSORS IN MPC

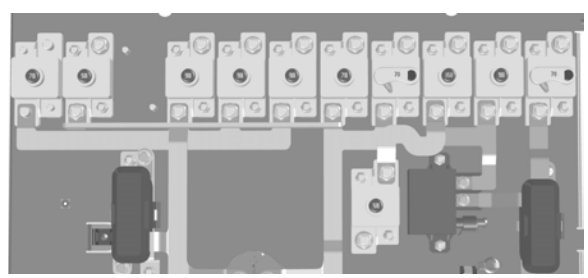


FIGURE 17: MAIN CIRCUIT BREAKERS IN MPC

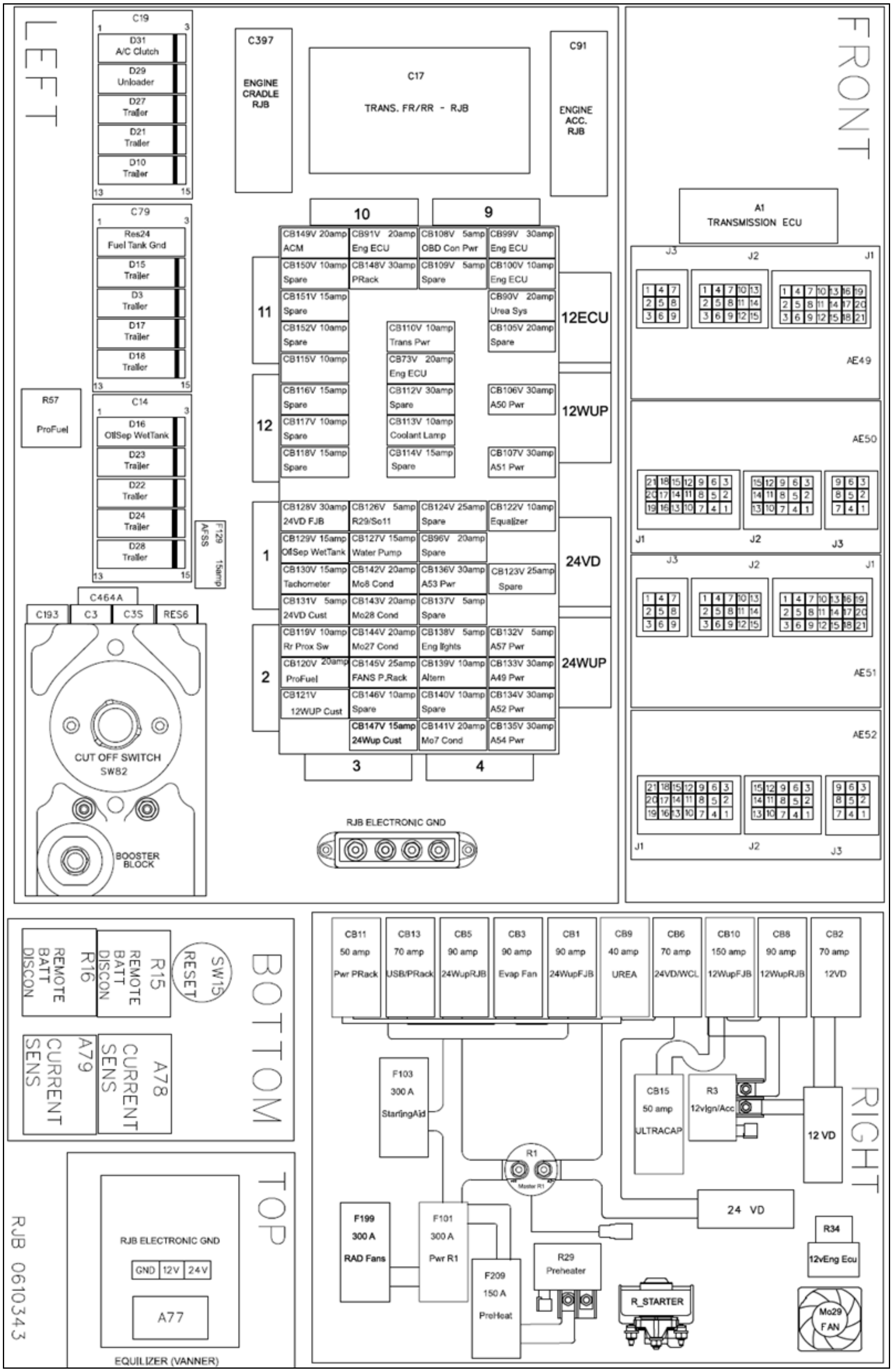


FIGURE 18: MAIN POWER COMPARTMENT COMPONENTS IDENTIFICATION

8.2 FRONT ELECTRICAL AND SERVICE COMPARTMENT (FJB)

The front electrical and service compartment is located on L.H. side of vehicle, under the driver's window. It contains the following components (Figure 19):

- Front terminal block;
- Master Control Module (MCM);
- Vehicle Electrical Center Front (VECF) and Multiplex Modules;
- Relays and fuses;
- ABS Electronic Control Unit (ECU);
- VECU with Volvo D13 engine;
- Gateway module

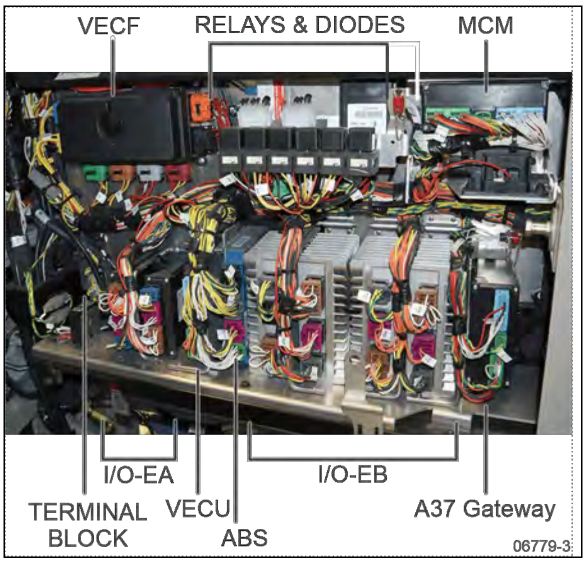


FIGURE 19: FRONT ELECTRICAL & SERVICE COMPARTMENT

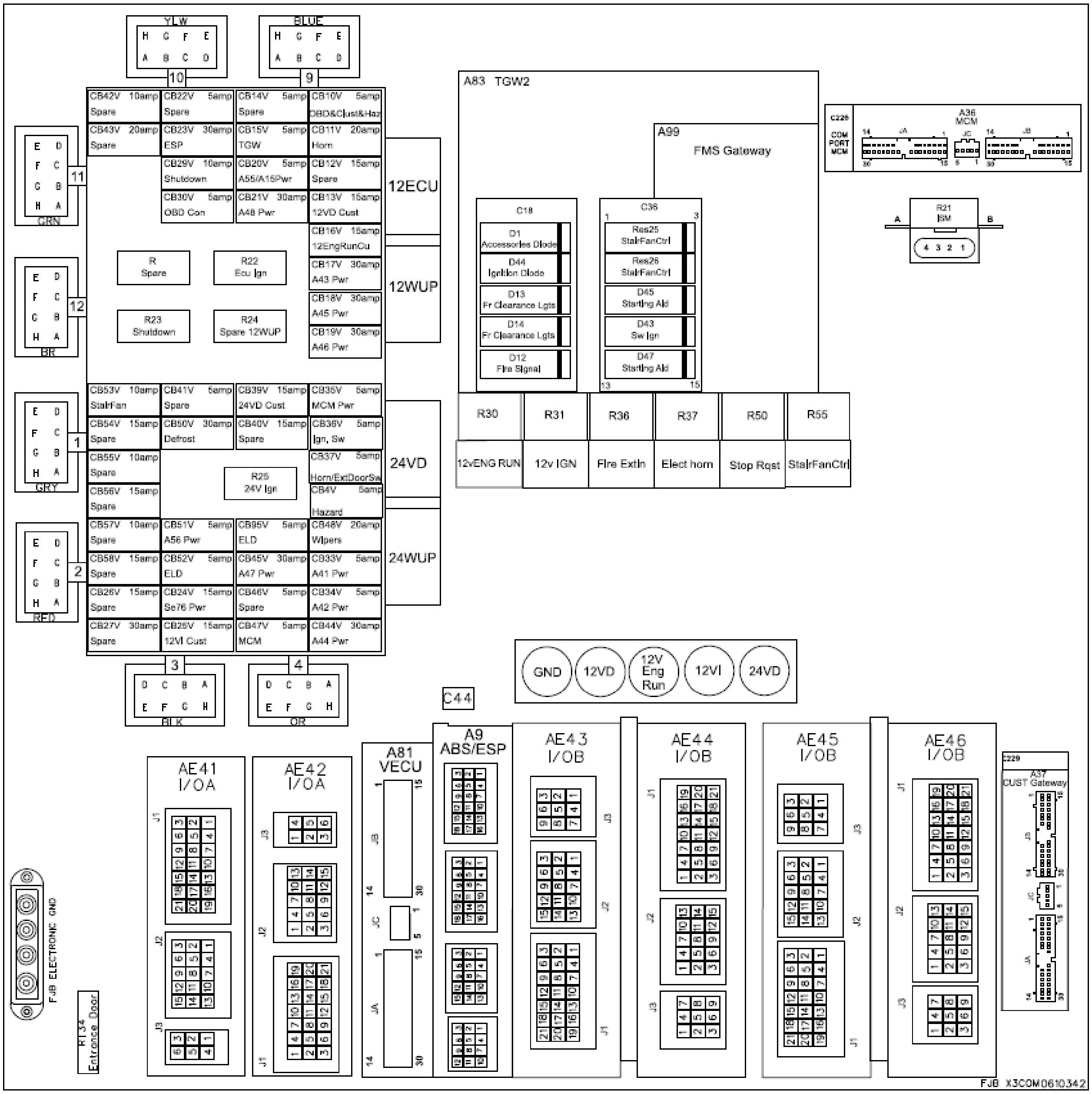


FIGURE 20: FRONT ELECTRICAL & SERVICE COMPARTMENT COMPONENTS IDENTIFICATION

8.3 A/C MODULE

The A/C module is located on the evaporator fan housing.

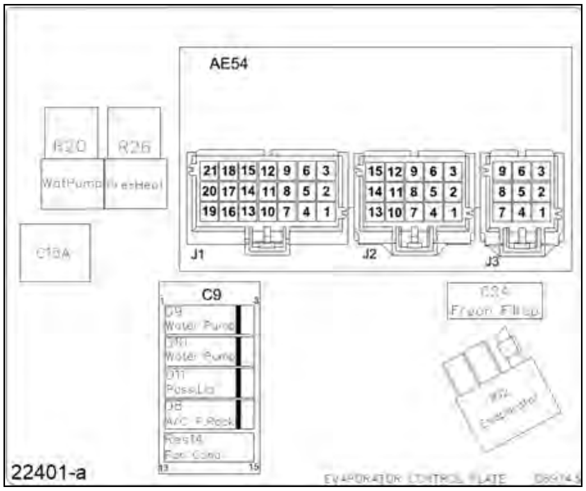


FIGURE 21: A/C MODULE

8.4 ENGINE REAR START PANEL

This control panel is located close to the back-up alarm in the engine compartment. This control panel includes the **engine rear start push button** and the **engine stop/ignition interlock** button. On some vehicles, a **tachometer** is also integrated in the start panel.

The **engine rear start push button** is used to start engine from engine compartment.

When servicing the engine, push the **engine stop/ignition interlock** button to prevent the engine from being started from the dashboard ignition switch or the rear start push button. Once servicing is done, twist and pull the button to allow normal engine start. Pressing the **engine stop/ignition interlock** button while the engine is running will stop the engine.

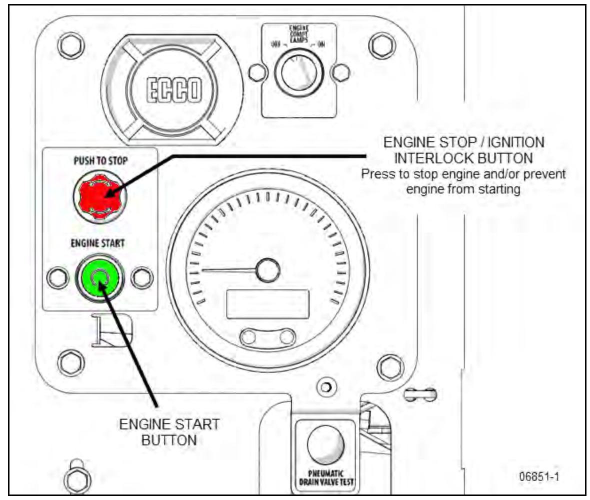


FIGURE 22: REAR START PANEL WITH TACHOMETER

8.5 ENTRANCE DOOR & WIPER CONTROL MODULES

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

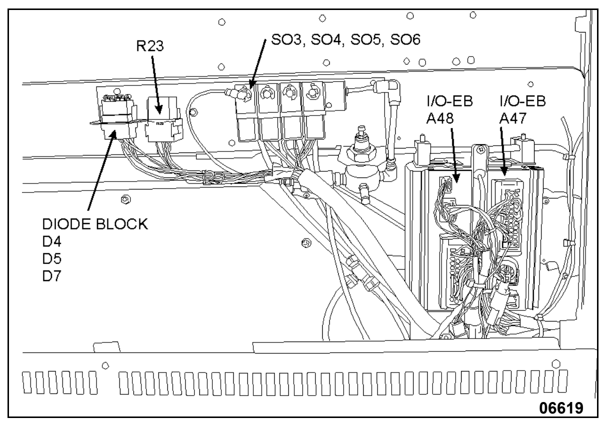


FIGURE 23: ENTRANCE DOOR & WIPER CONTROL PANEL

Entrance Door & Wiper Control Panel			
Multiplex Modules			
AE47	I/O-B	AE48	I/O-B
Relays			
R23	Windshield wipers		
Solenoids			
SO3	Door unlock solenoid valve	SO5	Door opening solenoid valve
SO4	Door unlock solenoid valve	SO6	Door closing solenoid valve
Diodes			
D4	Windshield wipers speed 2	D7	Entrance door
D5	Windshield wipers speed 1		

8.6 OVERHEAD COMPARTMENT MODULE

A single I/O B module, AE53 is found at the rear end of the left overhead compartment.

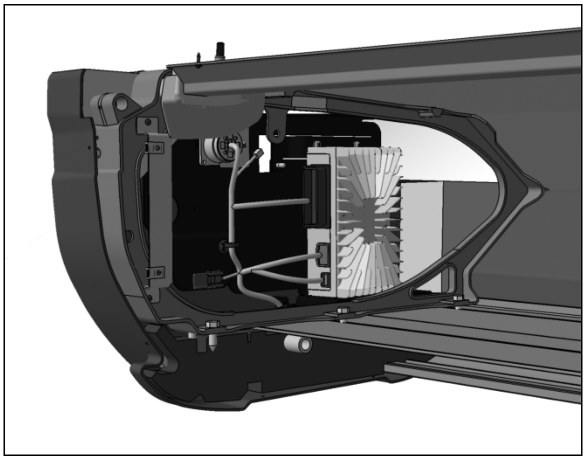


FIGURE 24: OVERHEAD COMPARTMENT I/O-EB MODULE AE53

8.7 NYCT AUXILIARY SYSTEMS IN PARCEL RACK

In the front road side overhead parcel racks, you will find the following components. (Figure 25, Figure 26)

Refer to pertaining supplier of the system and vehicle electrical schematics for information.

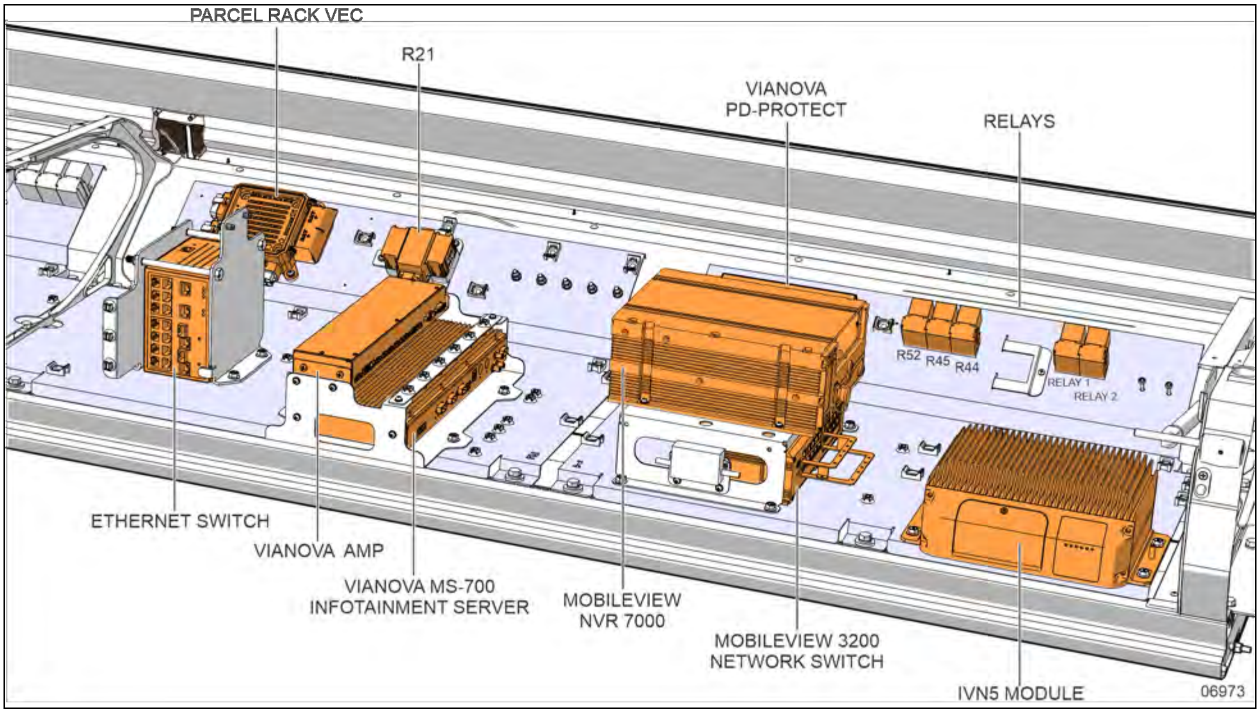


FIGURE 25 NYCT AUXILIARY SYSTEMS, PLATES 1 & 2

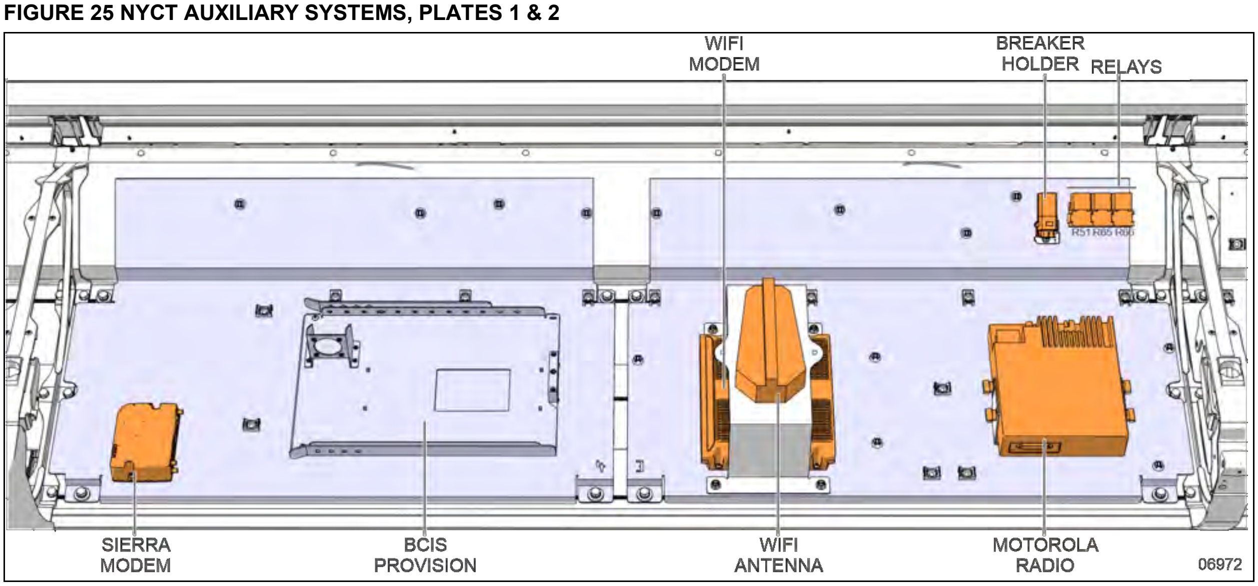


FIGURE 26: NYCT AUXILIARY SYSTEMS, PLATES 3 & 4

9. BATTERIES

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.

> **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.**

9.1 BATTERY INSTALLATION

The battery bank is composed of four AGM batteries. To prevent improper installation of the batteries, the positive (+) and negative (-) signs are laser cut on the battery deck steel sheet. When installing new batteries, place the battery negative and positive poles according to the signs on the battery deck (Figure 27).

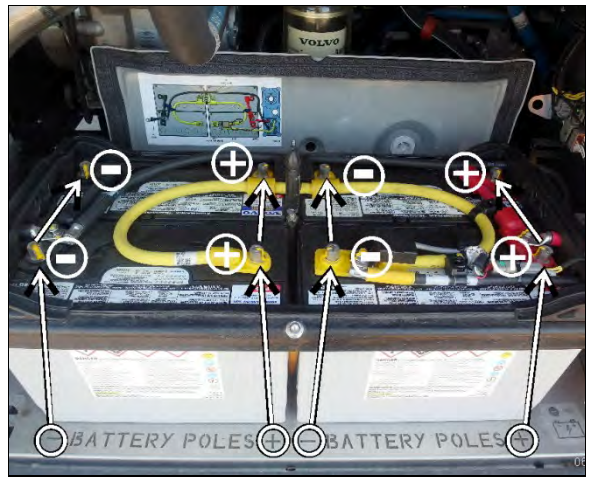


FIGURE 27: BATTERY INSTALLATION

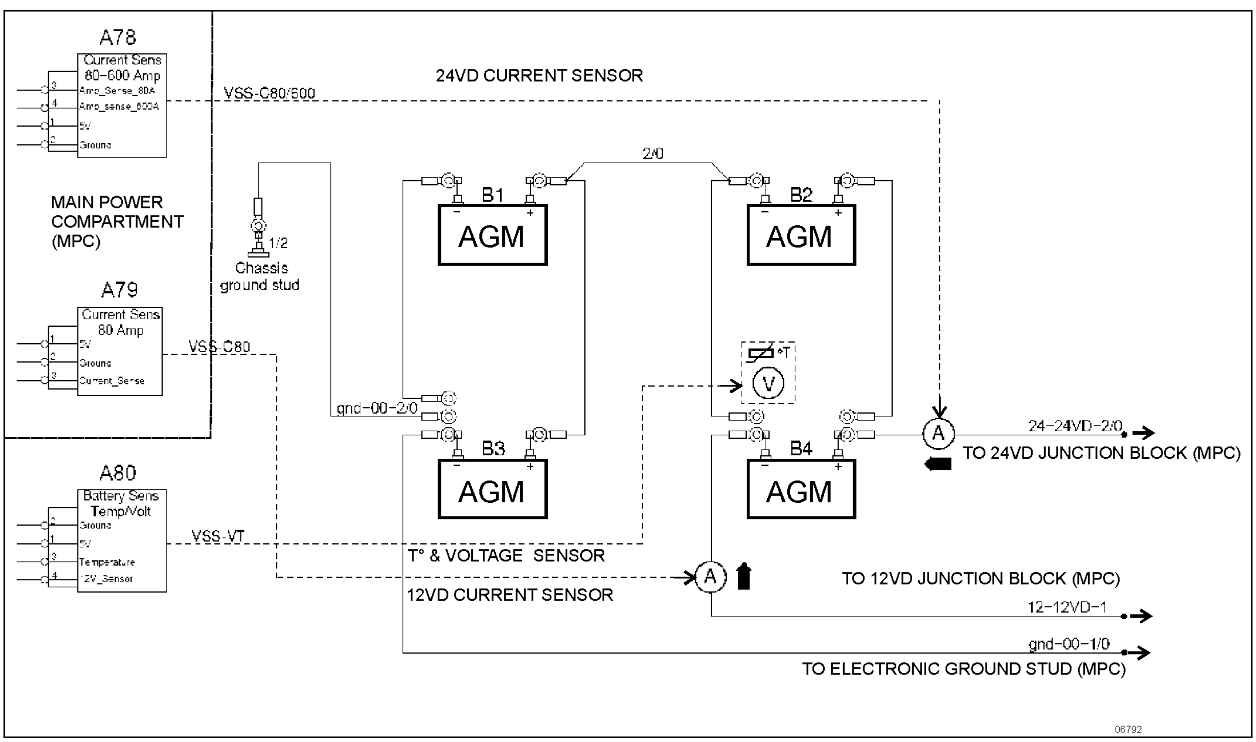


FIGURE 28: BATTERY CONNECTIONS SCHEMATIC

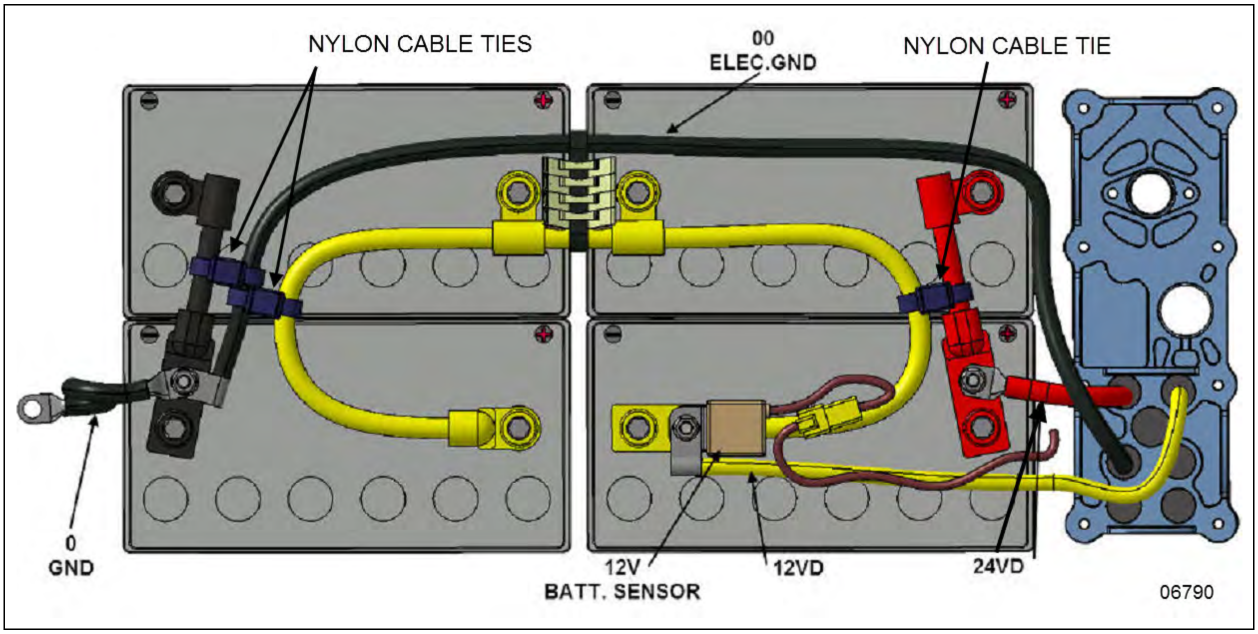


FIGURE 29: AGM BATTERY CONNECTIONS

9.2 AGM BATTERIES

This 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.

9.3 BATTERY DISCHARGE PROTECTION

To prevent discharge of the batteries when the engine in not running, some functions are automatically switched off if the batteries voltage drops below 24.4 volts for more than 30 seconds. The "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.

9.4 MAIN ELECTRICAL SHUT-OFF SWITCH

Main 12-volt and 24-volt battery (master) relays are provided for this vehicle. The relays are located in the main power compartment. The 24-volt battery relay R1 & 12-volt battery relay R3 engage when ignition key is in the ON or ACC position and the main electrical shut-off switch is set to the ON position.

When the main electrical shut-off switch is set to the OFF position, the main battery relays R1 & R3 disengage thus all electrical supply from the batteries to main circuit breakers CB1, CB3, CB5, CB8, CB10, CB11, CB13, is cut off, with the exception of the following items, among others.

- Main circuit breakers CB2, CB6, CB9 which are directly connected to the batteries;
- Battery equalizer check module;
- MCM;
- ECM;
- TCM (Allison transmission);
- Aftertreatment Control Module (ACM);
- Preheater electronic timer;
- Preheater and water recirculating pump;
- Entrance door;
- Radio memory;
- Fire suppression system (momentarily);
- Horn, Hazard:
- Wheelchair lift system;
- Cluster memory.

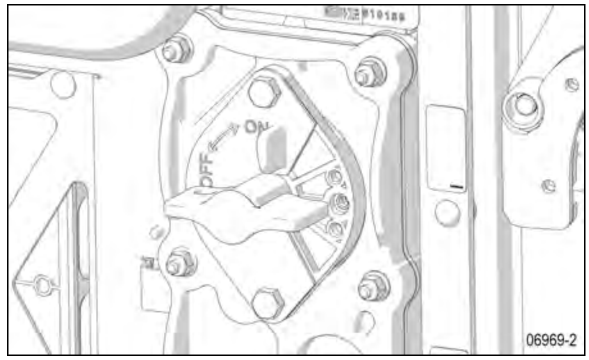


FIGURE 30: MAIN ELECTRICAL SHUT-OFF SWITCH

9.5 BATTERY REMOVAL AND INSTALLATION

The batteries are located in the R.H. side of the engine compartment.

> **DANGER**
>
> To prevent possible electric shocks or sparking, the main electrical shut-off switch in the R.H. side of the engine compartment (Figure 30) should be in the "Off" position before disconnecting cables from the batteries. In addition, trip main circuit breakers CB2 & CB6.

Battery Removal

1. Remove the battery bank cover and place behind the battery bank (***Figure 31***).


FIGURE 31: BATTERY BANK COVER REMOVED

2. Disconnect the ground cable first (***Figure 32***).

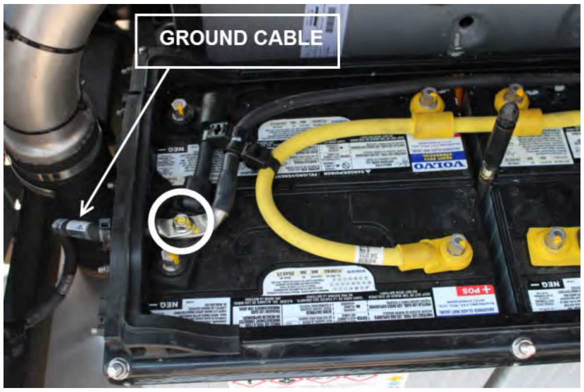


FIGURE 32: DISCONNECT GROUND CABLE FIRST

3. Using a 9/16 hex socket box, disconnect the eight (8) battery cable terminals (***Figure 33***).

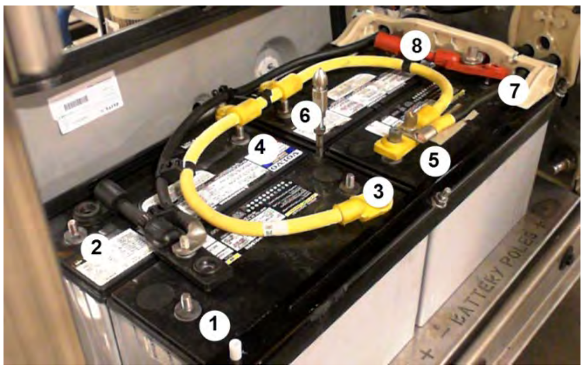


FIGURE 33: DISCONNECT 8 CABLE TERMINALS

4. Put the whole battery cable arrangement aside (***Figure 34***).

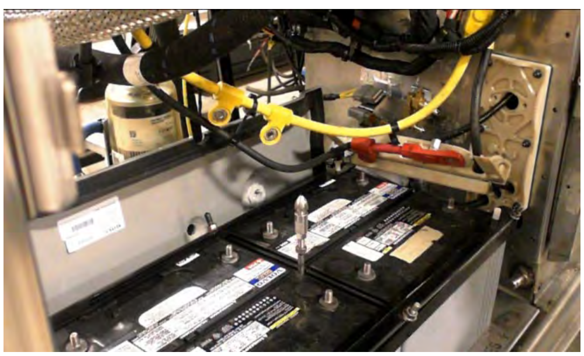


FIGURE 34

5. Unscrew three nuts (indicated with arrows) and then remove the front angle (***Figure 35***).

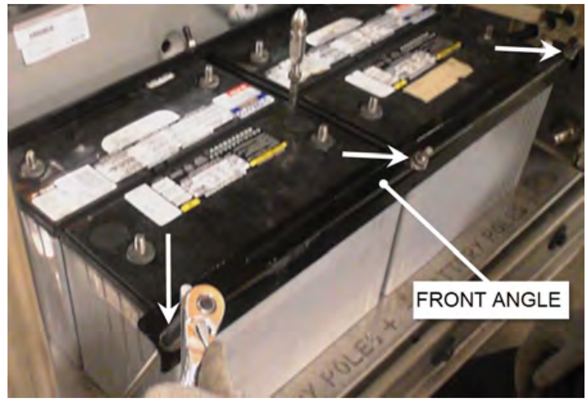


FIGURE 35: REMOVE THE FRONT ANGLE

6. Remove the rear angle similarly.

FIGURE 36: REMOVE THE REAR ANGLE

7. Slide the batteries on a mobile scissor lift table placed slightly lower than the battery deck level.

FIGURE 37

Battery Installation

Reinstalling the batteries is quite similar as the removal procedure but in reverse order.

However, special care should be taken to the following points:

1. To respect battery polarity in the arrangement, positive (+) and negative (-) signs are laser cut on the battery deck steel sheet. When installing the batteries, place the battery negative and positive poles according to the signs on the battery deck (Figure 38).

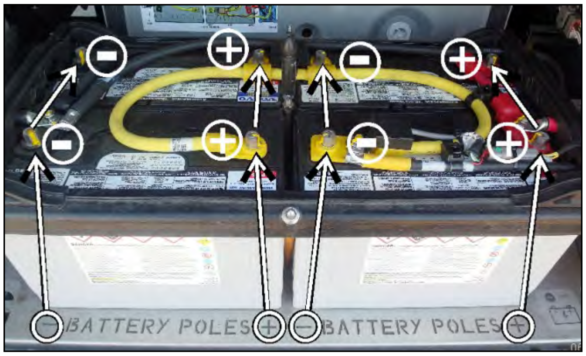


FIGURE 38: BATTERY BANK

2. Rest the aft batteries against the fold on the battery deck. Rest the fore batteries against the aft batteries.

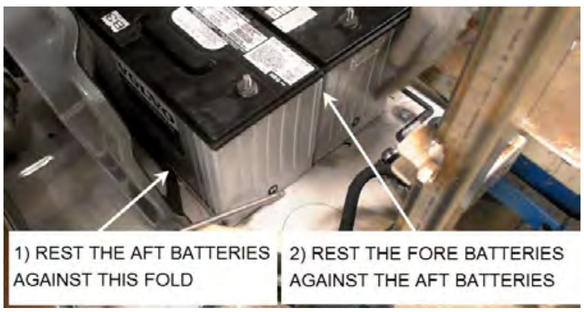


FIGURE 39: PROPER POSITIONING OF THE BATTERIES

3. The upper end of the rods is shaped to match with the angle (***Figure 40***).

4. Tighten the rod nut to the following torque:

TORQUE: 45-55 lb-in (5-6 Nm)

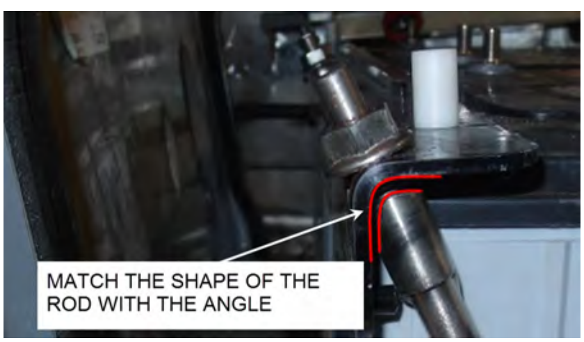


FIGURE 40: SHAPE OF THE ROD

5. Align the dowels on the angles with the holes on the cable guides (Figure 41).

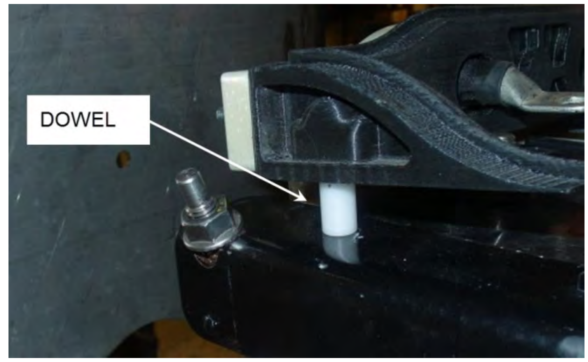


FIGURE 41: DOWEL ON ANGLE

NOTE
When partially disconnecting battery cable arrangement, wrap the battery terminals and cable ends with electric tape to prevent accidental grounding. The ground cables should always be disconnected first and connected last.

NOTE
When reinstalling batteries, battery connections must be tightened. A torque wrench is required to ensure an accurate tightening torque.

5. Connect the battery cables. Tighten the cable terminal (item 1, Figure 42) nuts to the following torque:

TORQUE: 170 lb-in (19 Nm)

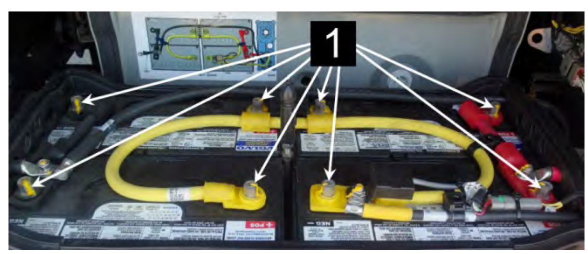


FIGURE 42: INSTALL THE BATTERY CABLE LUGS

6. Connect the ground cable last (Figure 43). Tighten the ground cable nut to the following torque:

TORQUE: 170 lb-in (19 Nm)

FIGURE 43: GROUND CABLE

7. To keep the battery connections clean, make sure that battery bank cover leans perfectly on the cable guides and the angles.

DANGER

To prevent possible electric shock or sparking, the main electrical shut-off switch 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 SAV00002E included at the end of this section to know the recommended products and where they are used.

9.6 AGM BATTERY RATING

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

- Reserve capacity: 200 minutes
- Cold Cranking Amps (CCA): 800 @ 0ºF (-18ºC)
- Weight: 69 lb (26,7 kg)

The reserve capacity is defined as the number of minutes a new, fully charged battery at 80ºF (26,6ºC) 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 0ºF (-18ºC) 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.

9.7 BATTERY TESTING

Several factors influence battery performance. The methods and inspection procedures proposed here will ensure your batteries are in good shape.

9.7.1 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. If the battery is bulged, 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.

9.7.2 Removing Surface Charge

Disconnect cables from the battery and attach alligator clamps to the contact lead pad on the battery as shown in Figure 46. Connect a load equal to half the CCA across the terminal for 5 seconds to remove surface charge from the battery.

9.7.3 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 load tester**. A charging system analyzer test equipment may also be used.

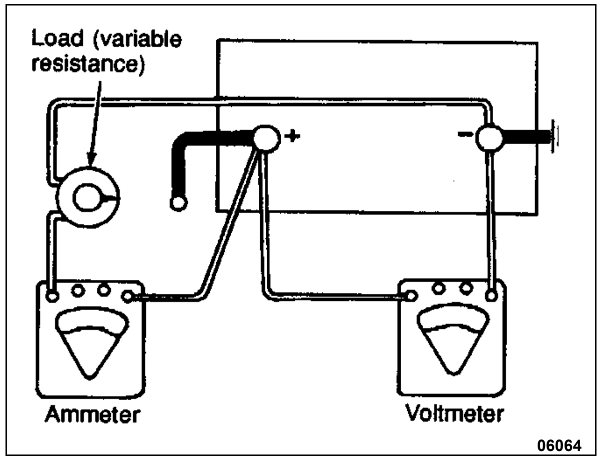


FIGURE 44: LOAD TEST

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

1. You cannot test a discharged battery. If the voltage is below 12.4 volts, be sure to completely charge the battery before continuing.
2. Connect a voltmeter, ammeter, and a variable load resistance as illustrated in Figure 44.
3. Apply a load equal to one-half the CCA rating @ 0ºF for 15 seconds. Note the voltage at 15 seconds with the load on and immediately shut the load off.
4. A voltage reading at least equal to the value from the chart below indicates a good battery.
5. If the voltage reading is less than the value from the chart <u>for a given battery temperature</u>, replace the battery.

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

NOTE

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

9.8 SEAT USB POWER SUPPLY

Two Samlex DC-DC converters provide 12V power to the vehicle's USB connectors.

For further details, consult the vehicle wiring diagram, Samlex supplier publication "Installation and user manual -SDC_IDC_series" and "Specifications IDC-360B-12".

FIGURE 45: DC-DC CONVERTERS

9.9 BATTERY CHARGING

DANGER

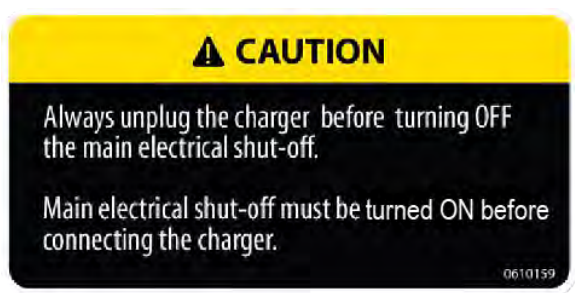
Wear adequate eye protection when working on or near the batteries. Ensure that metal tools or jumper cables do not contact the positive battery terminal (or a metal surface in contact with it) as a short circuit will result. Do not attempt to jump start a vehicle suspected of having a frozen battery 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.

The batteries used on this vehicle can be charged either on or off the vehicle. Use the booster block to charge the batteries when they are left on the vehicle and **make sure that the main battery disconnect switch is set to the *"On"* position.**

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.

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



The alligator clamps of the tester or charger must be placed between the terminal nuts and the lead pads of the terminal studs after the vehicle cables are detached. The alligator clamps should make firm contact with the lead pads (Figure 46).

FIGURE 46 ALLIGATOR CLAMP POSITION– TYPICAL AGM BATTERY

⚠ 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.

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 once – may greatly shorten its life.

- The maximum charge rate in amperes should be no more than 1/3 of the battery's reserve capacity minute rating.
- State-of-charge is estimated from the **OCV** (open-circuit voltage). Typical values are shown on the charging time table below.

CHARGING TIME TABLE FOR A SINGLE BATTERY				
OCV (AGM)	STATE OF CHARGE	CHARGER MAXIMUM RATE		
		30 A	20 A	10 A
12.8V	100%	Ready to use		
12.6V	75%	0.9	1.3	2.5
12.2V	50%	1.9	2.7	5.1
12.0V	25%	2.9	4.3	7.8
11.8V	0%	4.0	5.7	10.7

⚠ CAUTION

AGM Battery Charging Considerations

Many common battery chargers are not fully compatible with AGM batteries, however; they will not ruin the battery if used a few times over the battery's life.

Adversely, not all chargers are really AGM compatible and can do significant damage to an AGM battery. Large "wheeled chargers" found in many shops, which exceed 15.4 volts must be avoided.

If an AGM battery needs to be charged outside of the vehicle's charging system, charging voltage should be 13.8 –14.8 @ 77°F (25°C). Not to exceed 30 Amps.

The time required for a charge will vary according to the following factors:

Temperature

A longer time will be needed to charge any battery at 0ºF (-18ºC) than at 80ºF (27ºC). When a fast charger is connected to a cold battery, the current accepted by the battery will be very low at first, and then in time, the battery will accept a higher rate as it warms.

State of Charge

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

Charger Capacity

A charger supplying only 5 amperes will require a much longer period of charging than a charger that can supply 30 amperes.

9.9.1 Emergency Jump Starting

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.

WARNING

DURING EMERGENCY JUMP STARTING …

Cooling fans WILL start running for a short while.

Keep hands away from cooling fans. Keep the radiator door closed.

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.

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.

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

Apply parking brake and place the transmission to Neutral (N) position.

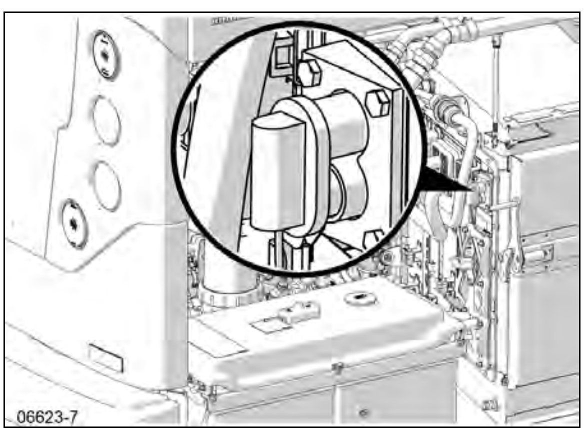


FIGURE 47: QUICK CONNECT JUMP START CONNECTOR

To jump start, proceed as follows:

1. Shut off all electrical equipment;
2. Remove the protective cap from the quick connect jump-start connector located in the engine curb side compartment;
3. Connect the jumper cable to the quick connect jump-start connector;
4. Start the vehicle with the dead battery;
5. Disconnect the jumper cable;
6. Reinstall the protective cap on the quick connect jump-start connector.

NOTE

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

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.

9.10 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.

9.11 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 sulfation 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.

9.12 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 tie-down clamp bolts should be kept properly tightened. For best results when cleaning the battery, wash first with a diluted solution of ammonia or soda to neutralize any acid present then wash out with clean water. The battery tie-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. Tighten as prescribed. Refer to torque tables at the beginning of this section.

MAINTENANCE

Battery terminals

Clean and coat terminals with Nyogel at the intervals specified by the Lubrication And Servicing Schedule in Section 24A: LUBRICATION & SERVICING SCHEDULE.

A protective coating should be applied on certain power connections that have been disconnected. Refer to Procedure SAV00002E included at the end of this section to know the recommended products and where they are used.

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. Tighten as prescribed. Refer to torque tables at the beginning of this section.

Replace protective caps to prevent corrosion and sparks.

9.13 COMMON CAUSES OF BATTERY FAILURE

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

1. A defect in charging system such as high resistance or a faulty alternator or regulator. The dashboard ALTERNATOR telltale light illuminates if one of the alternators is defective.

ALTERNATOR telltale

2. A malfunction within the 12-volt system (equalizer).
3. Overloads caused by a defective starter or excessive use of accessories.
4. Dirt and electrolyte on top of the batteries causing a constant drain.
5. Hardened battery plates, due to battery being in a low state of charge over a long period of time.
6. Shorted cells, loss of active material from plates.
7. Driving conditions or requirements under which the vehicle is driven for short periods of time.
8. A constant drain caused by a shorted circuit such as an exposed wire or water infiltration in junction boxes causing ground fault.
9. Extended operation of preheating system with engine not running.
10. Failing to close disconnect switches during the night.

9.14 TROUBLESHOOTING

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

1. Vehicle accessories and disconnect switches inadvertently left on overnight.

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

9.15 "BATTERY VOLTAGE WARNING" PICTOGRAM

If the "BATTERY VOLTAGE WARNING"  (Low Voltage – Connect Battery Charger) pictogram shows up in the DID (Driver Information Display), check the voltmeter gauge to determine if the battery voltage is too high or too low.

9.15.1 Voltage Gauge Definitions

Voltmeter drops below 24.4 volts dc

- o Check alternator output.
- o Check battery connections.
- o Check battery equalizer connections.

Voltmeter exceeds 30 volts dc

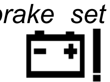
- o Check alternator output (voltage regulator might be defective).
- o Check battery connections.

Checking 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).
   - o Check battery equalizer connections.
   - o Check equalizer cables for proper gauge.
   - o Check battery connections.
2. Demand for 12-volt power exceeding rated amperage output of battery equalizers causing batteries to go out of balance.
   - o Reduce 12-volt load or install additional battery equalizer(s).

9.15.2 BATTERY warning Pictogram MAY appear as a reminder

If you leave *ignition ON, park brake set* and *engine not running*, this warning  may appear after 20 minutes as a reminder to connect the battery charger. The reminder will appear even if the batteries are in the right voltage range.
Confirm battery voltage is indeed correct with the DID Gauges screen and if you do need to leave the ignition ON for a prolonged period, connect a battery charger.

10. BATTERY EQUALIZER

The Vanner "Vann-Bus 80 Series" 100amp Battery equalizer with Power Management System is installed inside the main power compartment.

Refer to Vanner ***Vann-Guard 80 Series Owner's Manual*** found on your Technical Publications USB flash drive.

11. SUPERCAPACITOR STARTING MODULE

The vehicle may be equipped with a supercapacitor starting module located in the 3rd luggage bay. (Figure 48)

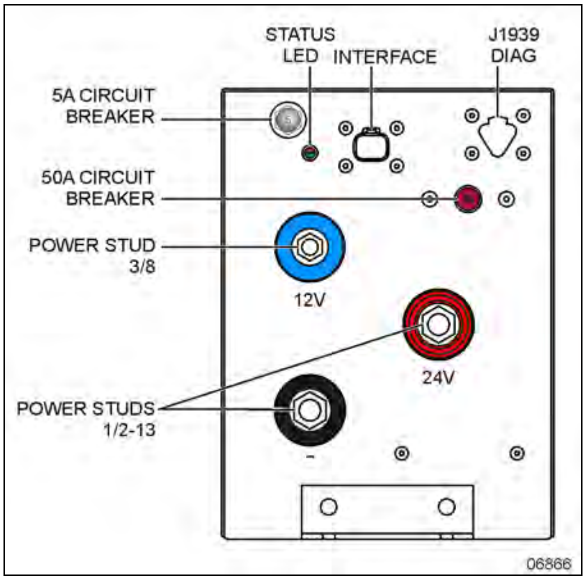


FIGURE 48: STARTING MODULE

This module houses supercapacitors that derive power from the vehicle electrical system and discharges it when starting the engine.

On engine start-up, the module provides power in parallel with the standard batteries. If the standard batteries are depleted, the module will provide enough power for engine start-up.

A vehicle equipped with a starting module will have a differing starting switch arrangement on the dashboard. This system uses an on/off ignition switch and an engine starting (cranking) switch.

FIGURE 49: SWITCH ARRANGEMENT WITH STARTING MODULE

> **WARNING**
>
> The starting module is a polarity sensitive device. Polarity should be strictly observed when connecting the KAPower module into any circuit

11.1 STARTING THE VEHICLE WITH DEPLETED BATTERIES.

With a supercapacitor starting module, if the batteries are depleted and the charging system works correctly, it is still possible to start the vehicle.

Place ignition switch to the “ON” position (Figure 49)

Press and hold engine start switch (Figure 49) until engine is running and keep holding minimum of 3 seconds after engine run.

Holding the switch provides the circuit with power coming from the starting module.

11.2 STARTING MODULE STATUS LED

The bi-color (red/green) LED is an indicator for how the starting module is functioning. The green side of the LED is connected parallel with the contactor. The red side is connected to an output on the module's programmable logic controller (PLC).

Green: Anytime the LED Status Indicator is illuminated green, the contactor is closed. In a typical engine-starting event you will see the LED illuminate during engine cranking and then go out for several seconds after the engine has started. The LED will then illuminate again and could remain illuminated for several seconds based on the condition of the module. The LED may “cycle” depending on the vehicle or system voltage during the recharging events.

Red: The PLC monitors the capacitor voltage during and after the recharge cycle. If the capacitor voltage drops to below an acceptable level in the first 5 minutes after the recharge, the red LED will flash, indicating a fault.

If at any time while the PLC is powered up, the 5A circuit breaker trips or the capacitor voltage level drops below 4 volts the red LED will flash. (Source: KBI)

11.3 TROUBLESHOOTING

Refer to supplier manual *KSM Starting Module Manual RevD.pdf* from KBI on the technical publications web site or on the technical publications USB drive for troubleshooting instructions.

⚠ **WARNING**
The Starting Module is a product of high electric power. Avoid shorting module terminals!

11.4 MAINTENANCE

Regularly inspect the wiring and bus bar connections to make sure they are clean and free of corrosion.

1/2-13 power stud nut torque:

180 lb-in (20 Nm)

3/8-16 12V power stud torque:

212 lb-in (24 Nm)

M10-1.5 bus bar ground stud:

240 lb-in (27 Nm)

11.5 HANDLING AND STORAGE

⚠ **CAUTION**
Module should be stored at a minimum voltage of 8V for the 24V circuit and 4V for the 12V circuit.

NOTE
The starting module is not a high-voltage device. It simply supplies the same voltage that it was charged up to. Handle it with the same respect you would give to a fully charged battery.

12. PRIME ENERGY MANAGEMENT SYSTEM

The acronym “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 alternators will use engine negative torque (braking, deceleration) to generate “Free” electricity.

Depending on the compressed 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 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.

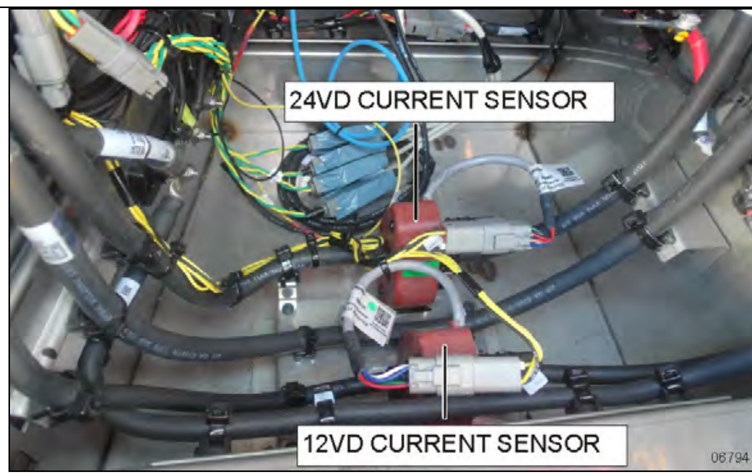
Maximum fuel economy is obtained on a ride when the mix of hilly and flat portions allows the batteries to be charged when the vehicle is in free wheel. It basically means that batteries are charged with free energy and that no fuel consumption is dedicated to charge the batteries.

12.1 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. Refer to Figure 50 below.

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

EQUALIZER



CURRENT SENSORS

FIGURE 50: PRIME ELECTRICAL COMPONENTS

1.1.1 Vanner 80 Series Battery Equalizer Fault Codes

The 80 equalizer can bus interface supports SAE J1939 diagnostic message 1 (DM1) for active diagnostic trouble codes. See list below. Refer to oem publication *Vanner Vann-guard 80 series owner's manual* pdf for additional details.

Description	SPN	FMI
Over voltage fault (OVF)	168	0: data valid, but above normal operating range – most severe
Under voltage fault (UVF)	168	1: data valid, but below normal operating range – most severe
Imbalance (IMB)	520448	0: data valid, but above normal operating range – most severe
Equalizer fault (EQFLT)	520449	1: data valid, but below normal operating range – most severe
Temperature sensor fault (TSF)	520450	0: data valid, but above normal operating range
Temperature sensor fault (TSF)	520450	1: data valid, but below normal operating range
Temperature sensor fault (TSF)	520450	2: data erratic, intermittent, or incorrect – most severe
12v current sensor fault (SCSF)	520451	0: data valid, but above normal operating range – most severe
12v current sensor fault (SCSF)	520451	1: data valid, but below normal operating range
12v current sensor fault (SCSF)	520451	2: data erratic, intermittent, or incorrect – most severe
24v current sensor fault (DCSF)	520452	0: data valid, but above normal operating range – most severe
24v current sensor fault (DCSF)	520452	1: data valid, but below normal operating range
24v current sensor fault (DCSF)	520452	2: data erratic, intermittent, or incorrect – most severe

12.2 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.

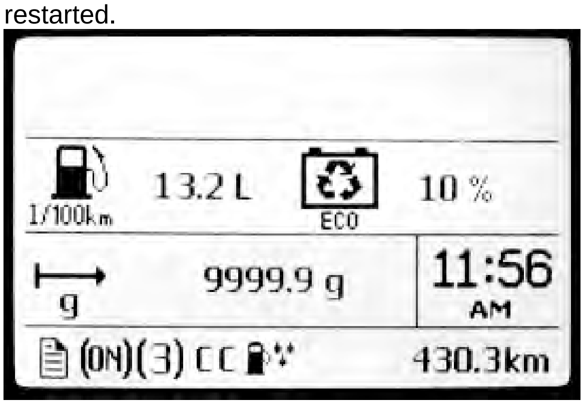


FIGURE 51: PRIME DID DISPLAY

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

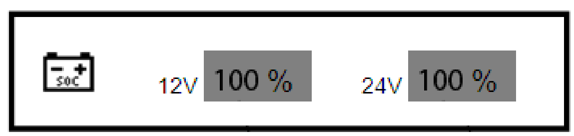


FIGURE 52: BATTERY STATE OF CHARGE

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

13. ALTERNATORS

Standard configuration includes three 24-volt 150A, self-regulated, belt driven, air-cooled HD 10 BOSCH alternators are used in the 24-volt electrical system.

NOTE
*For the complete removal/installation instructions, refer to Maintenance Information **MI16-17 Bosch HD10 alternator removal and installation** included at the end of this section.*

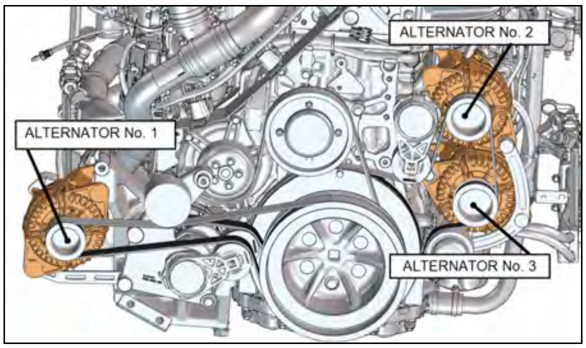


FIGURE 53: ALTERNATOR IDENTIFICATION

13.1 ALTERNATOR PERIODIC INSPECTION

When two alternators are not charging, the charging system warning light illuminates. This telltale will not illuminate if only one alternator is defective. However, a single defective alternator can be identified using the back-probing method described below.

charging system warning light

13.1.1 Alternator identification

Cold side alternators are the one found on the A/C compressor side. The hot side alternator is the one located on the engine turbo side.

In this configuration, the multiplex system will identify the alternator on the right (cold side) as *Upper Right*, *Lower Right* and the left (hot side) as *Lower Left.*

Cold Side (R.H.):

ALTERNATOR Up RH= upper right
ALTERNATOR Low RH=lower right

Hot Side (L.H.):
ALTERNATOR Low LH=lower left

13.1.2 Identifying a defective alternator using the instrument cluster DID

1. On the DID (Driver Information Display), select DIAGNOSTICS menu.
2. Select VIEW ACTIVE FAULTS and then ELECTRICAL.
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 Low RH
FMI (5)	OPEN CIRCUIT

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

13.1.3 Identifying a Defective Alternator – Back-probing AE49 & AE52 Multiplex Modules Method

Prerequisite conditions:

a) Engine running;

b) Parking brake applied.

Alternator Up RH =pin J1:20, module AE49
Alternator Low RH=pin J2:8, module AE52
Alternator Low LH= pin J2:9, module AE52

Back-probe pin 20 (AE49 J1:20):

- If multimeter reads 1-2 volts, the **upper R.H.** alternator is defective;
- If multimeter reads 12 volts, you have an open circuit;
- If multimeter reads 26 volts or greater, the **upper R.H.** alternator operates normally.

Back-probe pin 8 (AE52 J2:8) and a good ground (use ground stud in the compartment):

- If multimeter reads 1-2 volts, the **lower R.H.** alternator is defective;
- If multimeter reads 12 volts, you have an open circuit;
- If multimeter reads 26 volts or greater, the **lower R.H.** alternator operates normally.

Back-probe pin 9 (AE52 J2:9) and a good ground (use ground stud in the compartment):

- If multimeter reads 1-2 volts, the **lower L.H.** alternator is defective;
- If multimeter reads 12 volts, you have an open circuit;
- If multimeter reads 26 volts or greater, the **lower L.H.** alternator operates normally.

13.2 ALTERNATOR DRIVE BELT

MAINTENANCE

Drive belt

Inspect for crack or frayed material at the intervals specified by the Lubrication And Servicing Schedule in Section 24A: LUBRICATION & SERVICING SCHEDULE.

13.2.1 Removal and installation

1. Insert a ½″ socket drive into the automatic belt tensioner opening.
2. Twist the tensioning arm to slacken belt.
3. Remove belt.

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

FIGURE 54: ½″ SOCKET DRIVE WRENCH

NOTE

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

13.2.2 Adjustment

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

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.

14. STARTER

Refer to Mitsubishi Electric Corporation (MELCO) Service bulletin ME003-P found on your Technical Publications USB flash drive for information and maintenance instruction on MELCO 105P70 starter.

NOTE

For the complete removal/installation instructions, refer to Maintenance Information ***MI16-16 Starter removal and installation*** *included at the end of section 01ENGINE.*

15. EXTERIOR LIGHTING

The circuit for exterior lights, as well as their control switches, relays and circuit breakers are shown on the applicable wiring diagrams.

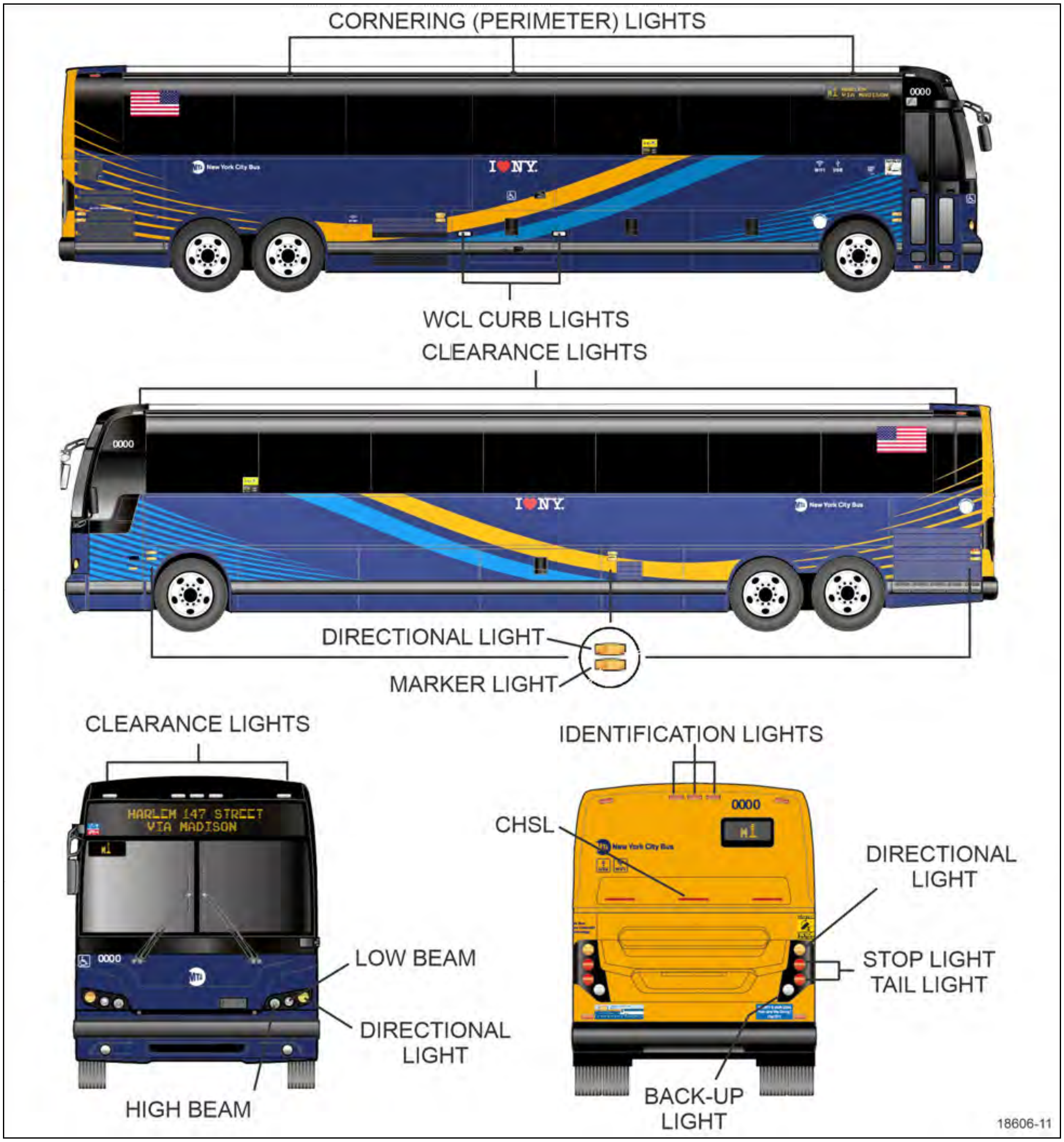


FIGURE 55: EXTERIOR LIGHTS

15.1 HEADLAMPS

Each headlamp assembly consists of two 90 mm (3½ inch) LED modules and one 100 mm (4 inch) 12-volt LED turn signal light (Figure 57).

Middle lamps are used for low beam. Inner lamps are used for high beam and light intensity is lower for the daytime running mode.

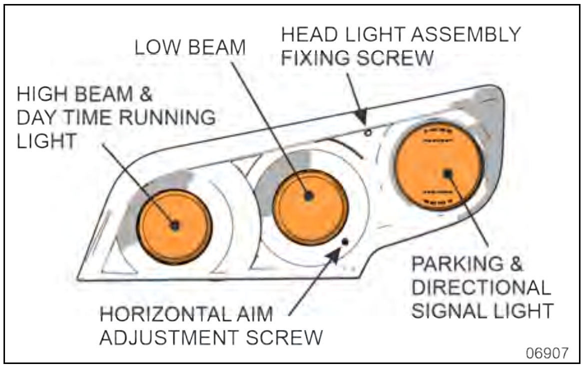


FIGURE 56: HEADLAMP ASSEMBLY

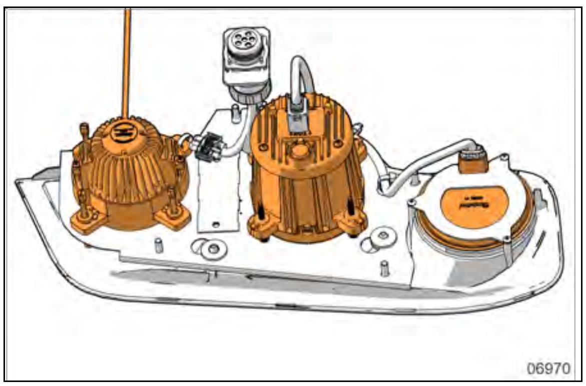


FIGURE 57: HEADLAMP ASSEMBLY

15.1.1 Maintenance

Clean headlamp assembly with soap and water. When a headlamp fails, a new module must be installed. Headlamp modules must be properly aimed to provide maximum allowable road illumination. When using mechanical aiming devices, follow the manufacturer's instructions.

15.2 LED MODULES AND TURN SIGNAL MODULE REPLACEMENT

1. Unscrew the 2 bumper retaining bolts shown on the image (47 lbs-ft).

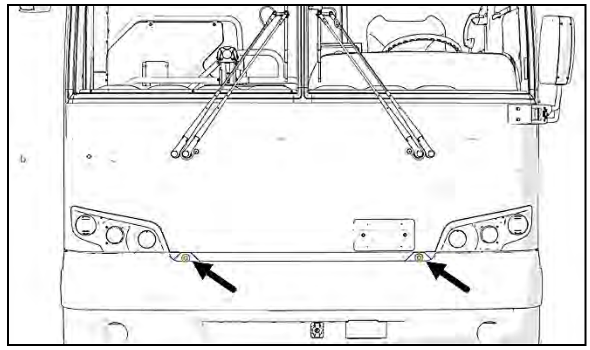


FIGURE 58: BUMPER RETAINING BOLTS

2. Lower the hinged bumper.
3. Remove the headlights bezel. To do so, unscrew the 2 Torx screws shown on the image. Disconnect the directional turn signal module cable and put the bezel aside.

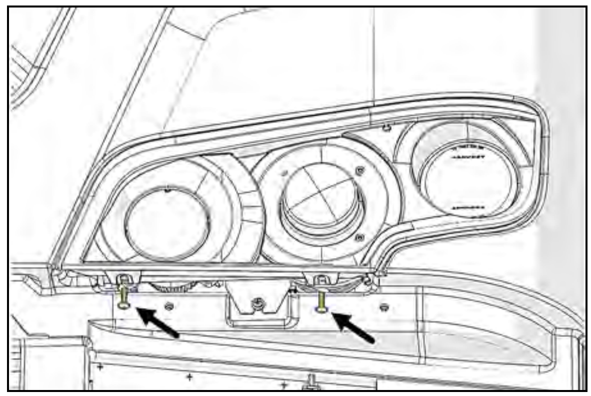


FIGURE 59: UNSCREW THE 2 TORX SCREWS

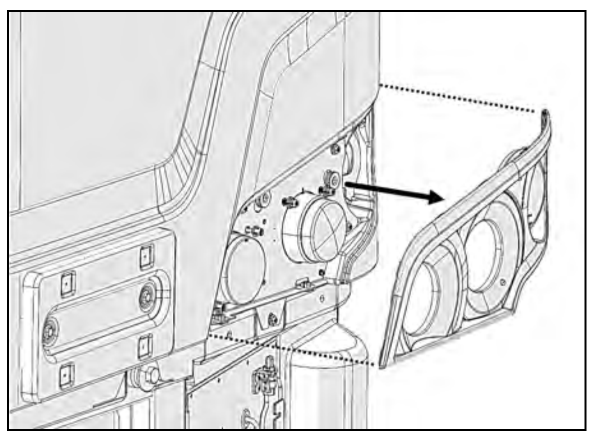


FIGURE 60: HEADLAMP ASSEMBLY BEZEL

4. Remove 4 screws holding the headlight module.

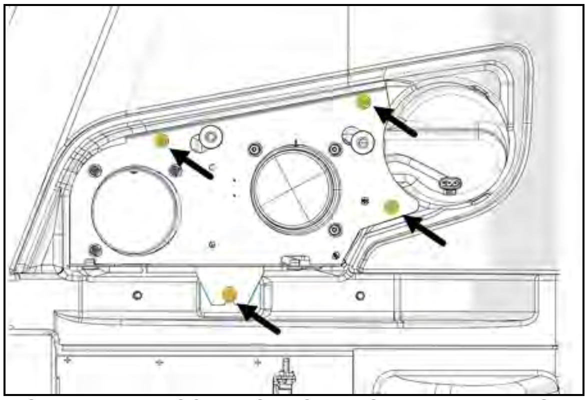


FIGURE 61: 4 SCREWS HOLDING THE HEADLIGHT MODULE

5. Unplug the connectors.

15.2.1 Directional Turn Signal Replacement

The front turn signal is part of the front bezel. The turn signal is a sealed module and should be replaced as an assembly.

1. Unscrew 3 fasteners and replace the turn signal module.

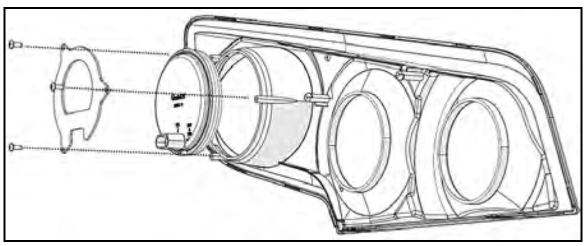


FIGURE 62: UNSCREW 3 FASTENERS

15.2.2 Low & High Beam LED module Replacement

1. Remove the existing LED module complete with adjuster screw.
2. Before installing the LED module, make sure the adjuster screw is adjusted according to the dimension on the two following images.

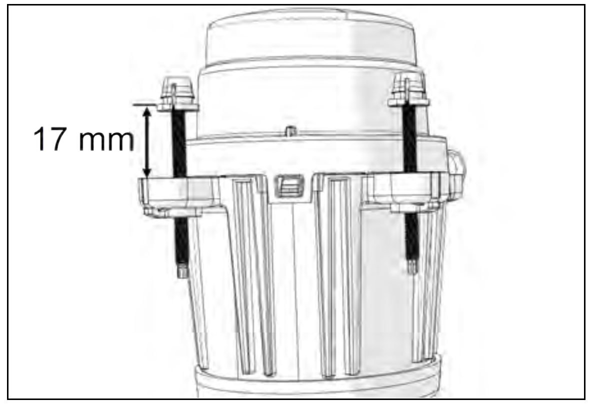


FIGURE 63: LOW BEAN LED MODULE

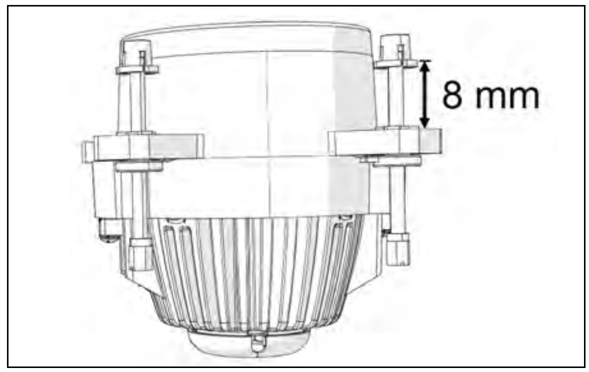


FIGURE 64: HIGH BEAN LED MODULE

3. Install the LED module. Snap the adjuster screw ends through the plate.

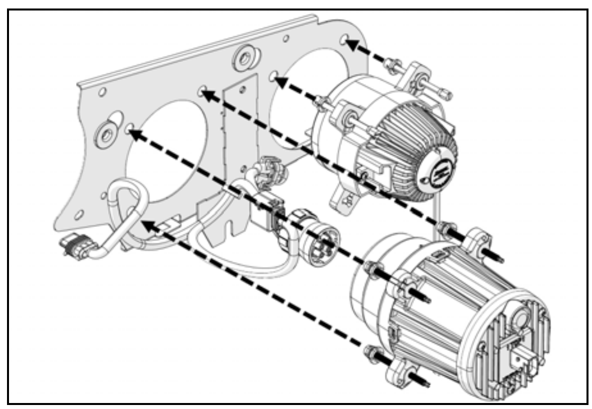


FIGURE 65: SECURING THE LED MODULE

15.3 HEADLAMP AIM ADJUSTMENT

Horizontal and vertical aiming of headlamp module is provided by adjusting screws that pivot the module in the housing for the proper alignment.

1. Headlamp aiming and inspection can be accomplished by visual means. This is done on a screen located at a distance of 25 feet (7,6 m) of the headlamps. It should be of

adequate size with a matte-white surface well shaded from extraneous light and properly adjusted to the floor area on which the vehicle stands. Provisions should be made for moving the screen or its vertical centerline so that it can be aligned with the vehicle axis. In addition to the vertical centerline, the screen should be provided with four laterally adjustable vertical tapes and two vertically adjustable horizontal tapes.

2. The four movable vertical tapes should be located on the screen at the left and right limits called for in the specification with reference to centerlines ahead of each headlamps assembly.

The headlamp centerlines shall be spaced either side of the fixed centerline on the screen by ½ the lateral distance between the light source centers of the pertinent headlamps. The horizontal tapes should be located on the screen at the upper and lower limits called for in the specification with reference to the height of beam centers and the plane on which the vehicle rests, not the floor on which the screen rests.

TABLE 1 – VERTICAL BEAM AIM GUIDELINES

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

3. The nominal vertical aim position on lower beam headlamps shall be adjusted based on the headlamp mounting height, from the ground to the light source center of the headlamp, according to table1.

4. High beam headlamps are aimed so that the center of the high-intensity zone is located at the horizontal and straight ahead vertically (Figure 67).

5. Low beam headlamps are aimed so that the top edge (the cutoff) of the high-intensity zone is at the vertical location as per Table 1 and the left edge of the high-intensity zone is at the vertical centerline of the headlamp (Figure 68).

6. The inspection limits for high-beam headlamps shall be with the center of the high-intensity zone from 10 cm (4 in) up to 10 cm (4 in) down; and, from 10 cm (4 in) left to 10 cm (4 in) right on a screen at 7.6 m (25 ft) (Figure 69).

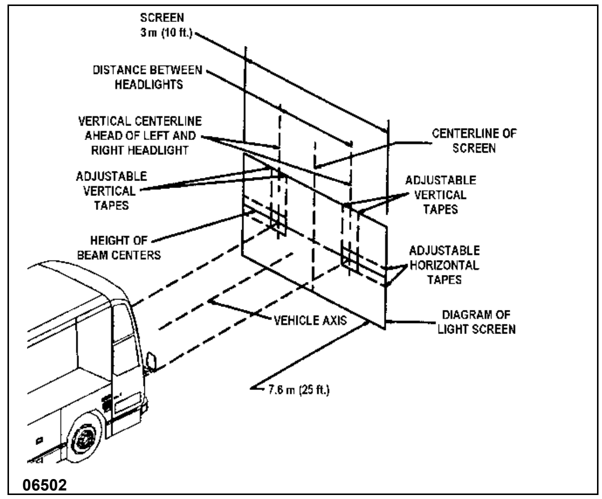


FIGURE 66: ALIGNMENT OF HEADLAMP AIMING SCREEN

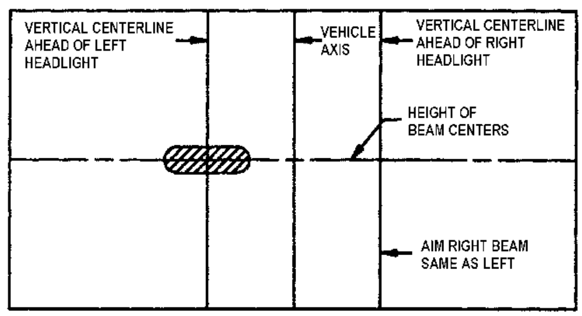
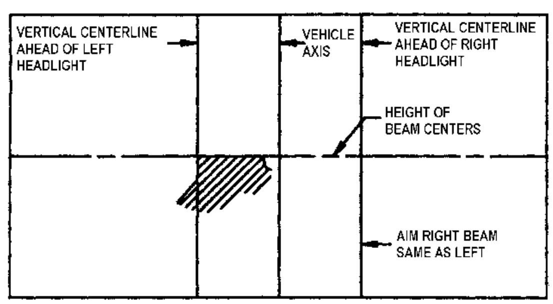


FIGURE 67: UPPER BEAM HIGH-INTENSITY ZONE PROPER LOCATION ON SCREEN 06503



06504

FIGURE 68: LOWER BEAM HIGH-INTENSITY ZONE PROPER LOCATION ON SCREEN

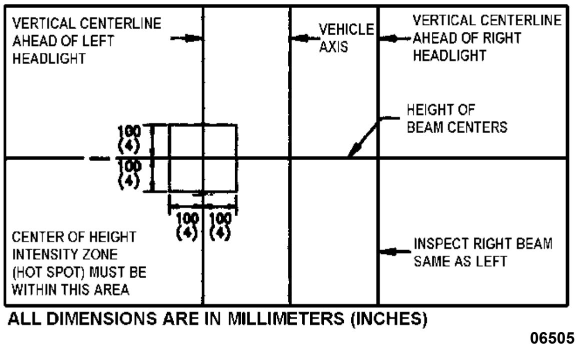


FIGURE 69: AIM INSPECTION LIMITS FOR UPPER-BEAM HEADLAMPS

7. The inspection limits in the vertical direction for low-beam headlamps or the low beam of a dual-beam headlamp, shall be as described in Table 1. In the horizontal direction, the left edge of the high-intensity zone shall be located from 10 cm (4 in) left to 10 cm (4 in) right of the vertical centerline of the beam. The viewing screen shall be located 7.6 m (25 ft) in front of the vehicle (Figure 70).

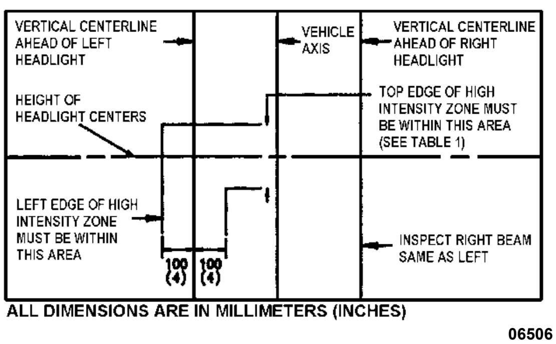


FIGURE 70: AIM INSPECTION LIMITS FOR LOWER-BEAM HEADLAMPS

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

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

The stop, tail, directional signal and back-up lights consist of individual lamps, each equipped with 6 LED lights, mounted together as a module.

LED lights are not replaceable and each lamp is serviced individually as a complete unit.

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.

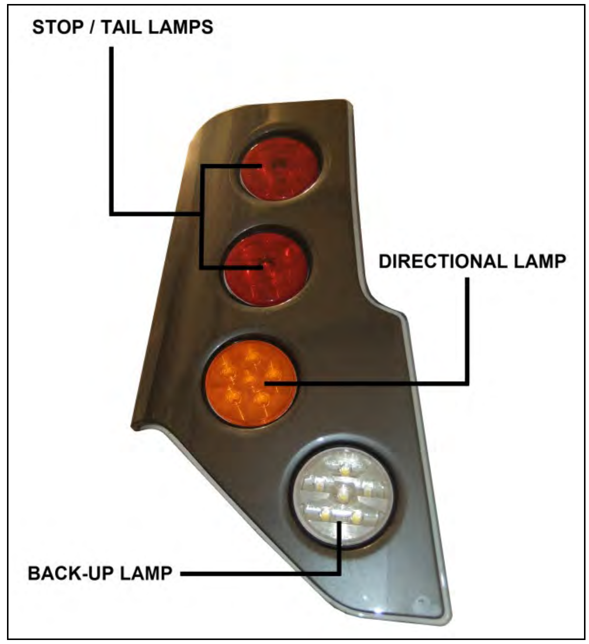


FIGURE 71: REAR TAIL LAMPS, SOME VEHICLES MAY HAVE THE DIRECTIONAL LAMP MAY BE MOUNTED ON TOP POSITION

15.4.1 Lamp Removal and Replacement

1. Open engine compartment rear door.
2. Remove the lamp pod from the engine compartment door by unscrewing the Torx hold down screws (4) at the back of the door and the two (2) side retaining nuts.
3. Remove the lamp support retaining screws (2), and then from the outside, disconnect and remove the faulty lamp and its support.
4. From the outside, install the new lamp with its support then fasten the retaining screws.
5. Reinstall the lamp pod on the door and reconnect the lamp.

15.4.2 Center Stoplights and Cyclops Light Removal and Replacement

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

1. Unscrew both "Phillips" light screws then remove the light assembly.
2. Install new light assembly and secure using screws.

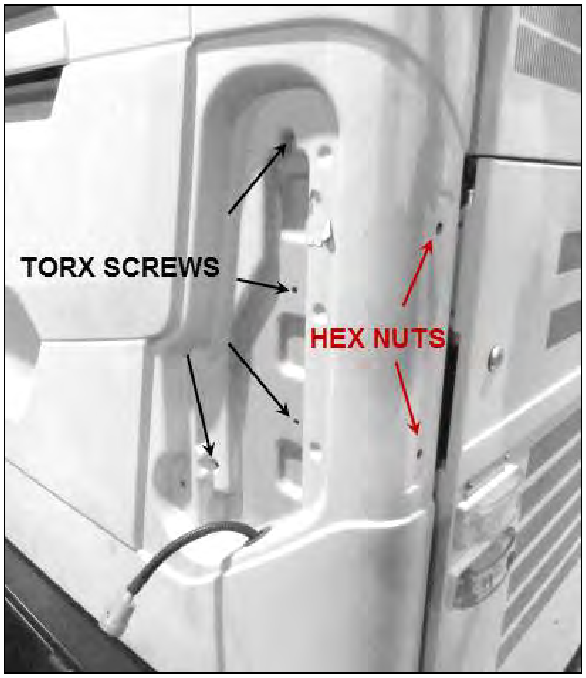


FIGURE 72: TAILLAMP POD RETAINING SCREWS & NUTS

15.4.3 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.

15.4.4 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.

15.5 LICENSE PLATE LIGHT

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

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

15.6 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.

15.6.1 Clearance and Identification Lights Removal and Replacement

The rear clearance and identification lights are red and the front ones are amber.

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

1. Unscrew both *"Phillips"* screws, and then remove the LED unit. Unplug the connectors.

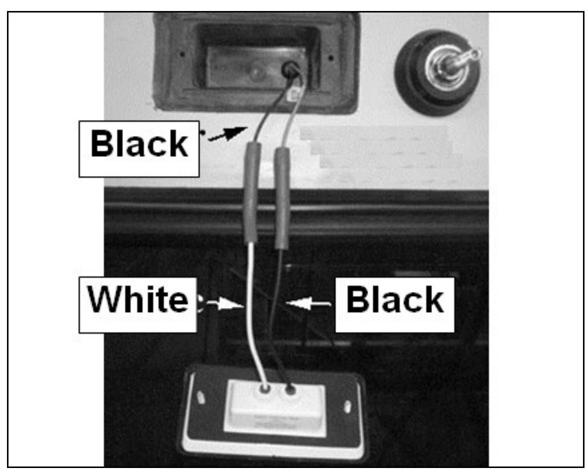


FIGURE 73: LED SEALED UNIT WIRE CONNECTION

2. Plug the new unit connectors. Engage the mating parts; push until the connector is fully seated. Turn slightly until you feel a click.

3. Position the new unit and maintain a pressure on the unit to compress the rubber seal. Tighten the “Phillips” screws.

FIGURE 74: CLEARANCE/IDENTIFICATION LIGHTS

15.6.2 Marker Lights Removal and Replacement

The amber and red marker lights are mounted along the sides of vehicle.

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”* screws, and then remove the marker light unit. Unplug the connector.
2. Plug the connector to the new marker light unit. Position the new light assembly and tighten the “Phillips” screws (19 lbs-in).

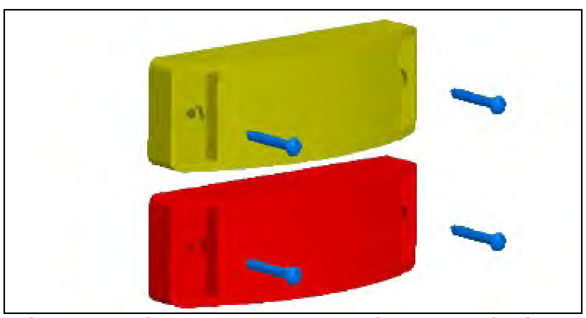


FIGURE 75: SIDE MARKER AND SIDE DIRECTIONAL LIGHTS

15.7 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.

15.7.1 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.

15.8 BAGGAGE COMPARTMENT, MAIN POWER COMPARTMENT LIGHTS

This type of compartment light is a sealed unit (LED) and can be replaced as a complete unit.

It is found in the following locations:

- Baggage compartments
- Main power compartment

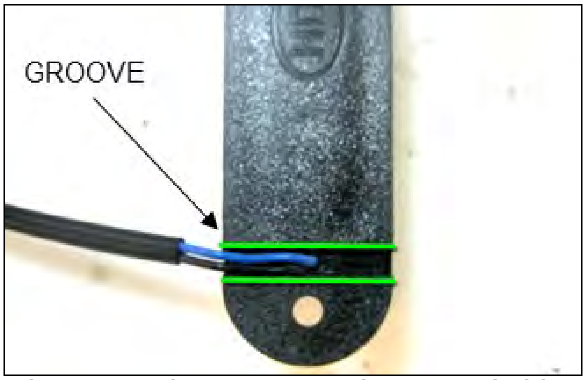


FIGURE 76: ROUTE THE WIRES IN THE GROOVE UNDER THE SEALED UNIT BODY

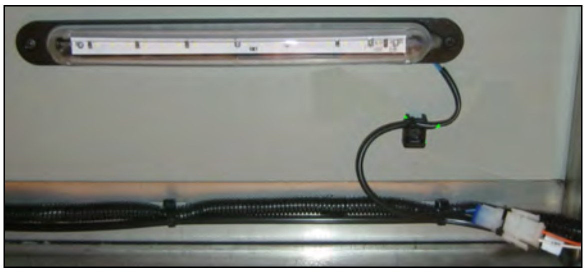


FIGURE 77: BAGGAGE COMPARTMENT LIGHTS LED SEALED UNIT

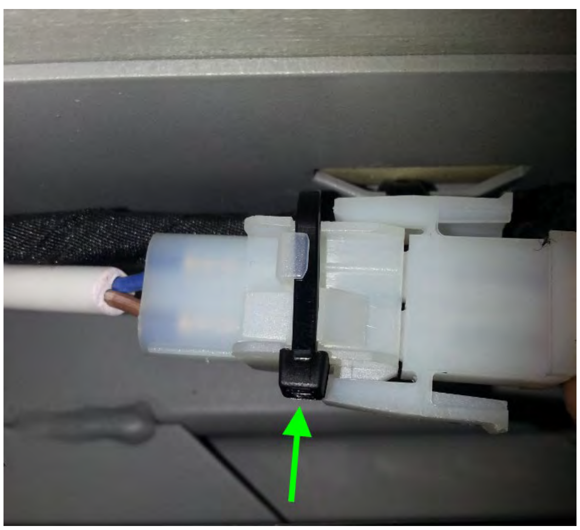


FIGURE 78: SECURE THE CONNECTOR WITH A NYLON TIE

15.9 ENGINE COMPARTMENT LIGHTING

Three 24-volts LED modules 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.

The light module is sealed thus not serviceable.

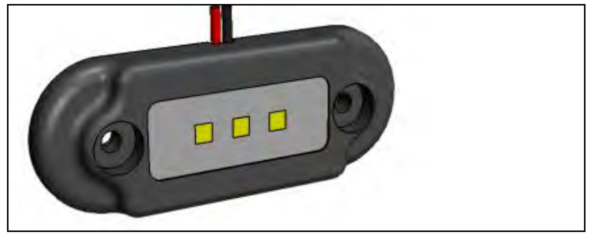


FIGURE 79: ENGINE COMPARTMENT LIGHT

15.10 PERIMETER LIGHTS

This type of light is a sealed unit (LED) and can be replaced as a complete unit. (Figure 80)

FIGURE 80:PERIMETER LIGHT

15.10.1 Replacement

1. Remove the fixing screws (Figure 81)

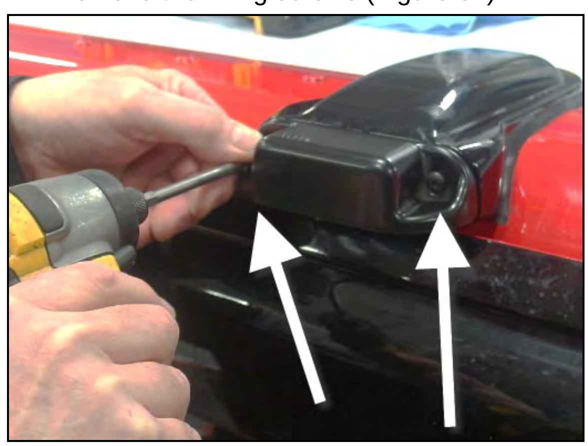


FIGURE 81: PERIMETER LIGHT DISASSEMBLY

2. Disconnect light.

3. Clean mounting surface vehicle side.
4. Confirm proper condition of sealing foam on new light unit.
5. Reassemble replacement unit in reverse order.

16. INTERIOR LIGHTING EQUIPMENT

16.1 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.

16.1.1 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 (Figure 82)

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

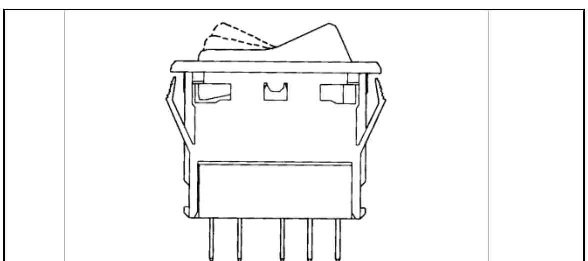


FIGURE 82: SWITCH

16.1.2 Instrument Cluster Lights

The instrument cluster is non-serviceable and must be replaced as a unit.

16.2 STEPWELL LIGHTS

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

16.2.1 Bulb Removal and Replacement

Proceed as follows to replace a defective bulb:

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

16.3 DRIVER'S AREA CEILING LIGHTS

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

FIGURE 83: DRIVER'S AREA CEILING LIGHT

16.3.1 Bulb Removal and Replacement

1. Pull the lamp assembly by the outer ring using your fingers.
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.

16.4 PASSENGER SECTION LIGHTING

The passenger section of coach is lit by two types LED strips installed on the overhead compartments. The aisle or *indirect lights* are located on front of overhead compartments, and provide soft, indirect cabin lighting and overhead compartment interior lighting.

More powerful lighting is provided by LED strips located under the overhead compartments, close to the windows. 24 volt power is available for this lighting. In order to save batteries during extended periods, a battery charger can be connected prior use.

Moreover, adjustable reading lamps are installed under the overhead compartments for passenger accommodation.

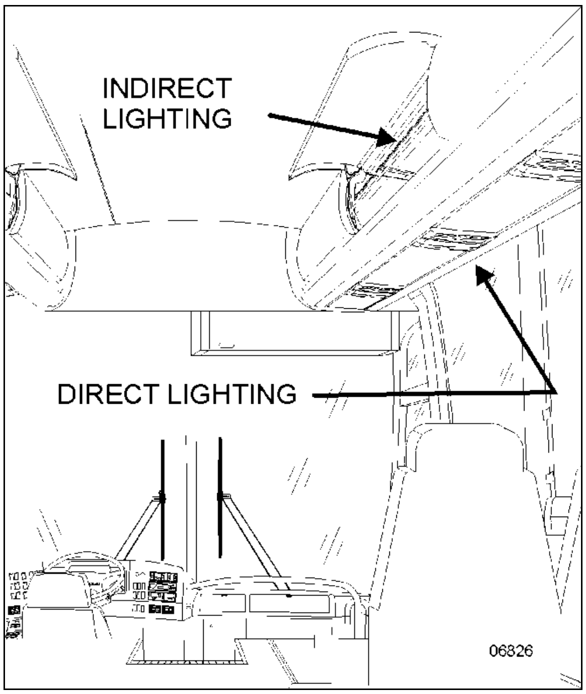


FIGURE 84: OVERHEAD COMPARTMENT LIGHTING

16.4.1 LED Indirect Lighting / Overhead compartment Interior Lighting

1. Open the overhead compartment access door.
2. Using a Phillips head screwdriver, unscrew and remove the existing LED strip (FIGURE 85).
3. Install a new LED strip as a complete unit.

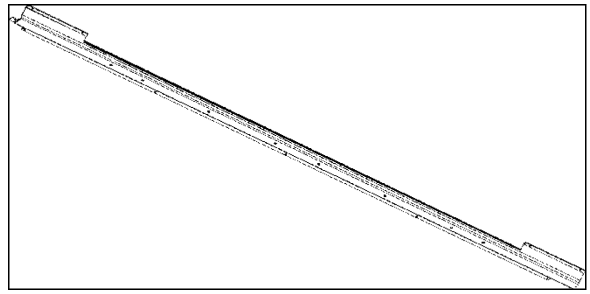


FIGURE 85: LED INDIRECT LIGHTING IN OVERHEAD COMPARTMENT

16.4.2 LED Direct Lighting

1. Start by pulling out the corner of the lens then delicately peeling it out of its seat.
2. Unscrew and remove the LED strip assembly (4 Phillips screws).
3. Install a new LED strip assembly.
4. Replace the screen lens by first inserting one side in the seat, then push the other side in and snap it in place by running it in from one corner to the next.

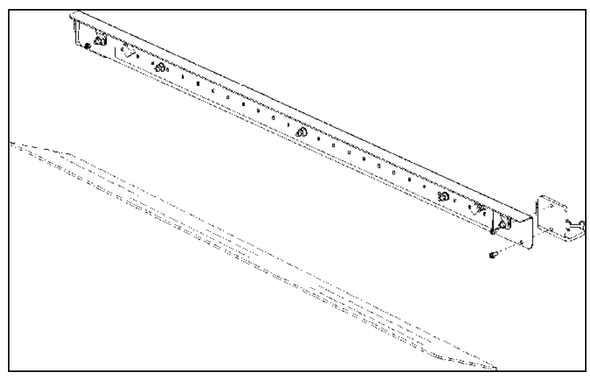


FIGURE 86: LED DIRECT LIGHTING AND LENS

16.4.3 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.

17. 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.

18. SPECIFICATIONS

AGM Battery

Make .... Odyssey
Model 31R-PC2150
Type .... Absorbed Glass Mat
Terminal Type .... Top Stud
Group Size 31
Volts 12
Load Test Amperage (1/2 CCAh) 575
Reserve Capacity (Minutes) 205

Cold Cranking (In Amps)
-At 0ºf (-18ºc) .... 1150A (Each Battery)

Maximum Dimensions
-Length (Including Flange) 13in/330mm
-Width 6.8in/173mm
-Height (Including Top Posts) 9.4in/239mm
-Approximate Weight .... 77.8 Lbs

Alternators

Make .... BOSCH
Series .... HD 10
Amperes 150
Volts 28.4
Output Power .... 3 Kw
Ground .... negative

Battery equalizer

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

Starter

Make .... Mitsubishi Electric Corporation (MELCO)
Type 105P70
Voltage 24

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

Starter solenoid

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

MAINTENANCE INFORMATION

MI15-24B

DATE :	MAY 2015	SECTION: 06 - Electrical
SUBJECT :	**POWER CABLES INSPECTION GUIDELINES**	

Revision: B Added: Power cables for L.H. side alternator & fan drive breaker box
March 25, 2020

APPLICATION

Model	VIN 
All Prevost models	

DESCRIPTION

It is important to carry out a regular inspection of the vehicle power cables. Power cables in poor condition can be the cause of failures and serious damage in the engine compartment.

Please note that some images in this document may represent arrangements different from those found on vehicles of former generations. However, inspection criteria and points to check presented in this document remain applicable in essence for all models of Prevost vehicles.

POWER CABLES MAINTENANCE SCHEDULE	
DESCRIPTION	**INTERVAL**
Perform power cables inspection	Every 3 months

POWER CABLES

- The power cables are those through which flow the highest currents. These cables are those with the largest electrical conductor diameters on the vehicle.

- The power cables are 1/0, 2/0, 3/0 wire gauges respectively Ø0.325in, Ø0.365in, Ø0.409in.

  Note: not to be confused with the 1, 2, 3 wire gauges that are actually smaller.

- There are power cables at the following locations:

• On the **alternators positive (+) stud terminal** and from there, up to junction block in the electrical compartment (Figure 1 to Figure 5).

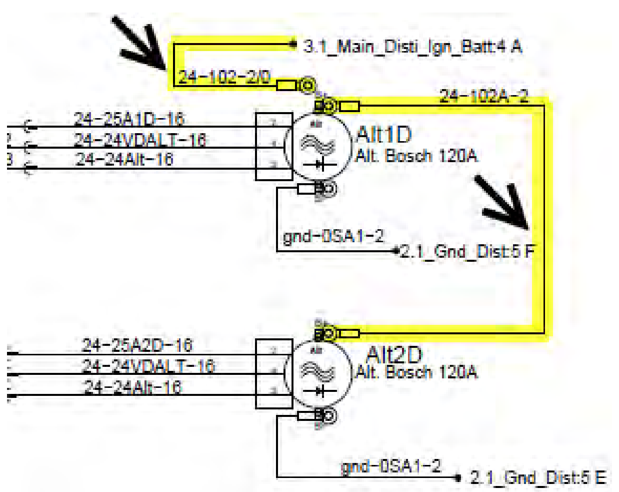


Figure 1 – R.H. SIDE ALTERNATORS (2x BOSCH) MECHANICAL COOLING FAN DRIVE CONFIGURATION

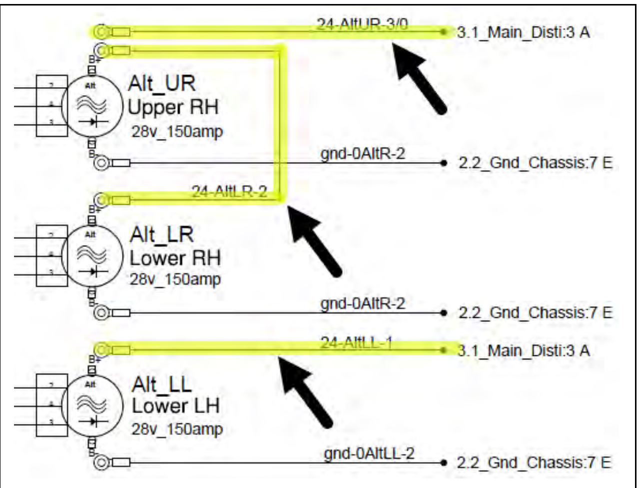


Figure 2 – L.H. + R.H. SIDE ALTERNATORS (3x BOSCH) ELECTRIC FAN DRIVE CONFIGURATION

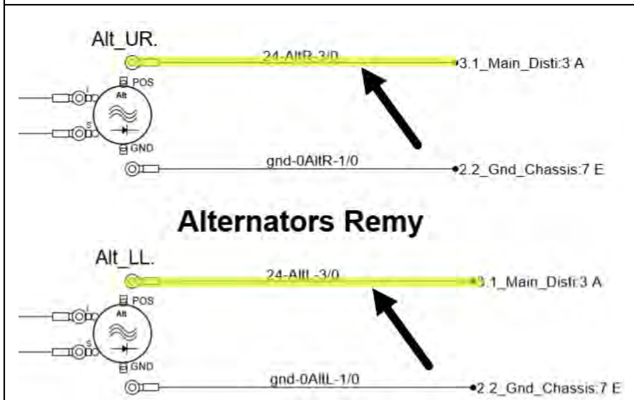


Figure 3 – R.H. + L.H. SIDE ALTERNATORS (2x DelcoRemy)

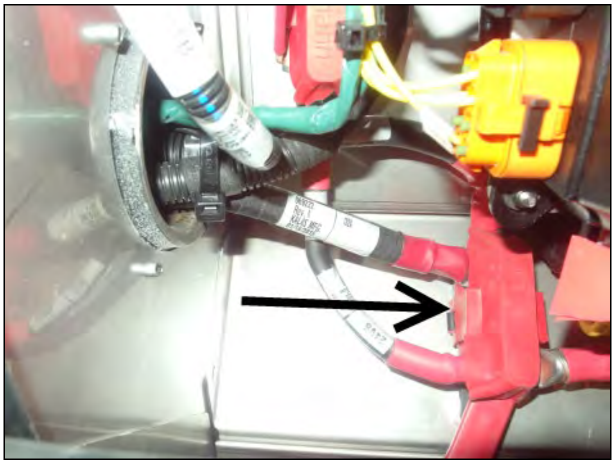


Figure 4: Bussman Junction Block - X3 Series.

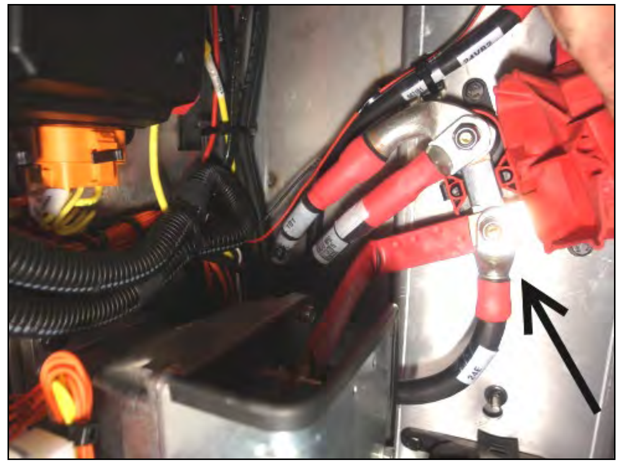


Figure 5: Bussman Junction Block - H3 Series.

- On the **starter positive (+) stud terminals** and from there, up to Bussman junction block in the electrical compartment (Figure 6, Figure 7).

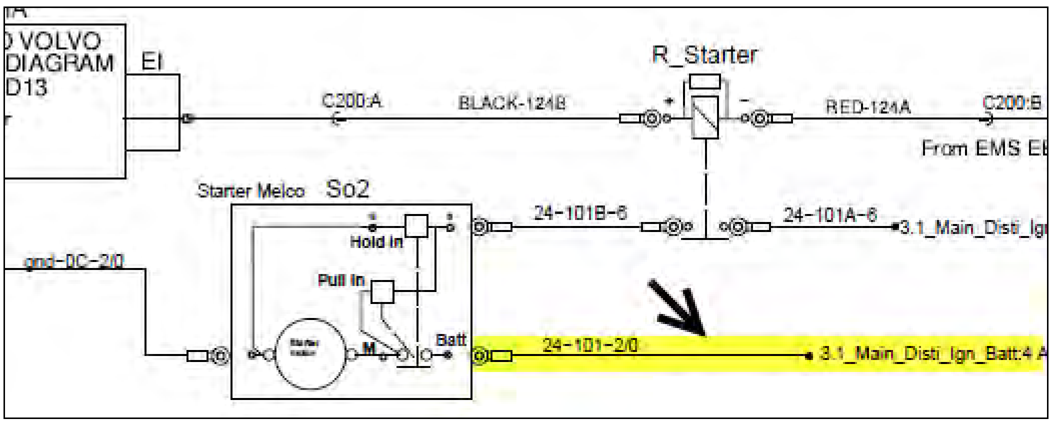


Figure 6

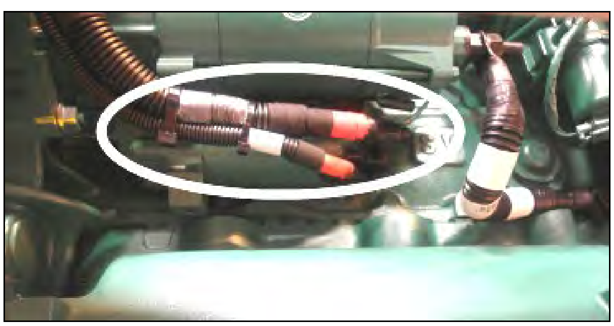


Figure 7: starter cables

- In the electrical compartment, **connected to the junction block** (Figure 8).

Figure 8

- In the **battery compartment** between **battery and master relay R1** (Figure 9).

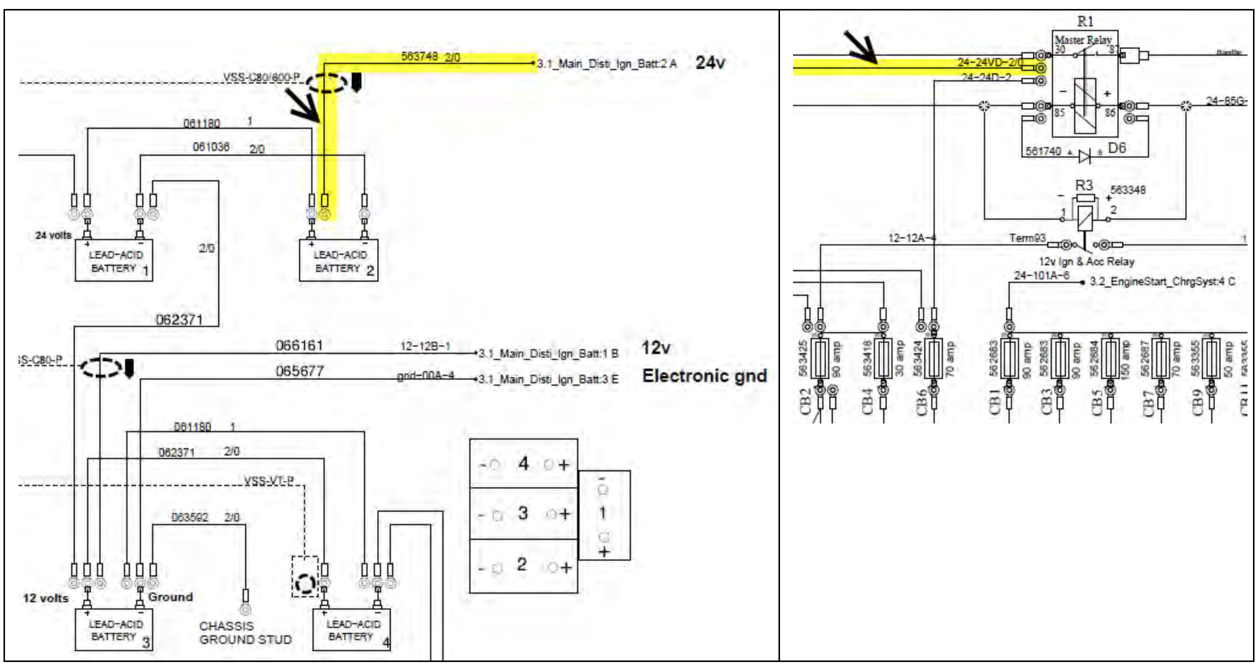


Figure 9

- Between **Bussman junction block** and **main circuit breaker bus bar** (Figure 10 & Figure 11).

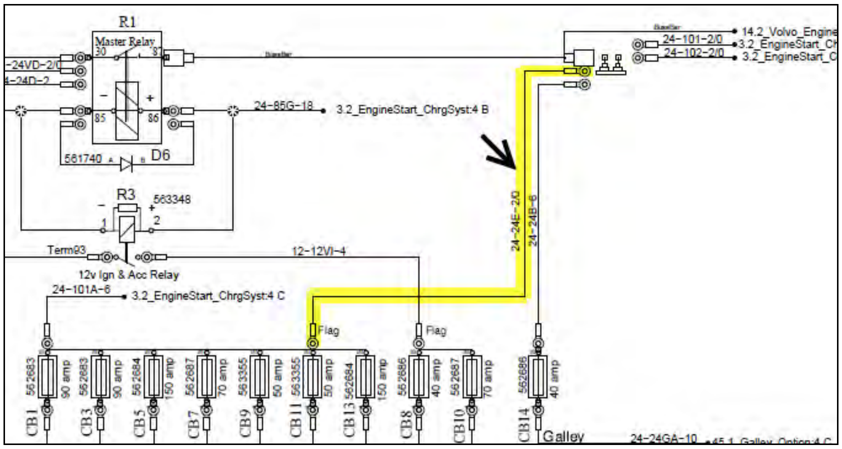


Figure 10

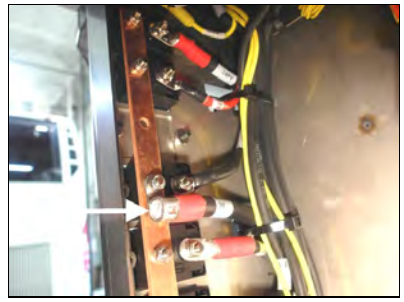


Figure 11: Power cable on main circuit breakers' bus bar.

- From the electric fan drive breaker box up to fuse F199 in main power compartment (Figure 12)

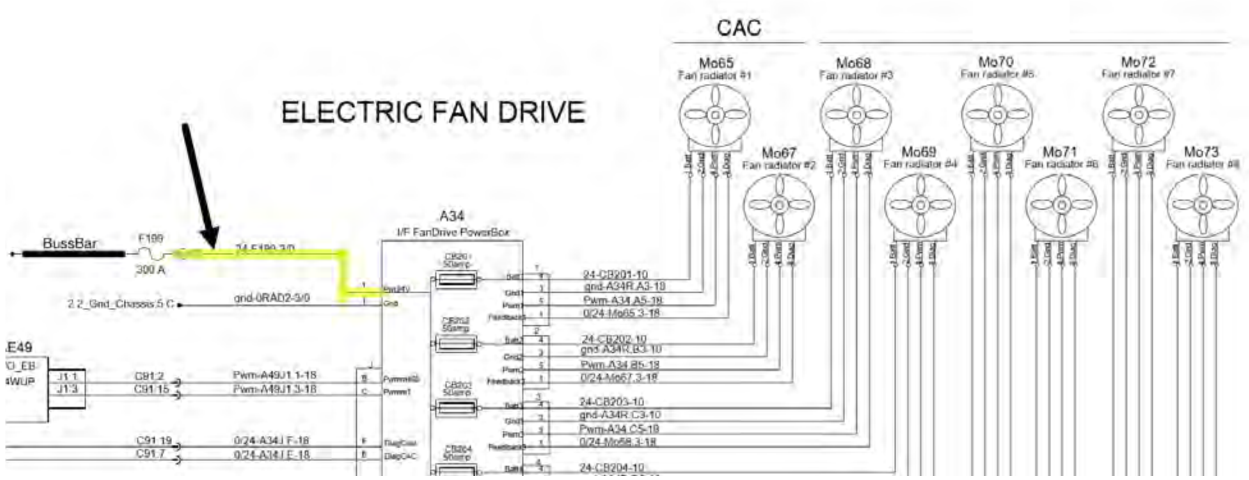


Figure 12: ELECTRIC FAN DRIVE BREAKER BOX

PROCEDURE

DANGER

Park vehicle safely, apply parking brake, stop engine. Prior to working on the vehicle, set the ignition switch to the OFF position and trip the main circuit breakers equipped with a trip button. On Commuter type vehicles, set the battery master switch (master cut-out) to the OFF position.

POWER CABLES GENERAL INSPECTION CRITERIA

1. **Make sure that the power cables are properly secured with appropriate fasteners so that they do not move. Movement of the cables can cause wear of the extruded protective sheath, strains on stud terminals and ring cable lugs.**

2. **Ensure that the power cables do not rub on other cables or other components.**

3. **Make sure ring cable lugs are securely attached to the stud terminals, that the retaining nut is tightened. Also, make sure that cable lug crimping holds firmly on copper conductor.**

OTHER THINGS TO CHECK

- Check for damages caused by electric arcs with loss of material along the copper conductor.
- Check for damaged cable extruded sheath and having lost its insulating properties.
- Bosch T1 alternator: ensure that the rubber grommets at the rear cap of the alternator are present.
- P-clamp type cable clamps must be suitable for cable diameter. The cable must remain in the P-clamp without moving or rubbing, thus oversized P-clamps are not allowed. Inspect the corrugated protective sheath passing through the P-clamp for signs of wear.
- At certain locations, power cables are protected by a corrugated protective sheath and should remain as such.

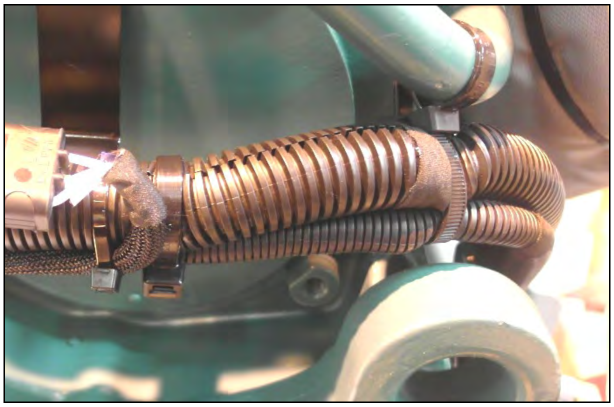


Figure 13: starter cables in a corrugated protective sheath.

- Ensure that the power cables do not rub on bolt heads or sharp metal edges that can cut or wear the cable extruded sheath.

- For power cables passing through a corrugated protective sheath, it is recommended to apply two layers of fabric tape every 3 to 6 inches minimum to prevent the cable from coming out of the corrugated protective sheath (Figure 14). The ends of the corrugated protective sheath should be covered with fabric tape (figure 15).

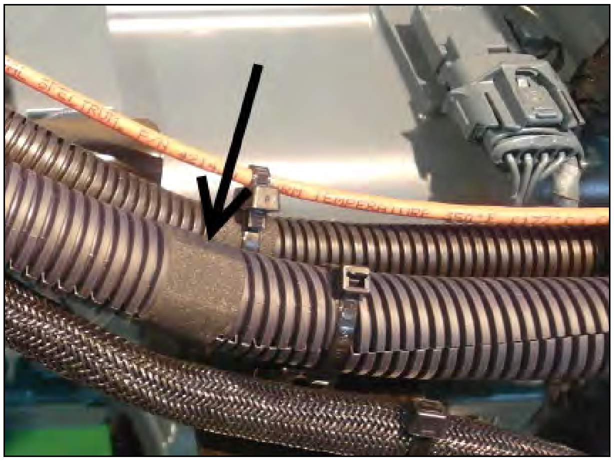


Figure 14: Two layers of fabric tape applied every 3 to 6 inches to prevent the cable from coming out of the corrugated protective sheath.

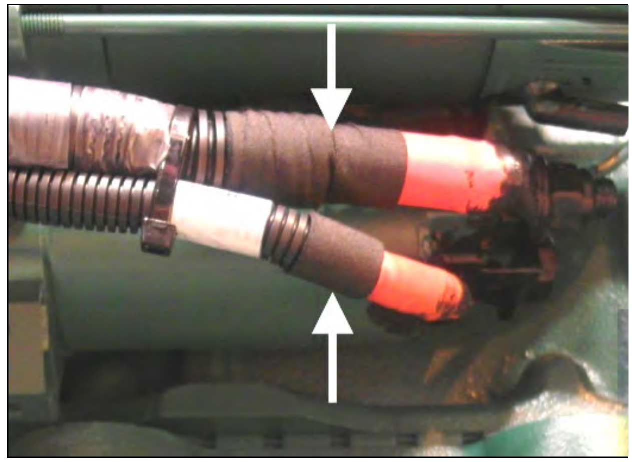


Figure 15: The ends of the corrugated protective sheath should be covered with fabric tape.

- Stud terminal nuts properly tightened. Use a nut with nylon insert to replace a similar nut where applicable. Protect ring cable lugs against tightening force by placing a flat washer between nut and ring cable lug.

When required, use fasteners that secure cables while preventing rubbing

RING CABLE LUGS

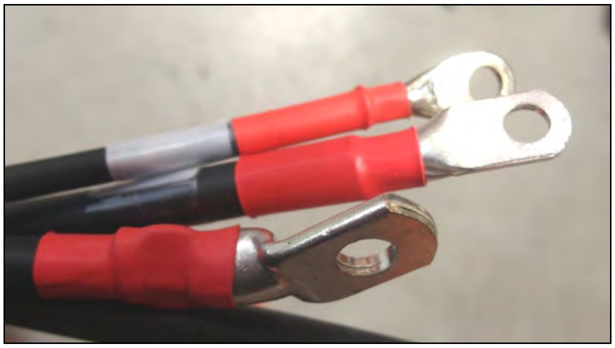


Figure 16: Cable lugs must be closed type, crimped or welded.

- Ring cable lugs should not be distorted.
- Ring cable lugs should not suffer strains that can deform.
- Ring cable lugs must be installed with smooth washers and nuts to prevent damage to the cable lug when tightening.

Figure 17: Power cable shouldn’t be bent just next to the cable lug. Angled cable lugs are used to avoid mechanical stress.

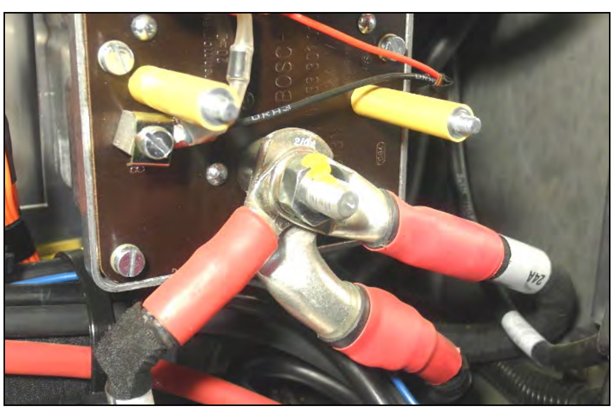


Figure 18: When several terminals are connected on a single stud terminal, the largest cable lug must be placed first, followed by the second larger and so on. Cable lugs should be distributed around the stud terminal in a way that no cable lug is distorted when tightening the nut.

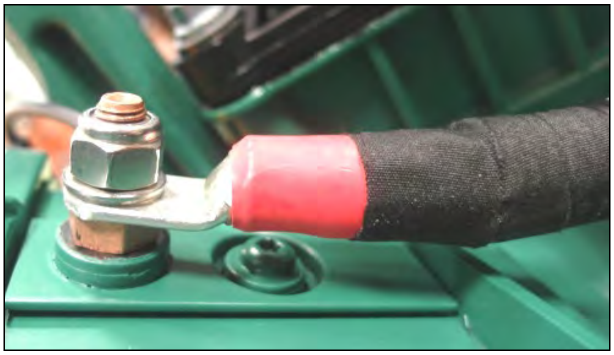


Figure 19: No exposed or broken copper strands.

- A shrink tubing (or fabric tape) should cover the copper strands.
- Ensure that the power cables and ground wire are not stretched tight.
- Ensure that the cable lugs are still properly crimped on the copper conductor, that the conductor strands are not broken so that the power cable retain its capacity and ensure unrestricted current flow.

BATTERY CABLES

- Battery interconnection cables must be checked too :

– Ensure the cables are properly fastened to battery posts and that the cables are in good condition (consult battery manufacturer documentation for appropriate tightening torque).

– No corroded or cut copper strands. No apparent copper strands. Protective sheath in good condition, no cuts, no rubbing against metal edges.

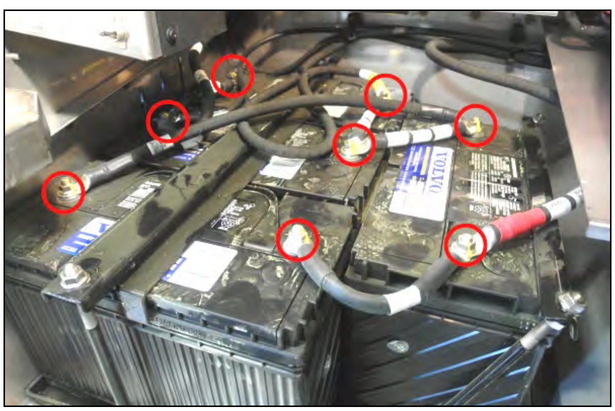


Figure 20: battery bank

STEEL P-CLAMPS

Figure 21: P-clamps are no longer used to secure power cables, but they can nevertheless be found on coaches of older generations. The piece of rubber that protects cable against the P-clamp steel loop must absolutely be in place. Replace any P-clamps where the rubber piece is missing, broken or likely to separate from the steel loop.

NOTE
Unlike steel P-clamps, plastic clamps have the advantage of being not conductive. A good practice would be to replace P-clamps ***securing power cables*** *with appropriate nylon cable ties like the following:* **#507664 CABLE TIE, DOUBLE LOOP** **#509491 CABLE TIE, WIDE**

Figure 22: P-clamp with appropriate diameter prevents the power cable or corrugated protective sheath from moving and rubbing inside the clamp.

ALTERNATORS

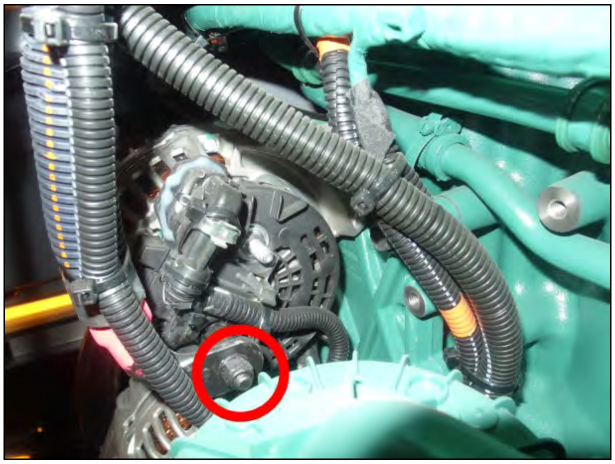


Figure 23: Make sure power cables/positive cables (+) are properly connected to alternator, that stud terminal nuts are properly tightened.

TERMINAL NUT PRESCRIBED TORQUE

<u>Delco Remy 55SI</u>
- Ground : 50-60 lb-in
- Positive (+): 80-125 lb-in
- Sense (S) 25-45 lb-in
- Indicator (I) 25-45 lb-in

<u>Bosch HD10</u>
- B1(+) terminal: 10 lbf-ft
- ground: 6 lbf-ft

<u>Bosch T1</u>
- D+: 21-28 lbf-in
- B+, B-: 88-115 lbf-in
- W: 36-48 lbf-in

<u>Delco 50DN</u>
- DC Output: 30-35 lbf-ft
- F1, F2, Relay: 6 lbf-ft

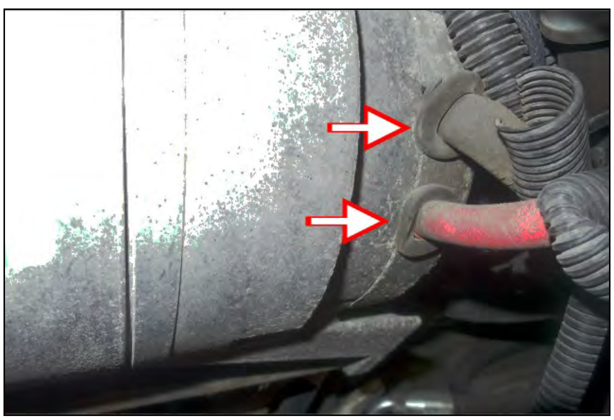


Figure 24: Bosch T1 alternator with the two required rubber grommets. Alternator cables connected to the alternator stud terminals must be protected against metal edges with rubber grommets.

Figure 25: Fire in engine compartment caused by rubbing of power cable against metal edge of Bosch T1 alternator rear cover. Lower rubber grommet was missing when fire occured. Evidence of electrical arc can be seen.

CORROSION PROTECTION

- Power cable connections on alternators, starter and ground connections exposed to water, dust, etc. should be protected against corrosion with Loctite Color Guard rubber coating (**Figure 26**) (Prevost p/n: 684013).

Figure 26: Loctite Color Guard.

Figure 27: Upper R.H. side Bosch alternator power cable lug protected with Color Guard rubber coating.

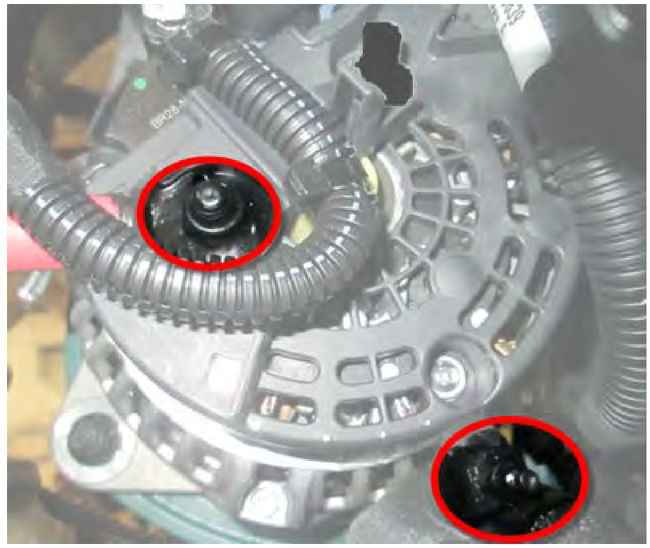


Figure 28: Lower R.H. side Bosch alternator power cable lug protected with Color Guard rubber coating.

Protect the cable lug similarly on the L.H. side alternator (with electric fan drive)

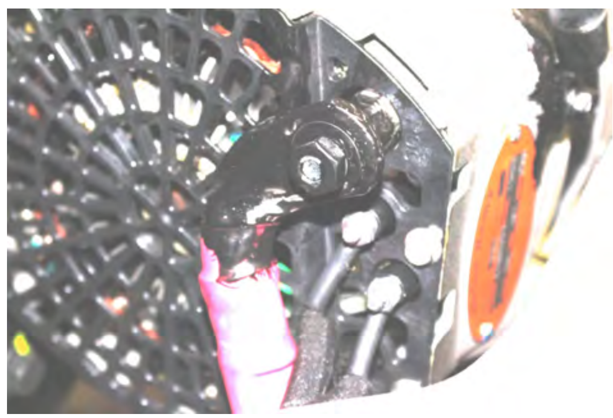


Figure 29: DELCO REMY ALTERNATOR

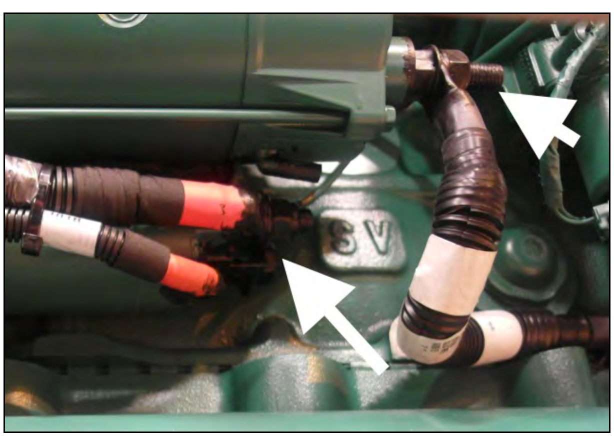


Figure 30: Starter power cable and ground cable lugs protected with Color Guard rubber coating.

PARTS / WASTE DISPOSAL

Discard according to applicable environmental regulations (Municipal/State[Prov.]/ Federal)

Access all our Service Bulletins on https://secureus5.volvo.com/technicalpublications/en/pub.asp
Or scan the QR-Code with your smart phone.

*E-mail us at **technicalpublications_prev@volvo.com** and type "ADD" in the subject to receive our warranty bulletins by e-mail.*

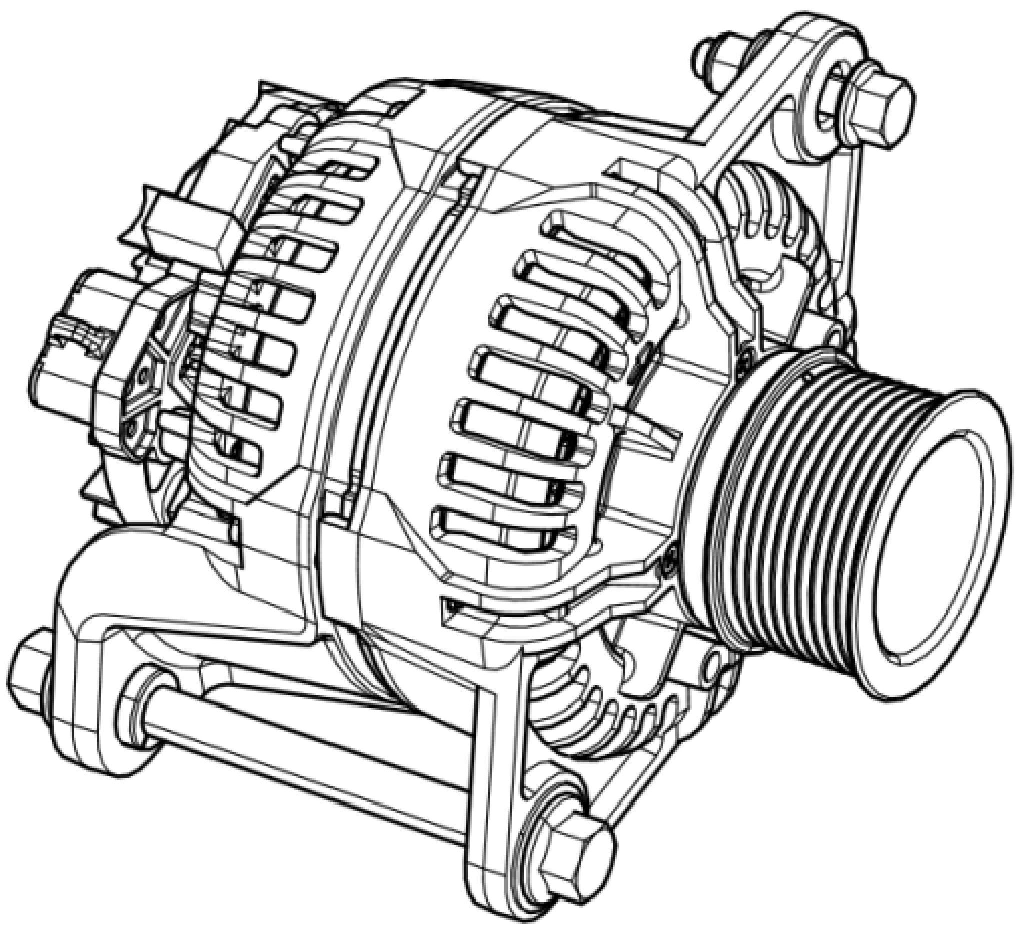
MAINTENANCE INFORMATION

MI16-17

DATE :	FEBRUARY 2016	**SECTION:** 06 - Electrical
SUBJECT :	**BOSCH HD10 ALTERNATOR REMOVAL AND INSTALLATION**	

Please, get the latest revision of Maintenance Information MI16-17 on Prevost Technical Publications web site:

https://techpub.prevostcar.com/en/



CONTENTS

SECTION CHANGE LOG

	DESCRIPTION	DATE
1		
2		
3		
4		
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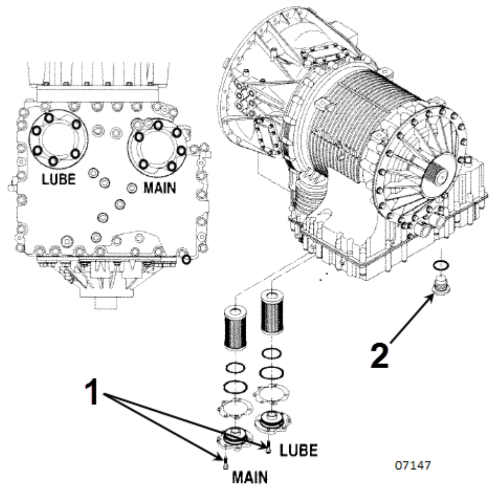
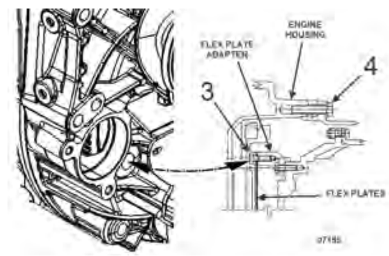
6		

1. TORQUE TABLES

1.1 ALLISON TRANSMISSION





ALLISON TRANSMISSION		
No	DESCRIPTION	TORQUE
1	Lube and main filter cover bolts	38-45 lb-ft (52-61 Nm)
2	Drain Plug	18-24 lb-ft (24-33 Nm)
3	Flex plate screws	24-30 lb-ft (33-41 Nm)
4	Transmission housing screws to engine housing	46-50 lb-ft (62-68 Nm)

2. DESCRIPTION

The vehicle is equipped with an Allison B500 automatic transmission

2.1 ALLISON AUTOMATIC TRANSMISSION

The Allison Transmission has 6 speeds with two top range (fifth and sixth) overdrives.

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.

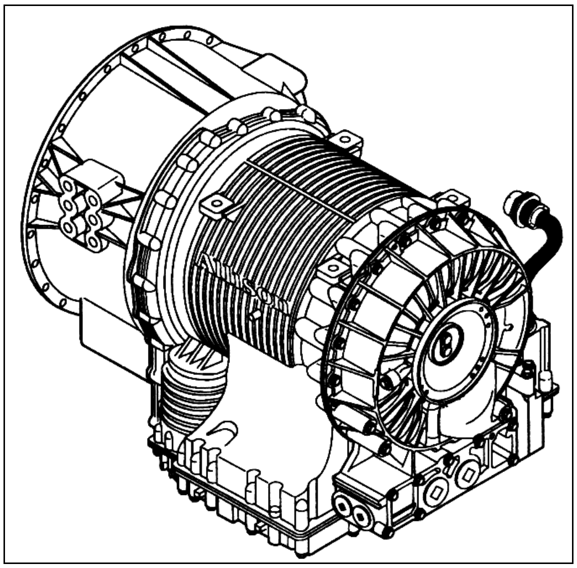


FIGURE 1: ALLISON TRANSMISSION (07075)

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 7 "Allison transmission troubleshooting" in this section).

2.1.1 Retarder

This 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 brakes.

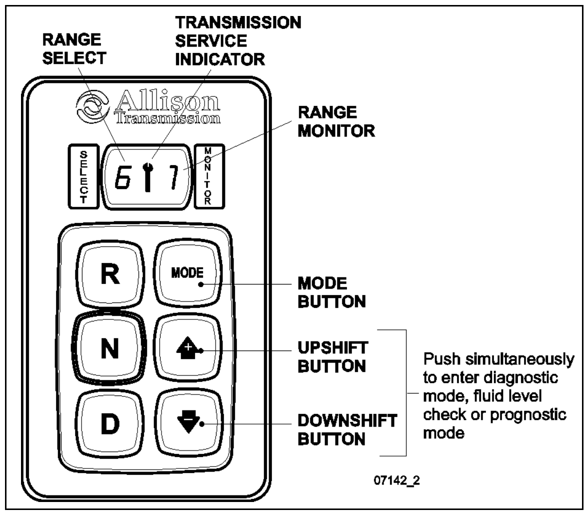


FIGURE 2: ALLISON PUSHBUTTON SHIFT SELECTOR

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.

3. ALLISON TRANSMISSION MAINTENANCE

3.1 MANUAL FLUID LEVEL CHECK

To gain access to the dipstick, open the engine compartment rear door; dipstick is located on the radiator side of the engine (Figure 3).

Clean all dirt from around the end of the fluid filler tube before removing the dipstick. Dirt or foreign matter must not be permitted to enter the fluid system since they will cause valves to stick, create undue wear to transmission parts and clog small passages. Check the fluid level using the procedures in Cold Check and Hot Check. Record any abnormal level on your *"Maintenance Records"*.

WARNING

When checking the fluid 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.

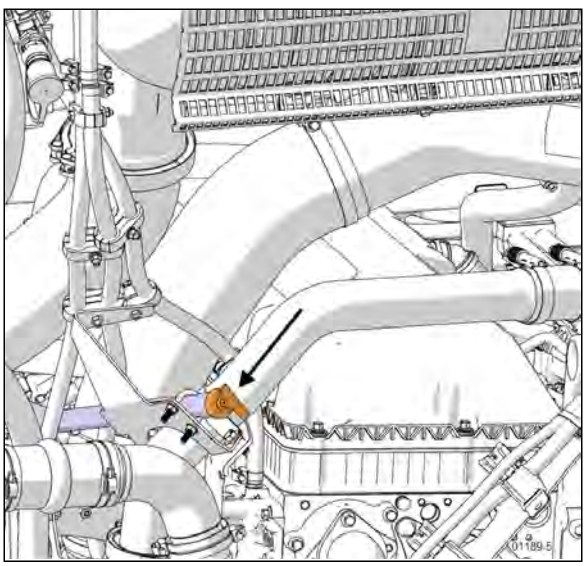


FIGURE 3: FLUID LEVEL DIPSTICK (ALLISON)

Always check the fluid level reading at least twice when the engine is running. Consistency is important in maintaining the accuracy of the reading. If inconsistent readings persist, check the transmission breather to ensure it is clean and free of debris.

3.1.1 Cold Check

The purpose of the **Cold Check** is to determine if the transmission has enough fluid to be operated safely until a **Hot Check** can be made.

CAUTION

The fluid level rises as sump temperature increases. DO NOT fill above the Cold Run band if the transmission fluid is below normal operating temperature. During operation, an overfull transmission can become overheated, leading to transmission damage.

1. Move the vehicle to a level surface, put transmission in «N» (Neutral), and set the parking brake.
2. With the engine idling (500 - 800 rpm), shift to «D» (Drive) and then shift to «R» (Reverse) to clear the hydraulic system of air.
3. Run the engine at idle in «N» (Neutral) for about one minute.
4. While the engine is running, remove the dipstick from the tube and wipe it clean (Figure 3). Insert the dipstick into the fill tube, pushing down until it stops.
5. 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 fluid 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.
6. Perform a **Hot Check** at the first opportunity after the normal operating temperature of 160ºF to 200ºF (71ºC to 93ºC) is attained.

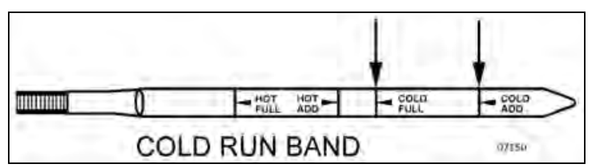


FIGURE 4: COLD CHECK

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 following these conditions:

- Engine is idling (500-800 rpm) in «N» (Neutral).
- Transmission fluid is at normal operating temperature.
- The vehicle is on a level surface.

3.1.2 Hot Check

To perform a **Hot Check**, do the following:

1. The **Hot Check** can be performed when the transmission fluid reaches the normal operating temperature (160ºF to 200ºF / 71ºC to 93ºC). The transmission fluid temperature can be checked with the Driver Information Display (DID) when selecting the Gauge menu (refer to the ''Operator's Manual'' for added information).

CAUTION

The fluid **must be hot** to obtain an accurate check because the fluid level rises as temperature increases.

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.

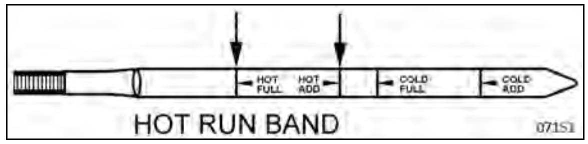


FIGURE 5: HOT CHECK

NOTE

The Cold Check is more appropriate for verifying the fluid 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.***

3.2 FLUID LEVEL CHECK USING THE PUSHBUTTON SHIFT SELECTOR

Fluid level sensor (OLS) is provided as a standard equipment with the vehicle transmission. With the OLS and Allison 5th generation shift selector, a more accurate electronic fluid level check is achieved compared with the dipstick.

Fluid 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. Wait for at least 2 minutes to allow the fluid to settle;
3. Press simultaneously the (Upshift) and (Downshift) arrow buttons once.
4. Fluid level codes are displayed once the following parameters are met :
   - The vehicle has been stationary for approximately 2 minutes to allow the fluid to settle;
   - Engine at idle;
   - Fluid at normal operating temperature, between 104°F (40°C) and 220°F (104°C);
   - Transmission in «N» (Neutral);
   - Transmission output shaft stopped;
   - Fluid level sensor present and working.
5. <u>Correct fluid level</u> is displayed as shown.

6. Low fluid level is displayed as shown. The number indicates the number of quarts of fluid the transmission requires.

7. High fluid level condition with the number of quarts in excess is displayed as shown.

NOTE
Confirm a low fluid level condition by making a manual fluid level check.

8. To exit the Fluid Level Display Mode, press any range button «R», «N» or «D» at any time.

NOTE
Note that the quantities LO 4 QTS and HI 3 QT are the lowest & highest values displayed and that the actual variation in fluid level may exceed these numbers.

If the fluid level check cannot be completed, an invalid for Display fault is reported. Refer to table below to review the codes and conditions.

CODE	**CAUSE OF FAULT CODE**
SETTLING OK	Settling time too short
ENG RPM TOO LOW	Engine speed (rpm) too low
ENG RPM TOO HIGH	Engine speed (rpm) too high
MUST BE IN NEU	N (Neutral) must be selected
FLUID TEMP TOO LOW	Sump fluid temperature too low
FLUID TEMP TOO HIGH	Sump fluid temperature too high
VEH SPD TOO HI	Output shaft speed
SENSOR FAILED	Sensor failure

3.3 RECOMMENDED AUTOMATIC TRANSMISSION FLUID

Only use fluids meeting Allison Transmission specification TES295 or TES389 in your transmission. Refer to TES295 or TES389 Approved Fluids list, found under the Service/Parts heading on the home page of the Allison Transmission web site **www.allisontransmission.com.**

Allison Transmission recommends you take the following into consideration when selecting the appropriate fluid type for your transmission:

- Fluids meeting specification TES295 are preferred over TES389 fluids for use in all transmission applications.
- TES295 fluids are fully qualified for Severe Duty and Extended Drain intervals.
- A TES295 fluid allows you to operate at a lower ambient temperature than a TES389 type fluid.
- TES389 fluid is the minimum fluid requirement approved for use in Allison transmissions.
- To extend the TES389 fluid drain intervals beyond the recommended mileage or hours change interval, use a fluid analysis program.

When choosing a fluid type to use, consider what the minimum fluid operating temperature of the fluid will be based on the ambient temperatures reached in the geographical location for the vehicle.

Transmission Fluid Operating Temperature Requirements

Fluid type	**Minimum operating temperature**	
	Celsius	**Fahrenheit**
TES295	-35	-31
TES389	-25	-13

CAUTION
Disregarding minimum fluid temperature limits can result in transmission malfunction or reduced transmission life.

3.3.1 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.

3.3.2 Keeping Fluid Clean

Fluid must be handled in clean containers, fillers, etc., to prevent foreign material from entering the transmission. Place the dipstick on a clean surface area while filling the transmission.

CAUTION

Containers or fillers that have been used to handle antifreeze or engine coolant must NEVER be used for handling transmission fluid. Antifreeze and coolant solutions contain ethylene glycol that, if introduced into the transmission, can cause the clutch plates to fail.

3.3.3 Fluid Contamination

At each fluid change, examine the drained fluid 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 fluid system.

3.3.4 Metal Particles

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

CAUTION

If excessive metal contamination has occurred, replacement of the fluid cooler and replacement of all bearings within the transmission is recommended.

3.3.5 Coolant Leakage

If engine coolant leaks into the transmission fluid 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.

3.4 FLUID AND FILTER CHANGE INTERVAL

TABLE 1

Allison Transmission Recommended Fluid And Filter Change Intervals (with retarder) For transit and intercity coach with duty cycle greater than one (1) stop per mile.					
Using TES389 or Mixture[1]			**Using 100% TranSynd or TES295 Approved Fluid[1]**		
Fluid	**Filters**		**Fluid**	**Filters**	
	Main & Lube	**Internal**		**Main & Lube**	**Internal**
6,000 Miles *Note: always replace main and lube filters with the fluid change*	**6,000 Miles** *Note: always replace main and lube filters with the fluid change*	**Overhaul**	**84,000 Miles** *Note: always replace fluid every two main and lube filters changes*	**42,000 Miles**	**Overhaul**

[1] Refer to SECTION 24A : LUBRICATION & SERVICING SCHEDULE for important information regarding fluid and filter servicing.

3.4.1 Fluid and Filter Change Information

Allison transmissions are factory fill with **Castrol TranSynd** fluid. Fluid change must be performed with the vehicle on a flat and level surface and with parking brake applied. Fluid and filter change frequency is determined by the severity of service and operating conditions of the transmission and by the filter equipment installed. 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
*The transmission is equipped with **High Capacity filters**. High Capacity filters allow for increased fluid and filter change intervals in transmissions utilizing TES295 approved fluid or TranSynd. High Capacity filters eliminate the requirement of the initial 5000 miles (8000km) main filter change.*

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 should be used.

IMPORTANT NOTE
A mixture of TES295 and TES389 fluid must continue to use the TES389 fluid change intervals, until two fluid changes with only TES295 fluid have occurred, at which time the TES295 schedule may be used.

3.5 FLUID AND FILTER CHANGE PROCEDURE

3.5.1 Drain

1. The transmission should be at an operating temperature of 160ºF (71ºC) to 200ºF (93ºC) when the fluid is drained. This will ensure quicker and more complete fluid drainage.
2. Remove the drain plug from under the transmission (Figure 6) and allow the fluid to drain into a suitable container. Check the condition of the fluid as described previously.
3. Remove twelve bolts (item 1), two filter covers (item 2), two gaskets (item 3), two O-rings (item 4), two O-rings (item 5) and the two filters (item 6) from the bottom of the control module (Figure 6).
4. When reinstalling parts, lubricate and install new O-rings (4) and (5) on each cover (2). Lubricate O-ring inside filter (6) and push filter onto cover (2). Install new gaskets (3) on cover (2) and align holes in gaskets with holes in cover.

⚠ **CAUTION**
Do not use bolts to draw the cover to sump. This can damage the cover, seal, or sump.

5. Install filter and cover assemblies into the filter compartment. Align each filter/cover assembly with the holes in the channel plate/sump. Push the cover assemblies in by hand to seat the seals.
6. Install twelve bolts and both covers.

TORQUE: 38-45 lb-ft (52-61 Nm)

7. Inspect the drain plug and O-ring. Replace if necessary. Reinstall the drain plug.

TORQUE : 18-24 lb-ft (24-33 Nm)

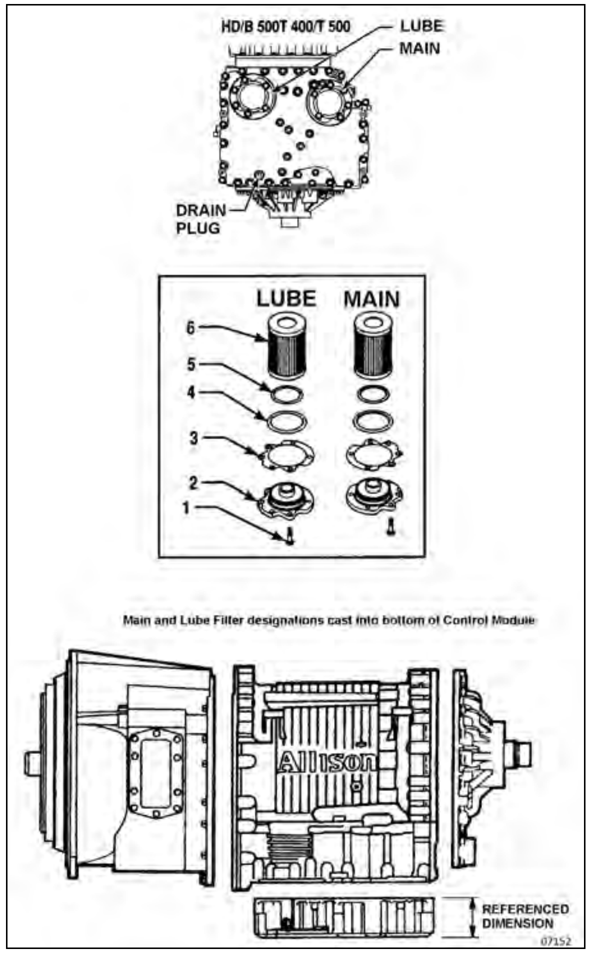


FIGURE 6: DRAIN PLUG AND FILTERS

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)

3.5.2 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 fluid cooler lines.

Using the fluid level dipstick filler tube, refill with 28 US qts (26.5 liters) and check the fluid level using the **Fluid Level Check Using Pushbutton Shift Selector** procedure in this section. Add transmission fluid according to pushbutton shit selector fluid level check.

3.6 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. Fluid leaks (correct immediately);
3. Loose, dirty, or improperly adjusted throttle sensor linkage;
4. Damaged or loose fluid lines;
5. Worn or frayed electrical harnesses, improper routing;
6. Worn or out of phase drive line U-joint and slip fittings.

CAUTION

DO NOT pressure wash the transmission electrical connectors. Water and detergent will cause the contacts to corrode or become faulty.

3.6.1 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.

4. ALLISON TRANSMISSION FLUID COOLER REMOVAL

4.1 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 fluid cooler. Cover hose ends and fittings to prevent fluid contamination.

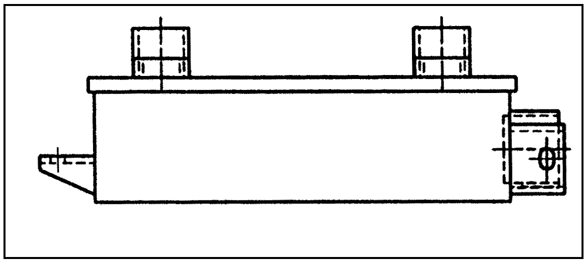


FIGURE 7: COOLER WITH RETARDER (07073)

WARNING

A significant amount of fluid may drain from fluid 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 fluid cooler from engine compartment.

5. ALLISON TRANSMISSION REMOVAL

The following procedure deals with the removal of the Allison transmission without removing the power plant cradle from vehicle. The methods used to support the transmission and engine depend upon conditions and available equipment.

1. Select transmission's "NEUTRAL" positions, 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.

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 fluid to drain. Inspect the drain plug washer and replace it if necessary. Reinstall the drain plug (see *"3.5 Fluid and Filter Change"* in this section.

TORQUE: 18-24 lb-ft (24-33 Nm)

WARNING

It is better to drain fluid when it is still warm. Avoid contact with fluid 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 fluid cooler hoses from transmission. Cover hose ends and fittings to prevent fluid contamination.

WARNING

A significant amount of fluid may drain from fluid 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.
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 (Figure 8).

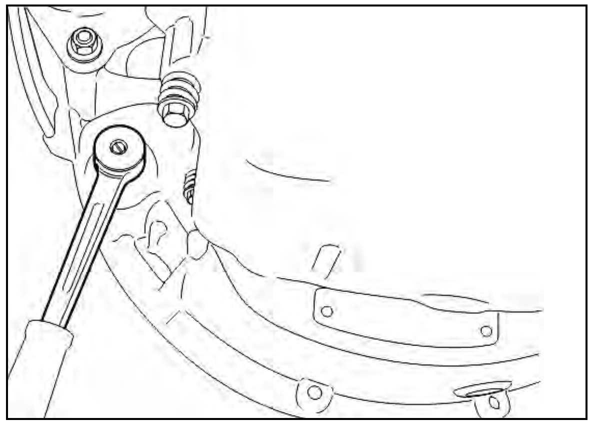


FIGURE 8: VOLVO ENGINE CRANKING POSITION

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.

6. ALLISON TRANSMISSION INSTALLATION

1. Place the transmission on a transmission jack.
2. Install a headless guide bolt into one of the 12 threaded holes in the flex plate adapter.

NOTE
For more clearance between the tag axle and transmission, the tag axle may be unloaded and jacked up.

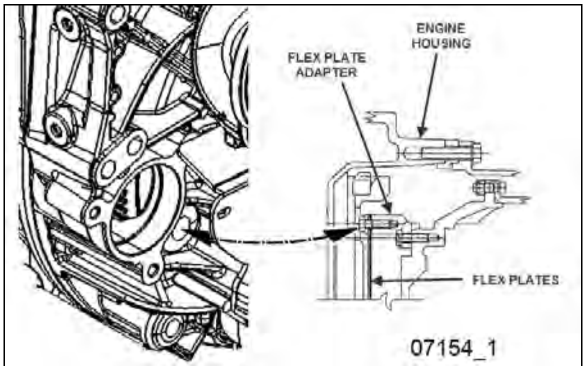


FIGURE 9: TRANSMISSION INSTALLATION

3. With the engine starter removed, use Volvo engine turning tool #88800014 (Figure 10) to align one of the 12 attaching screw holes in the flex plate with the engine starter access opening. If you do not have the Volvo tool, place a wrench on the crankshaft pulley attaching screw to turn it and therefore turn the flex plate.

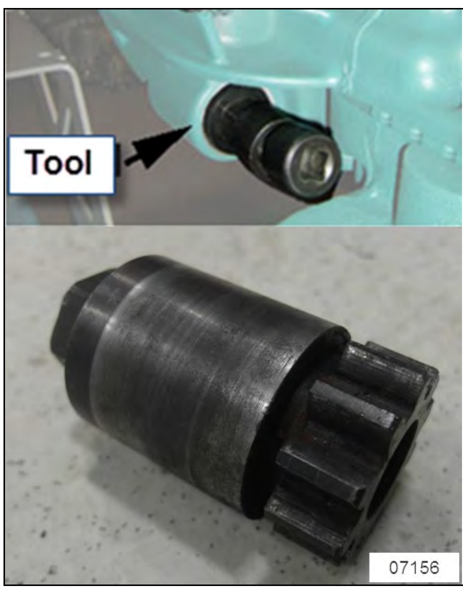


FIGURE 10: VOLVO ENGINE TURNING TOOL #88800014

4. Apply clear silicone (Prevost #680457 or equivalent) on the spacer and install it on the engine housing (Figure 11).

FIGURE 11: SPACER INSTALLATION

5. Lubricate the flywheel center pilot boss with molybdenum disulfide grease (Molycote G, or equivalent).
6. Raise transmission and position the flywheel pilot boss with the crankshaft hole.
7. Turn the flex plate adapter into the transmission to align the headless guide bolt with the flex plate hole facing the engine starter access opening.

WARNING
Severe damages and/or personal injury can occur if transmission is not adequately supported.

8. Apply clear silicone (Prevost #680457 or equivalent) around the edge of the transmission housing (Figure 12).

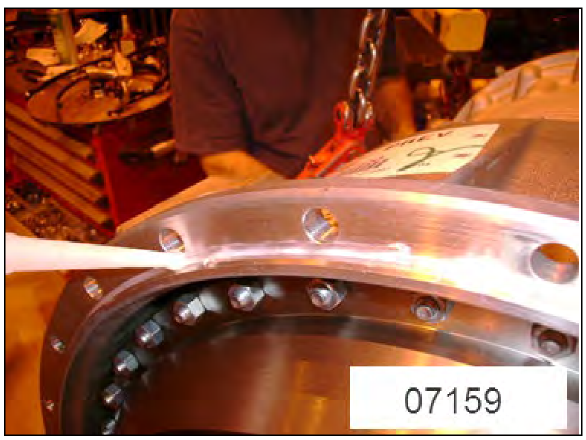


FIGURE 12: SILICONE APPLICATION TRANSMISSION HOUSING

9. Seat the transmission against the engine housing (with the spacer in place). NO FORCE SHOULD BE REQUIRED. If interference is encountered, move the transmission away from engine, then investigate the cause.

⚠ CAUTION

The transmission housing must be seated against the engine housing (with the spacer in place) prior to tightening any screws. DO NOT USE SCREWS TO SEAT THE HOUSING.

10. Start all screws attaching the transmission housing to the engine housing.
11. Tighten them gradually in a crisscross sequence as shown in Figure 13. Apply the following torque value:

TORQUE: 46-50 lb-ft (62-68 Nm)

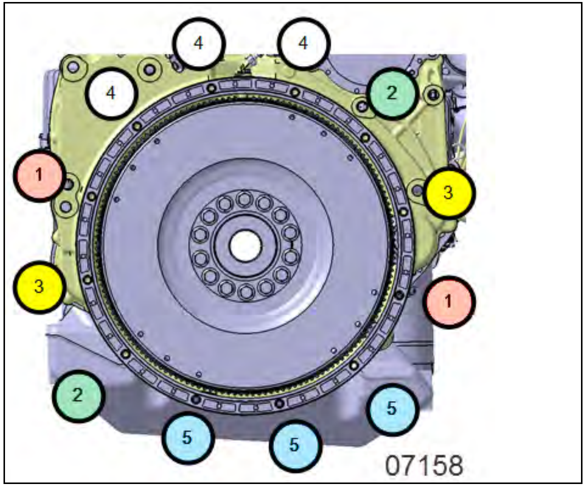


FIGURE 13: CRISS CROSS PATTERN

12. Remove the headless guide bolt from the flex plate adapter through the engine starter access opening. Replace it with a self-locking screw, finger-tighten then start the remaining screws. Use Volvo engine turning tool #88800014 (Figure 10) to align holes. If you do not have the Volvo tool, place a wrench on the crankshaft pulley attaching screw to turn it and therefore turn the flex plate.
13. Tighten all screws to the following torque value:

TORQUE: 24-30 lb-ft (33-41 Nm)

NOTE

Reinstall engine starter and connect cables.

Reinstall access plug below starter motor.

14. Remove jack from under transmission.
15. Connect all sensors.
16. Connect the main wiring harness.
17. Connect the air supply line (steel-braided hose) to the retarder control valve (if applicable).
18. Connect the two transmission fluid cooler hoses as they were previously.
19. Reinstall clamps and brackets, and replace locking ties previously removed during removal procedure.
20. Install propeller shaft and its safety guard. Refer to Section 09, *"PROPELLER SHAFT"*.
21. Install transmission dipstick and filler tube.
22. Install cross member under transmission.
23. Install engine splash guards.
24. 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 (Figure 14) or in the R.H. side rear service compartment.
25. Make sure that the drain plug is in place, and then remove the transmission dipstick and pour approximately 28 US qts (26.5 liters) of automatic transmission fluid through the filler tube. Check and adjust fluid level.

⚠ CAUTION

Do not overfill the transmission. Overfilling can cause fluid aeration (milky appearance) and overheating. If overfilling occurs, drain fluid as required to bring it to the proper level.

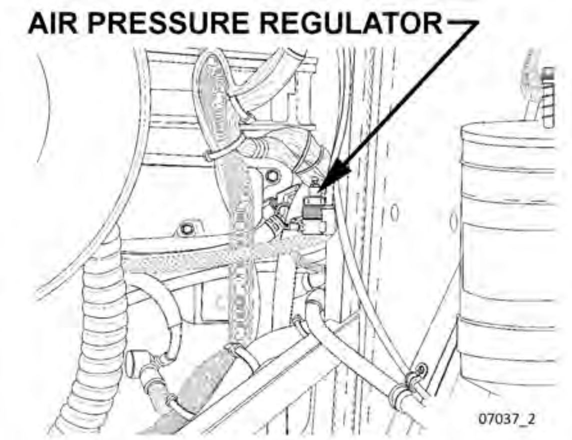


FIGURE 14: AIR PRESSURE REGULATOR (TYPICAL)

7. ALLISON TRANSMISSION TROUBLESHOOTING

The Allison transmission is equipped with a Transmission Control Module (TCM) which involves specific diagnostic incident codes. The TCM unit is located in the coach main power compartment.

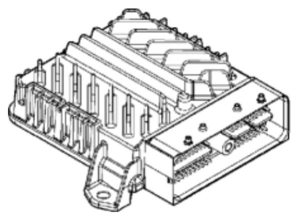


FIGURE 15: TRANSMISSION CONTROL MODULE (07140)

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.

7.1 DIAGNOSTIC TROUBLESHOOTING CODES (DTC) — ALLISON 5TH GENERATION CONTROLS

Diagnostic features are provided with the transmission control system to assist in troubleshooting of malfunctions and/or the monitoring of specific operating parameters. When a control system malfunction is detected, a series of Diagnostic Trouble Codes (DTCs) are used to identify and clarify the nature of the malfunction. These DTCs are each named by a 5 character alphanumeric string that refers to a diagnostic algorithm running pass/fail tests to help identify a malfunction in the transmission or vehicle operation. Most DTCs have some kind of diagnostic response that the operator notices, such as an illuminated CHECK light, selector display change, lock in range, or inhibit shifts condition.

DTCs are logged in the Transmission Control Module (TCM) memory by severity and by their active/inactive status with the most severe and active codes listed first. A maximum of five DTCs (numbered d1- d5) from most recent to oldest may be read from the shift selector. As DTCs are added, the oldest inactive DTC (historic) is dropped from the list. If all DTCs are active, the DTC with the lowest priority is dropped from the list.

An active code is any code that is current in the TCM decision-making process and has failed the DTC test(s) associated with that specific diagnostic algorithm. Historical codes, which are by definition inactive, are codes that are no longer failing their algorithm but are retained in the TCM in order to help the technician analyze possible causes and provide them direction if the vehicle is brought in before they are cleared from the queue.

DTCs can be cleared manually by the operator or they clear automatically from last (d5) to first (d1) in the queue after a number of engine starts, without becoming active again.

7.1.1 Using Shift Selector for Accessing Diagnostics Information

DTCs can be displayed on the display portion of the shift selector. A DTC is either active or historic. An active DTC is a DTC that is current in the TCM decision-making process. Historic DTCs are retained in the TCM memory and do not necessarily affect the TCM decision-making process.

7.1.2 Display Sequence

Up to five DTCs may be displayed one at a time from the selector once the diagnostic display mode has been initiated by the operator. Each DTC is 5 characters in length. The DTC status active or inactive is shown below the DTC.

Shows active DTC P0730

The operator presses the MODE button to read the next DTC in the queue (if any) or requests to exit diagnostics mode. The diagnostics mode times out and returns the selector to normal operating mode after approximately 10 minutes of operator inactivity.

7.1.3 Diagnostic Code Display and Clearing Procedure

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 ⬆ (Upshift) and ⬇ (Downshift) arrow buttons five times (Prognostics enabled) to access the Diagnostic Display Mode. With Prognostics disabled, press the ⬆ (Upshift) and ⬇ (Downshift) arrow buttons twice.
2. Press the MODE button to read the next code in the queue, if any.

To clear all active stored codes:

While in Diagnostic Mode, clear all active codes by pressing and holding the MODE button for approximately three seconds until the MODE message flashes. Release the MODE button. The MODE message should not remain illuminated if the active DTC shown in the display has cleared.

While in Diagnostic Mode, press and hold the MODE button for 10 seconds to clear both active codes and inactive codes. The MODE message flashes a second time indicating all codes are cleared from the queue.

7.1.4 Exiting Diagnostic Mode

Exit the diagnostic mode by one of the following methods:

1. Press simultaneously the ⬆ (Upshift) and ⬇ (Downshift) arrow buttons at the same time on the pushbutton shift selector.
2. Press any range button «D», «N» or «R» on the pushbutton shift selector.
3. After approximately 10 minutes of inactivity at the pushbutton shift selector, the diagnostic mode automatically exits and returns to normal operating mode.
4. Turn off power to the TCM (shut off the engine using the ignition key).

NOTE
Be sure to record all codes displayed before they are cleared. This is essential for troubleshooting.

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.

7.1.5 Diagnostic Trouble Code Response

The electronic control system is programmed to inform the operator of a problem with the transmission system via the CHECK light and shift selector display while it automatically takes action to protect the operator, vehicle, and transmission. When the Transmission Control Module (TCM) flags a Diagnostic Trouble Code (DTC) as active, the TCM may take a combination of diagnostic responses as listed in the following table.

CATEGORY OF RESPONSE	ACTIONS TAKEN
DNS - Do Not Shift	Release lock up (LU) clutch and inhibit lock up operation. Inhibit shifts from the current attained range. Turn on the CHECK light. Display the current attained range in the MONITOR window of the shift selector. Blank the SELECT window of the shift selector. Ignore any range selection inputs from the shift selector.
SOL OFF - SOLenoid OFF	All solenoids are commanded off, resulting in hydraulic default operation of the transmission – PCS1 & PCS2 are on hydraulically when off electrically.
RPR - Return to Previous Range	When the speed sensor ratio or PS1 tests do not pass, the TCM commands the same range as commanded before the shift.
NNC - Neutral No Clutches	When certain speed sensor ratio or PS1 tests do not pass, the TCM a neutral condition with no clutches applied.
DNA - Do Not Adapt	The TCM stops adaptive shift control while the code is active.

7.2 DIAGNOSTIC TROUBLESHOOTING CODES (DTC) LIST - ALLISON 5TH GENERATION CONTROLS

DTC	Description	CHECK 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 Circuit Low Voltage	No	Use default throttle values. Freezes shift adapts.
P0123	Pedal Position Sensor Circuit High Voltage	No	Use default throttle values. Freezes shift adapts.
P0218	Transmission Fluid Over Temperature	Yes	Use default sump temp
P0562	System Voltage Low	No	Inhibit TCC Operation, DNA
P0602	TCM Not Programmed	Yes	Lock in Neutral
P0604	Control module random access memory (RAM)	Yes	Lock in Neutral
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)
P0642	Sensor Reference Voltage "A" Circuit Low	Yes	Default sensor data used
P0643	Sensor Reference Voltage "A" Circuit High	Yes	Default sensor data used
P0657	Actuator Supply Circuit Voltage 1 Open (HSD 1)	Yes	SOL OFF, DNA, Inhibit TCC operation, Inhibit main modulation
P0658	Actuator Supply Voltage 1 (HSD1) Low	Yes	DNS, SOL OFF (hydraulic default)

DTC	Description	CHECK Light	Inhibited Operation Description
P0659	Actuator Supply Voltage 1 (HSD1) High	Yes	DNS, SOL OFF (hydraulic default)
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
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
P0715	Turbine Shaft Speed Sensor Circuit	Yes	DNS, Lock in current range
P0716	Turbine Shaft Speed Sensor Circuit Performance	Yes	DNS, Lock in current range
P0717	Turbine Shaft Speed Sensor Circuit No Signal	Yes	DNS, Lock in current range
P071A	RELS Input Failed On	Yes	Inhibit RELS operation
P071D	General Purpose Input Fault	Yes	None
P0720	Output Shaft Speed Sensor Circuit	Yes	DNS, Lock in current range
P0721	Output Shaft Speed Sensor Circuit Performance	Yes	DNS, Lock in current range
P0722	Output Speed Sensor Circuit No Signal	Yes	DNS, Lock in current range
P0725	Engine Speed Sensor Circuit	No	Default to turbine speed
P0726	Engine Speed Sensor Circuit Performance	No	Default to turbine speed
P0727	Engine Speed Sensor Circuit No Signal	No	Default to turbine speed
P0729	Incorrect 6th Gear Ratio	Yes	DNS, Attempt 5th, then 3rd
P0731	Incorrect 1st Gear ratio	Yes	DNS, Attempt 2nd, then 5th
P0732	Incorrect 2nd Gear ratio	Yes	DNS, Attempt 3rd, then 5th
P0733	Incorrect 3rd Gear ratio	Yes	DNS, Attempt 4th, then 6th
P0734	Incorrect 4th Gear ratio	Yes	DNS, Attempt 5th, then 3rd
P0735	Incorrect 5th Gear ratio	Yes	DNS, Attempt 6th, then 3rd, then 2nd
P0736	Incorrect Reverse Gear ratio	Yes	DNS, Lock in Neutral
P0741	Torque Converter Clutch System Stuck Off	Yes	None
P0752	Shift Solenoid 1 Valve Performance-Stuck On	Yes	DNS
P0776	Pressure Control Solenoid (PCS) 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 Fluid Pressure Switch 1 Circuit Low	Yes	DNS, Lock in current range
P0843	Transmission Fluid Pressure Switch 1 Circuit High	Yes	DNS, Lock in current range
P0847	Transmission Fluid Pressure Switch 2 Circuit Low	Yes	None

DTC	Description	CHECK Light	Inhibited Operation Description
P0848	Transmission Fluid Pressure Switch 2 Circuit High	Yes	None
P088A	Transmission Fluid Filter Maintenance Alert	No	None
P088B	Transmission Fluid Filter Maintenance Required	No	None
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	Unexpected Mechanical Gear Disengagement	Yes	DNS, Lock in first
P0897	Transmission Fluid Deteriorated	No	None
P0960	Main Pressure Modulator Solenoid Control Circuit Open	Yes	None
P0962	Main Pressure Modulator Solenoid Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)
P0963	Main Pressure Modulator Solenoid Control Circuit High	Yes	None
P0964	Pressure Control Solenoid 2 (PCS2) Control Circuit Open	Yes	DNS, SOL OFF (hydraulic default)
P0966	Pressure Control Solenoid 2 (PCS2) Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)
P0967	Pressure Control Solenoid 2 (PCS2) Control Circuit High	Yes	DNS, SOL OFF (hydraulic default)
P0968	Pressure Control Solenoid 3 (PCS3) Control Circuit Open	Yes	DNS, SOL OFF (hydraulic default)
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)
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
P097A	Shift Solenoid 1 (SS1) Control Circuit Open	Yes	Lock in range
P097B	Shift Solenoid 2 (SS2) Control Circuit Open	Yes	7-speed: Allow 2 through 6, N, R
P0989	Retarder Pressure Sensor Circuit Low	No	None
P0990	Retarder Pressure Sensor Circuit High	No	None
P1739	Incorrect Low Gear Ratio	Yes	Command 2nd and allow shifts 2 through 6, N, R
P1790	Gear Shift Module 1 Calibrated Invalid	Yes	Shift selector language or units incorrect
P1791	Gear Shift Module 2 Calibrated Invalid	Yes	Shift selector language or units incorrect
P1891	Throttle Position Sensor PWM Signal Low	No	Use default throttle values
P1892	Throttle Position Sensor PWM Signal High	No	Use default throttle values
P2184	Engine Coolant Temperature Sensor 2 Circuit Low Input	No	Use default engine coolant values
P2185	Engine Coolant Temperature Sensor 2 Circuit High Input	No	Use default engine coolant values
P2637	Torque Management Feedback Signal (A)	Yes	Inhibit SEM

DTC	Description	CHECK Light	Inhibited Operation Description
P2641	Torque Management Feedback Signal (B)	Yes	Inhibit LRTP
P2669	Actuator Supply Circuit Voltage 2 Open (HSD2)	Yes	SOL OFF, Inhibit TCC operation, Inhibit Main modulation, ONA
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)
P2684	Actuator Supply Circuit Voltage 3 Open (HSD3)	Yes	SOL OFF, Inhibit TCC operation, Inhibit Main modulation, ONA
P2685	Actuator Supply Voltage 3 (HSD3) Low	Yes	DNS, SOL OFF (hydraulic default)
P2686	Actuator Supply Voltage 3 (HSD3) High	Yes	DNS, SOL OFF (hydraulic default)
P2714	Pressure Control Solenoid 4 (PCS4) Stuck Off	Yes	DNS, RPR
P2715	Pressure Control Solenoid 4 (PCS4) Stuck On	Yes	DNS, SOL OFF (hydraulic default)
P2718	Pressure Control Solenoid 4 (PCS4) Control Circuit Open	Yes	DNS, SOL OFF (hydraulic default)
P2720	Pressure Control Solenoid 4 (PCS4) Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)
P2721	Pressure Control Solenoid 4 (PCS4) Control Circuit High	Yes	DNS, SOL OFF (hydraulic default)
P2723	Pressure Control Solenoid 1 (PCS1) Stuck Off	Yes	DNS, RPR
P2724	Pressure Control Solenoid 1 (PCS1) Stuck On	Yes	DNS, RPR
P2727	Pressure Control Solenoid 1 (PCS1) Control Circuit Open	Yes	DNS, SOL OFF (hydraulic default)
P2729	Pressure Control Solenoid 1 (PCS1) Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)
P2730	Pressure Control Solenoid 1 (PCS1) Control Circuit High	Yes	DNS, SOL OFF (hydraulic default)
P2736	Pressure Control Solenoid 5 (PCS5) Control Circuit Open	Yes	Inhibit retarder operation
P2738	Pressure Control Solenoid 5 (PCS5) Control Circuit Low	Yes	Allow 2 through 6, N, R. Inhibit retarder and TCC operation
P2739	Pressure Control Solenoid 5 (PCS5) Control Circuit High	Yes	Inhibit retarder operation
P273F	Retarder Fluid Temperature Sensor Over Temperature Condition	No	None
P2742	Retarder Fluid Temperature Sensor Circuit – Low	No	Use default retarder temp values
P2743	Retarder Fluid Temperature Sensor Circuit – High	No	Use default retarder temp values
P2761	TCC PCS Control Circuit Open	Yes	Inhibit TCC operation
P2763	TCC PCS Control Circuit High	Yes	Inhibit TCC operation
P2764	TCC PCS Control Circuit Low	Yes	7-speed: Allow 2 through 6, N, R. Inhibit TCC operation
P2789	Transmission Clutch Life Expired (Clutch Adaptive Learning at Limit)	No	None
P2793	Gear Shift Direction Circuit	Yes	Ignores PWM input from shift selector
P2808	Pressure Control Solenoid 6 (PCS6) Stuck Off	Yes	DNS, RPR
P2809	Pressure Control Solenoid 6 (PCS6) Stuck On	Yes	DNS, RPR
P2812	Pressure Control Solenoid 6 (PCS6) Control Circuit Open	Yes	DNS, SOL OFF (hydraulic default)
P2814	Pressure Control Solenoid 6 (PCS6) Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)

DTC	Description	CHECK Light	Inhibited Operation Description
P2815	Pressure Control Solenoid 6 (PCS6) Control Circuit High	Yes	DNS, SOL OFF (hydraulic default)
U0073	CAN Communication Bus 1 Off	No	Use default values
U0074	CAN Communication Bus 2 Off	No	Use default values
U0100	Lost Communications with ECM A	Yes	Use default values
U0103	Lost Communication with Gear Shift Module (Shift Selector) 1	Yes	Maintain range selected, observe gear shift direction circuit
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)	Yes	Ignore shift selector inputs
U0333	Incompatible Gear Shift Module 2 (Shift Selector)	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

8. SPECIFICATIONS

ALLISON AUTOMATIC TRANSMISSION

Allison B500
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

Mounting:
Engine.................... SAE #1 flywheel housing, flex disk drive

Torque converter:
Type....................One stage, three element, polyphase
Stall torque ratio....................TC 551-1.8
Lockup clutch with torsional damper....................Integral/standard

Gearing:
Type....................Patented, constant mesh, helical, planetary

Ratio:
First....................3.51:1
Second....................1.91:1
Third....................1.43:1
Fourth....................1.00:1
Fifth....................0.74:1
Sixth....................0.64:1
Reverse....................4.80:1

Total coverage[1]:
6 speed....................5.48:1

- **Gear ratios do not include torque converter multiplication.**

Fluid System:
Fluid type....................TRANSYND, TES295, TES389
Capacity (excluding external circuits)....................Initial fill 47 US qts (45 liters)
Fluid change....................24 US qts (23 liters)
Fluid change (with retarder)....................28 US qts (26.5 liters)

Fluid Filters:
Make.................... Allison Transmission
Type....................Disposable cartridge

[1] 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 a larger total coverage number have a wider variety of available ratios.

CONTENTS

SECTION CHANGE LOG

	DESCRIPTION	DATE
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2		
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4		
5		
6		

1. STANDARD TORQUE SPECIFICATION TABLES

Refer to Section 00 general information for Standard Torque Specifications.

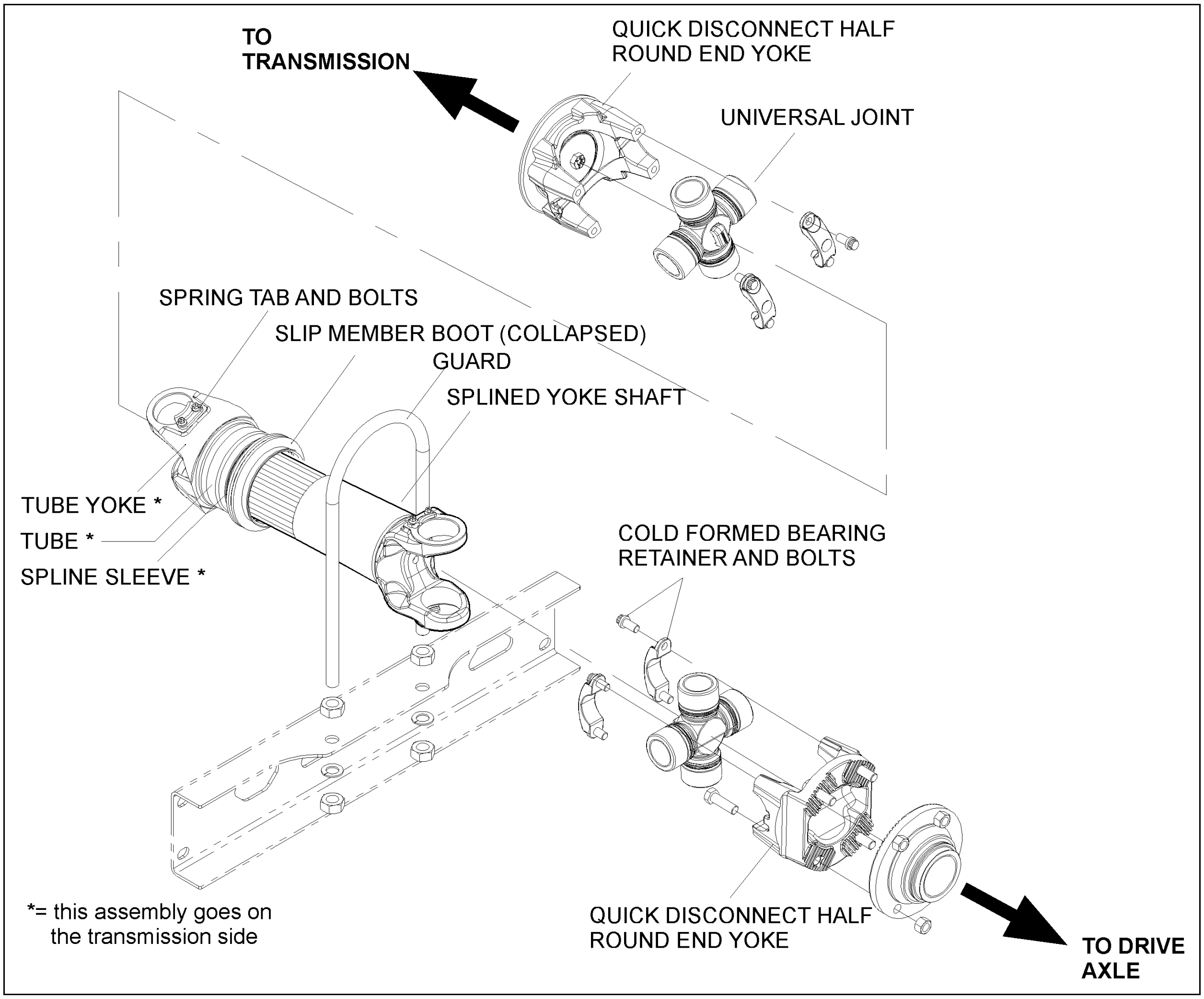


FIGURE 1: PROPELLER SHAFT ASSEMBLY (typical)

2. PROPELLER SHAFT DESCRIPTION

The propeller shaft transmits power from the transmission to the differential. The propeller shaft is Dana Spicer Life Series SPL250 type with tubular shafts. It is provided with two heavy-duty universal joints (**FIGURE 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).

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.

For further information, please consult **Spicer Life Series Driveshaft Service Manual DSSM-0100** included on your Technical Publications USB flash drive.

MAINTENANCE

Perform "Inspection Procedures" as per *Spicer Life Series Driveshafts Service Manual DSSM-0100* at the intervals specified by the Lubrication And Servicing Schedule in Section 24: LUBRICATION & SERVICING.

NOTE

Repair kits are available for overhaul of the propeller shaft assembly. Refer to Parts Manual, Section 9.

MAINTENANCE

Lubricate propeller shaft universal joints at the intervals specified by the Lubrication And Servicing Schedule in Section 24A.

Apply grease gun pressure to the lube fittings (1 grease fitting on each universal joint). Use a good quality lithium-base grease such as: NLGI No.2 E.P. Grease (suitable for most temperatures). Refer to Spicer Driveshaft's Service Manual DSSM-0100 for further details.

NOTE

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

3. NYCT PROPELLER SHAFT MAINTENANCE DIRECTIVE

WARNING

NYCT MAINTENANCE DIRECTIVE PROHIBITS REUSE OF PROPELLER SHAFT COLD FORMED BEARING RETAINERS AND BOLTS OR STAMPED STRAPS AND STRAP BOLTS

FIGURE 2: COLD FORMED BEARING RETAINER AND BOLTS AS USED ON PREVOST X3-45 COMMUTER

DO NOT reuse **cold formed bearing retainers** and **bolts**. Reuse of bearing retainer and bolts can cause driveline failure, which can result in separation of the driveline from the vehicle.

a) Before removing the driveshaft from vehicle, inspect all components (universal joints, slip joints, hardware, etc.) for deterioration (rust or corrosion) or excessive play. If all components pass inspection, grease universal joints until they are properly lubricated *(*fresh grease showing at all u-joint end caps). If any component does not accept grease, it must be replaced.

b) Replace splined slip joint if seal is damaged or if welch plug (cap) is missing (when applicable).

c) Unless the slip section (joint) is being replaced, the driveshaft must be removed as an assembly. The driveshaft must be completely disconnected from the differential and transmission yokes **only***;* the slip section must not be disconnected unless it is being replaced.

d) The driveshaft and yokes must be marked (phasing marks) (see paragraph 4.3 MARK PROPELLER SHAFT (PHASING MARKS)) before removal to ensure reinstallation in the same position as removed.

e) **All universal joints securing hardware (bearing retainers and bearing retainers bolts, spring tabs and bolts) must be removed and replaced** using new OEM specified replacement parts (FIGURE 1).

f) When removing the universal joint from the yoke, **the end caps must remain attached to the cross at all times** if the universal joint is to be reused (Electrical or masking tape can be used to keep the end caps in place while driveshaft is removed.)

g) Unless the universal joint is being replaced, universal joint end caps **must not be removed** for any reason. If the end caps become dislodged while the driveshaft is removed from the vehicle, the universal joint must be replaced. If replacement is needed, the universal joint **must be replaced as a complete assembly**.

h) Universal joints **must be treated as a single unit**. This means that parts (such as the cross, needle bearings, or end caps) **must not be interchanged** between new and used joints.

i) Universal joints **must be positioned and seated correctly between the yoke tabs (ears)** on the input (tail shaft side) and carrier (differential side) yokes ().

j) The driveshaft must be installed facing the correct direction, in particular, with respect to the splined slip joint.

k) The driveshaft must be phased correctly.

l) All fasteners must be torqued to manufacturer's specifications and torque-marked. DO NOT use air or power tools to install and torque bolts or fasteners.

m) Bolt locking tabs, <u>if used</u>, must be bent over the flats of the bolts after final torque is checked.

n) The driveshaft guard (hoop) must be in place.

o) Driveshaft universal joints must be greased properly.

NOTE: If necessary, rotate driveshaft to allow access to all grease fittings.

p) It is the responsibility of the maintainer who begins the driveshaft installation to complete the procedure in its entirety. **The installation procedure must not he carried over (passed on) to the next shift.**

Supervisors must witness and verify the correct installation of the driveshaft as follows:

a) The universal joint caps must be seated properly between the yoke tabs (ears) (FIGURE 26).

b) All universal joint bearing retainers must have been replaced using new hardware and fasteners.

c) All fasteners have been torqued properly and are torque-marked.

d) Locking tabs, if used, must be bent over the bolts.

e) There must be no mixing of new and old parts on a universal joint.

f) The driveshaft must be phased properly.

g) Driveshaft guard (hoop) must be in place.

h) Driveshaft universal joints must be greased after reinstallation of driveshaft in vehicle (fresh grease showing at all u-joint end caps).

4. U-JOINT SERVICE – QUICK REFERENCE GUIDE

This section is intended as a "quick reference" only. Refer to **Spicer Driveshaft Service Manual DSSM-0100** for detailed warnings and instructions.

Precautions

a) Always follow all safety practices when servicing, removing, and/or installing a propeller shaft.

b) Always use support strap to prevent this heavy propeller shaft from falling out of the vehicle during removal and installation.

c) Always put the transmission in neutral before working on the propeller shaft.

d) Never heat components or use a sledgehammer or floor jack to remove the propeller shaft from the vehicle.

Do NOT reuse bearing retainers and bolts.

e) Only replace u-joints with genuine Dana Spicer service parts.

4.1 LUBRICATION PROCEDURE

WARNING
Read "Spicer Life Series Driveshaft Lubrication Warnings and Cautions" in **Spicer Driveshaft's Service Manual DSSM-0100.**

1. Use recommended lubricant to purge **all** four seals of each universal joint. This flushes abrasive contaminants from each bearing assembly and assures proper filling of **all** four bearings.

WARNING
Maximum grease gun pressure should not exceed 60 psi. Excessive grease gun pressures may cause seal damage.

2. Make sure fresh grease is evident at all u-joint bearing seals.

FIGURE 3: BEARING LUBRICATION ZIRK

FIGURE 4: BEARING LUBRICATION

3. If any of the seals fail to purge, try to move the propeller shaft from side-to-side while applying grease gun pressure.

a) If all four bearing positions still do not purge, releasing seal tension may be necessary.
b) Remove the bearing retainer bolts and bearing retainers and discard. Do NOT reuse.
c) Once the bearing cups are free, allow the propeller shaft to rest on the support strap.
d) Apply a c-clamp around the inboard bearings.

FIGURE 5: C-CLAMP

e) Apply grease gun pressure. Completely purge both bearings.

f) If bearings still do not purge, complete the removal of the u-joint and inspect for blockage.

g) If the u-joint still do not purge at all four positions after following the steps in this procedure, replace the u-joint.

4.2 INSPECTION RECOMMENDATIONS

1. U-joint inspections should be performed every time a vehicle comes in for scheduled maintenance.

2. Visually inspect for damaged bearing retainers, loose bearing retainer bolts, loose companion flange, bolts and nuts, loose or missing spring tabs or spring tab bolts, damaged tangs on end fittings, damaged or missing rotating bearing cups. If any of these situations are evident, replacement of the component is necessary.

3. Check all input and output end fittings for looseness. Take hold of the end fitting with both hands. Try to move it vertically and horizontally to feel any looseness.

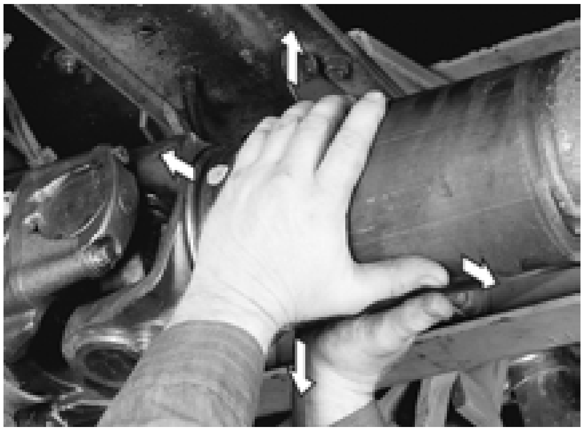


FIGURE 6: CHECK FOR LOOSENESS

4. There should be less than **.006"** movement in the u-joint relative to the end yoke. If looseness is greater than .006", the u-joint should be replaced.
5. Check for the presence of all grease zerk fittings. Damaged zerks should be replaced. Loose zerks should be tightened.

4.3 MARK PROPELLER SHAFT (PHASING MARKS)

1. Mark all mating propeller shaft components with a paint marker to assure proper phasing during reassembly.
2. Reassembly of a propeller shaft that is out of phase can cause vibration and failure to propeller shaft components.

FIGURE 7: PHASING MARKS

4.4 GREASE ZERKS

- Replace damaged zerks.
- Torque zerks to 15 lbf-ft.
- Zerks should be lined up with outboard bearings.
- Clean zerk nipples before greasing.

4.5 OTHER INSPECTIONS

Refer to **Spicer Driveshaft's Service Manual DSSM-0100** for detailed information on:

- The slip member inspection,
- Grease zerk inspection,

Tubing inspection.

5. REMOVAL

WARNING

Read “Spicer Life Series Driveshaft Removal Warnings and Cautions” in **Spicer Driveshaft’s Service Manual DSSM-0100.**

5.1 PROPELLER SHAFT REMOVAL

1. Mark propeller shaft (phasing marks). It is imperative to mark all the mating components of a propeller shaft, as illustrated below. Mark the propeller shaft with a marking stick, paint marker or other legible marking device. In addition, be sure to mark all bearing positions, spline positions and shaft locations. This assures proper reassembly of the propeller shaft into the vehicle, in its original position.

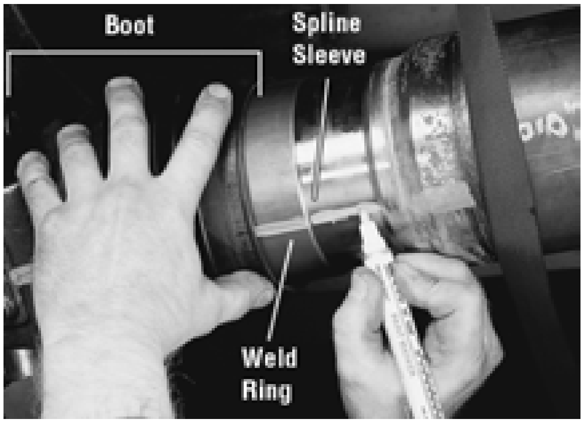


FIGURE 8: PHASING MARKS

FIGURE 9: PHASING MARKS

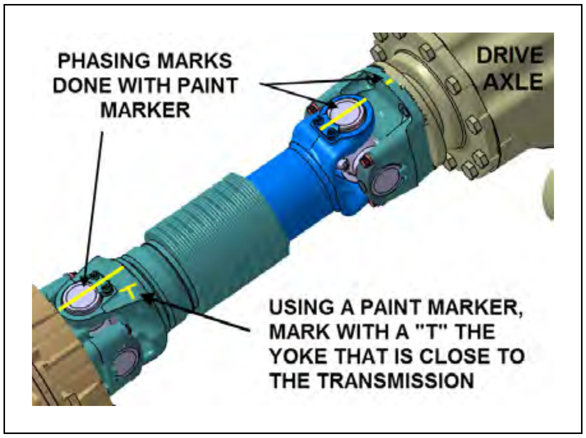


FIGURE 10: PHASING MARKS

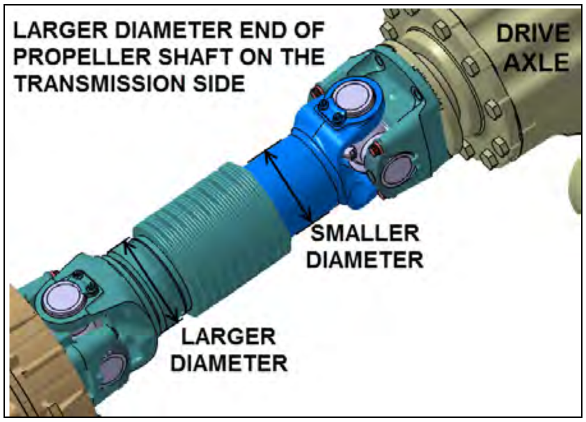


FIGURE 11: PROPELLER SHAFT PROPER ORIENTATION

2. Be sure to ALWAYS use support straps to prevent the propeller shaft from falling out of the vehicle.

3. Remove the bearing retainers and bolts <u>at rear end</u>. Discard bolts, and bearing retainers.

FIGURE 12: COLD FORMED BEARING RETAINERS

4. It may be necessary to unseat bearing cup assemblies by tapping on yoke or bearing cup with a soft-faced hammer. Once the bearing cup assemblies are free, collapse the propeller shaft until both bearing assemblies clear the open end yoke cross holes. Allow the propeller shaft to rest on support strap.

FIGURE 13: UNSEATING BEARING CUP ASSEMBLIES

5. Remove bearing retainers and bolts at the front end.
6. Inspect all end yoke cross hole surfaces and bolt hole threads for damage. If the bolt hole threads are damaged, the yoke must be replaced.
7. Inspect for raised metal or fretting on open yoke cross holes can be removed with a fine-toothed file and/or emery cloth.

FIGURE 14: RAISED METAL OR FRETTING ON OPEN YOKE CROSS HOLES

8. Inspect the end yoke cross holes for distortion and damage.

5.1.1 Inspect Companion Flange/Flange Yokes

1. Inspect all flange bolt hole threads or through holes for damage. If the bolt hole threads or through holes are damaged, the flange must be replaced.
2. Inspect all flange faces for galling or damage. If damaged, the flange must be replaced.

5.2 REMOVAL PROCEDURE FOR UNIVERSAL JOINT KIT

1. **For Quick Disconnect Style:** Remove spring tab bolts and discard, and remove outboard bearing cap assemblies.

FIGURE 15: SPRING TAB BOLTS REMOVAL

2. Make sure universal joints cross assembly is not tilted in the yoke. Place bearing cup spacer onto the base of the arbor press and under the yoke. If the arbor is larger than the bearing cup diameter, a smaller diameter push rod will be needed to avoid damaging the yoke or bearing.

FIGURE 16: CORRECT POSITIONING

FIGURE 17: INCORRECT POSITIONING

3. Using an arbor press, press down on the upper bearing cup assembly until the shoulder of the journal cross makes contact with the inside of the yoke ear.

CAUTION

DO NOT over press the bearing cup and journal cross. This can damage the inside of the yoke ear.

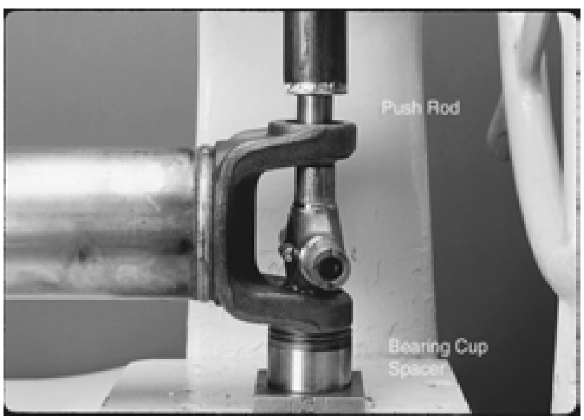


FIGURE 18

4. The bearing cup is not designed to drop out of the yoke. Move the partially pressed-out bearing cup from side to side, to "walk" the bearing cup out of the yoke ear. Remove the bearing cup from the trunnion.
5. Place the yoke in the press, with the remaining bearing cup face down. Using a push rod, press on the end of the journal cross trunnion. Continue to press down on the journal cross trunnion until the shoulder of the journal cross makes contact with the inside of the yoke ear.

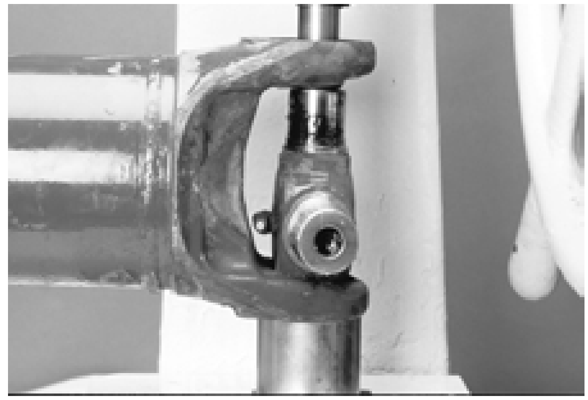


FIGURE 19

5.2.1 Inspect Tube Yoke and Flange Yoke (If Applicable)

1. Inspect the tube yoke and flange yoke (if applicable) cross hole surfaces for damage or raised metal. Raised metal or fretting can be removed from yoke cross holes with a fine-toothed file and/or emery cloth.

FIGURE 20: RAISED METAL OR FRETTING CAN BE REMOVED FROM YOKE CROSS HOLES WITH A FINE-TOOTHED FILE

5.3 REMOVAL PROCEDURE FOR SLIP MEMBER BOOT

1. It is imperative to mark all mating components of the propeller shaft. Mark the propeller shaft with a marking stick, paint marker or other legible marking device.
2. Remove and discard both boot clamps. Clamps may be separated using a chisel to disengage locking hooks. DO NOT reuse clamps.

FIGURE 21: BOOT CLAMP

3. Completely collapse the boot toward the yoke shaft to expose weld ring and spline sleeve area. Wipe weld ring and spline sleeve areas clean.
4. Remove the yoke shaft and boot from the spline sleeve. Discard boot.
5. Inspect the yoke shaft spline surface for damage. If the splines are damaged, missing or twisted, or any Glidecote is missing, complete propeller shaft replacement is necessary.
6. Inspect the spline sleeve for damage. If the splines are damaged, missing or twisted, complete propeller shaft replacement is necessary.
7. Inspect the entire slip assembly for contaminants. If the slip assembly shows evidence of rust or the lube is severely contaminated, complete propeller shaft replacement is necessary.

6. INSTALLATION

> **⚠ WARNING**
>
> Read “Spicer Life Series Driveshaft Installation Warnings and Cautions” in **Spicer Driveshaft’s Service Manual DSSM-0100.**

6.1 SLIP MEMBER AND BOOT INSTALLATION

1. Clean ALL grease from yoke shaft and spline sleeve. Make sure grease-cutting solvent does not intrude into the tube through the vent hole in the spline sleeve plug. Be sure the phasing marks made during disassembly are not removed.

FIGURE 22: CLEAN GREASE FROM SPLINE SLEEVE

2. After all traces of grease and cutting solvent have been removed from the yoke shaft and spline sleeve, apply half of the grease provided to the yoke shaft splines and the other half to the spline sleeve, cover the entire splined surface.

FIGURE 23: APPLY GREASE

3. Measure and place a mark 2.25 inches (55-60mm) from yoke shaft shoulder with a marking stick, paint marker or other legible marking device.

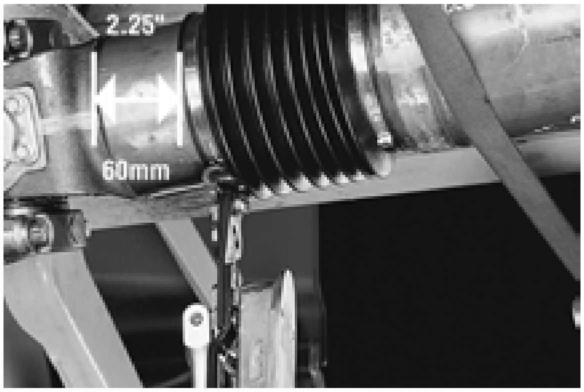


FIGURE 24: POSITION THE END OF THE BOOT AT THE 2.25 INCHES (55-60MM) MARK MADE ON THE YOKE SHAFT SHOULDER

4. Position a clamp on each end of the new boot. Slide the boot onto the grease-free yoke shaft shoulder.
5. Collapse the boot and insert the yoke shaft into the splined sleeve, making sure phasing marks are in line. Position the end of the boot at the 2.25 inches (55-60mm) mark made on the yoke shaft shoulder and tighten boot clamps to the specified torque. Yoke shaft shoulder must be clean, dry and grease free.

Failure to properly install and tighten boot clamps could allow intrusion of contaminants and can cause driveline failure, which can result in separation of the driveline from the vehicle.

6. Before the propeller shaft is completely installed in the vehicle, slowly collapse and extend the propeller shaft to make sure the boot clamps are stationary. If the clamps are not stationary, recheck for proper clamp torque. If clamps still are not stationary, repeat disassembly and assembly procedure. DO NOT reuse clamps

6.2 PROPELLER SHAFT INSTALLATION

1. Before installing the propeller shaft, inspect the yoke surface for burrs and damage. Mating surfaces should be clear of rust, contamination and grease.
2. With safety straps in place, align the phasing marks between the yoke and propeller shaft.

FIGURE 25: ALIGN THE PHASING MARKS BETWEEN THE YOKE AND PROPELLER SHAFT

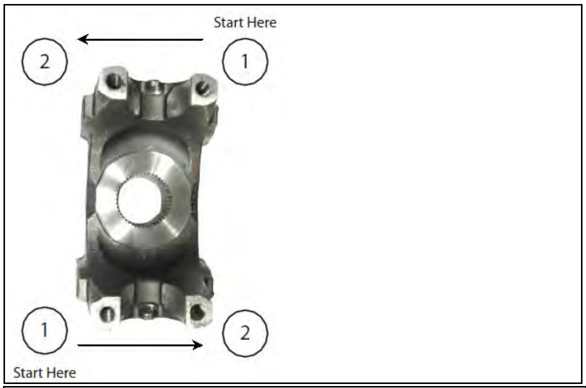
3. Align the bearing cups with the yoke ears making sure that the cups are evenly spaced between the tabs (ears) of the yoke. A soft faced hammer can be used to fully seat the bearing cups into the yoke.

FIGURE 26: YOKE TAB (EAR)

Note: Bearing cups must be fully seated between the yoke tabs (ears). Failure to seat the cups properly will result in a premature failure.

4. Install bearing retainers and lock bolts.
5. It is important that the bearing retainer bolts are torqued in the correct sequence. Following the diagram below. Torque the number one bolt before moving to the number two bolt. Always torque in a counter clockwise direction starting with the number one position.

Failure to torque bearing retainer bolts in the proper sequence could result in premature failure.



BEARING RETAINER BOLT TORQUE (HALF ROUND)			
Series	Head size	Size	Bolt torque
SPL250	12 point	12-1.25mm	100 lbf-ft[1]

6. Grease the U-joint and slip member after propeller shaft installation. Refer to *4.1 LUBRICATION PROCEDURE.*

6.3 UNIVERSAL JOINT INSTALLATION

1. Remove needle retaining plugs from all bearing cup assemblies. Using a high quality National Lubricating Grease Institute E. P. Grade 2 lubricating grease, wipe each bearing cup assembly with grease. Fill all cavities between the needle rollers. Also apply a liberal coating of grease on the bottom of each bearing cup assembly and on the lip of the seal.

FIGURE 27: GREASING BEARING CUP

Caution - Spicer DOES NOT recommend wiping the outside of bearing cup assemblies or yoke cross holes with grease, oil or silicone-based sprays. This could result in bearing cup assembly rotation in yokes.

2. Position the journal cross into the yoke cross holes with the grease zerk fitting inward toward tubing. The double-headed, grease zerk (nipple) fitting should be perpendicular to the yoke cross holes.

Note: Failure to properly position the universal joint will result in the inability to grease the universal joint.

FIGURE 28: POSITION THE JOURNAL CROSS INTO THE YOKE CROSS HOLES WITH THE GREASE ZERK FITTING INWARD TOWARD TUBING

Note: Always inspect bearing cups for rollers that may have fallen (downed rollers) out of place before installation.

3. Move one end of the journal cross to cause a trunnion to project through the cross hole beyond the outer machined face of the yoke ear. Take one bearing cup assembly and position an installation height tool on the end of the bearing cup assembly. Place the bearing cup assembly over the protruding trunnion diameter and align it to the yoke cross.

FIGURE 29

4. Align the yoke in an arbor press with the bearing assembly resting on the base of the press. Cover the yoke ear with a metal plate

[1] Prevost production line torque value

that has 0.25 inch (6.4mm) minimum thickness. Push the yoke onto the bearing cup assembly until it is flush with the cross hole face. Do not remove the installation height tool.

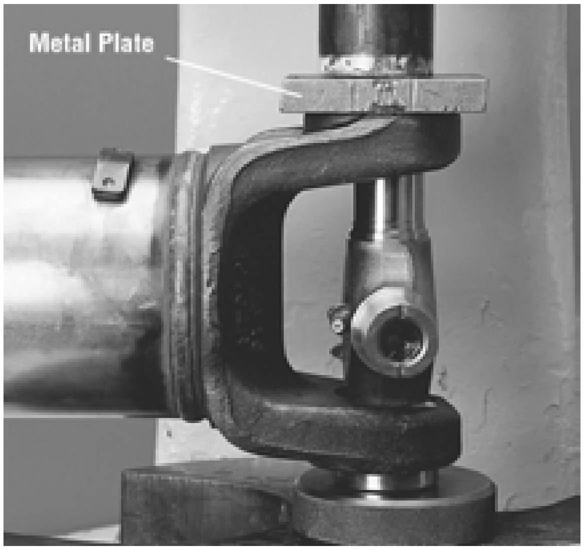


FIGURE 30

5. Flip yoke 180 degrees. Position the remaining installation height tool on the end of another bearing cup assembly. Place bearing cup assembly over trunnion diameter and align it to the yoke cross hole. Push the bearing cup assembly until both installation height tools are flush with the cross hole face.
6. Install new spring tabs and 8mm thread bolts. Make sure that no grease or foreign material is present between the contact areas of the spring tabs, bearing cups and yoke cross hole faces. Tighten bolts to the required torque.

FIGURE 31

SPRING TAB BOLT TORQUE

Bolts are specially heat-treated. DO NOT substitute inferior grade bolts.

Series	Head size	Size	Bolt torque
SPL250	8mm 6 Points	8mmx1.00	25-30lb-ft

7. 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.

8. SPECIFICATIONS

PROPELLER SHAFT

Make .... Dana-Spicer Inc.
Series SPL250

CONTENTS

SECTION CHANGE LOG

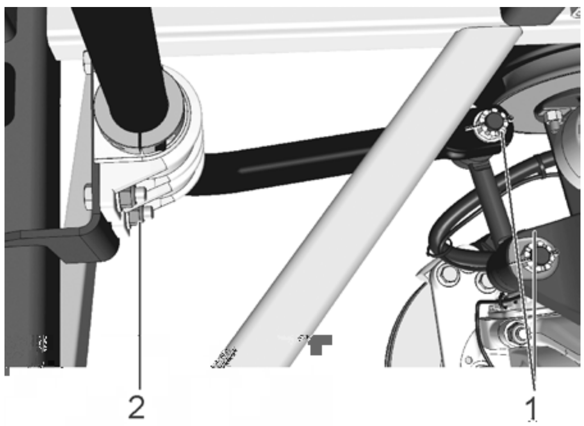
	DESCRIPTION	DATE
1		
2		
3		
4		
5		
6		

1. TORQUE TABLES

The following tables list the tightening torques 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.

For other torque specifications, refer to Dana manuals listed in paragraph 2.1 reference manuals in this section.

1.1 FRONT I-BEAM AXLE AND RELATED COMPONENTS



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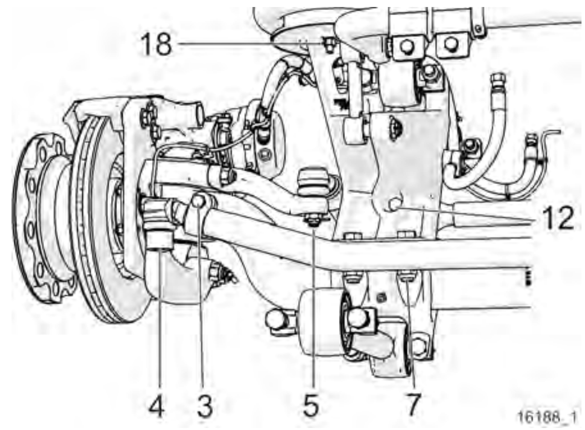
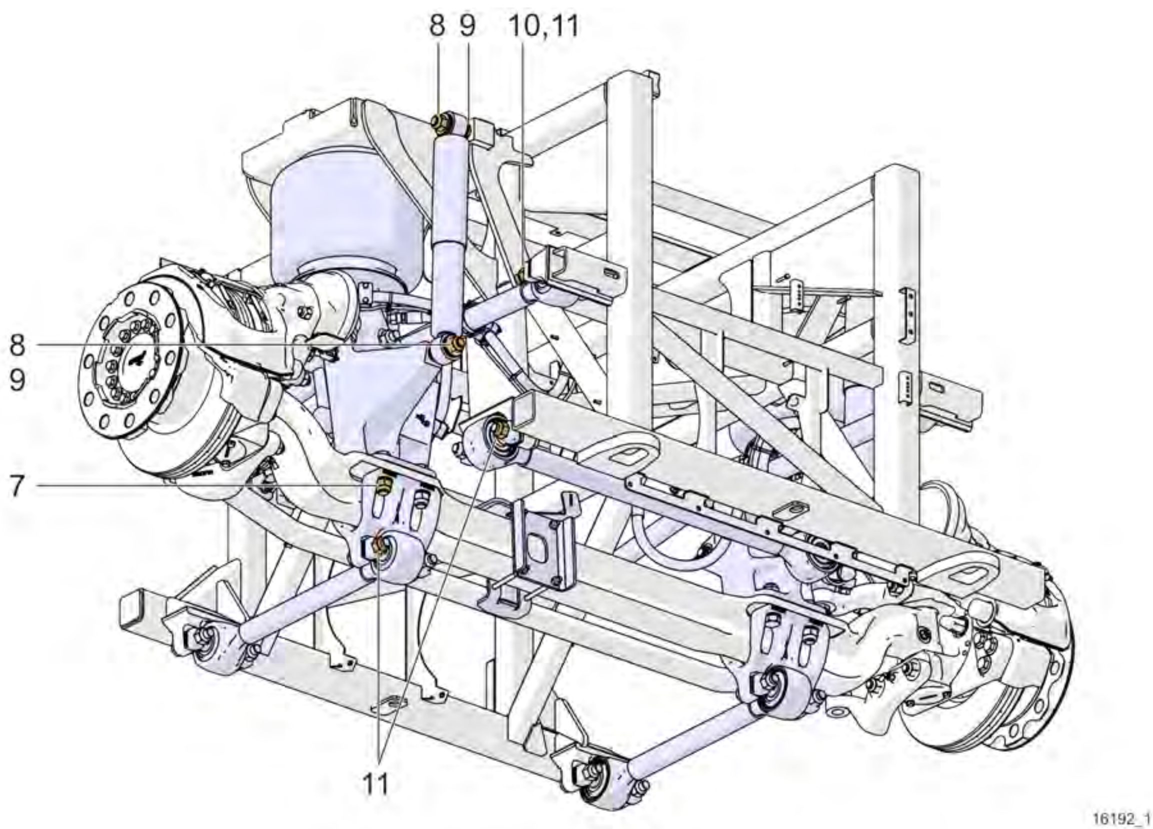
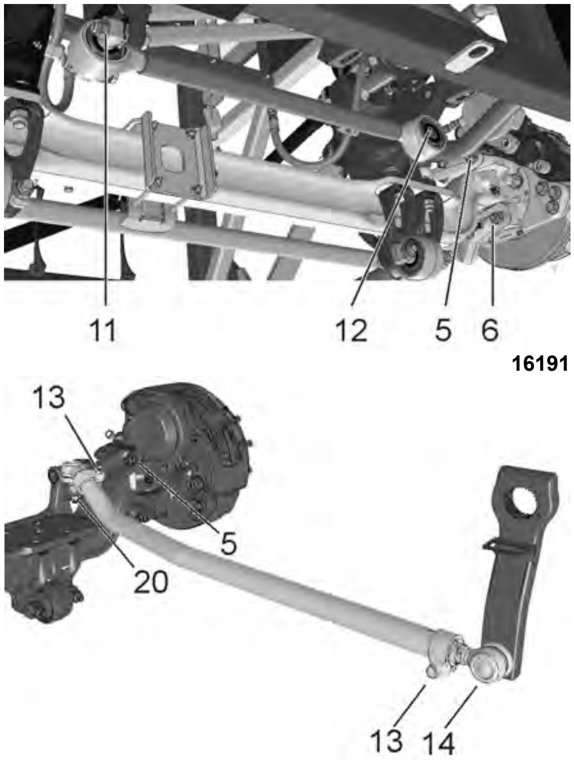
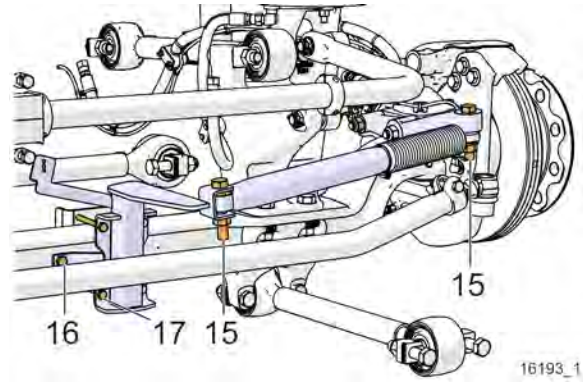


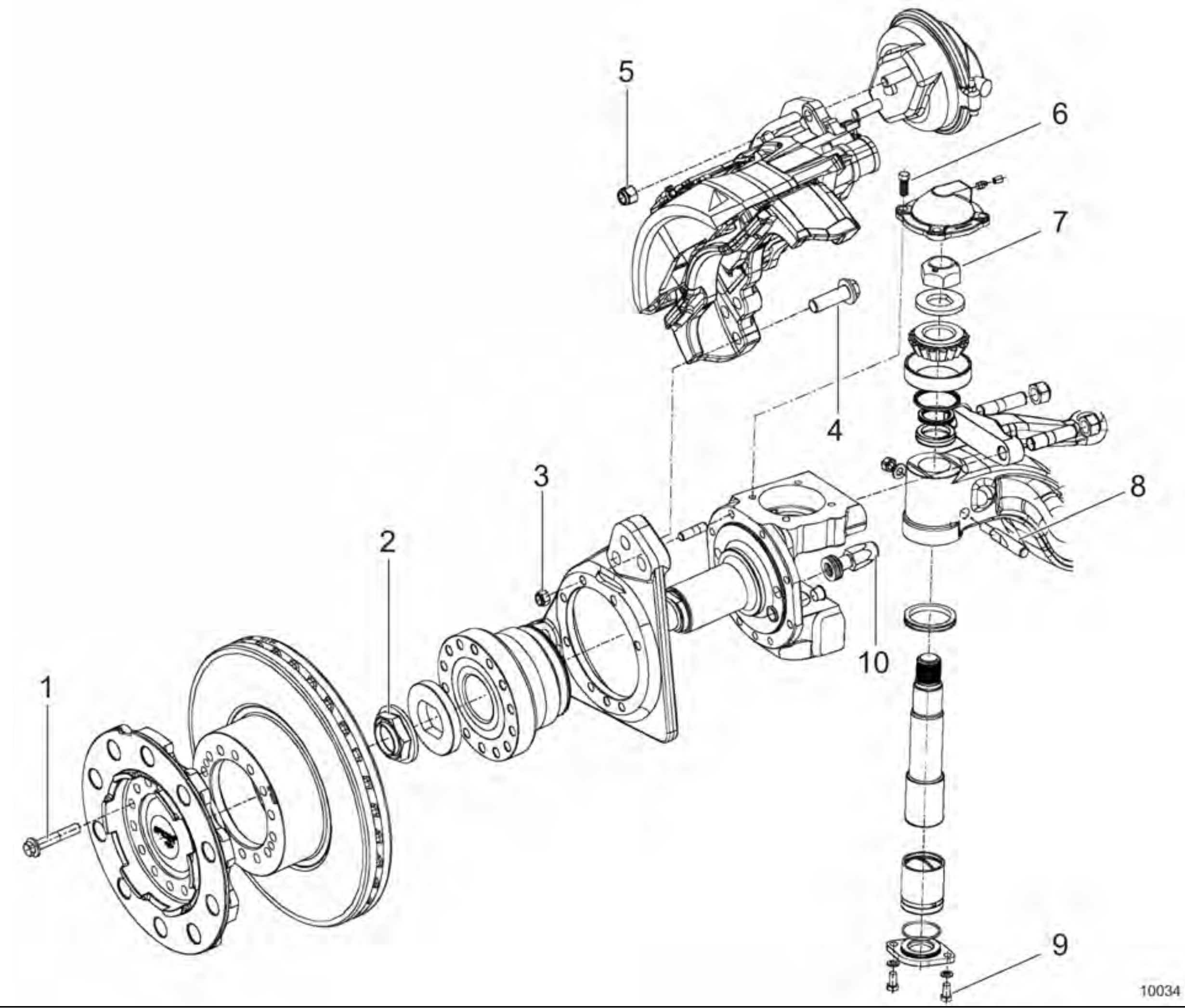






FRONT I-BEAM AXLE			
No	DESCRIPTION	QTY	TORQUE (dry)
1	Sway bar link, upper and lower nuts	4	165-200 lb-ft (224-271 Nm)
2	Sway bar bushing collars (front suspension)	8	80-100 lb-ft (108-136 Nm)
3	Tie rod end clamp bolts	2	118-133 lb-ft (160-180 Nm)
4	Tie rod end ball pin nuts	2	155-170 lb-ft (210-230 Nm)
5	Steering arm stud nuts	2	285-315 lb-ft (386-427 Nm)
6	Tie rod arm stud nuts	4	285-315 lb-ft (386-427 Nm)
7	I-beam axle mount nuts	8	230-280 lb-ft (312-380 Nm)
8	Shock absorber upper & lower mounting nuts	2	99-121 lb-ft (134-164 Nm)
9	Shock absorber pins, upper & lower	2	350-400 lb-ft (475-542 Nm)
10	Radius rod retaining studs	4	90-110 lb-ft (122-149 Nm)
11	Radius rod retaining nuts	18	225-255 lb-ft (305-346 Nm)
12	Transverse radius rod taper pin screw	1	206 lb-ft (279 Nm)
13	Drag link clamp bolts	2	118-133 lb-ft (160-180 Nm)
14	Drag link ball joint stud nut, fore	1	165-236 lb-ft (224-320 Nm)
15	Steering damper nuts	2	100-120 lb-ft (136-163 Nm)
16	Steering damper bracket bolt	1	39-45 lb-ft (53-61 Nm)
17	Steering damper bracket nuts	4	30-36 lb-ft (41-49 Nm)
18	Air spring nut	4	25 lb-ft (34 Nm)
19	Steering damper arm nuts	2	285-315 lb-ft (386-427 Nm)
20	Drag link ball joint stud nut, aft	1	140-200 lb-ft (190-271 Nm)

1.2 FRONT I-BEAM AXLE HUB, ROTOR AND BRAKES



HUB, ROTOR AND BRAKE			
No	DESCRIPTION	QTY	TORQUE (dry)
1	Hub Flanged Bolt	28	174-192 lb-ft (236-260 Nm)
2	Stake Hub Nut	2	575-626 lb-ft (780-849 Nm)
3	Caliper Bracket Nut – Self Lock	16	85-103 lb-ft (115-140 Nm)
4	Brake Caliper Mounting – Bolt	12	433-479 lb-ft (587-649 Nm)
5	Brake Chamber Nut – Self Lock	4	133-155 lb-ft (180-210 Nm)
6	Kingpin cover Screw	8	51-62 lb-ft (69-84 Nm)
7	Kingpin Nut – Self Lock	2	500-700 lb-ft (678-949 Nm)
8	Draw key, Nut	2	51-62 lb-ft (69-84 Nm)
9	Kingpin lower cover Screw	4	26-32 lb-ft (35-43 Nm)
10	Back & Front Lock - Stop Bolt	3	85-103 lb-ft (115-140 Nm)a

2. DESCRIPTION

The Dana Spicer S84U front axle is of the ''Reverse Elliot'' type. The front axle consists of a girder section beam with knuckles. Each knuckle is carried on a parallel king pin, with a steep angle taper roller bearing at its top and a plain phosphor bronze bush at 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 further in Section 14: STEERING of this manual.

2.1 REFERENCE MANUALS

Additional information is found in the following manuals included on your vehicle Technical Publications USB flash drive:

For kingpin rework:
Dana Parts & Service Instructions S84U Steer Axle KING PIN REWORK_ Manual NO 1985 B iss A

For hub bearing rework:
Dana Parts & Service Instructions S84U Steer Axle HUB BEARING REWORK_ Manual NO 1963 B iss A

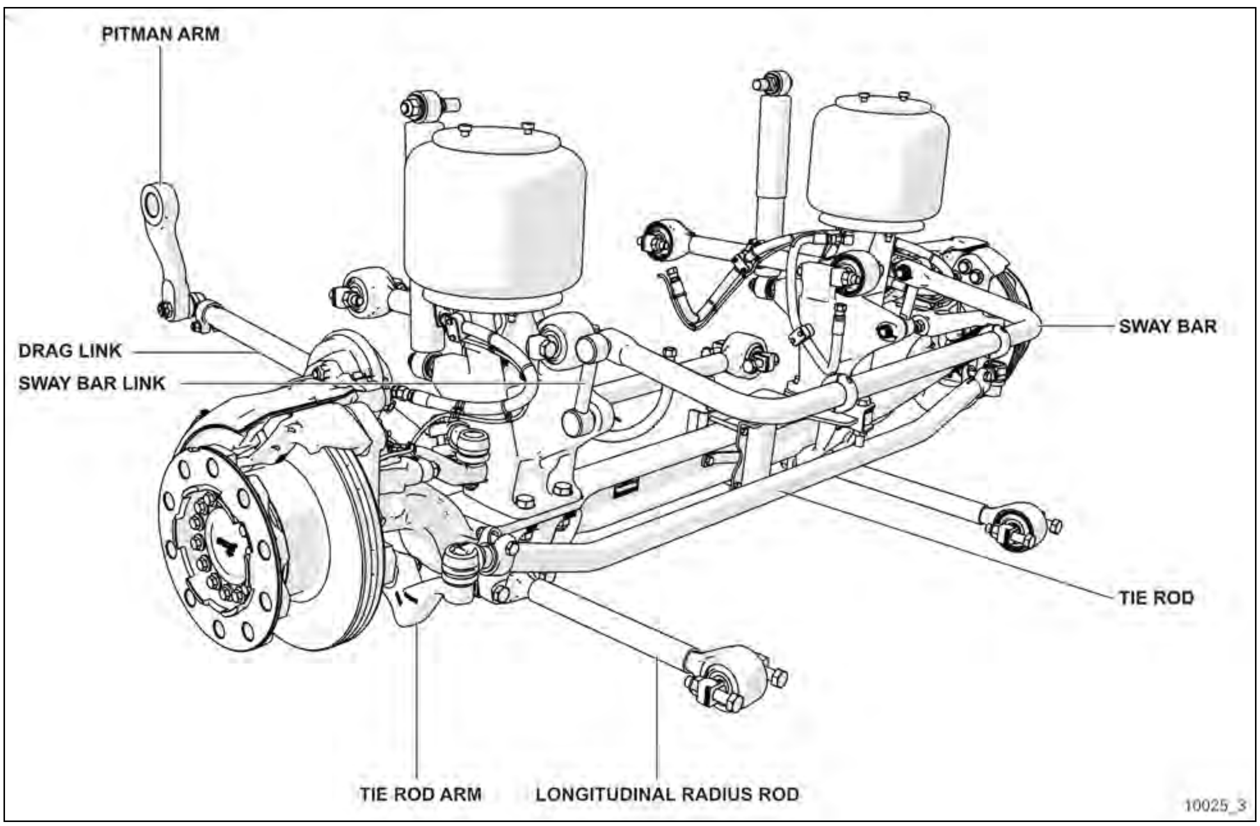
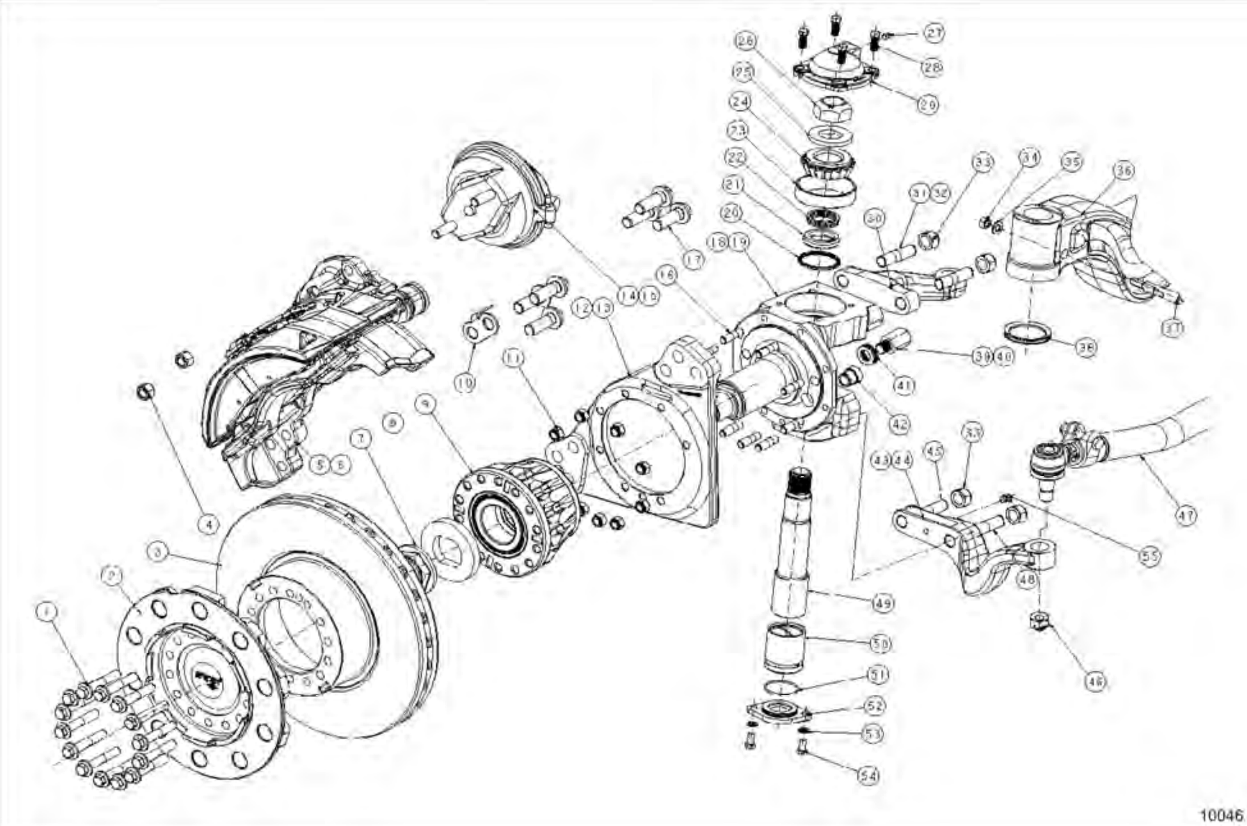


FIGURE 1: FRONT AXLE ASSEMBLY (I-BEAM)



TYPICAL S84U AXLE

ITEM	DESCRIPTION	QTY	ITEM	DESCRIPTION	QTY
1	Flanged Bolt	28	29	Cap - Knuckle Top	2
2	Hub	2	30	Top Steering Lever	1
3	Brake Disc	2	31	Top Steering Lever - Stud L.H.	2
4	Nut – Self Lock	4	32	Top Steering Lever - Stud R.H.	2
5	Brake L.H.	1	33	Nut - Self Lock	8
6	Brake R.H.	1	34	Drawkey - Nut	2
7	Stake Nut	2	35	Drawkey - Washer	2
8	Collet Washer	2	36	Beam - Axle	1
9	Hub Bearing	2	37	Drawkey	2
10	Wear Sensor Clip	2	38	V Ring Seal	2
11	Nut – Self Lock	16	39	Back Lock - Stop Bolt	2
12	Brake Mounting Bracket L.H.	1	40	Front Lock - Stop Bolt	1
13	Brake Mounting Bracket R.H.	1	41	Stop bolt - washer	4
14	Actuator L.H.	1	42	ABS Sensor - Bush	2
15	Actuator R.H.	1	43	Bottom Steering Lever L.H.	1
16	Stud	16	44	Bottom Steering Lever R.H.	1
17	Brake fixing - Bolt	12	45	Bottom Steering Lever - Stud	2
18	Knuckle L.H.	1	46	Nut - Self Lock (Tie Rod)	2
19	Knuckle R.H.	1	47	Socket & Tie Rod Assy	1
20	Oil Seal	2	48	Socket Assy R.H.	2
21	Sleeve - Knuckle Bearing	2	49	Socket Assy L.H.	2
22	Shim	A/R	50	Kingpin - Bushing	2
23	Bearing Cup	2	51	O Ring Seal	2
24	Bearing Cone	4	52	Kingpin	2
25	Washer (Collet)	1	53	Washer	2
26	Nut – Self Lock	2	54	Cap - Knuckle Bottom	2
27	Lub Nipple (Straight)	2			
28	Screw	2			

3. LUBRICATION

MAINTENANCE

Knuckle pins are provided with grease fittings for pressure lubrication. These grease fittings should be serviced at the intervals specified by the Lubrication And Servicing Schedule in Section 24: LUBRICATION & SERVICING.

Good quality lithium-base roller bearing mineral grease NLGI No.1 or NLGI No.2 are recommended.

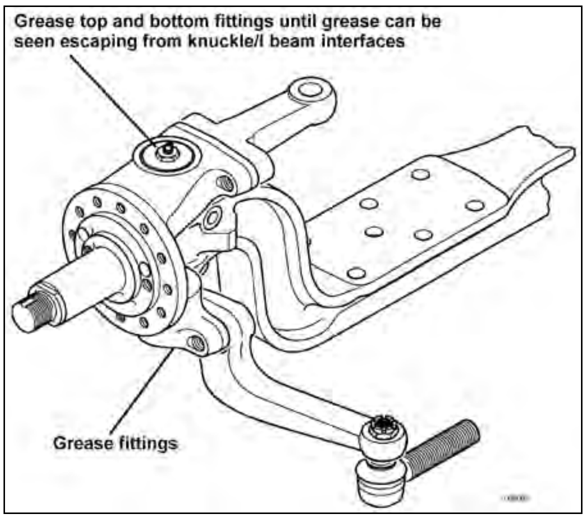


FIGURE 2: FRONT AXLE GREASING POINTS

4. MAINTENANCE

A periodic inspection of the front axle assembly should be made to check that no damage and distortion have taken place. All the bolts and and stop screws should be checked and tightened, as required, to the torque specifications given at the beginning of this section. Also check the condition of the steering knuckle kingpins and bushings. In case of excessive looseness, the bushings and kingpins should be replaced.

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

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

CAUTION

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

5. 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.

5.1 REMOVAL

1. Raise the vehicle by its jacking points on the body (see Section 18, *''Body''* under paragraph ''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''*).

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

2. Exhaust compressed air from the air supply system by opening the drain valve of each reservoir.
3. Install jacks under axle jacking points to support the axle weight.
4. Disconnect the steering drag link from the steering arm.
5. Remove the ABS sensors from their location in hubs.
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 springs mounting supports.
10. Using the jacks, slowly lower the axle assembly, and carefully pull away from underneath vehicle.

5.2 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 1 ''Specifications'' at the end of this section for applicable checks. *Refer to torque tables at the beginning of this section for tightening.*

6. SERVICE INSTRUCTIONS FOR STEER AXLE

6.1 STEERING KNUCKLE KINGPIN INSPECTION

MAINTENANCE

An inspection should be made at the intervals specified by the Lubrication And Servicing Schedule in Section 24: LUBRICATION & SERVICING.

Check permissible slackness in the kingpins as follows:

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.

6.1.1 Checking Lateral Slackness

Following regular and thorough greasing practices will maximise bushing life. This procedure measures the upper bearing & lower bushing wear due to side and vertical loading. While this is being carried out, the brake must be applied.

1. Place a set-square with its stock on ground and its blade against tire wall.
2. Place a mark on the ground to indicate position of stock end.
3. Insert a lever through bottom cut-out of wheel and lever it upwards thus moving set-square outboard.
4. Mark the changed position of the stock end.
5. Maximum allowable stock displacement for 22.5" wheels is **0.315 in (8mm)**.
6. If displacement exceeds stated allowance then need for bushing / 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.

6.1.2 Checking Vertical Slackness

1. This is measured by a dial indicator anchored to axle beam and having its pointer placed vertical against knuckle top.
2. Place a jack against underside of knuckle and, while applying a lifting force, observe any movement on indicator dial.
3. **If vertical movement is evident and it exceeds 0.030” (0.76mm)** then readjustment of knuckle is required by adjusting thickness of bearing adjusting shims. In this case, refer to:

Dana Parts & Service Instructions S84U Steer Axle KING PIN REWORK_ Manual NO 1985 B iss A.

6.2 STEERING TIE ROD INSPECTION

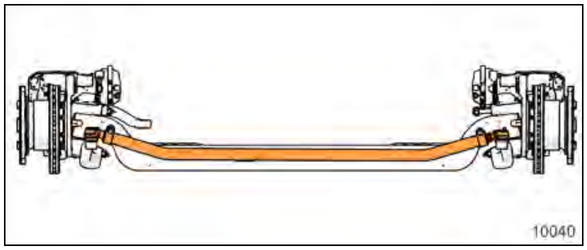


FIGURE 3 TIE ROD

The steering tie rod on the axle requires several visual and functional inspections. Refer to Section 14– STEERING under heading FRONT I-BEAM AXLE TIE ROD.

Detailed information can also be found in the following supplier publication: **TRW_Front_Axle_Steering_Bar_Service_Information_XSZ143**

7. 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**.

7.1 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.

7.2 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 7.1, *''Inspection Before Alignment''* in this section.
2. Check the hub bearings. See section 13, *''Wheels, hubs and Tires''* under paragraph Front and Tag Axle Wheel Hubs.
3. Check and adjust the toe-in.

7.3 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 7.1, *''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 7.5 ''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.

7.4 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 :

7.4.1 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 spring 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.

7.4.2 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 7.5 ‘’Hydraulic Stop’’ in this section.

7.5 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.*

7.6 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 (Figure 4).

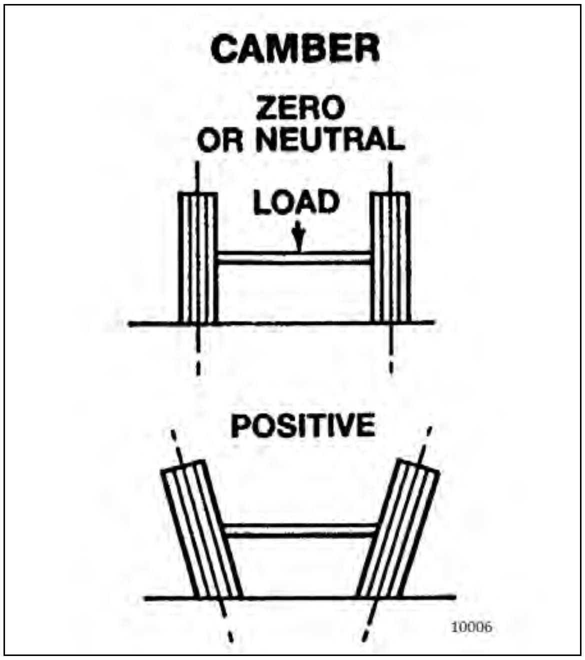


FIGURE 4: CAMBER

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.

7.6.1 Camber Check

For camber specifications, refer to paragraph 8: '' ALIGNMENT 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 specifications, verify the steering knuckle pins and axle center.
3. Check the wheel lateral distortion as instructed in Section 13, *''Wheels, Hubs and Tires''* under heading, *''Checking for Distorted Wheel on Vehicle''*. If distortion is excessive, straighten or replace wheel(s).

7.7 FRONT AXLE CASTER

For caster specifications, refer to paragraph 8: ''ALIGNMENT 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 (Figure 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).

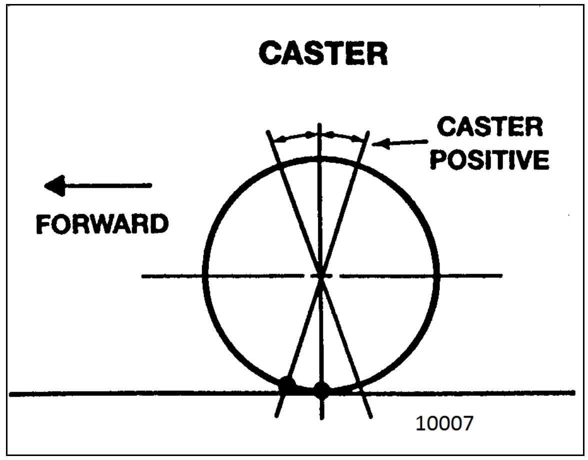


FIGURE 5: CASTER

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.

7.8 FRONT WHEEL TOE-IN

Wheel toe-in is the degree (usually expressed in fractions of an inch) where 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 Figure 6).

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

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

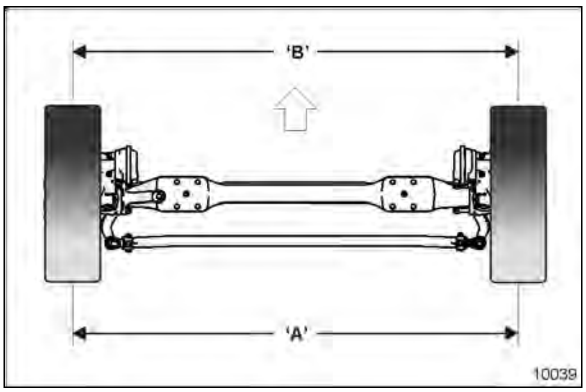


FIGURE 6: TOE-IN MEASUREMENT

For toe-in specifications, refer to paragraph 8 ''Alignment 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.

7.8.1 Inspection and Adjustment

Before adjusting 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 on the right hand (curb side) tie rod end where the adjuster sleeve is located.
   b. Turn the adjuster sleeve (Figure 7) until the specified toe-in measurement is obtained.
   c. Tighten the clamp bolt nuts

   TORQUE: 118-133 lb-ft (160-180 Nm)

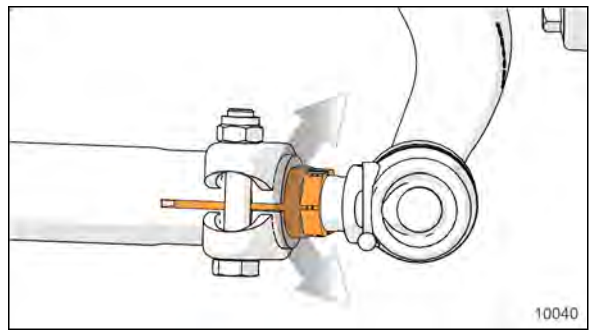


FIGURE 7: FINE ADJUSTER SLEEVE ON TIE ROD

8. ALIGNMENT SPECIFICATIONS

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

9. TROUBLESHOOTING

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

10. SPECIFICATIONS

Front Axle

Make .... DANA SPICER

Model S84U

Front Track .... 84.5 inches (2147 mm)

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

CONTENTS

SECTION CHANGE LOG

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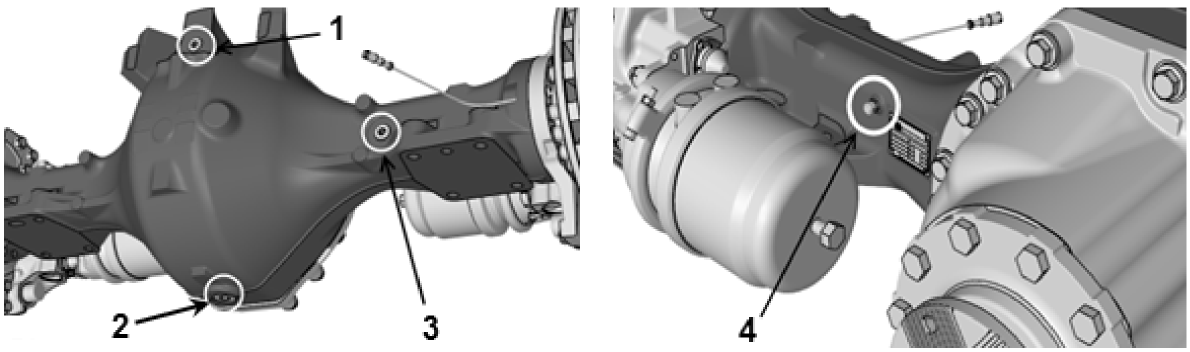
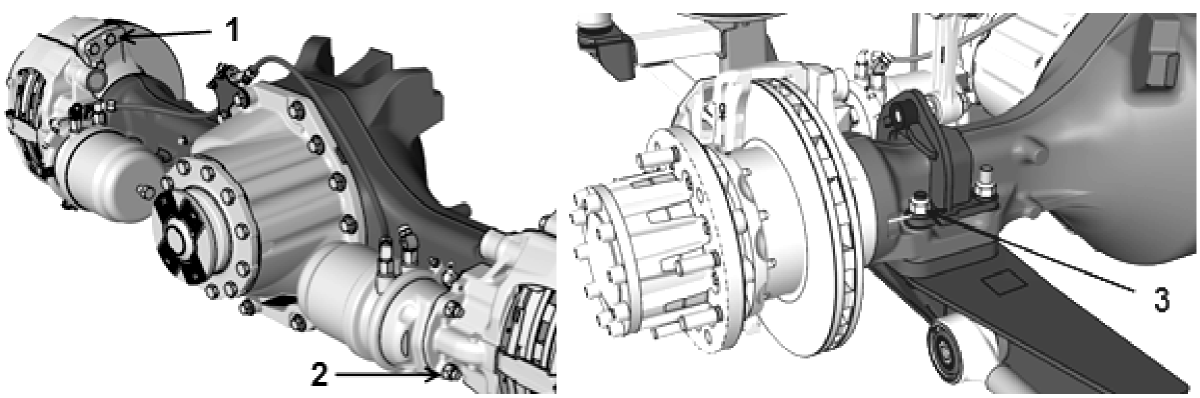
1. TORQUE TABLES

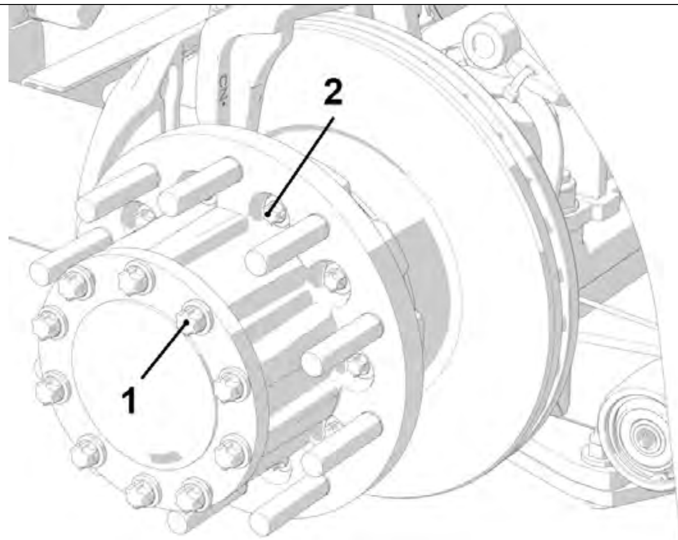
1.1 ZF A132 DRIVE AXLE



ZF A132 DRIVE AXLE		
No	DESCRIPTION	TORQUE
1	Filler plug	52 lb-ft (71 Nm)
2	Drain plug	96 lb-ft (130 Nm)
3	Level check plug	52 lb-ft (71 Nm)
4	Breather	4 lb-ft (5 Nm)

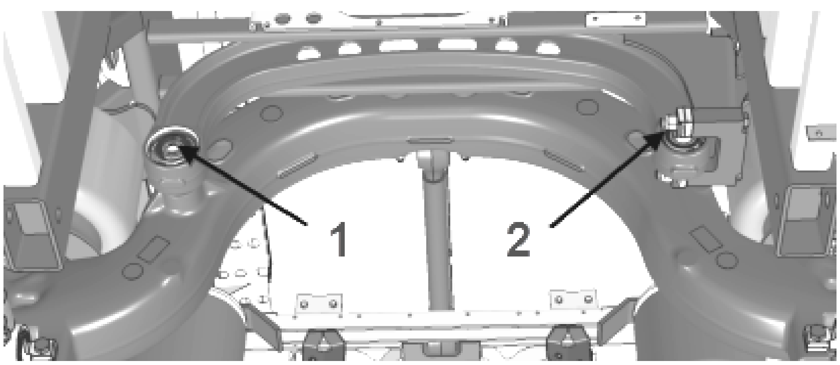


ZF A132 DRIVE AXLE		
No	DESCRIPTION	TORQUE
1	Caliper mounting bolts	200 lb-ft (271 Nm)
2	Brake air chamber mounting bolts	120-150 lb-ft (163-203 Nm)
3	Axle to frame mounting bolts	405-495 lb-ft (549-671 Nm)



ZF A132 DRIVE AXLE		
No	DESCRIPTION	TORQUE
1	Drive shaft flange bolts cap screw M18x1.5x50mm G10.9	325 lb-ft (441 Nm)
2	Hub cap screw Torx M16x1.5x60	221 lb-ft (300 Nm)

1.2 TAG AXLE



TAG AXLE		
No	DESCRIPTION	TORQUE
1	Tag axle transversal radius rod (stud) retaining bolt	198 lb-ft (268 Nm)
2	Tag axle radius rods nut	228-252 lb-ft (309-342 Nm)

2. ZF A132 DRIVE AXLE

This vehicle is equipped with a ZF model A132 Hypoid Single Reduction drive axle, fitted with two Knorr Bremse brake chambers, Knorr Bremse SN7 disc brake and companion flange for Dana Spicer SPL250 propeller shaft. Visual brake wear indicator and a potentiometer wear indicator are installed. The carrier gear ratio is 3.82.

NOTE
Additional information is found in the following manuals, included on your vehicle technical publications USB drive: • ***OPERATING INSTRUCTIONS ZF AXLE A132 (version with US hub) #5871 207 982 EN.*** • ***ZF AXLE A132 REPAIR MANUAL #5871 207 002E***

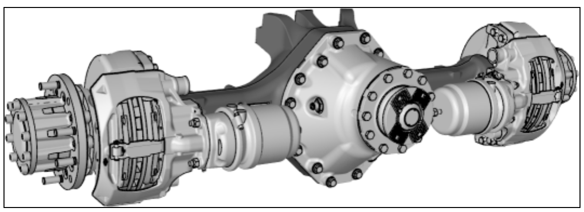


FIGURE 1: ZF A132 DRIVE AXLE 11019

2.1 MAINTENANCE

Proper vehicle operation starts with preventive maintenance, which includes adequate operation of the differential.

The most common causes of drive axle failures are spinout, shock, fatigue, overheating and lack of lubrication. Monitor these conditions as they could be the first steps leading to improper maintenance, expensive repairs, and excessive downtime.

Inspect at the pinion oil seal, axle shaft flange and carrier housing joint 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 radius rods, as directed in Section 16, *"Suspension".*

2.1.1 Differential Oil Type

Use **Mobil Delvac Synthetic Gear Oil 80W-140 (**ZF lubricant class 12M). Other approved lubricants may be use. Additional lubrication information is covered in ZF's list of lubricants TE-ML 12.

2.1.2 Checking and Adjusting the Differential Oil Level

1. Place the vehicle on a level surface.
2. Level check plug must be cleaned carefully before opening.
3. Check oil level at room temperature only.

MAINTENANCE
Oil level check Check differential oil level and add if necessary at the intervals specified by the Lubrication And Servicing Schedule in Section 24A.

WARNING
Check the oil level when the axle is at room temperature. When hot, the oil temperature may be 190ºF (88ºC) or more and can cause burns. Also, a correct reading is not obtained when the axle is warm or hot.

4. Make sure the axle is at room temperature.
5. Clean the area around the level check plug. Remove the level check plug from the differential case.
6. The oil level must be even with the bottom of the level check bore.
7. If oil flows from the hole when the plug is loosened, the oil level is too high. Let drain the oil to the correct level.
8. If the oil level is below the bottom of the level check bore, add the specified oil through the level check bore.
9. Reinstall the level check plug using a new seal (O-ring).

Tighten to 52 lb-ft (71 Nm)

2.1.3 Differential Oil Change

1. Place the vehicle on a level surface.
2. Drain, filler and level check plugs must be cleaned carefully before opening.
3. Drain oil only at operating temperature, immediately after the vehicle has been operated for an extended period of time.
4. Renew seals components (O-rings).

MAINTENANCE

Oil change interval – Lubricant class 12M

Change differential oil and breather, clean the drain plug's magnetic inserts at the intervals specified by the Lubrication And Servicing Schedule in Section 24A.

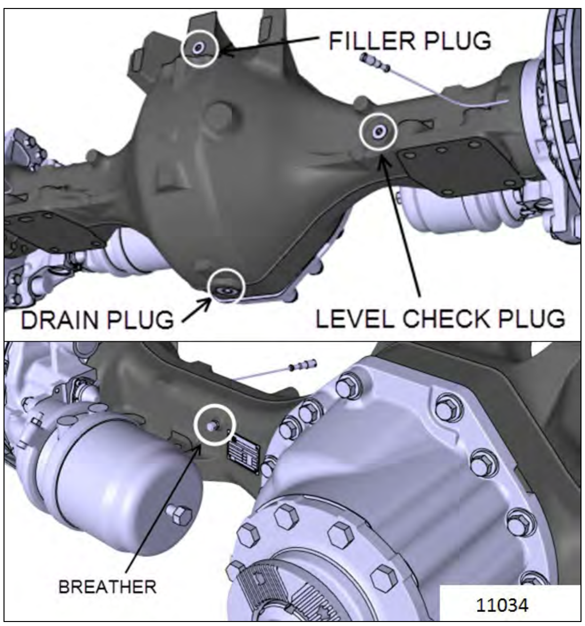


FIGURE 2: ZF A132 DRIVE AXLE

5. Put a large container under the differential case drain plug. The differential case contains approximately 19 quarts of oil.
6. Remove the drain plug from the bottom of the differential case. Drain all the oil and discard in an environment friendly manner.
7. Clean the magnetic insert of the drain plug, fit a new seal (O-ring) and reinstall drain plug.

WARNING

The oil temperature may be extremely high! Risk of burn injuries.

8. Remove the filler plug and the level check plug.
9. Reinstall the drain plug.

Tighten to: 96 lb-ft (130 Nm)

10. Add the specified oil at the filler plug until the oil level is even with the bottom of the level check bore.

Filling volume is about 19 quarts (18 liters) at the level check bore

11. Allow the oil to flow through the axle and check the oil level again after some minutes. Refill if necessary until specified level is reached and remains constant.
12. Reinstall the filler plug and level check plug using new seals (O-ring).

TORQUE: 52 lb-ft (71 Nm)

13. Replace the breather with every oil change.

TORQUE: 4 lb-ft (5 Nm)

2.1.4 Compact Bearing (Hub Unit) Axial Play Check

Check the compact bearing (hub unit) axial play every 100 000 miles. Furthermore, the bearing must be checked in case of brake disk change, ABS fault message and rising noise level at increasing speed.

Perform compact bearing (hub unit) axial play check as described in paragraph 6.2 HOW TO CHECK THE AXIAL PLAY of the following manual: OPERATING INSTRUCTIONS ZF AXLE A132 (version with US hub) #5871 207 982 EN.

MAINTENANCE

Compact bearing (hub unit) axial play

Check the bearing axial play at the intervals specified by the Lubrication And Servicing Schedule in Section 24A.

2.1.5 Compact bearing (hub unit) Grease Change

Perform compact bearing (hub unit) grease change as described in paragraph 7.3 GREASE CHANGE IN THE HUB of the following manual: OPERATING INSTRUCTIONS ZF AXLE A132 (version with US hub) #5871 207 982 EN.

MAINTENANCE

Compact bearing (hub unit) axial play – ZF Lubricant class 12H

The compact bearing grease must be change at the intervals specified by the Lubrication And Servicing Schedule in Section 24A.

The list of approved Lubricant Class 12H grease types is found in ZF's list of lubricants TE-ML 12.

2.1.6 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.

2.2 DRIVE AXLE FLANGE SHAFT REMOVAL/INSTALLATION

Refer to paragraphs **9-Towing** and **11-Replacement of Axle Insert** in the following manuals, included on your vehicle USB flash drive:

- *OPERATING INSTRUCTIONS ZF AXLE A132 (version with US hub) #5871 207 982 EN.*

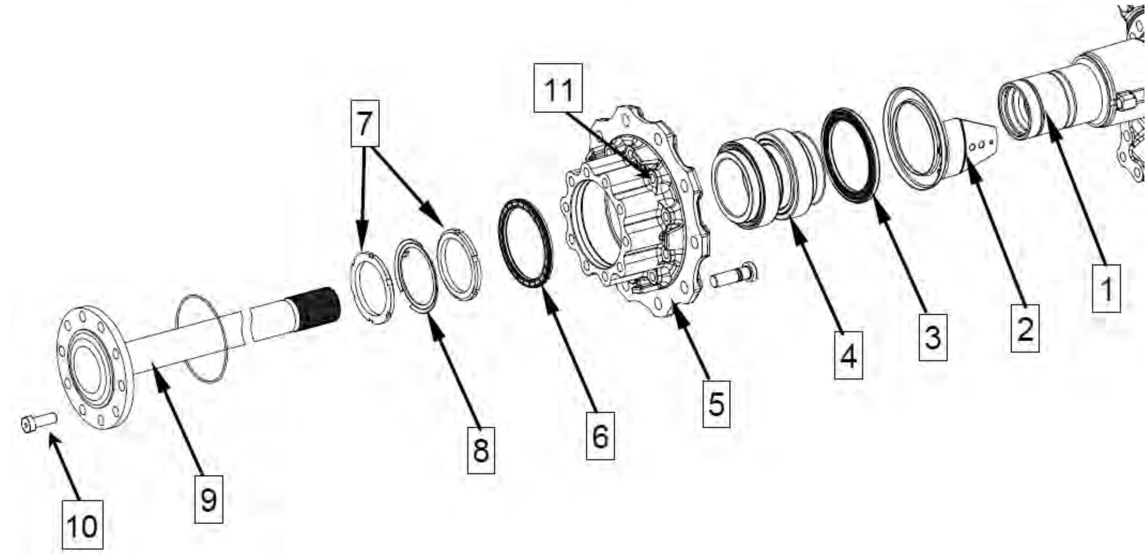


FIGURE 3: ZF A-132 DRIVE AXLE HUB ASSEMBLY

1	hub carrier	**10**	cap screw external Torx M18x1.5x50mm G10.9 torque=325 lbf-ft (use E24 External Torx driver)	 External Torx driver
2	screen sheet			
3	shaft seal (with impulse disc)			
4	compact bearing (hub unit)			
5	hub			
6	shaft seal	**11**	cap screw external Torx M16x1.5x60 torque=221 lbf-ft (use E20 External Torx driver)	
7	slotted nut			
8	locking plate			
9	flange shaft			

2.3 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 from the front wheels and drive axle wheels. Place jack stands under the rear chassis hoisting points. 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.
3. Disconnect the propeller shaft as directed in Section 9, *"Propeller Shaft",* in this manual.
5. Disconnect the lower end both height control valve link then move the arm up to exhaust air suspension.
6. Disconnect the ABS speed sensors connector located over the differential housing.

NOTE
When removing drive axle, if unfastening cable ties is necessary for ease of operation, remember to replace them afterwards.

7. Disconnect the air brake supply hoses over the differential carrier.

NOTE
Position the hoses so they will not be damaged when removing the axle.

8. Install jack stands under the drive axle subframe at the four locations shown on **FIGURE 4**.

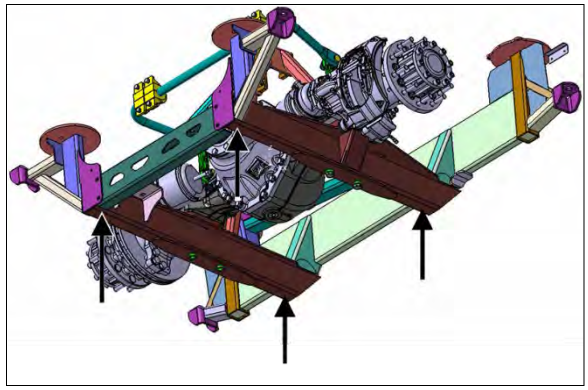


FIGURE 4: SUPPORT THE DRIVE AXLE SUBFRAME AT THE FOUR LOCATIONS SHOWN

9. Disconnect the lower ends of the four shock absorbers as outlined in Section 16, *"Suspension"* under heading *"Shock Absorber Removal".*
10. Remove the two sway bar links.
11. Remove the lower and upper longitudinal radius rod supports as outlined in Section 16, *"Suspension",* under heading *"Radius Rod Removal".*
12. Remove the transversal radius rod (panhard bar).
13. Remove the two retaining nuts from each of the four air springs lower mounting supports.
14. Disconnect the drive axle speed sensor.
15. Use the jacks to lower axle. Carefully pull away the drive axle assembly from underneath vehicle.
16. 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.

2.4 DISASSEMBLY, REASSEMBLY, ADJUSTMENT AND TORQUE CHART

Disassembly and re-assembly procedures are covered in the following manual:

- *ZF AXLE A132 REPAIR MANUAL #5871 207 002E*

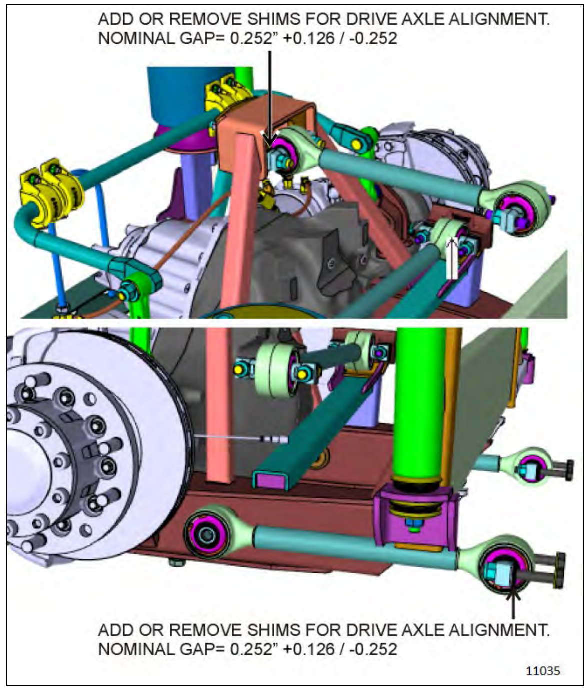
2.5 ZF A132 DRIVE AXLE ALIGNMENT

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.



2.5.1 Procedure

1. Park vehicle on a level surface, then chock front vehicle wheels.
2. Using two jacking points (which are at least 30 inches [76 cm] apart) on drive axle, raise the vehicle sufficiently so that wheels can turn freely at about ½ inch from ground. Secure in this position with safety stands, and release parking brake.
3. Install wheel mount sensors on front end and drive axle wheels (Figure 8).

NOTE
Select axle specifications in the appropriate chart.

4. With the system installed as in Figure 8, adjust drive axle according to specifications' chart below.

DRIVE AXLE ZF A-132			
	Minimum value	Nominal value	Maximum value
Thrust angle	±0.11°		
Total toe	0.15° toe-in	0°	0.15° toe-out

3. TAG AXLE

The tag axle is located behind the drive axle. It carries a single wheel and tire on each side.

The system allows unloading of the tag axle air springs without raising the axle 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.

Refer to the *"OPERATOR'S MANUAL"* for location of controls

The tag axle service brakes operate only when the axle is in normal driving (loaded) position.

3.1 UNLOADING TAG AXLE

To reduce the turning radius, the air springs pressure will be automatically reduced by 75% when the coach is moving at speed lower than 5 mph (8 km/h) and with more than 1½ turn from the steering.

3.2 TAG AXLE WHEEL BEARINGS

The unitized hub bearings used on the tag axle 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 at the intervals specified by the Lubrication And Servicing Schedule in Section 24A: LUBRICATION & SERVICING SCHEDULE.

3.3 REMOVAL AND REINSTALLATION

3.3.1 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.

1. Connect an external air pressure line to the emergency fill valve in the engine compartment.
2. 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.

3. Disconnect tag axle air springs pneumatic hoses and install valves or plugs.
4. Raise the vehicle using the lifts.
5. Dismount tag axle components.
6. Before reinstalling air spring hoses, make sure there is no pressure left inside by opening the valves or unloading tag axle.

3.3.2 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 (Figure 5) or see Section 18, *"Body"* under heading: *"Vehicle Jacking Points"*). Place jack under frame.
2. Remove drive axle wheels (if required, refer to Section 13, *"Wheels, Hubs And Tires"*).
3. 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.

4. Install jacks under tag axle jacking points to support the axle weight (Figure 5).

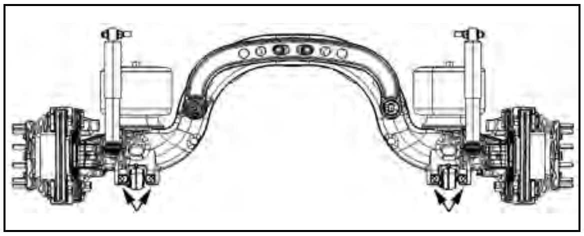


FIGURE 5: JACKING POINTS ON TAG AXLE 11023

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.
14. Reverse removal procedure to reinstall.

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.

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.

3.3.3 Removing Transversal radius Rod

1. Unfasten bolts and nuts fixing transversal radius rod ball joint to rear underframe.
2. Remove the air bellows retaining nuts from each of the two upper mounting plates.
3. Install extractor tool g32952 onto transversal rod. Figure 6
4. Partially unscrew ball joint fixing bolt.
5. Tighten extractor threaded rod.
6. Supporting the transversal radius rod at all times, gradually extract transversal radius rod from tag axle.
7. Reinstall by reversing procedure.

Torque: 198 lb-ft (268 Nm)

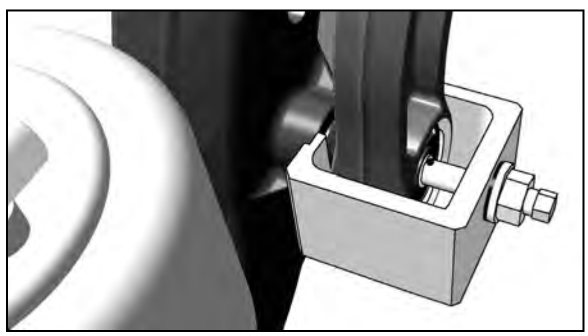


FIGURE 6: INSTALLING EXTRACTOR TOOL

CAUTION

It is strongly suggested to use the extractor tool in order to remove transversal radius rod.

3.4 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. Tag axle alignment is achieved with the use of shims inserted between the lower longitudinal radius rod supports and axle. Tag axle alignment is factory set and is not subject to any change, except if vehicle has been damaged by an accident or if there are requirements for parts replacement.

CAUTION

If this setting is altered significantly, it will cause excessive tire wear.

NOTE

It may be necessary to adjust the axle TOE as well as its alignment. In this case, insert shims (7 min. - P/N 121203 or 15 min. - P/N 121240) in between mounting plate and spindle, as required.

If axle has been removed for repair or servicing and if all parts are reinstalled exactly in their previous locations, axle alignment is not necessary. However, if the suspension supports have been replaced or have changed position, proceed with the following instructions to verify or adjust the tag axle alignment.

NOTE

For an accurate alignment, the tag axle must be aligned with the drive axle.

Adjust tag axle according to 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

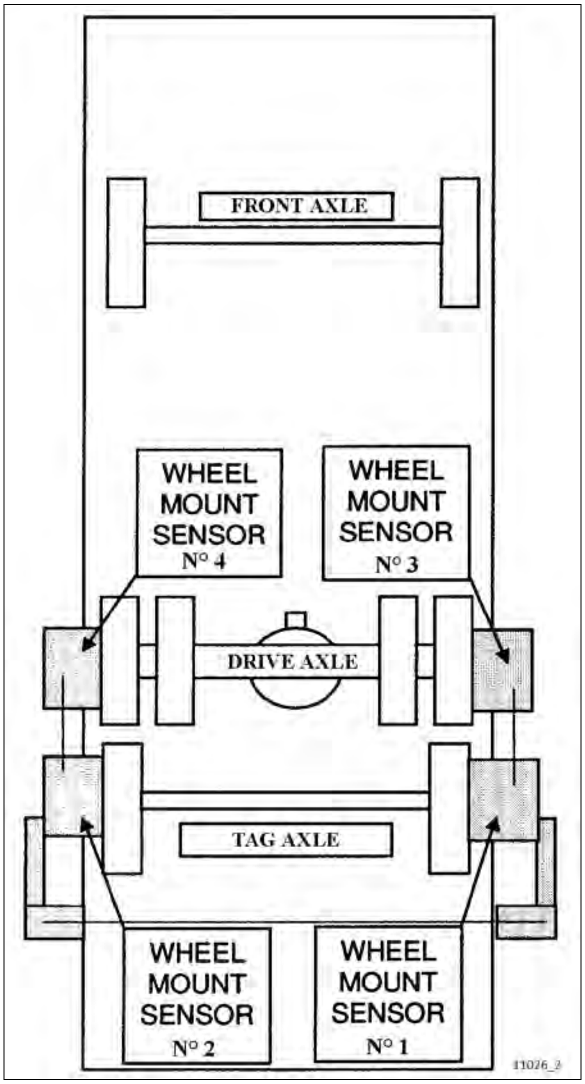


FIGURE 7: TAG AXLE ALIGNMENT

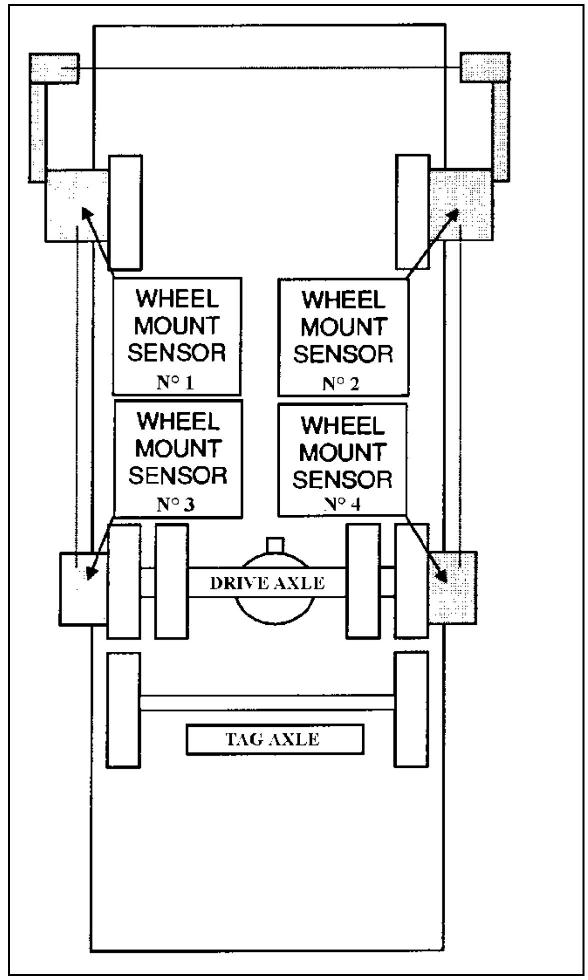


FIGURE 8: FRONT & DRIVE AXLE ALIGNMENT 11025

4. SPECIFICATIONS

ZF A132 Drive Axle

Make and model .... ZF A132
Drive track .... 73.6 inches (1 870 mm)
Gear type .... Hypoid
Axle type .... Full floating
Oil fill quantity .... 19.5 quarts (39 pints)
Ratio 3.82

TAG AXLE

Make .... Prevost
Rear track .... 82.1 inches (2 084 mm)
Axle type .... Forged

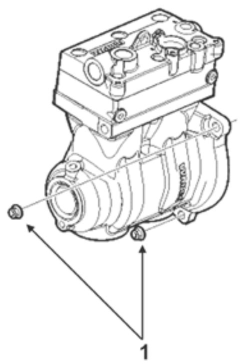
CONTENTS

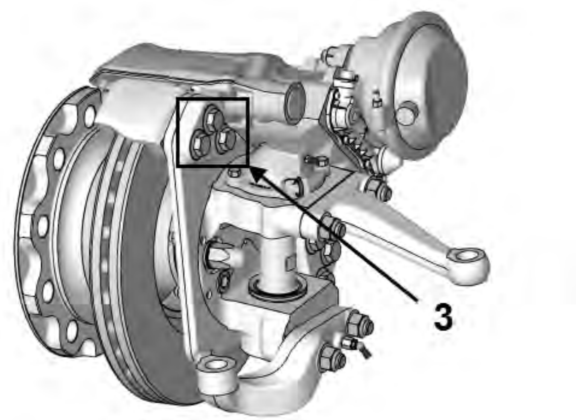
SECTION CHANGE LOG

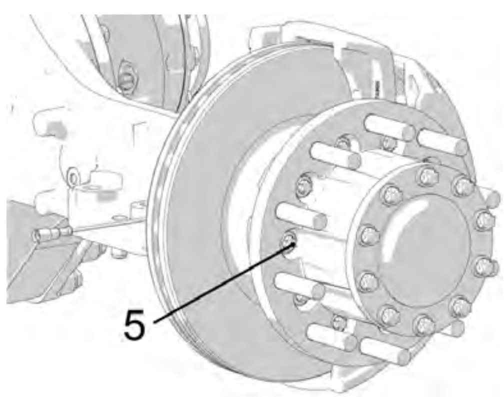
	DESCRIPTION	DATE
1	Accessories & secondary tank location corrected	Nov 2022
2		
3		
4		
5		
6		

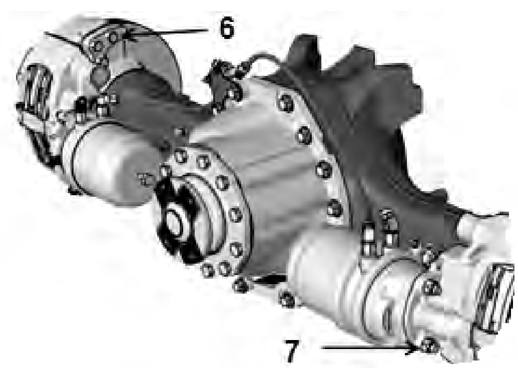
1. TORQUE TABLES

1.1 BRAKE AND AIR SYSTEM



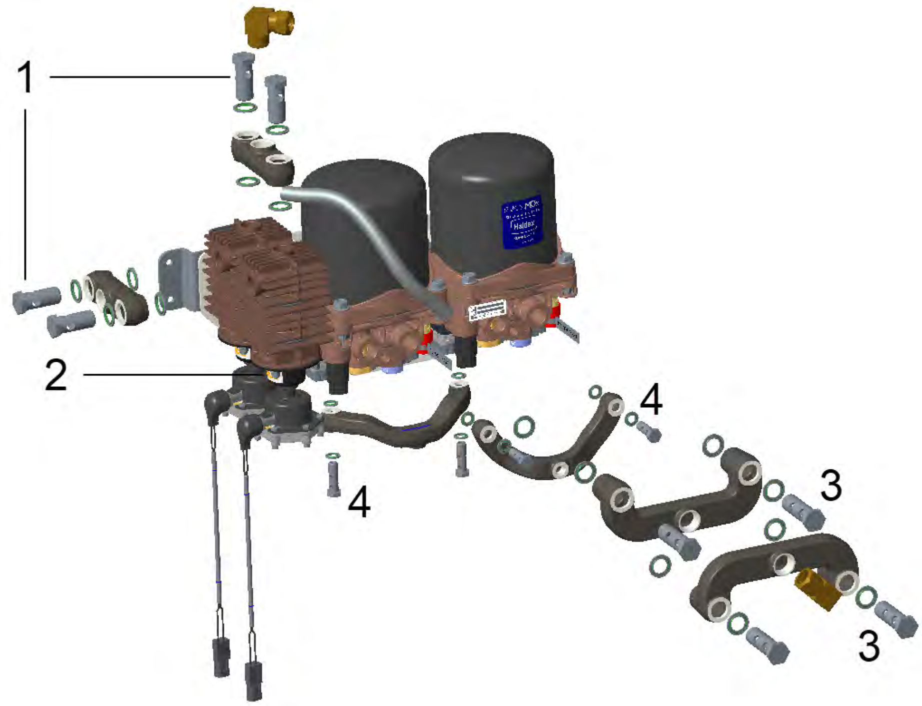




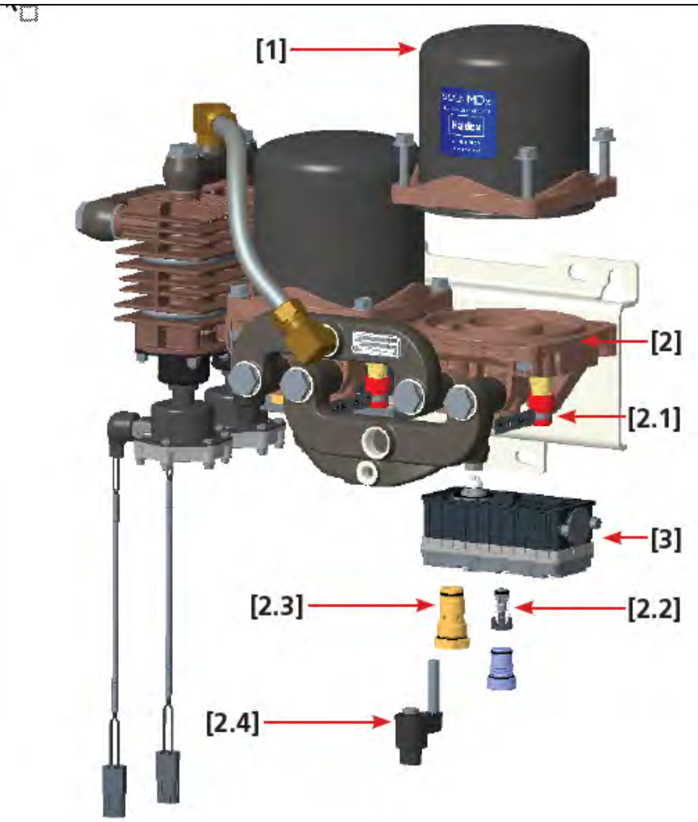


BRAKE AND AIR SYSTEM		
No	DESCRIPTION	TORQUE
1	Compressor flange mounting nuts	63 lb-ft (85 Nm)
3	Front I-beam caliper mounting bolts	350-393 lb-ft (475-533 Nm)
5	ZF drive axle - hub to disc cap screws	221 lb-ft (300 Nm)
6	ZF drive axle - caliper mounting bolts	200 lb-ft (271 Nm)
7	ZF drive axle - brake chamber mounting bolts	120-150 lb-ft (163-203 Nm)

1.2 MISCELLANEOUS TORQUES



AIR DRYER		
No	DESCRIPTION	TORQUE
-	Dual Concep bracket mounting bolts (4x)	7 lb-ft
-	Dual Concep bolts to bracket (4x)	6-11 lb-ft
-	Governor mounting bolts (2x)	14 lb-ft
-	Air dryer mounting bolts (6x)	59 lb-ft
1	Dual Concep inlet and outlet manifold M22 banjo bolts	45-55 lb-ft
2	Automatic drain valve mounting nuts to Consep	80-98 lb-in
3	Dryer inlet and outlet manifold M22 banjo bolts	45-55 lb-ft
4	Dryer control and purge manifold M12 banjo bolts	130-150 lb-in



AIR DRYER		
No	DESCRIPTION	TORQUE
1	Cartridge canister bolts	32-35 lb-ft
2.2	Check valve plug	84-94 lb-in
2.3	Turbo protection valve	45-55 lb-ft
2.4	Heater retaining screw	45-55 lb-in
3	Valve unit bolts	62-80 lb-in

* Hand tight first then tighten using wrench the number of turns specified in table**.**

2. AIR SYSTEM

The basic air system consists of an air compressor, tanks, valves, filters and interconnecting lines and hoses. It provides a means for breaking, 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.

3. 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 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.

4. AIR TANKS

The air coming from the compressor is first forwarded to the ping tank, then to the Haldex condenser-separator, the air dryer, the wet air tank, the primary (for the primary brake system), secondary (for the secondary brake system), and accessory (for the pneumatic accessories) air tanks.

Two additional air reservoirs are installed on the vehicle: the kneeling air tank and the parking brakes overrule air tank.

4.1 WET TANK AUTOMATIC DRAIN VALVE

The wet tank automatic drain valve (Figure 1) is designed to remove liquids from the wet tank each time the brake is applied as the solenoid is connected to the stop light circuit. A built-in heater prevents freeze-ups and keeps the air system clean in all temperature.

4.1.1 Installation

1. Make sure that there is no pressure in the wet tank (emptied tank).
2. Fit the automatic drain valve to the wet tank. Tighten valve finger tight and then tighten an additional 1 ½ turns, do not over tighten.
3. Connect the power cable to the valve connector.
4. Charge the air system and make sure there is no leakage. Also check functioning of the drain valve by applying the service brake.

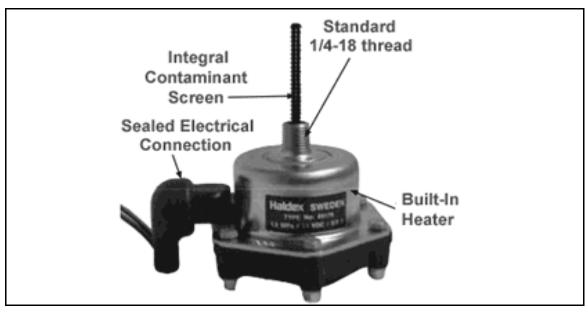


FIGURE 1: WET TANK AUTOMATIC DRAIN VALVE

4.2 MAINTENANCE

MAINTENANCE

Air tank purge

A recommended purge using the bottom drain cock should be done at the intervals specified by the Lubrication And Servicing Schedule in Section 24A: LUBRICATION & SERVICING SCHEDULE.

It is important to empty the tanks completely to ensure that water and moisture is totally evacuated from the tank.

4.2.1 Wet Air Tank

This reservoir, located above the L.H. inner wheel of drive axle in the rear wheelhousing, is provided with an automatic drain valve and does not need to be purged manually.

4.2.2 Primary Air Tank

This reservoir is located above the R.H. inner wheel of the drive axle and is provided with a bottom drain valve. It is recommended to purge the primary air tank at the intervals specified by the Lubrication and Servicing Schedule in Section 24A: LUBRICATION & SERVICING SCHEDULE.

4.2.3 Emergency/Parking Brakes Overrule Air Tank

The parking brakes overrule air tank is installed at the ceiling of the rear baggage compartment, on the L.H. side, and is provided with a bottom drain valve.

4.2.4 Ping Tank

The ping tank is located in the engine compartment, fore of the power steering tank; it is accessible through the engine compartment R.H. side door. This tank is used to dissipate heat and to reduce noise produced by the air compressor cycling on and off. The ping tank is not provided with a drain valve.

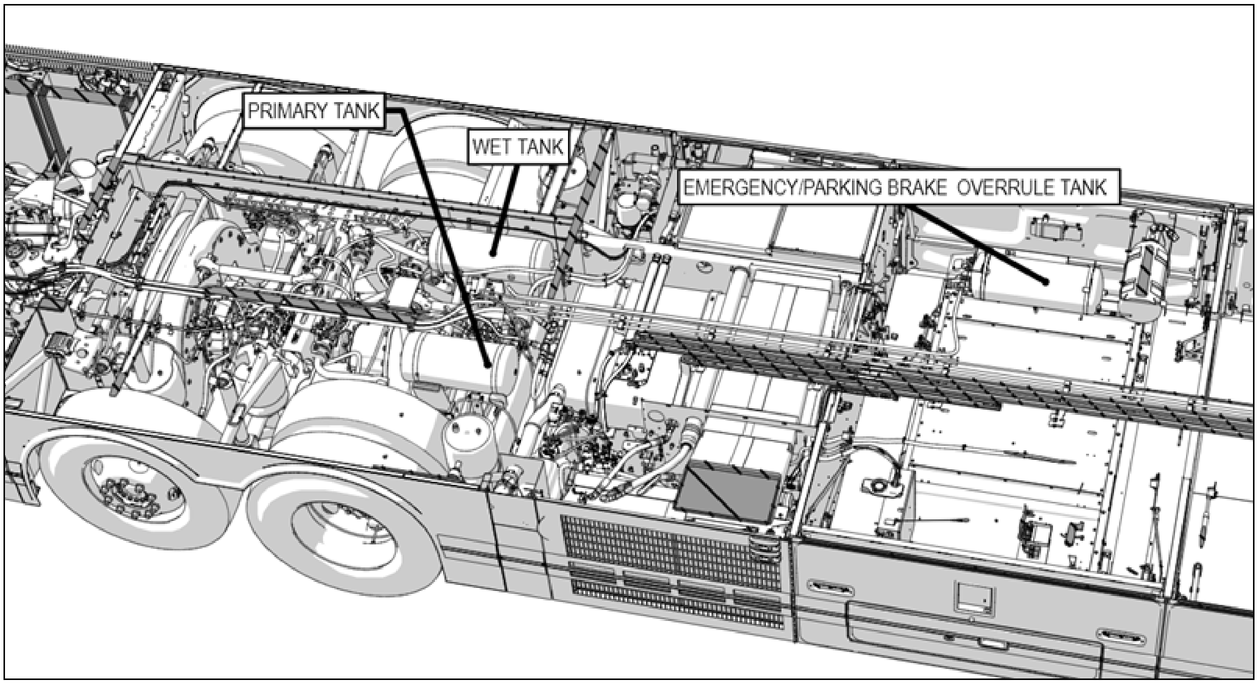


FIGURE 2: AIR TANKS LOCATION – REAR END

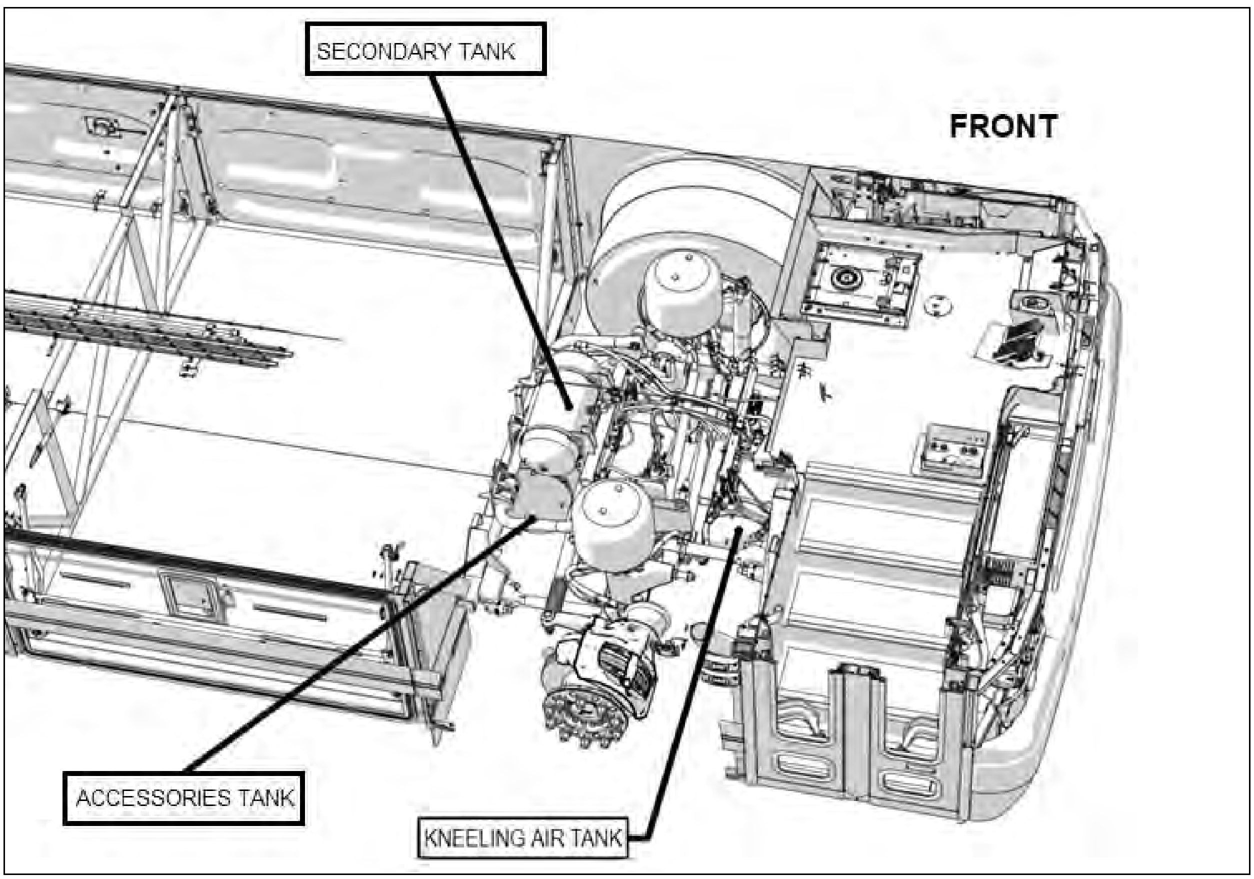


FIGURE 3: AIR TANKS LOCATION – FRONT END

4.2.5 Accessory Air Tank

This tank is found above the secondary air tank. It is provided with a bottom drain valve.

4.2.6 Secondary Air Tank

This tank is found aft of the front axle and the accessory air tank. It is equipped with a bottom drain valve.

4.2.7 Kneeling Air Tank

This tank is installed fore of the front axle. It is equipped with a bottom drain valve.

MAINTENANCE

Air tank purge

A recommended purge using the bottom drain cock should be done at the intervals specified by the Lubrication And Servicing Schedule in Section 24A: LUBRICATION & SERVICING SCHEDULE.

It is important to empty the tanks completely to ensure that water and moisture is totally evacuated from the tank.

5. EMERGENCY AIR SYSTEM FILL VALVES

The vehicle is equipped with three (3) air system emergency fill valves to supplement the air system when air pressure is low and the engine cannot be operated.

Air system emergency valves are fitted with either standard tire valve stem (Schrader) and pneumatic quick coupling fitting.

Air fill valves are as follows:

1- One quick coupling fitting and one air fill valve fitted with standard tire valve stem located near the engine air filter supply air for all systems through the wet tank.

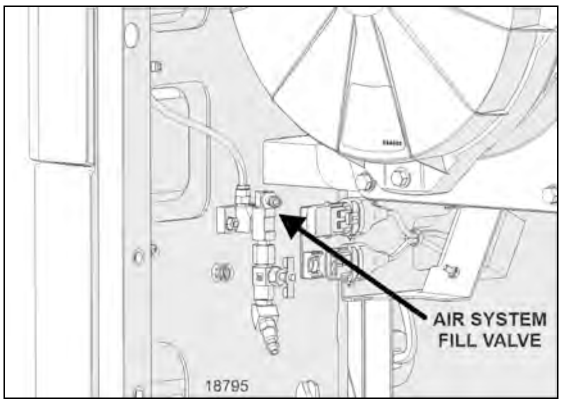


FIGURE 4: AIR FILL VALVE NEAR THE ENGINE AIR FILTER

2- One air fill valve fitted with standard tire valve stem located in the front service compartment supplies air for the accessories, secondary, wet, kneeling and parking brake overrule tanks.

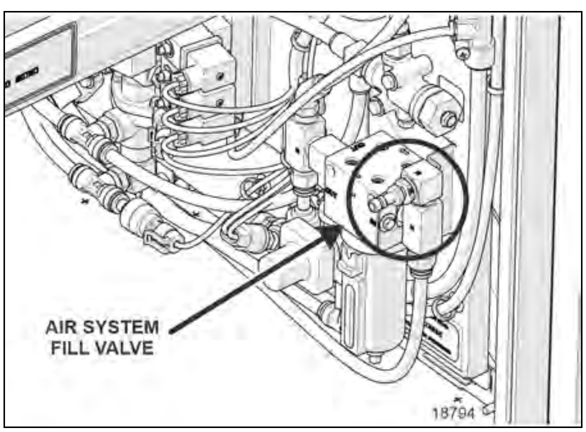


FIGURE 5: AIR FILL VALVE IN FRONT SERVICE COMPARTMENT

3- One quick coupling air fill fitting identified AIR SUPPLY is located behind the flip down hatch on the front bumper. It supplies air from a tow truck for all systems through the air dryer.

One quick coupling fitting identified BRAKE is located behind the flip down hatch on the front bumper. It supplies air for the operation of the vehicle service brake from the tow truck.

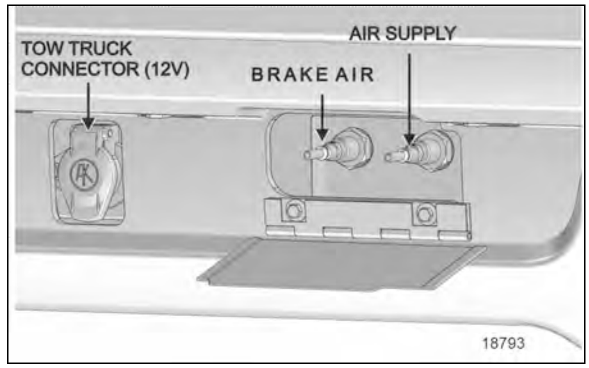


FIGURE 6: CLOSE-UP VIEW OF THE FRONT BUMPER

⚠ CAUTION
Maximum allowable air pressure is 144 psi (965 kPa).

6. ACCESSORY AIR FILTER

This filter is located inside the front electrical and service compartment (Figure 7). Its main function consists in filtering the air supplied to the suspension /leveling system, the kneeling air tank and the accessory air system.

Filter element: 5 microns
¼ PF NPT ports

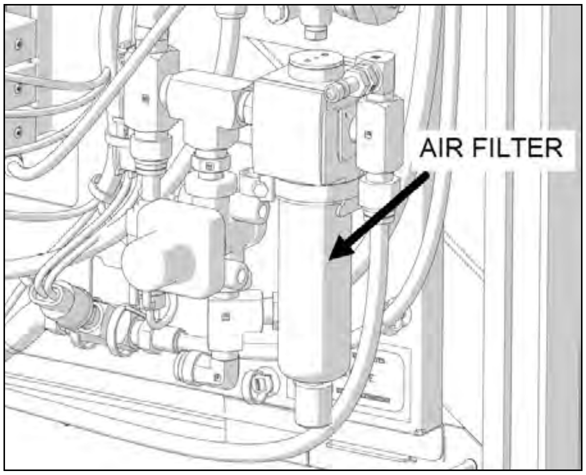


FIGURE 7: ACCESSORY AIR FILTER

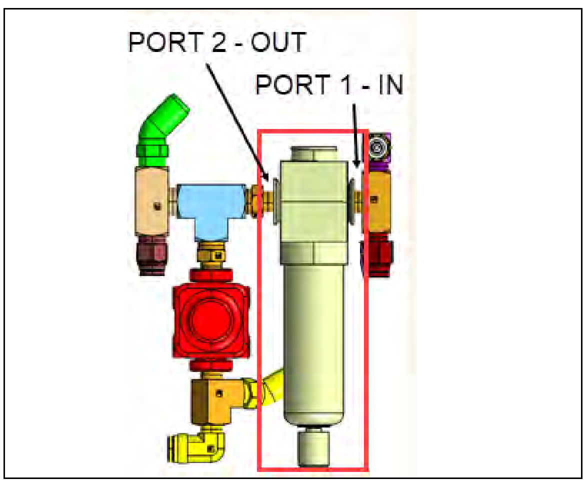


FIGURE 8: ACCESSORY AIR FILTER

6.1 ACCESSORY AIR FILTER DRAIN

The bowl is fitted with a manual/semi auto drain. Turn the drain valve to the ON position and then allow draining. Once purged, return to the OFF position.

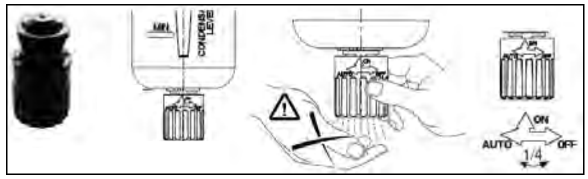


FIGURE 9: DRAIN VALVE

6.2 ACCESSORY AIR FILTER ELEMENT REPLACEMENT

Replace the accessory air filter element according to Lubrication and Servicing Schedule. Moreover, the filter element should be changed when differential pressure exceeds 15 psi (105 kPa) between filter inlet and outlet ports.

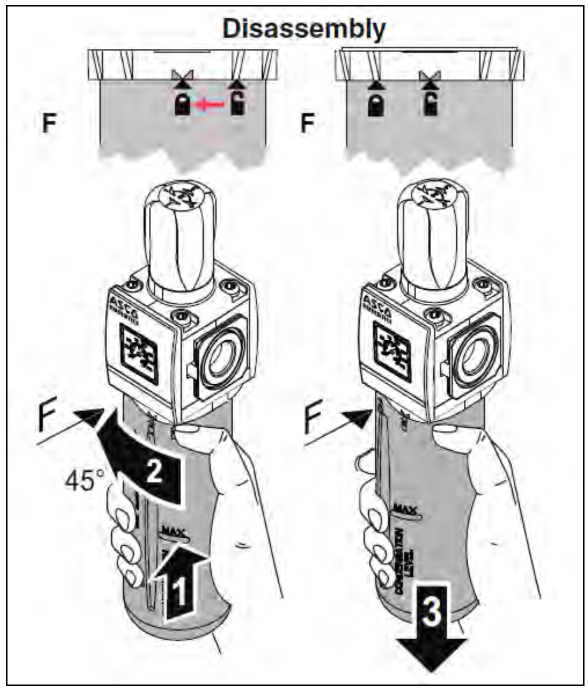


FIGURE 10: BOWL REMOVAL

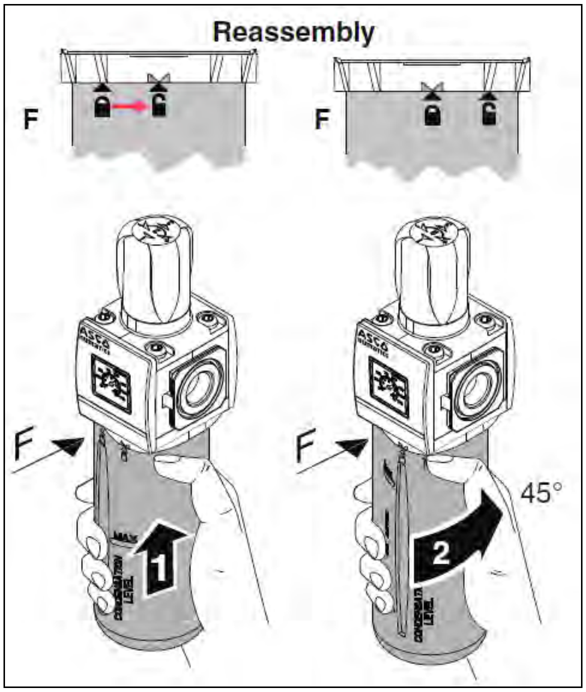


FIGURE 11: ACCESSORY AIR FILTER BOWL INSTALLATION

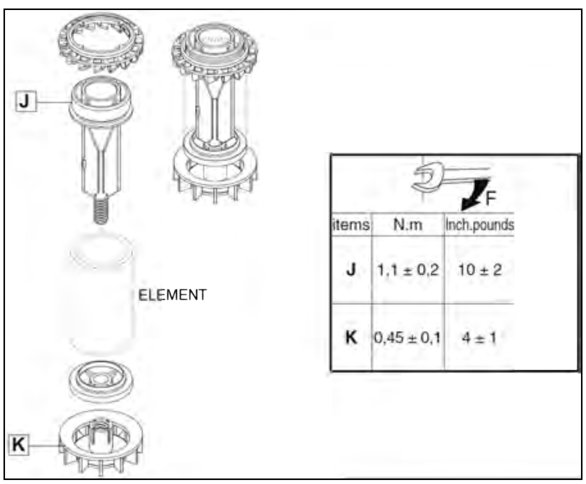


FIGURE 12: ACCESSORY AIR FILTER ARRANGEMENT

8. AIR DRYER

7. 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 lines running from the primary and secondary air tanks, as shown on the pneumatic system diagram provided with the vehicle. The accessory air gauge is connected to the front pneumatic panel in the front compartment of the vehicle. 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 85 psi (414 kPa). Moreover, if pressure drops below 85 psi (414 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.

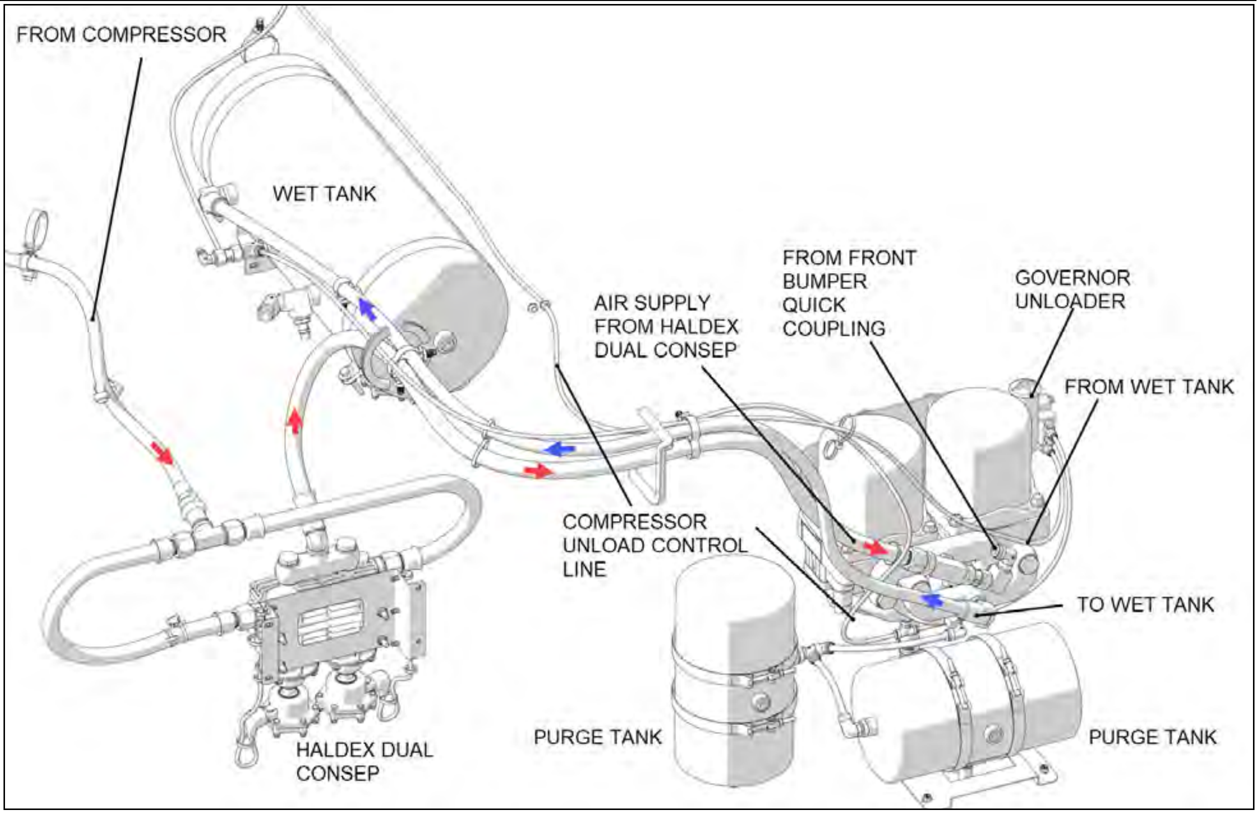


FIGURE 13: AIR DRYER PLUMBING

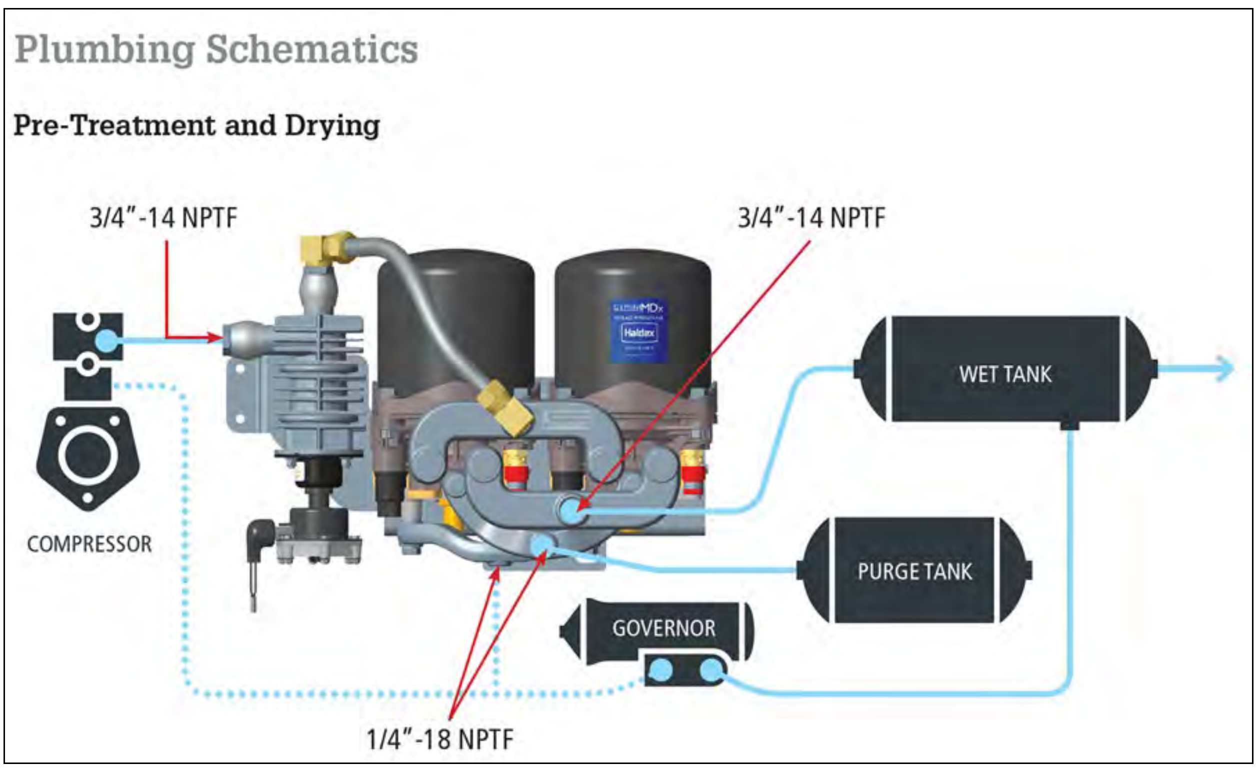
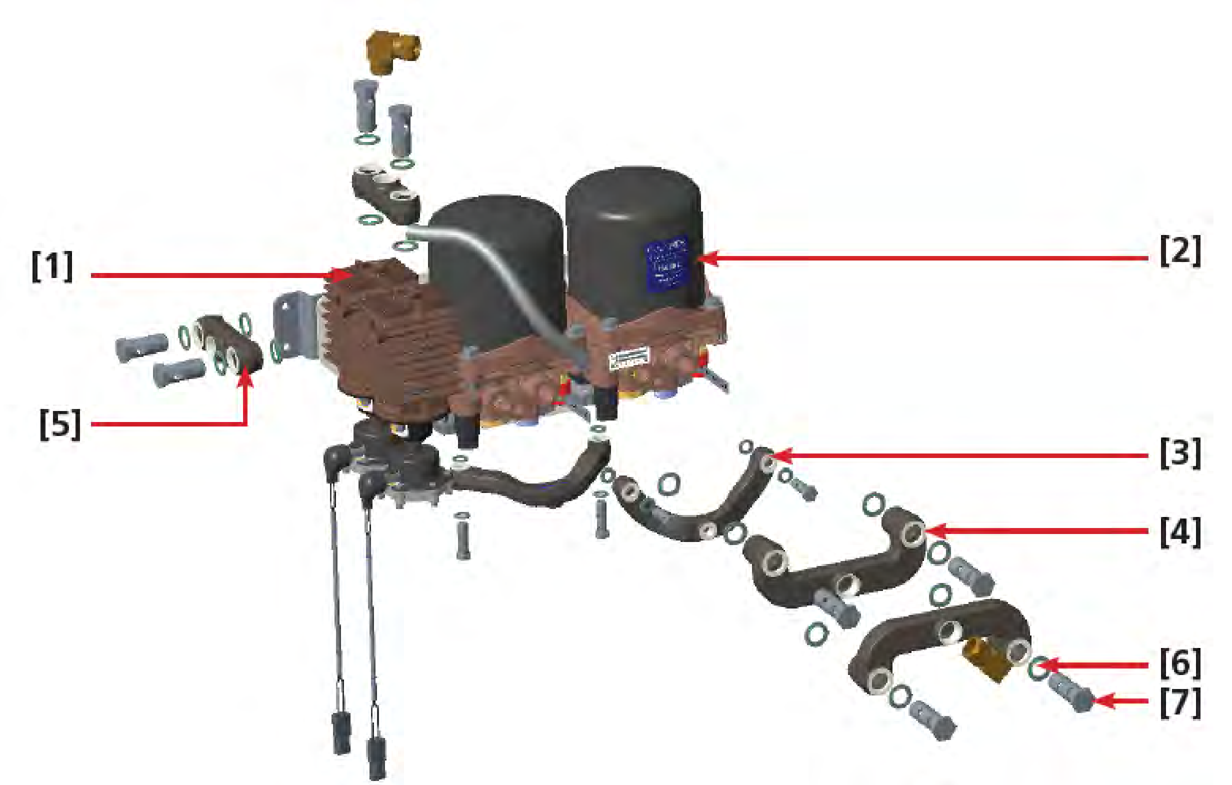


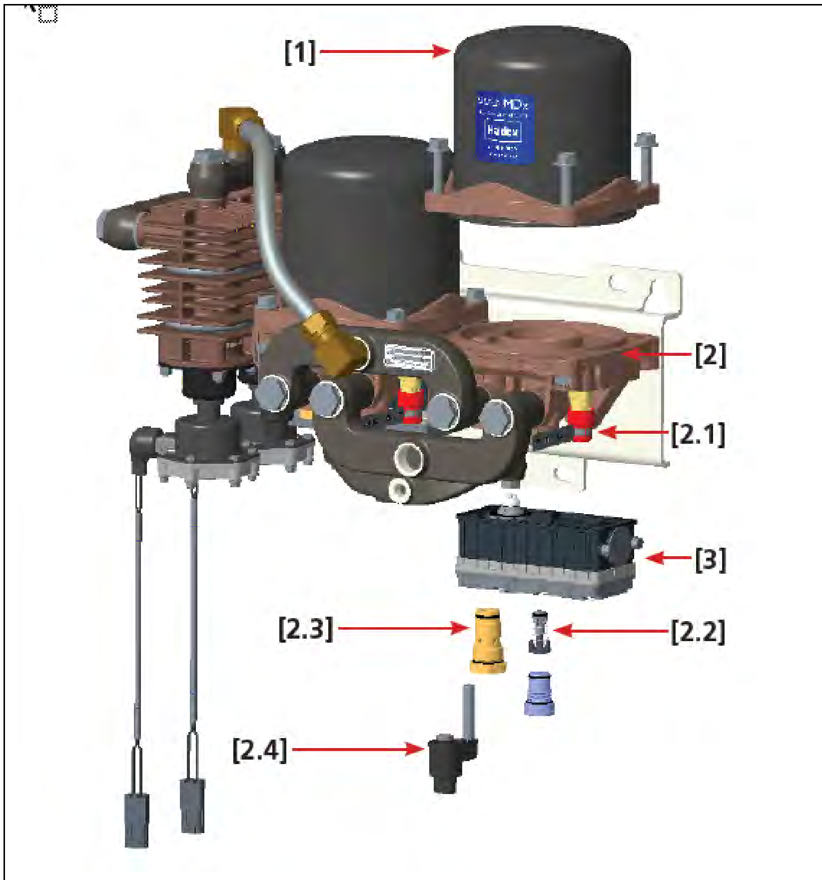
FIGURE 14: AIR DRYER CONNECTIONS SCHEMATIC

Inlet/Outlet Ports	3/4" - 14 NPT
Control Port	1/4" - 18 NPT

LOCTITE 567 thread sealant: Apply on all NPT threads



1	Dual Consep
2	Dual DRYest Air Dryers
3	Cast Aluminum Purge Manifolds
4	Cast Aluminum Outlet Manifolds
5	Cast Aluminum Concep Manifolds
6	Sealing Washers
7	Banjo Bolts



1 – cartridge canister

2 – air dryer base

2.1 – safety valve

2.2 – outlet check valve

2.3 – turbo-protection valve TPV

2.4 –heater element

3 – valve unit

Haldex Gemini MDx Overview

In its most basic form, the Gemini MDx dual dryer is the connection of two DRYest Air Dryers in parallel to treat the compressed air produced by high capacity air compressors. The GeminiMDx is a desiccant type dryer that removes moisture and contaminants from the compressed air before entering the air brake system.

Dual Consep (Condenser/Separator) pre-treats the compressed air before entering the air dryers and extend the life of the air dryer's desiccant cartridge.

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 is located in a small compartment, aft of the evaporator compartment.

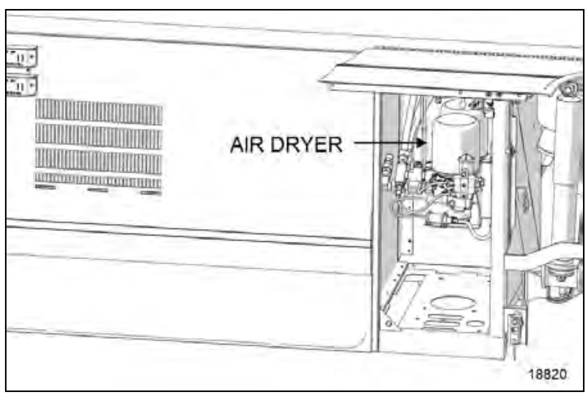


FIGURE 15: AIR DRYER LOCATION – STREET SIDE

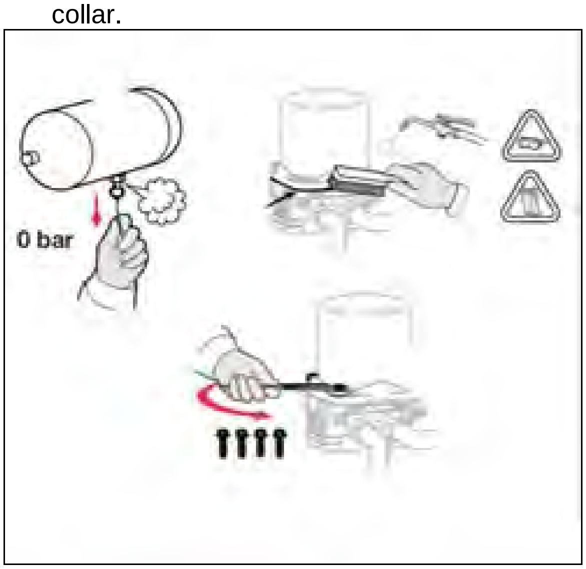
For more information on Haldex Gemini MDX Twin Air dryer, refer to the following manual included on your Technical Publications USB flash drive:

- ***Haldex Gemeni MDX twin air dryer_Installation & Service Manual L31279_2019***

8.1 REPLACING THE DESICCANT CARTRIDGE

To replace the desiccant cartridge:

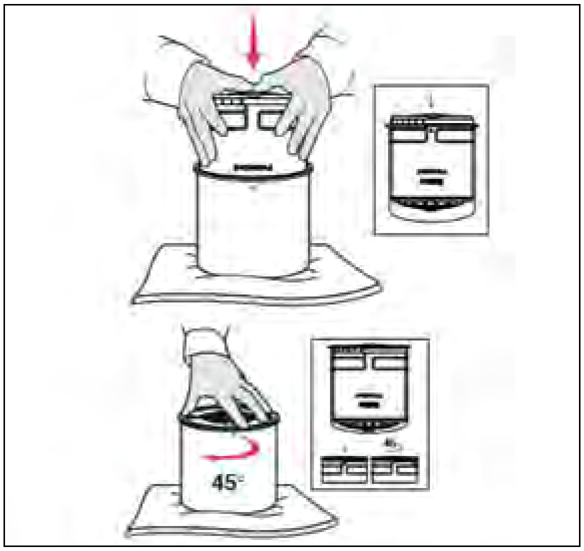
1. Ensure air pressure is at 0 PSI in air system.
2. Clean and remove all debris around cartridge canister.
3. Remove four retaining bolts from retaining collar.



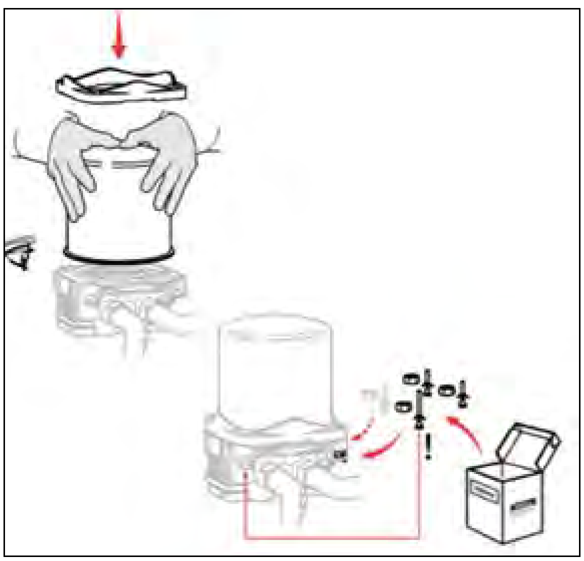
4. Lift cartridge canister away from dryer base.
5. Inspect and remove any debris from dryer base. Discard old O-rings and clean sealing surface.

6. Ensure that protection cap for safety valve housing is not damaged. If cap is off, snap cap back into place.
7. Flip cartridge canister upside down. Rotate desiccant cartridge 45° and remove from canister.

8. Install desiccant cartridge into canister and rotate 45° to secure the cartridge to the canister.



9. Apply silicone-based grease to O-rings.
10. Install replacement nut and plastic locking pins.
11. Install cartridge canister with retaining collar on dryer base.



12. Using a cross pattern, tighten the four mounting bolts to 32-35 ft-lbs (43-47 Nm).

MAINTENANCE

Air dryer cartridge

Replace the air dryer desiccant cartridge at the intervals specified by the Lubrication & Servicing Schedule in Section 24A.

9. HALDEX CONDENSER - SEPARATOR

The Consep Air Condenser-Separator is located in the rear wheelhousing, fore of drive axle (Figure 16). When present, the Consep is mounted in the air line between the compressor and the air dryer. It condenses, separates and removes 90% of the oils, liquids and other contaminants. It reduces corrosion and possible failure of air brake system components caused by contamination and significantly increases the air dryer desiccant life.

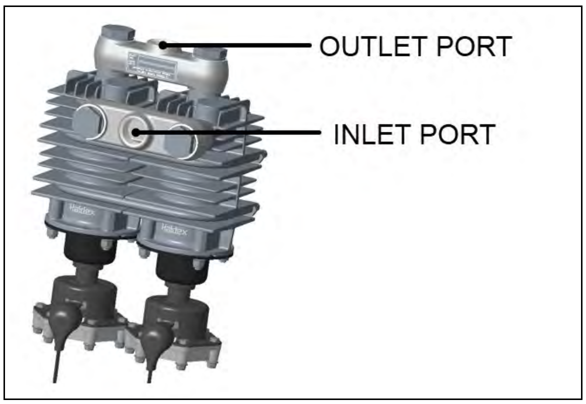


FIGURE 16: HALDEX CONSEP CONDENSER SEPARATOR

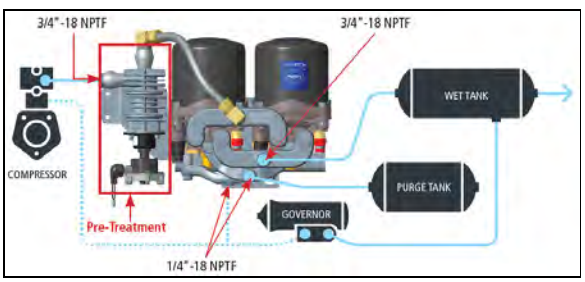


FIGURE 17: CONSEP OVERVIEW

The automatic heated drain valve installed on the Consep ensures that liquids are removed upon each brake application for optimum performance. The drain valve's integrated filter prevents damage from large debris.

The automatic drain valve activates when the rear stop lights turn ON, with the prerequisite conditions of having a vehicle speed greater than 2 mph and the engine running.

The solenoid remains energized simultaneously with activation of the rear stop lights to heat up air output to prevent it from freezing. However, Multiplex programming will ensure that the solenoid remains energized for at least of 45 seconds but not longer than 5 minutes.

9.1 PERIODIC INSPECTION

The Consep requires little maintenance during its long service life. The Consep must be inspected periodically for proper operation. The interval between inspections is determined by the type of service. High compressor duty cycles and high temperatures can cause a buildup of carbon in the condenser, drain valve and filter. This contamination must be removed for proper operation.

For more information on the periodic inspection, refer to **Haldex Consep Condenser Separator, Installation, Maintenance & Inspection L31167** included on your technical publications CD.

10. 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 as, 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
Green	Primary system, Supply/Delivery
Red	Secondary system
Brown	Parking & emergency brake system, trailer Brake
Blue	Suspension
Black & translucent	Accessories, valve exhaust tube
Yellow	Air compressor unload

10.1 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 200ºF (93ºC).

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.

10.2 FLEXIBLE HOSES

A flexible hose is used normally where it is impractical to use copper or nylon tubing due to constant flexing during operation, such as brake chamber hoses or belt tensioner air cylinder hoses. Hose connections should be tested for leakage at least every 6,250 miles 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.

10.3 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.

10.4 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.

10.5 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.

11. AIR COMPRESSOR

The Wabco System Saver 636 Twin Cylinder air compressor is located on the right side of the engine, at the flywheel end (Figure 18). Its function is to provide and maintain air under pressure to operate devices in brake and air systems.

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, found on your Technical Publications USB flash drive.

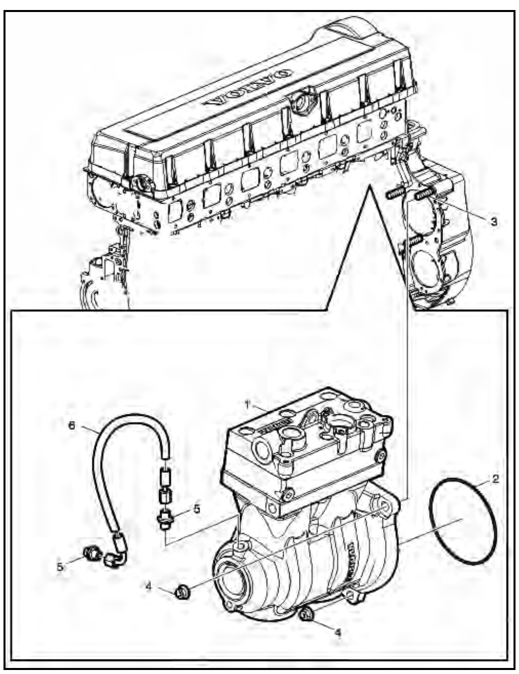


FIGURE 18: AIR COMPRESSOR LOCATION

Item	Description	Notes
1	Air Compressor	Wabco 636
2	O-ring	
3	Stud (3)	M12
4	Flange Nut (3)	
5	Nipple (2)	
6	Hose Assembly	

11.1 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.
6. Remove and retain the oil supply tube that runs between the compressor and the engine.
7. Reverse removal procedure for installation.

12. MISCELLANEOUS VALVES

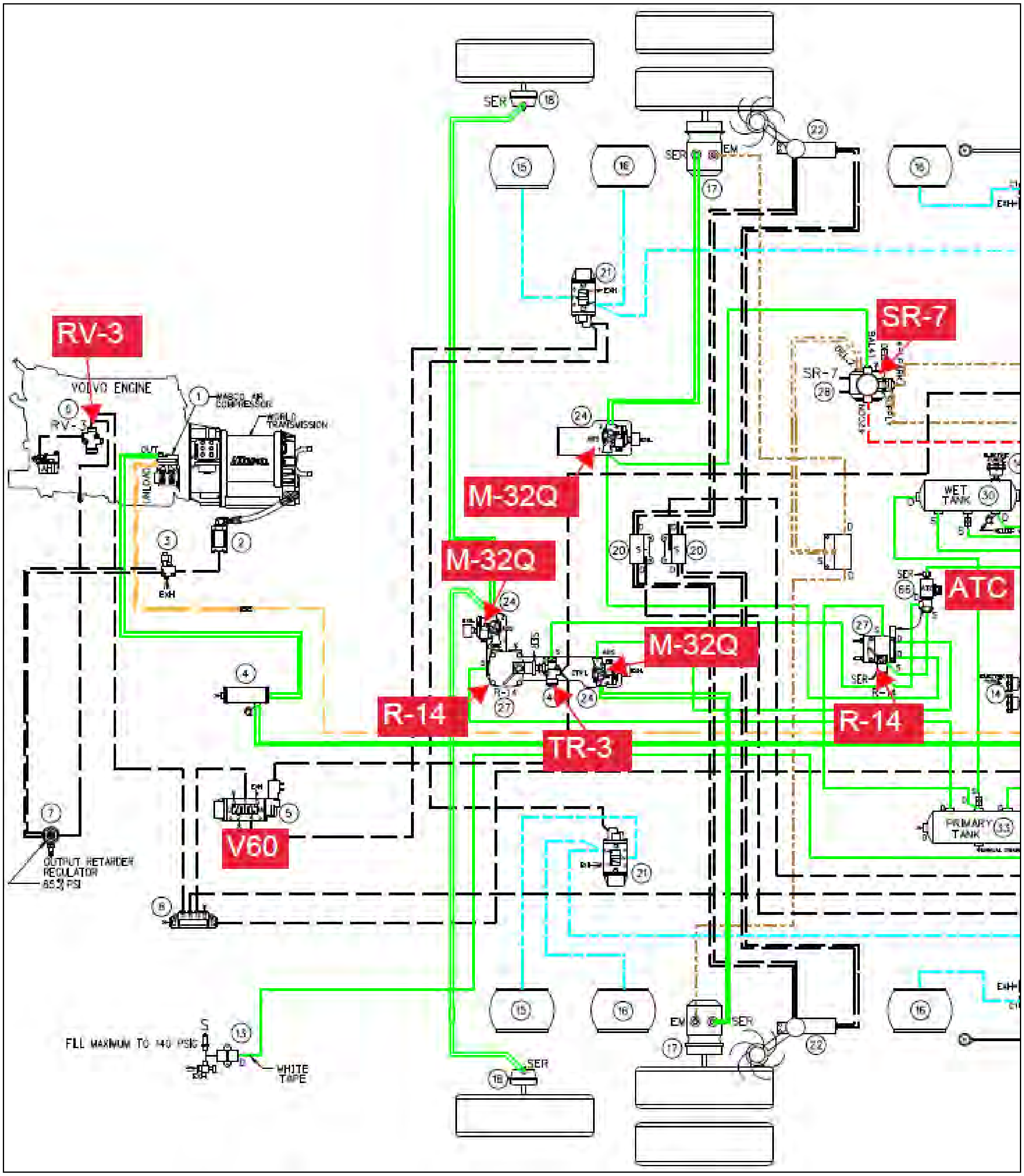


FIGURE 19 : PARTIAL PNEUMATIC DIAGRAM

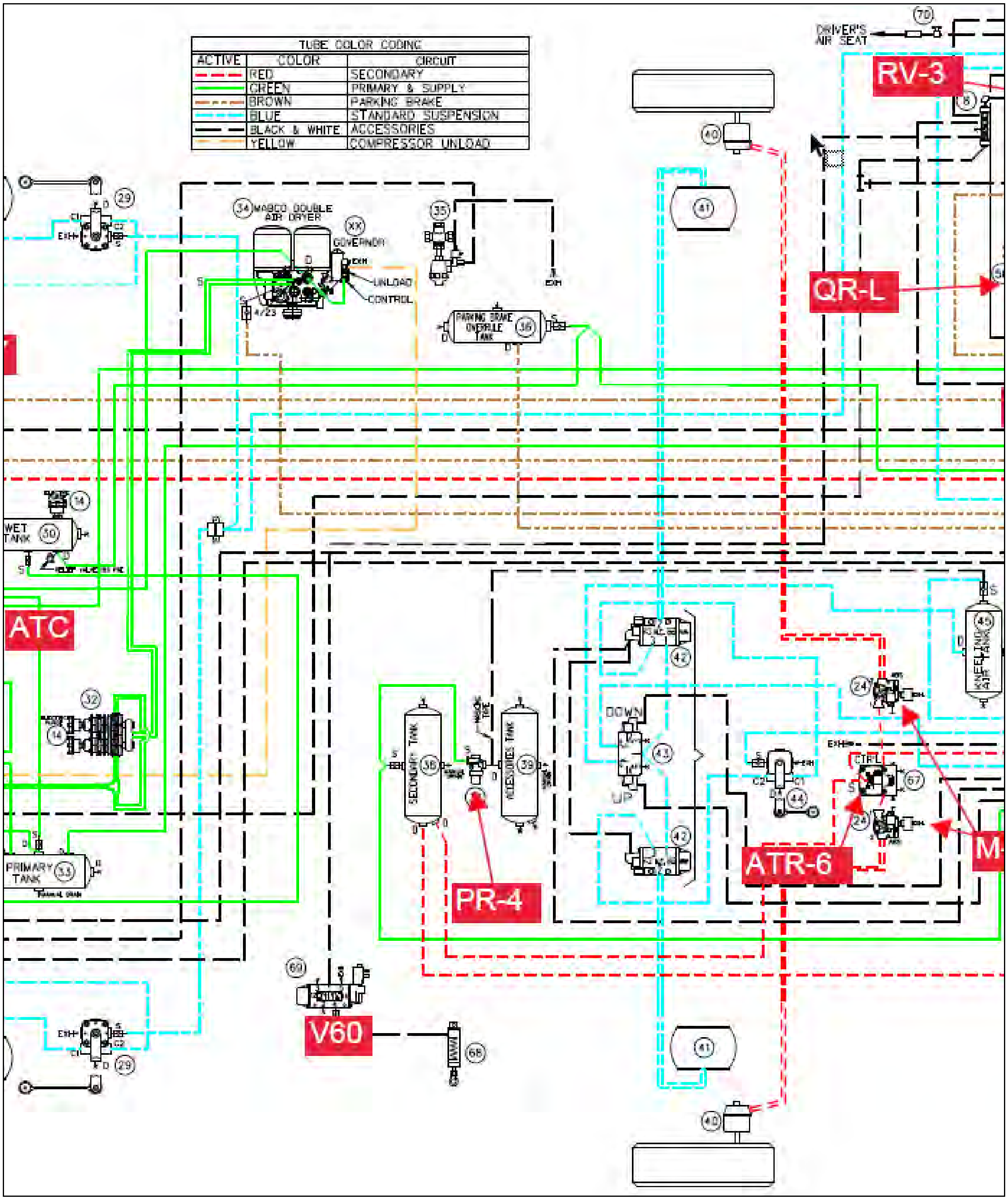

TUBE COLOR CODING
ACTIVE
COLOR
CIRCUIT
RED
SECONDARY
GREEN
PRIMARY & SUPPLY
BROWN
PARKING BRAKE
BLUE
STANDARD SUSPENSION
BLACK & WHITE
ACCESSORIES
YELLOW
COMPRESSOR UNLOAD
DRIVER'S AIR SEAT
RV-3
QR-L
WABCO DOUBLE AIR DRYER
GOVERNOR
UNLOAD
CONTROL
PARKING BRAKE OVERRULE TANK
WET TANK
ATC
PRIMARY TANK
SECONDARY TANK
ACCESSORIES TANK
PR-4
DOWN
UP
KNEELING AIR TANK
CTRL
ATR-6
V60
M-

FIGURE 20

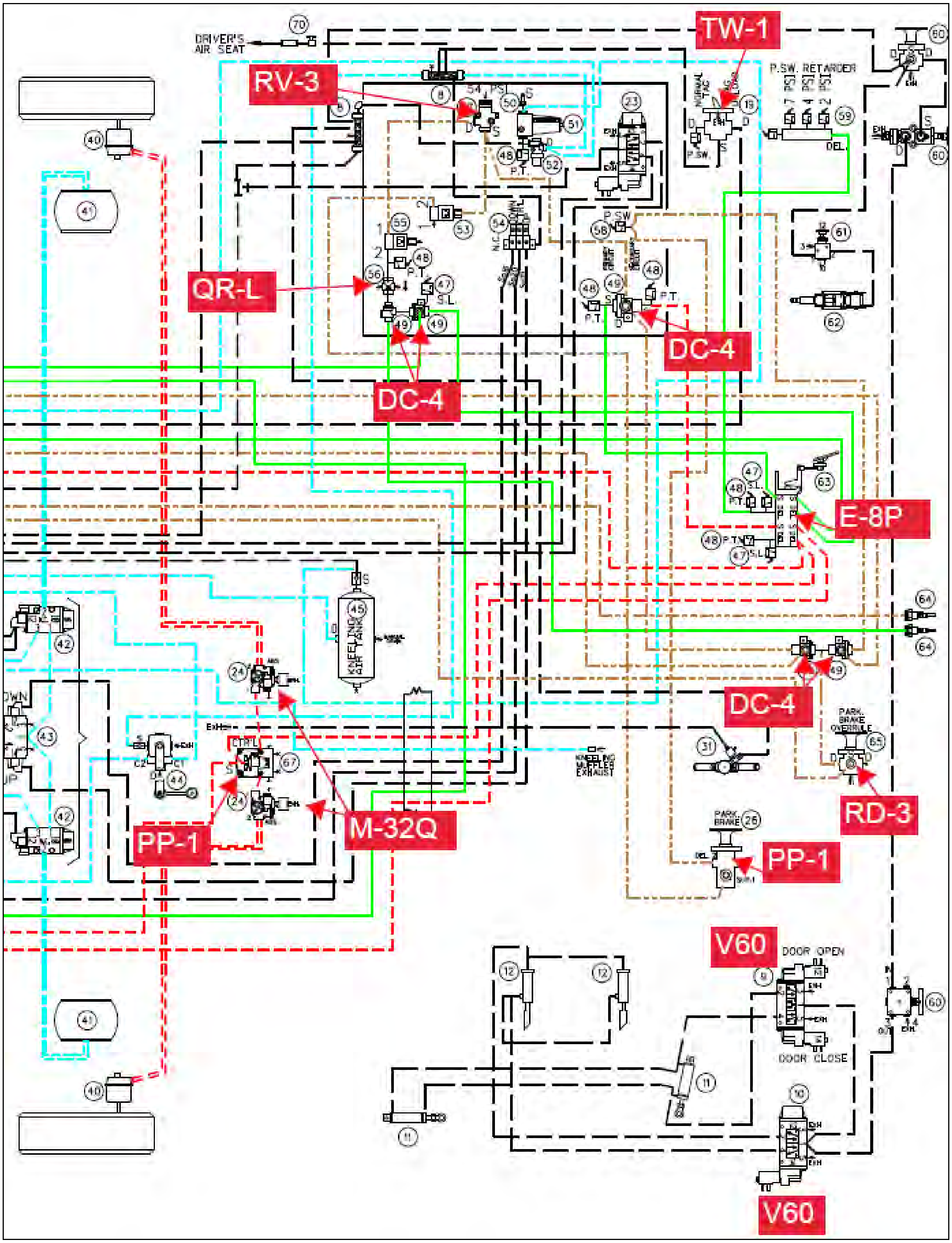

TW-1
RV-3
QR-L
DC-4
DC-4
DC-4
E-8P
DC-4
M-32Q
PP-1
PP-1
RD-3
V60
V60
DRIVER'S AIR SEAT
P.SW. RETARDER
KNEELING AIR TANK
KNEELING MUFFLER EXHAUST
PARK BRAKE OVERRIDE
PARK BRAKE
DOOR OPEN
DOOR CLOSE

FIGURE 21

12.1 EMERGENCY / PARKING BRAKE CONTROL VALVE (PP-1)

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.

Maintenance and repair information on this valve is supplied in the applicable booklet, found on your Technical Publications USB flash drive, under reference number **Bendix Service Data SD-03-3611**.

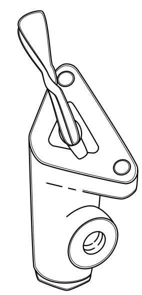
12.2 EMERGENCY / PARKING BRAKE OVERRULE CONTROL VALVE (RD-3)

BENDIX® RD-3™ VALVE

A RD-3 control valve is used when the vehicle is equipped 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, found on your Technical Publications USB flash drive, under reference number **Bendix Service Data SD-03-3611**.

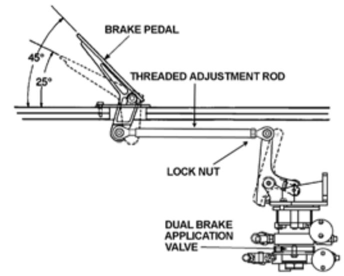
12.3 FLIP-FLOP CONTROL VALVE (TW-1)



A flip-flop control valve mounted on the front service compartment is provided to unload the tag axle air springs.

Maintenance and repair information on this valve is supplied in the applicable booklet, found on your Technical Publications USB flash drive, under reference number **Bendix Service Data SD-03-3602**.

12.4 DUAL BRAKE APPLICATION VALVE (E-8P)



The E-8P 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.

12.4.1 Brake Pedal Adjustment

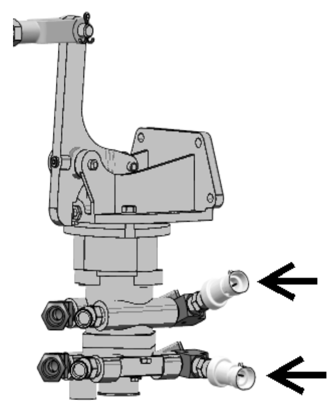
After brake pedal replacement or repair, adjust the pedal to its proper position according to the following procedure:

1. Replace the linkage, loosen threaded rod lock nut and screw or unscrew the threaded adjustment rod in order to obtain a 45º brake pedal inclination.
2. Tighten threaded rod lock nut.

12.4.2 Maintenance

Maintenance and repair information on the E-8P dual brake application valve is supplied in the applicable booklet, found on your Technical Publications USB flash drive, under reference number **Bendix SD-03-830**.

12.5 STOPLIGHT SWITCHES



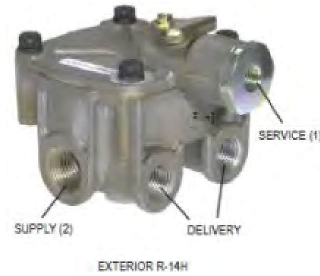
Two Electro-pneumatic stoplight switches are mounted on the dual brake application valve (E-8P). The upper one is used for the primary air circuit while the lower one is used for the secondary air circuit. Both switches are connected in parallel and have the same purpose, i.e. completing the electrical circuit and lighting the stoplights when a brake application is made.

12.6 PARKING BRAKE ALARM SWITCH

Refer to the appropriate booklet (Bendix, SL-5 Stop Light Switch; reference no. **BENDIX SERVICE DATA SD-06-1804**), found on your Technical Publications USB flash drive.

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.

12.7 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.

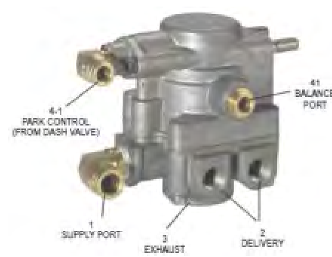
Maintenance and repair information on these valves is supplied in the applicable booklet, found on your Technical Publications USB flash drive, under reference number **Bendix Service Data SD-03-1064**.

12.8 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, found on your Technical Publications USB flash drive, under reference number **Bendix Service Data SD-13-4861**.

12.9 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 chamber and performs the following functions:

- Provides a rapid application of the spring brake chamber when parking.
- Modulates the spring brake chamber 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, found on your Technical Publications USB flash drive, under reference number **Bendix Service Data SD-03-9043**.

12.10 PRESSURE PROTECTION VALVE (PR-4)

Maintenance and repair information on the pressure protection valve is supplied in the applicable booklet, found on your Technical Publications USB flash drive, under reference number **Bendix Service Data SD-03-2010**.

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

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.

PR-2™ PRESSURE PROTECTION VALVE

12.11 SHUTTLE-TYPE DOUBLE CHECK VALVE (DC-4)

Maintenance and repair information on the shuttle-type double check valve is supplied in the applicable booklet, found on your Technical Publications USB flash drive, under reference number **Bendix Service Data 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.

12.12 PRESSURE REDUCING VALVE RV-3

The Bendix RV-3 pressure reducing valve is a normally open pressure control device. The function of the RV-3 valve is to reduce system air pressure and maintain a constant specified pre-set pressure below that of system pressure. A pressure reducing valve is installed upstream of the AHI module (Aftertreatment hydrocarbon injector).

Maintenance and repair information on the pressure reducing valve is supplied in the applicable booklet, found on your Technical Publications USB flash drive, under reference number **Bendix Service Data SD-03-3515**.

12.13 ANTILOCK MODULATOR (M-32QR)

The M-32QR (quick release) antilock system modulator is high capacity, on/off air valve that incorporate a pair of electrical solenoids for control. The solenoids provide the electro-pneumatic interface between the antilock controller electronics and the air brake system. The modulator is used to control the braking function on individual or dual service actuators during antilock activity.

Maintenance and repair information on the antilock modulator valve is supplied in the applicable booklet, found on your Technical Publications USB flash drive, under reference number **Bendix Service Data SD-13-4870**.

12.14 INVERSION VALVE (TR-2, TR-3)

The TR-2 & TR-3 valves are normally open, pilot-operated, inverting, on-off, two-way valves. As control pressure is reduced to the point that the piston return spring or springs overcomes the force on the control piston, the valve will deliver full supply pressure at the delivery port.

Maintenance and repair information on the antilock modulator valve is supplied in the applicable booklet, found on your Technical Publications USB flash drive, under reference number **Bendix Service Data SD-13-4650**.

12.15 INLINE QUICK RELEASE VALVE (QR-L)

The QR-L quick release valve is a quick release valve. Its purpose is to “speed up” the release of air from air lines and devices it is attached to. Although primarily intended to enhance air system performance by rapidly exhausting supply or control air pressure from vehicle air lines, it can be used in a variety of different applications. It is uniquely suitable as an air system performance enhancement due to its 0 psi crack and differential pressure. Supply and delivery pressure is the same throughout the air pressure range.

Maintenance and repair information on the inline quick release valve is supplied in the applicable booklet, found on your Technical Publications USB flash drive, under reference number **Bendix Service Data SD-03-906**.

13. EMERGENCY DOOR OPENING VALVES

Three pressure release valves are installed on the vehicle.
Once the air pressure is released in the entrance door and latching cylinders by either one of these valves, unlock then push or pull to open the entrance door.

The usual rotary valve is located in the stepwell. (Figure 22)

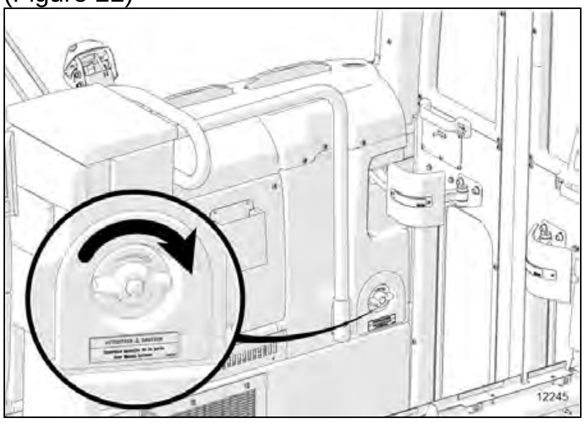


FIGURE 22: STEPWELL ENTRANCE DOOR RELEASE

One PP1 valve is placed on the lateral console. Pull to release air. (Figure 23)

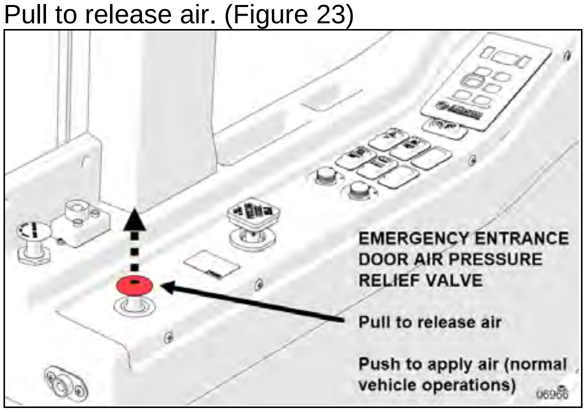


FIGURE 23 LATERAL CONSOLE ENTRANCE DOOR RELEASE (PP-1).

Additionally, a “push to exhaust” control valve is located in the front service compartment.
Push two seconds to release air. The PP1 valve on the lateral console will pop up.(Figure 24)

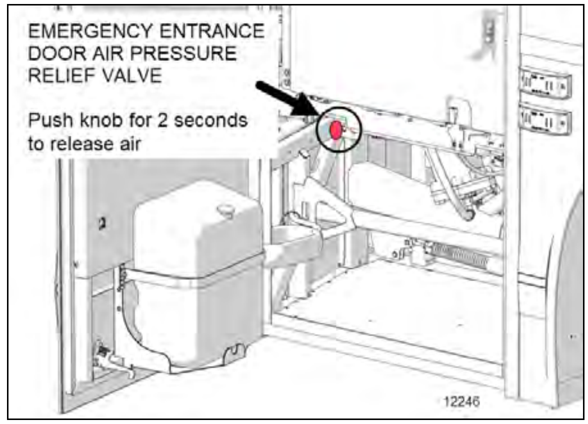


FIGURE 24: FRONT SERVICE COMPARTMENT ENTRANCE DOOR RELEASE.

13.1 EMERGENCY DOOR RELEASE SYSTEM INSPECTION

Test each valve periodically to confirm proper operation. Replace any defective valve.

14. AIR SYSTEM TROUBLESHOOTING

Consult the following list to troubleshoot 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, found on your Technical Publications USB flash drive.

Air pressure does not rise to or does not maintain a normal setting:

- Defective air gauge (registering incorrectly).
- Excessive leaking in air system.
- Tank 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.
- Worn compressor or excessive wear on piston and/or ring.
- Engine speed too low.

Air pressure rises above a normal setting:

- Defective air gauge (registering incorrectly).
- Faulty sensor.
- Restriction in line between governor and compressor unloading mechanism.
- Air system governor defective.

Air pressure drops quickly when engine is stopped:

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

15. 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/parking brakes are mounted on the drive axle and will apply automatically if primary system pressure falls below 60 psi (413 kPa).

Brake application or release, which is speed 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.

The parking brake override system can cancel the parking brakes, enabling the driver to move the vehicle to a safe parking place. Operate this system by pushing down and holding the control knob located on the L.H. console (see *"Operator's Manual"* for more details).

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 "Torque Tables" for recommended tightening torques).

16. DISC BRAKES

Knorr-Bremse SN7 disc brakes are used on all axles.

The front axle service brakes are actuated by 24 inch^2 effective area air brake chambers. The drive axle service brakes as well as the emergency/parking brakes are actuated by 24 inch^2 effective area air brake chambers. On the tag axle, the service brake chambers have a 16 inch^2 effective area.

The *Knorr-Bremse SN7* brakes are supplied with automatic clearance 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 Publications USB flash drive and also available on Prevost Technical Publications site.

16.1 INSPECTION POINTS

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.

The following inspection points will ensure long-life and trouble-free operation of the disc brake.

MAINTENANCE

Check brake pads & discs wear visually (this is independent of any electronic wear indicator fitted to the vehicle) at the intervals specified by the Lubrication and Servicing Schedule in Section 24: LUBRICATION & SERVICING.

MAINTENANCE

With every pad replacement or once a year whichever comes first:

1. Check correct functioning of the adjuster (see 16.2.6).
2. Check that caliper operates smoothly over its full range of movement (see 16.2.6).
3. Check the adjuster cap for correct fitting and condition (item 37).
4. Check the sealing elements for correct fitting and condition (items 9, 58) (see 16.2.10 Caliper Guide Pin Seals & 16.2.11 Tappet & Boot Assemblies).
5. Check the caliper bearing in the area of the rubber bush/guide sleeve (item 6) (see 16.2.8 step 2).
6. Check the caliper running clearance (see 16.2.7).
7. Check fitting and condition of the cover (item 10) and cover (item 68, bearing variants may exist).

MAINTENANCE

Moisture and dirt is the enemy. 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.

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 rubber bush/guide sleeve (item 6, Figure 25), guide pin (items 4 & 5 Figure 26, screw (items 39 & 40) and cap (items 10 & 68) is required.

- excessive or abnormal play
- movement along guide pins is hard or impossible (due to corrosion or dirt)
- A missing guide pin cap

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.

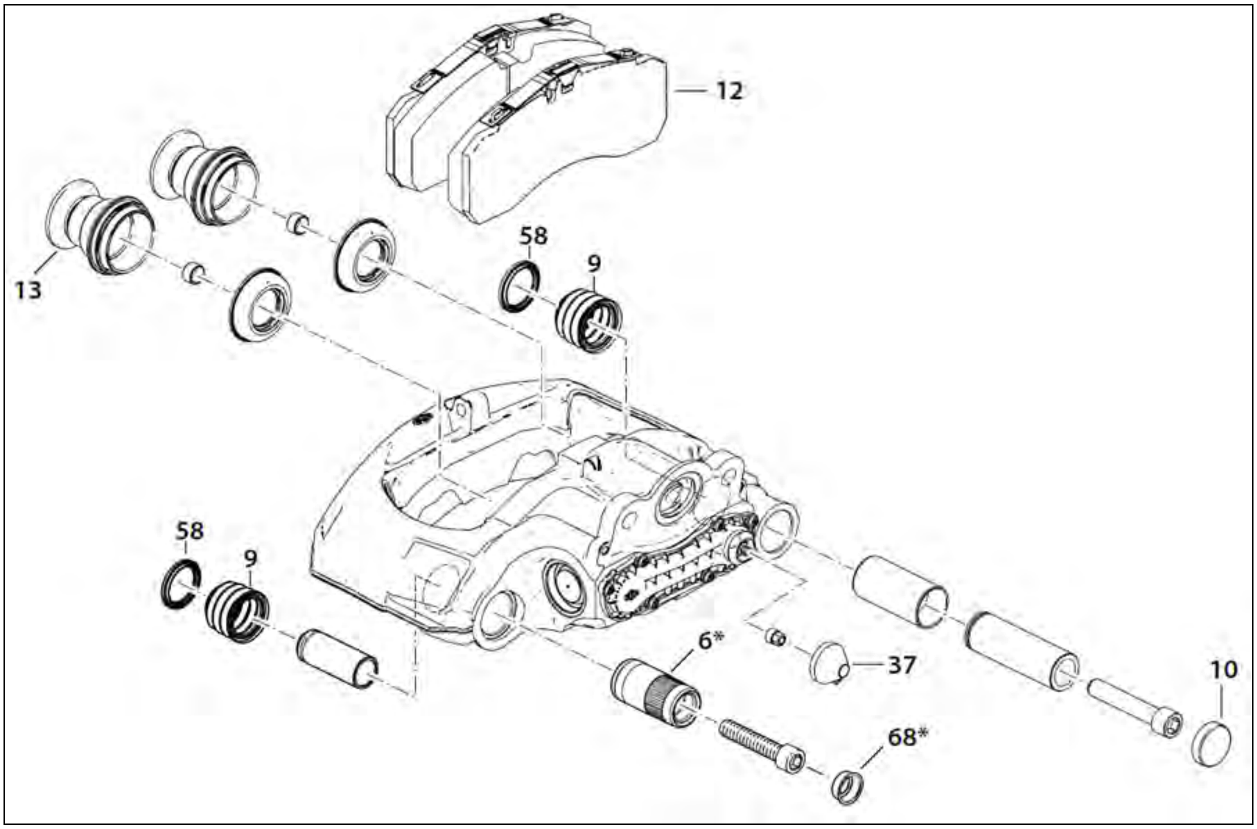
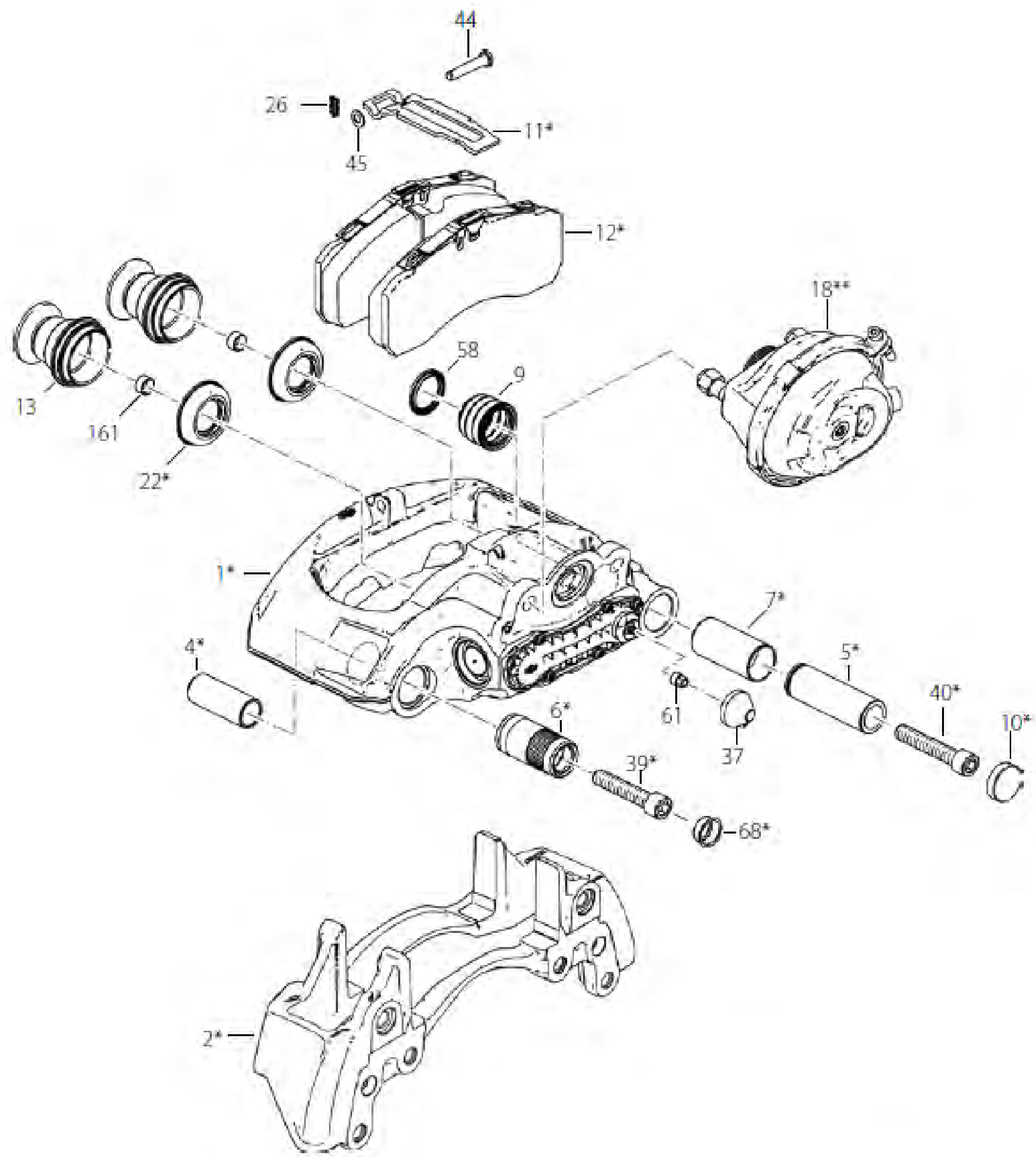


FIGURE 25: INSPECTION POINTS IDENTIFICATION



Legend

- 1 Caliper*
- 2 Carrier*
- 4 Guide Pin*
- 5 Guide Pin*
- 6 Rubber Bush or Guide Sleeve* (floating bearing side)
- 7 Brass Bush* (fixed bearing side)
- 9 Inner Boot*
- 10 Cover*
- 11 Pad Retainer*
- 12 Pad (complete)*
- 13 Tappet and Boot Assembly
- 18 Brake Actuator**
- 22 Inner Seal*
- 26 Spring Clip
- 37 Adjuster Cap
- 39 Caliper Bolt*
- 40 Caliper Bolt*
- 44 Pad Retainer Pin
- 45 Washer
- 58 Ring*
- 61 Shear Adapter
- 68 Cover*
- 161 Tappet Bush

* Variants possible (see also contents leaflet in the service kit)

** Brake chamber or spring brake

FIGURE 26: DISC BRAKE COMPONENTS

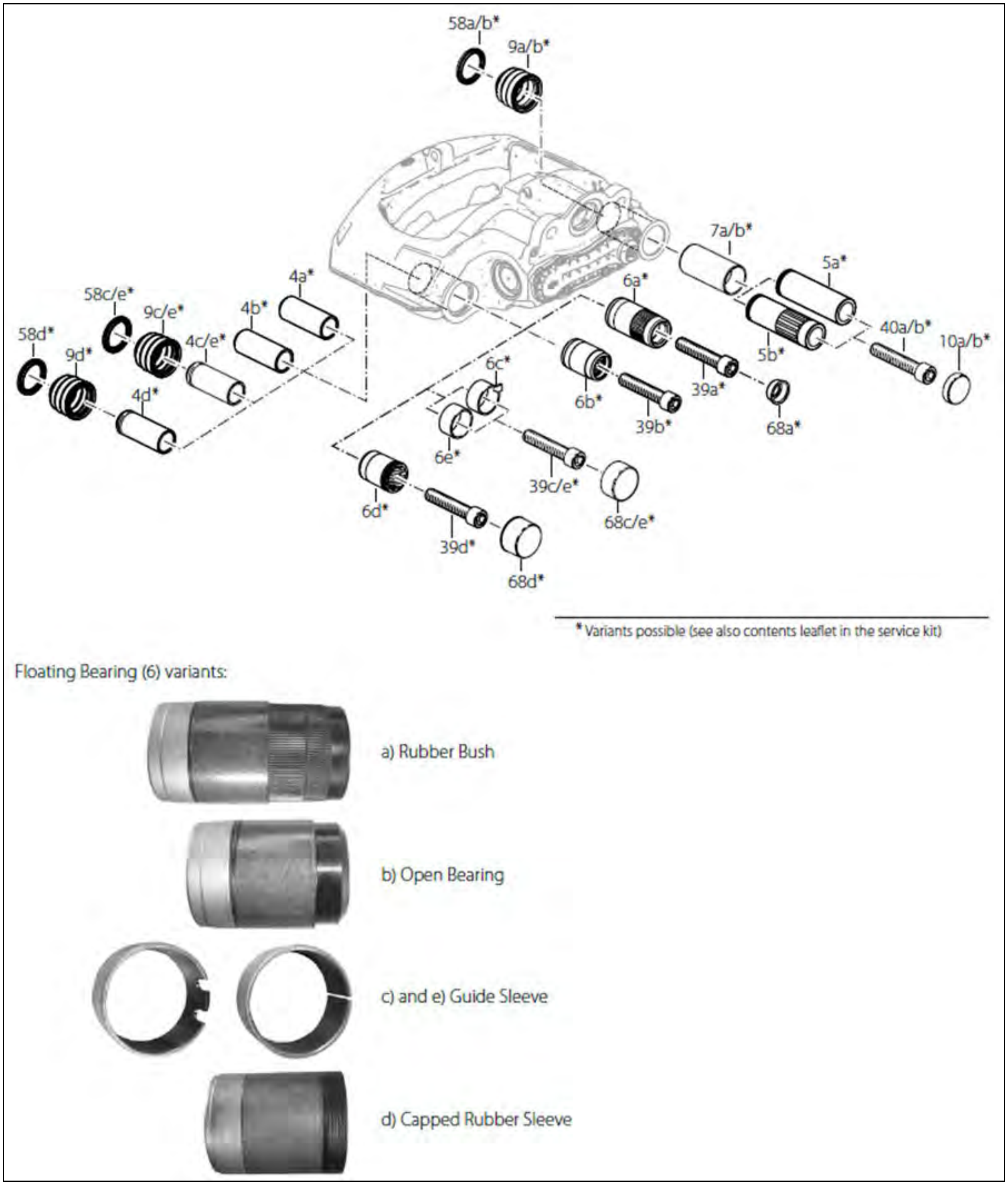


FIGURE 27: IDENTIFICATION OF GUIDE & SEAL VARIANTS

16.2 VISUAL AND FUNCTIONAL CHECK

16.2.1 Wear Check of 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 checked according to the Lubrication and Servicing Schedule interval.

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.

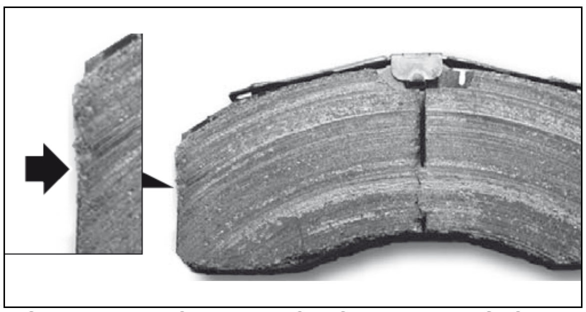


FIGURE 28: MINOR BREAKOUTS AT THE EDGES ARE PERMITTED (SEE ARROW)

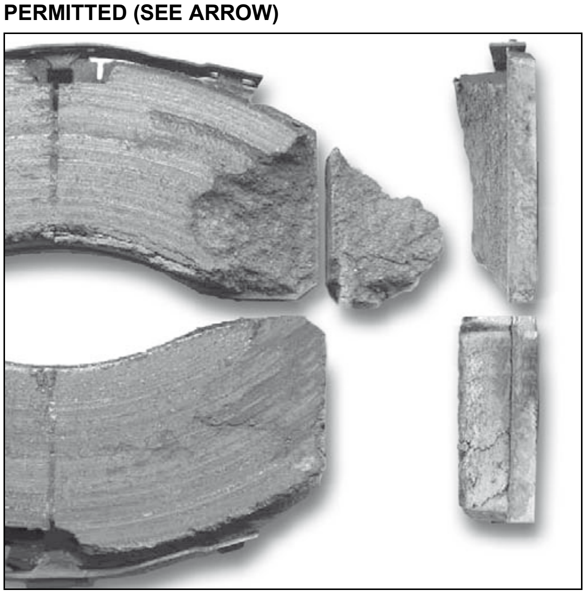


FIGURE 29:MAJOR BREAKOUTS ON THE SURFACE OF THE BRAKE PAD ARE NOT PERMITTED

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: 1.181 in (30 mm)
B= Backplate 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 backplate and friction material: 0.433 in (11 mm)

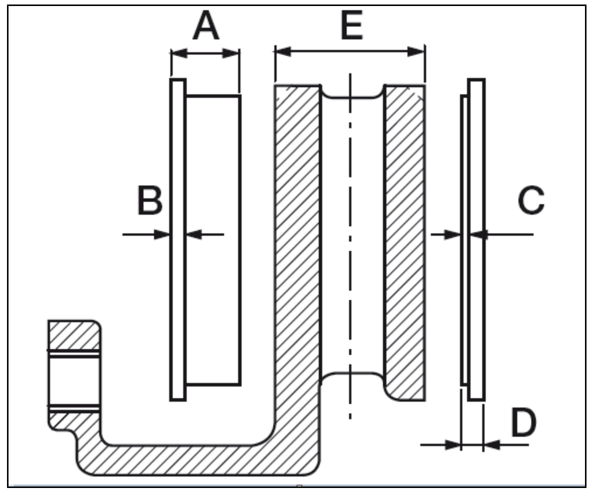


FIGURE 30: BRAKE PADS DIMENSIONS

Exaggerated wear difference between inner and outer brake pads

The total thickness of the friction material of the inner and outer pad should be equal. If the difference between the two pads is greater than 3.5 mm, then the following checks are necessary:

- Bearing clearance check (see 16.2.7 & 16.2.8).
- Free movement of the brake pads in the caliper (see 16.2.6).
- Possible collision with other parts on the axle or vehicle body.
- Excessive dirt and grime present.
- Piping of the compressed air line

Example 1)

E=0.748 in (19 mm)
F=0.590 in (15 mm) > NOT OK

Example 2)

E=0.453 in (11.5 mm)
F=0.512 in (13 mm) > OK

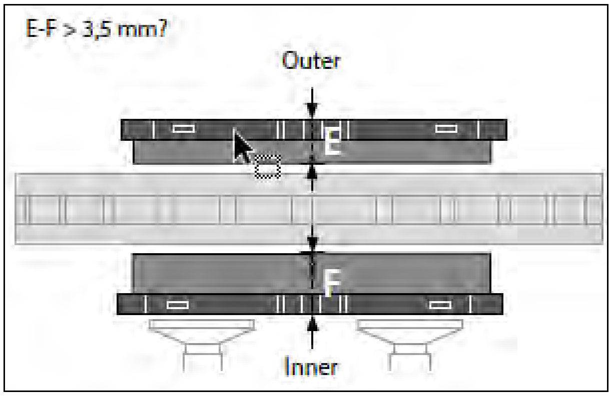


FIGURE 31: EXAGGERATED WEAR DIFFERENCE BETWEEN INNER AND OUTER BRAKE PADS

Exaggerated tangential oblique wear of brake pads

The total thickness of the friction material at either end of the pad should be equal. If the difference between the two ends is greater than 2 mm, then the following checks are necessary:

- Bearing clearance check (see 16.2.7 to 16.2.9).
- Free movement of the brake pads in the caliper (see 16.2.6).
- Possible collision with other parts on the axle or vehicle body.
- Excessive dirt and grime present.
- Piping of the compressed air line. In addition, the piping must be replaced.

Example 1)
G=21 mm
H=18 mm > NOT OK

Example 2)
G=18 mm
H=19 mm > OK

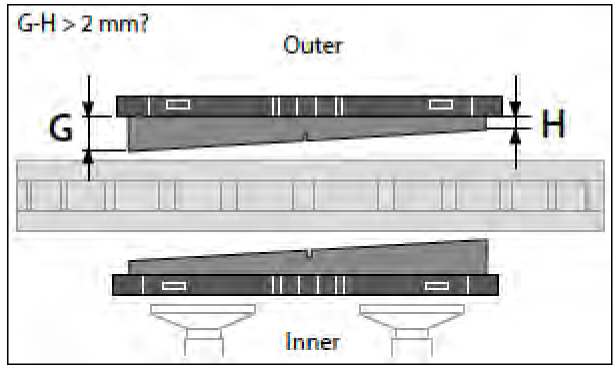


FIGURE 32: EXAGGERATED TANGENTIAL OBLIQUE WEAR OF BRAKE PADS

Exaggerated taper wear of brake pads

The total thickness of the friction material in the radial direction should be equal. If the difference between the top and bottom ends is greater than 1 mm, then the following checks are necessary:

- Bearing clearance check ((see 16.2.7 to 16.2.9).
- Free movement of the brake pads in the caliper (see 16.2.6).
- Possible collision with other parts on the axle or vehicle body.
- Excessive dirt and grime present.

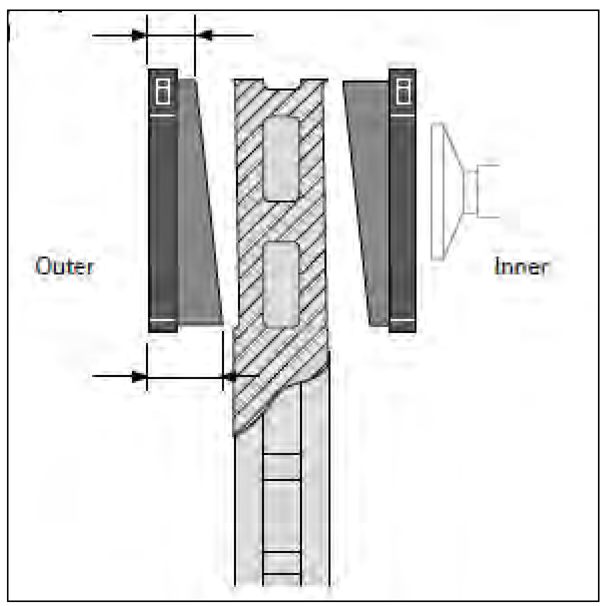


FIGURE 33: BRAKE PAD WITH EXAGGERATED TAPER WEAR

16.2.2 Wear Check of Disc

Measure the thickness of the brake disc at the thinnest point. Be aware of possible burring at the edge of the disc.

M= Total thickness of the brake disc

New condition = 1.77 in (45 mm)
Worn condition = 1.457 in (37 mm) (the disc must be replaced).
If the disc dimension M ≤ 1.535 in (39 mm) or N≤ 0.039 in (1 mm), it is recommended that the disc should be renewed when the brake pads are changed.

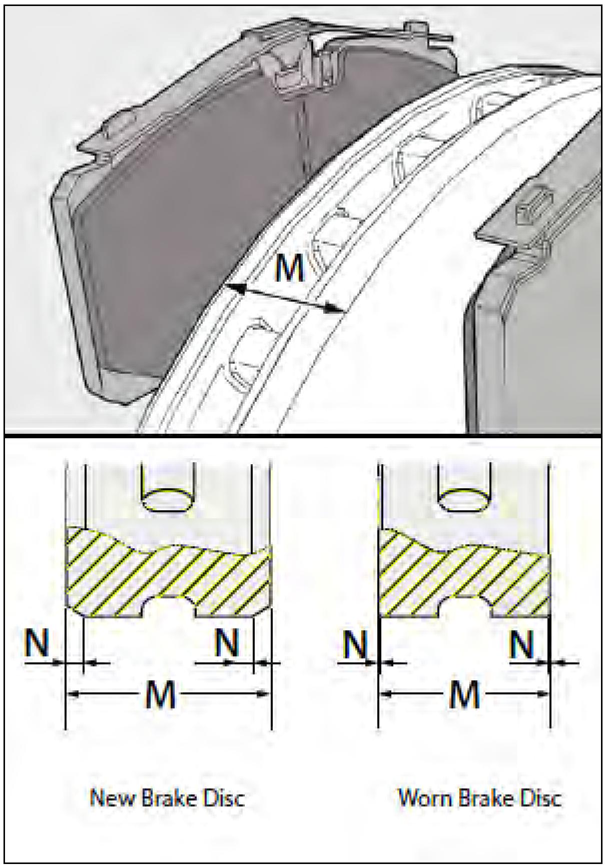


FIGURE 34: BRAKE DISC THICKNESSES AND OPTICAL WEAR INDICATOR

Check the discs per axle at each change of pads for grooves and cracks. If necessary, replace the disc.

The figure shows possible surface conditions of the brake disc.

A1 = Small cracks spread over the surface are allowed.

B1 = Cracks less than 0.059 in (1.5 mm) deep or wide, running in a radial direction are allowed.

Cracks to a max. length of 0.75 x 'a' are allowed (a = width of the friction ring).

C1 = Unevenness of the disc surface less than 1.5 mm deep is allowed.

D1 = Cracks going through to the cooling duct or onto the inner or to the outer edge of the friction ring are not allowed and the disc MUST BE REPLACED.

The photograph shows a real-life example of such cracks and wear grooves.

Note:
In case of surface conditions A1, B1 or C1, the disc can continue to be used until the minimum thickness A = 37 mm is reached.

Knorr-Bremse discs are normally service-free and grinding when changing pads is not necessary. However, grinding could be useful, e.g. to increase the load-bearing surface of the pads after severe grooving on the entire friction surface has occurred. To meet safety requirements, the minimum thickness after machining must be greater than 39 mm.

In addition, the recommendations of the vehicle manufacturer about the machining of the brake disc MUST be followed.

WARNING
Grinding of splined disc is not allowed.

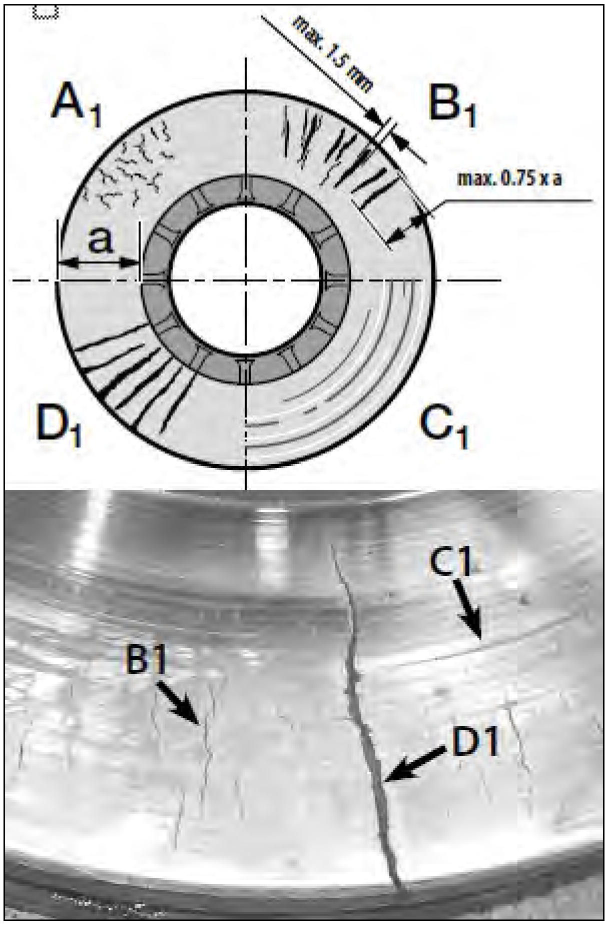


FIGURE 35: TOLERANCES AND EXAMPLES OF CRACKS AND GROOVES

16.2.3 Wear Check of Pad/Disc –Drive Axle – Equipped With L-bracket Wear Indicator

The condition of the pad/disc can quickly be checked without removing the wheel by checking the position of the caliper compared to the tip of the wear indicator.

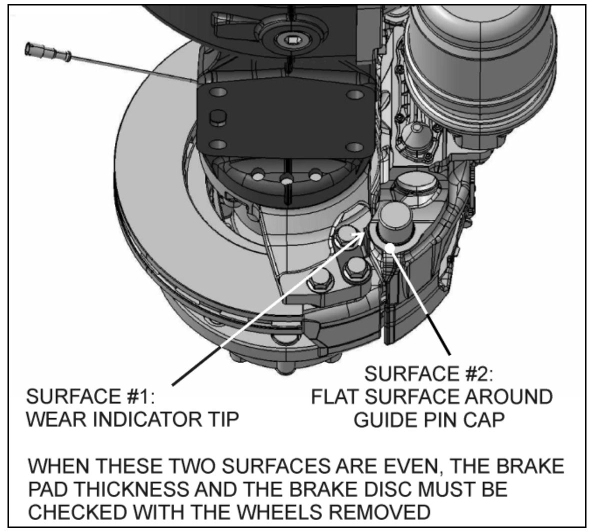


FIGURE 36: BRAKE PAD WEAR CHECK ON DRIVE AXLE

16.2.4 Wear Check of Pads/Disc – Front and Tag Axle – Equipped With Visual Wear Indicator

The condition of the pads can be checked without removing the wheel by checking the position of the caliper compared to the tip of the wear indicator or carrier depending on vehicles.

In one variant of the visual wear indicator (Figure 36), 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 (FIGURE 38). If any minimal tolerance limits have been reached, the pads and/or disc must be changed.

Refer to ***Knorr-Bremse Pneumatic Disc Brake Y006471 Service***.

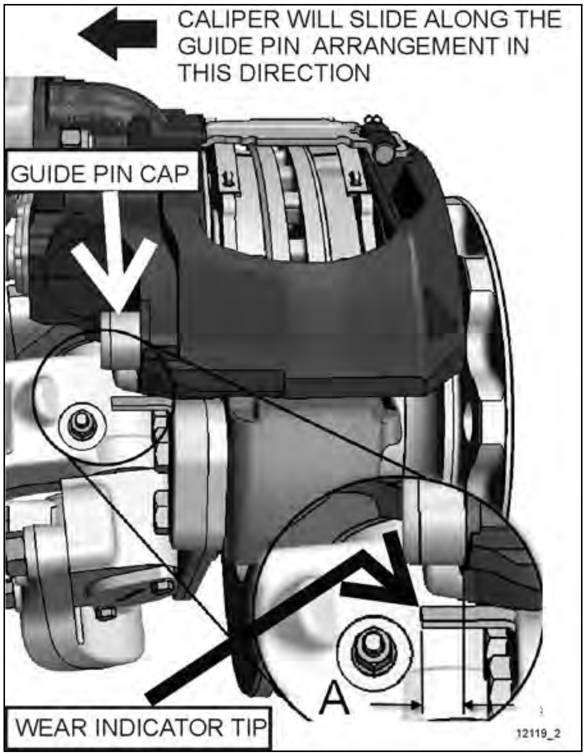


FIGURE 37: BRAKE PAD WEAR CHECK ON THE FRONT AND TAG AXLE 12119

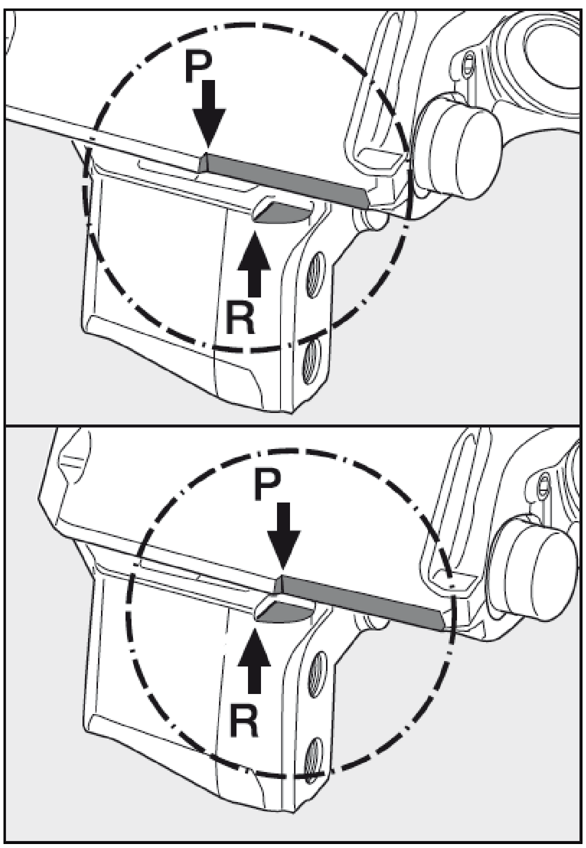


FIGURE 38: PAD WEAR CHECK FRONT AND TAG AXLE

16.2.5 Continuous Wear Sensor option

Some vehicles have a potentiometer installed directly on the brake caliper.

Wear percentage can be consulted via the DID. Access the « Brake Lining Remaining » MENU

Front axle wear sensors are connected to multiplex module **A44**.

Right hand (curbside) wear sensors for both rear axles are connected to **A50**

Left hand (road side) wear sensors for both rear axles are connected to **A51**

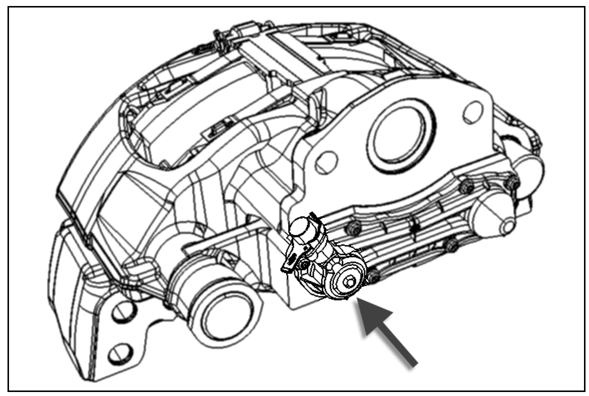


FIGURE 39: POTENTIOMETER

16.2.6 Checking Correct Functioning of the Adjuster / Checking That Caliper Operates Smoothly Over Its Full Range of Movement

1. Before starting work, ensure that the wheels are chocked and the vehicle cannot roll away.
2. Ensure that service brake and parking brake are in the released condition.
3. Check the supply pressure of the brake system. Connect an additional external supply to prevent pressure drop.
4. Jack up the axle and remove the wheel.
5. Check the brake disc temperature, it should be between 14°F and 122°F (-10°C and 50°C).

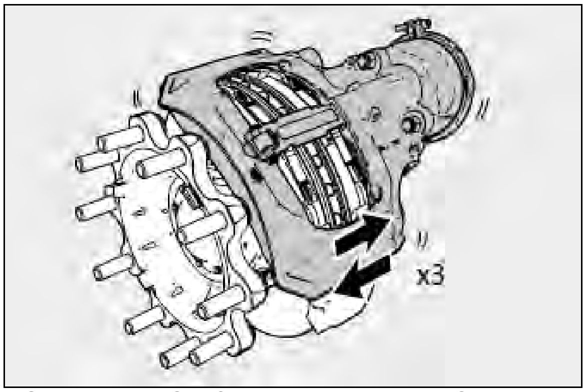


FIGURE 40: PUSH CALIPER THREE TIMES IN AXIAL DIRECTION

6. Push and pull caliper three times in axial direction to assess any existing air gap (see Figure 40. If no movement is possible, clean the disc brake and if necessary, replace the bearings. Once movement is obtained, continue as follows:

7. Pull off the adjuster cap (37) using the tag, taking care not to lose the shear adapter (61) (see Figure 41).

Removal of the adjuster cap (37) with a screwdriver, or similar, is not allowed since the seal may be damaged.

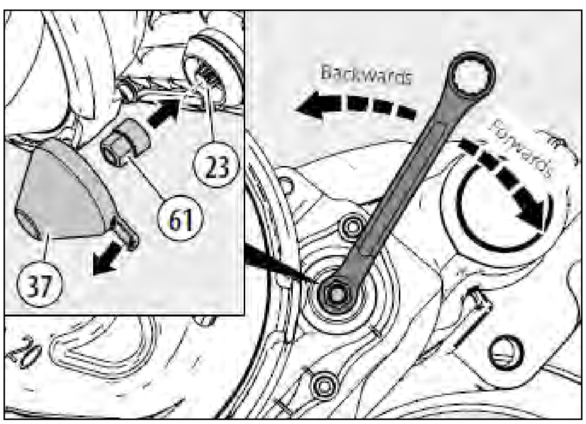


FIGURE 41: REMOVE CAP, INSERT NEW BRAKE PADS, SET THE STARTING GAP

8. Insert new brake pads).

9. Set the starting gap by turning the adjuster (23) with the shear adapter (61) backwards and then forwards (note that when turning backwards a noticeable clicking can be heard and felt), until a value of 0.051 in (1.3 mm) air gap has been achieved (measure between the brake pad and tappets (13).

10. Apply the brakes 20x with medium pressure.

11. Check the gap between each of the tappets (13) and inboard pad backplate (12). This must be measured over the whole tappet surface of both tappets using two feeler gages simultaneously (feeler gages must be at least 8 ½ in / 220 mm long) (see Figure 42).

12. If the gap difference between the two tappets is > 0.009 in / 0.25 mm **then the caliper bearing clearance must be checked** *(see 16.2.7 Caliper check - Caliper Running Clearance & 16.2.8 Caliper check - Caliper Movement Along Guide Pins)*.

13. In addition, each gap must measure between 0.023 - 0.047 in (0.6 - 1.2 mm).

If the clearance is too great, there is a danger of brake failure. If the clearance is too small, there is a danger of overheating that may lead to consequential damage.

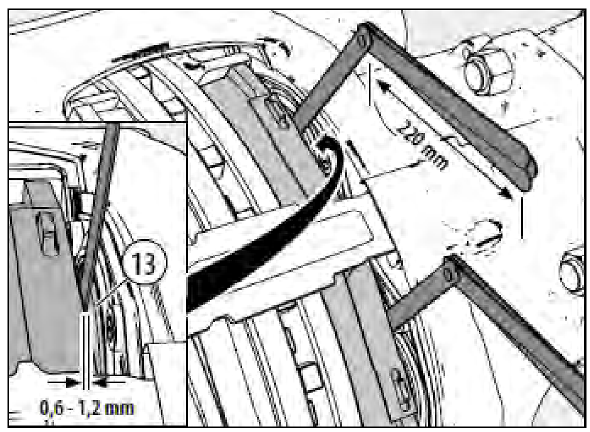


FIGURE 42: CHECK GAP BETWEEN TAPPETS AND INBOARD PAD

If the air gap is larger than 0.047 in / 1.2 mm, the adjuster must be checked as follows:

14. Turn the adjuster with adapter (61) **3 clicks** anticlockwise (increasing the air gap) (see Figure 43).

Make sure the ring spanner or socket can turn freely clockwise during the following procedure.

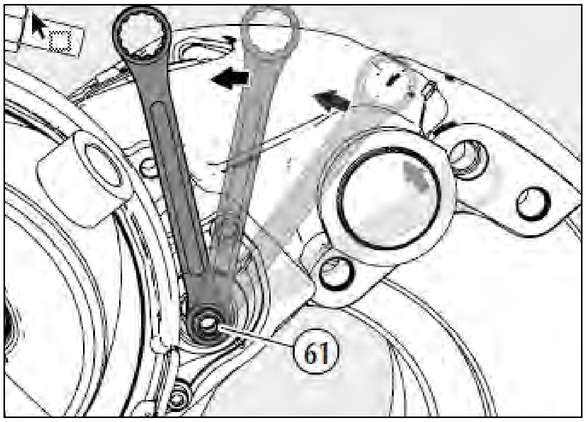


FIGURE 43: TURN ADAPTER 3 CLICKS ANTICLOCKWISE

15. As a visual aid, position a ring spanner or socket onto the adjuster (including Adapter (61)) as shown. Apply the brakes 5 to 10 times, the spanner or socket should turn clockwise (viewed from actuator side) in small increments if the adapter is functioning correctly (see Figure 44 and note below).

Note: As the number of applications increases, incremental movement of the ring-spanner or socket will decrease.

If the spanner or socket does not turn or turns only with the first application or turns forward and backward with every application, the automatic adjuster has failed and the caliper must be replaced.

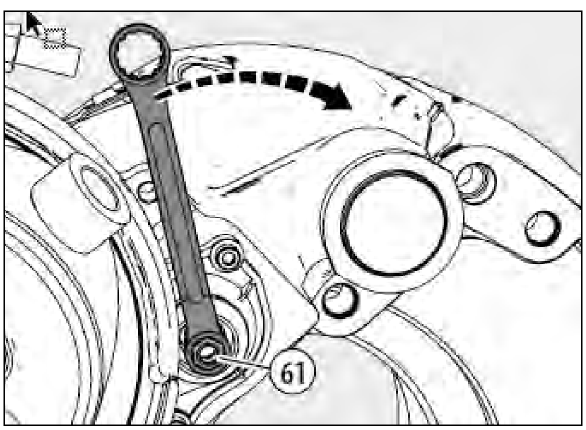


FIGURE 44: APPLY THE BRAKE 5-10 TIMES, SPANNER TURNS CLOCKWISE

16. If necessary, clean the contact area of the cap. Lightly grease the contact surface of the cap with white grease. The tag of the adjuster cap (37) should be positioned as shown by the arrow in the adjacent figure. This ensures access is maintained for subsequent removal (see Figure 45).

Note: A new adjuster cap (37) should be fitted even if the brake pads are not being replaced.

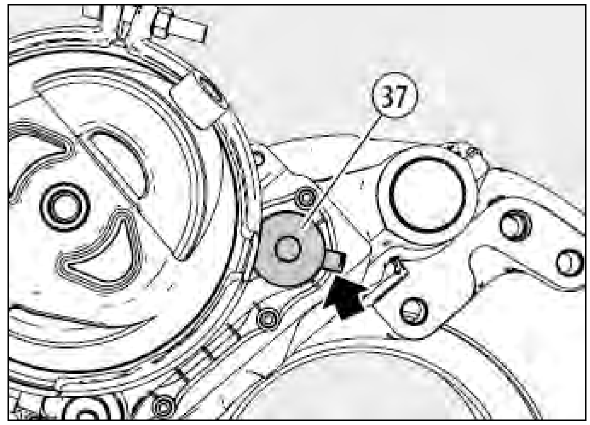


FIGURE 45: TAB POSITIONING OF THE CAP

If the air gap is smaller than 0.023 in / 0.6 mm, the parameters and functions must be checked as follows:

17. Check functioning of the brake actuator.
18. Remove brake actuator.
19. Check position of the lever (19) inside the caliper in its released state (see arrow).

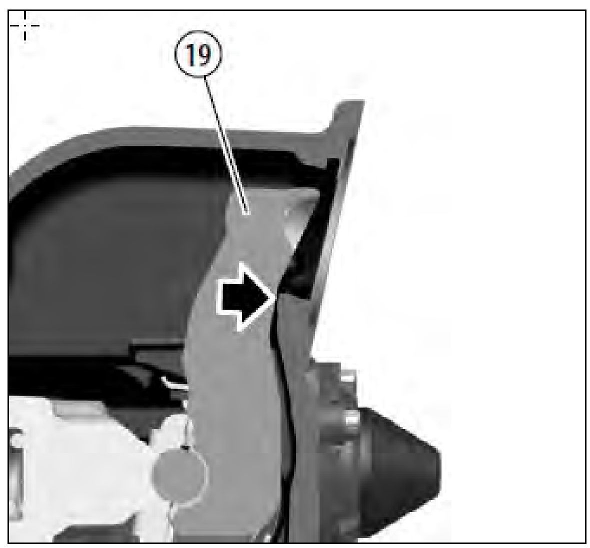


FIGURE 46: CHECK LEVER POSITION

20. Remove brake pads (12). If necessary, remove dirt from brake pads, caliper and carrier.

-Check brake pads for wear from the tappets and if necessary replace brake pads.

- Check for abnormal wear of the contact areas of the carrier. If necessary, replace the carrier.

21. Check the brake disc.
22. Check caliper running clearance (see 16.2.7 & 16.2.8).
23. Fit the brake pads.
24. Fit the brake actuator.
25. Recheck the adjuster (see 16.2.6).

If the air gap is still smaller than 0.6 mm between both tappets, the brake caliper must be replaced.

16.2.7 Caliper check - Caliper Running Clearance

The Knorr Bremse air disc brake is designed to move freely, with minimal force.

1. Before starting work, ensure that the wheels are chocked and the vehicle cannot roll away.
2. Ensure that service brake and parking brake are in the released condition.
3. By pushing and pulling the caliper in an axial direction by hand (see arrows in Figure 47), 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 guide pin seals must be further examined *(see 16.2.10 & 16.2.11)*.

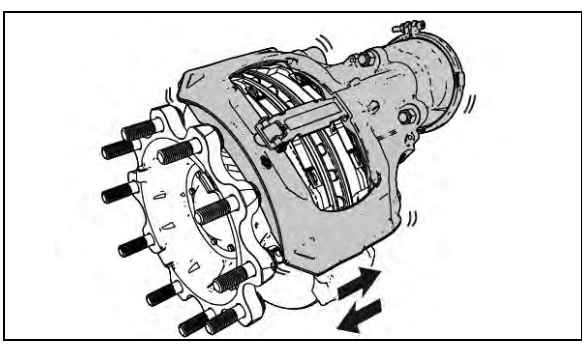


Figure 47: running clearance

16.2.8 Caliper check - Caliper Movement Along Guide Pins

1. With the open bearing variant (6b), clean the protruding area of the guide pin (4b) from outside of the caliper and if necessary remove any light corrosion using an emery cloth.
2. Lightly apply grease to the protruding area of the guide pin (4b).
3. Remove brake pads.
4. Fully wind back the tappets (13) using a ring spanner and shear adapter (61) (see Figure 48).

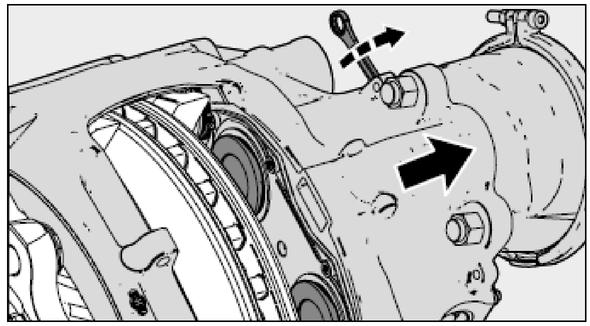


FIGURE 48: REWIND TAPPETS COMPLETELY AND PUSH CALIPER IN DIRECTION OF MIDDLE OF VIEW

5. Push caliper inboard towards vehicle's center (see Figure 49).

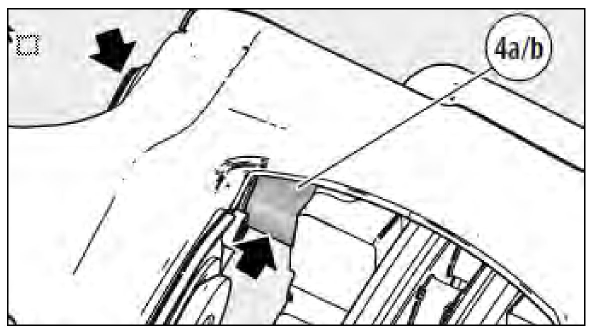


FIGURE 49: FREE GUIDE PIN OF DIRT

6. With both open bearing variants (6a and 6b), clean guide pin (4a or 4b) from the inner area of the caliper, removing any dirt or corrosion.
7. Lightly apply grease to guide pin (4a or 4b).
8. Caliper (1) must slide freely along the whole length of the guide pin arrangement; movement should be greater than 0.984 in / 25 mm. (see Figure 50).

If the caliper does not move at least 0.984 in / 25 mm, the caliper guide pin seals must be examined *(see 16.2.10 & 16.2.11)*.

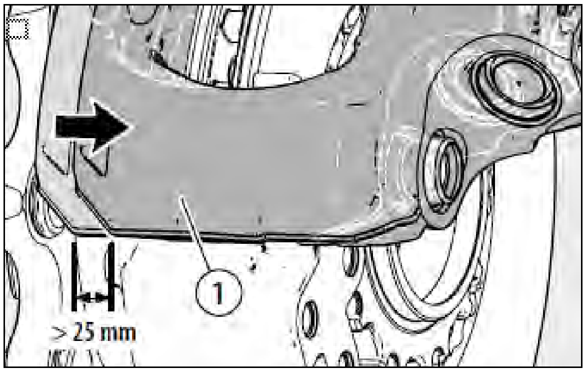


FIGURE 50: FREE MOVEMENT OF CALIPER > 0.984 IN / 25 MM

16.2.9 Clearance Measurement Check of Bearing Variants (6)

***Note:** Before commencing (removing the wheel), make sure there is no contact between caliper and axle, vehicle, chassis sections or carrier. In such cases, it will be necessary to replace the caliper bearings (see Knorr-Bremse Pneumatic Disc Brake Y006471 Service Manual.).*

To measure the clearance, the following steps must be taken:

1. Remove the wheel.
2. Remove pad retainer.

To achieve the correct reading it is necessary to have a pair of new brake pads fitted. If the clearance measuring is not taking place during a brake pad replacement, the current position of the assembled pads must be noted before removing, so that they can be re-assembled in the same position.

Remove old pads and replace with a pair of new pads.

3. Fasten a magnetic dial-gage holder to the carrier (2) on the floating bearing side of the caliper (1). Use the casting tag on the caliper (1) as the measuring point - see arrows A (see Figure 51).
4. Set the dial gage to zero.
5. Place a suitable tool (e.g. screwdriver with at least 200 mm in length) in a central position between carrier (2) and caliper (1) and lever them in opposite directions (using normal hand-force).
6. Read the maximum value of the bearing clearance on the dial gage and compare with the values in the table (see Table).

If the clearance exceeds the given tolerance, the complete bearing will need replacing using the relative service kit.

If the clearance measuring is not taking place during a brake pad replacement, the new pads should be removed and the previously marked brake pads fitted in their original positions, otherwise renew the brake pads as an axle set and adjust the air gap (*refer to **Knorr-Bremse Pneumatic Disc Brake Y006471 Service Manual***).

7. Fit the wheels. After replacing the wheel check that it runs interference free.

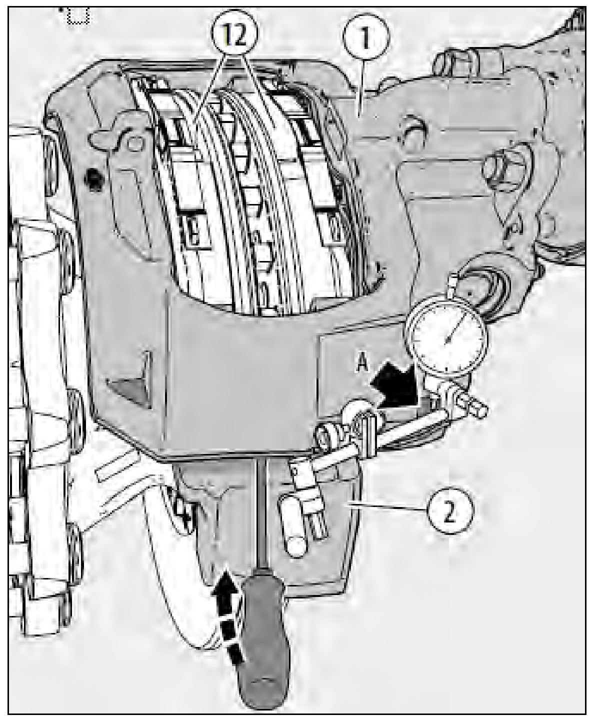


FIGURE 51: OBTAINING MAXIMUM VALUE OF BEARING CLEARANCE

Bearing variants (6)	Max. bearing clearance
6a Rubber Bush	2 mm
6b Open Bearing	2 mm
6c Guide Sleeve	1 mm
6d Capped Rubber Sleeve	2 mm
6e Guide Sleeve	1 mm

Maximum bearing clearance tolerances of bearing variants

16.2.10 Checking Sealing Elements – Caliper Guide Pin Seals

The guide pin (5a or 5b) (as fitted to the fixed bearing side) is sealed with cover (10a or 10b) and inner boot (9a or 9b).

The floating bearing side with guide pin (4c, 4d or 4e) is sealed with inner boot (9c, 9d or 9e) and with cover (68c 68d or 68e). All variants (9), (10) and (68) must be free of any signs of damage (see Figure 52).

Check for correct location and fitting.

If necessary, remove pads (12) to inspect the inner boots (9).

If necessary, repair caliper with suitable service kit.

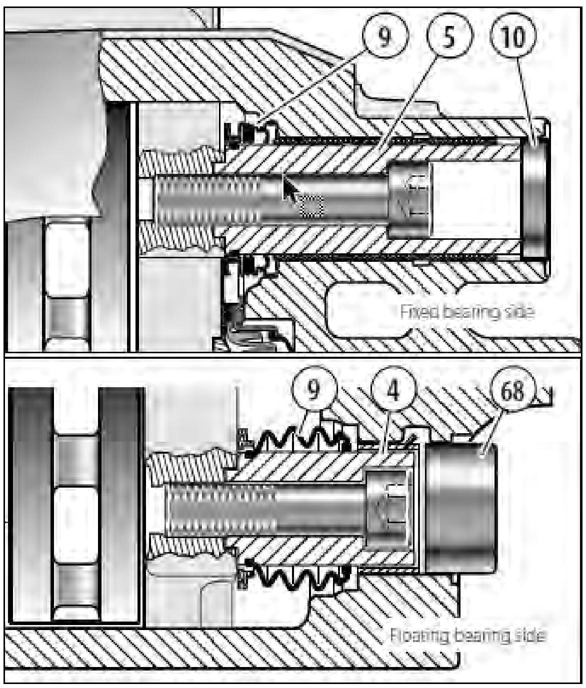


FIGURE 52: CHECKING OF GUIDE PIN AND SEALS

16.2.11 Checking Sealing Elements – Tappets and Boot Assemblies

Remove pads (12) (r*efer to* ***Knorr-Bremse Pneumatic Disc Brake Y006471 Service Manual***).

Screw out the tappets (13) using the shear adapter (61) clockwise until the boots are clearly visible (see Figure 53).

The tappets must not be extended more than 1.181 in / 30 mm, otherwise synchronization is lost and the caliper must be replaced.

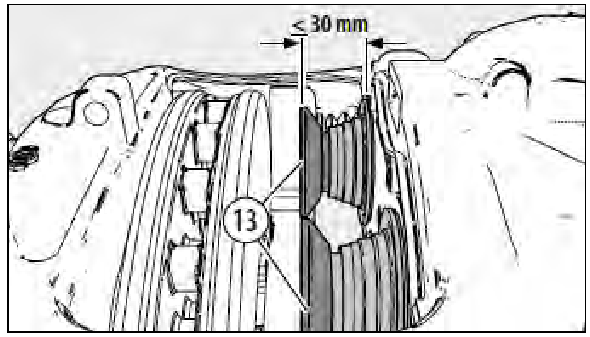


FIGURE 53: SCREW OUT TAPPETS - MAX. 1.181 IN / 30 MM

The rubber boots on the tappets (13) must not have any cuts/tears or show any other signs of damage. Check for correct location and fitting.

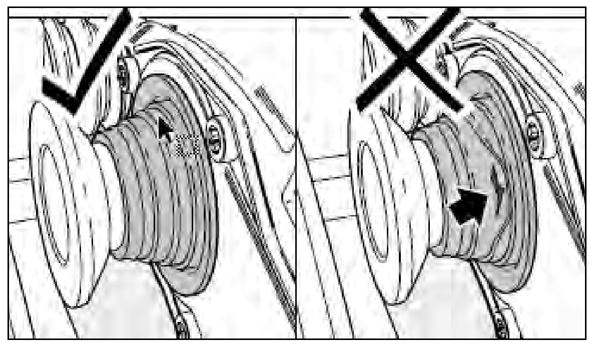


FIGURE 54: CHECK RUBBER BOOTS FOR DAMAGE

Note: The penetration of dirt and moisture into the brake will lead to corrosion and impair the function of the clamping mechanism and wear adjuster.

If necessary replace tappet and boot assemblies (r*efer to* ***Knorr-Bremse Pneumatic Disc Brake Y006471 Service Manual)****.*

16.3 BRAKE PAD REPLACEMENT

Brake pad replacement procedure has slightly changed with the introduction of the new N2G adjuster on the vehicles.

The full wording of the processes is included in the latest Knorr-Bremse service manual.

Refer to ***Knorr-Bremse Pneumatic Disc Brake Y006471 Service Manual****.*

After fitting new pads,

1. Turn the adjuster (thru shear adapter) clockwise ↻ until the pads come into contact with the disc.
2. Then turn back the adjuster counterclockwise ↺ **<u>three “clicks”</u>** and check the **caliper running clearance**.

- *During the turning of the adjuster, you will notice a changed clicking noise. It is not caused by a defect of the mechanism.*
- *Also the “feel” during the rotation of the adjuster and the position of the spanner after the 3 clicks has changed.*

17. 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 workman’s’ arm sleeves. If such equipment is not available, carefully clean parts and assemblies in 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 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, 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 at 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.

18. 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 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 Dryer Built-in Governor Cutout

CONDITION: Vehicle leveled, parking brake applied.

1. Completely drain wet, primary and secondary air tanks 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 85 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 13 seconds or less.
6. Air dryer built-in governor cut-out. Cuts out at the correct pressure of 140 psi (965 kPa).
7. Air dryer built-in governor cut-in. Cuts in around 122 psi (841 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 Dryer Built-in Governor Cutout Point

- Perform a telltale light and gauge test. Replace entire cluster if found defective.

OR

- Repair or replace air 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 Tank 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 122-140 psi (841- 965 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 dashboard.
3. Pressure drop should not be more than 3 psi (20 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 122-140 psi (841- 965 kPa) and foot brake applied, coat all air line connections and brake pneumatic components with a water and soap solution. Bubbles will indicate an air leak, and none should be permissible. Repair or replace defective parts.
- Listen for leaks and correct as required.
- Redo test to check all items repaired or replaced.

19. BRAKE 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 **FIGURE 55.**

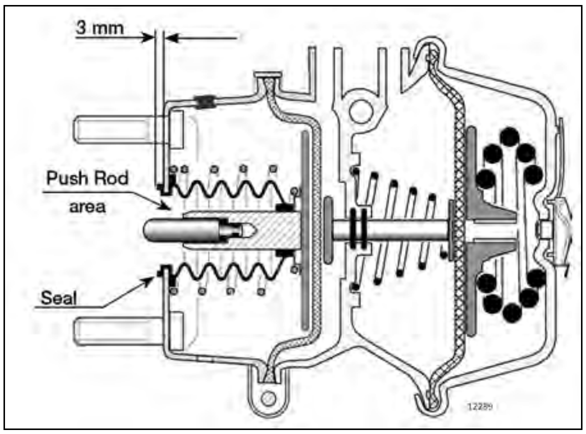


FIGURE 55: DRIVE AXLE BRAKE CHAMBER

The front and tag axle brake chambers are used only for service brake duty (FIGURE 56).

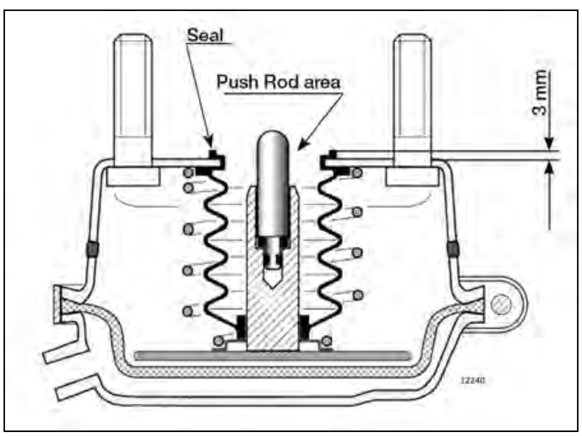


FIGURE 56: FRONT AND TAG AXLE BRAKE CHAMBER

19.1 MAINTENANCE

Every 6,250 Miles 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 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.

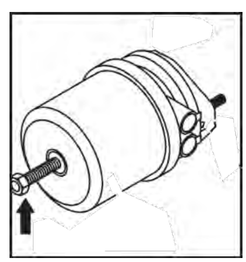
b) Coat clamping ring(s) with a soapy solution. If leakage is detected, tighten clamping ring only enough to stop leakage. ***Do not overtighten*** as this can distort sealing surface or clamping ring. Coat area around push rod hole (loosen boot if necessary). No leakage is permitted. If leakage is detected, the diaphragm must be replaced.

19.2 EMERGENCY/PARKING BRAKE MANUAL RELEASE

DANGER
Never stand in the axis line of the spring brake actuators, 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 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.

19.3 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.

Use the following steps in conjunction with Brake chamber Replacement procedure found in Knorr-Bremse Pneumatic Disc Brake SN7 Service Manual Y006471.

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 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 tank.
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 adjuster (drive axle).
8. Unbolt and remove the brake chamber from vehicle.

19.4 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. Make sure the drain hole of the brake chamber is in the lower position for proper moisture evacuation.

19.5 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:

- 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.

NOTE
To gain access to a given brake chamber, the corresponding wheel can be removed (refer to Section 13: "Wheels, Hubs and Tires").

3. Exhaust compressed air from air system by opening the drain valve of each tank.
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.

20. ANTI-LOCK BRAKING SYSTEM (ABS)

This system 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.

20.1 TROUBLESHOOTING AND TESTING

For detailed information, troubleshooting and testing refer to Bendix booklet "*Bendix Service Data EC80 ESP Controller (SD-13-4986)"* found on the Technical Publications USB flash drive and web site.

20.2 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.

20.3 BENDIX EC-80 CONTROLLER

This control unit, a.k.a 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.

For further detail, consult **Bendix Service Data SD-13-4986.**

Maintenance

No specific maintenance is required. The ECU is not serviceable. When found to be defective, replace.

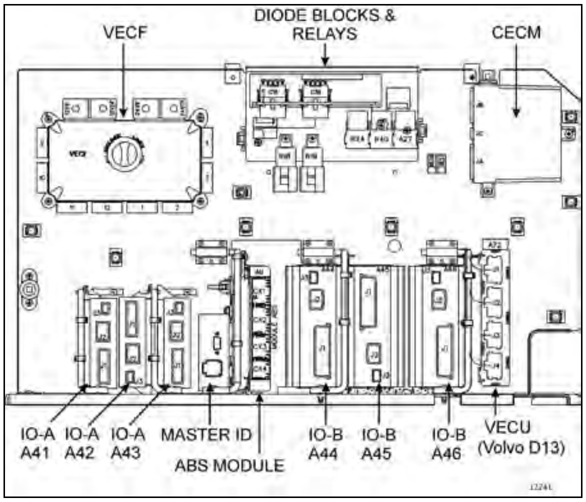


FIGURE 57: ABS ECU LOCATION

> **CAUTION**
>
> In order to protect the ABS electronic control unit from voltage surges, always disconnect before performing any welding procedure on vehicle.

20.4 SENSORS

The sensors are mounted on the front and drive axle wheel hubs (Figure 58). 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.

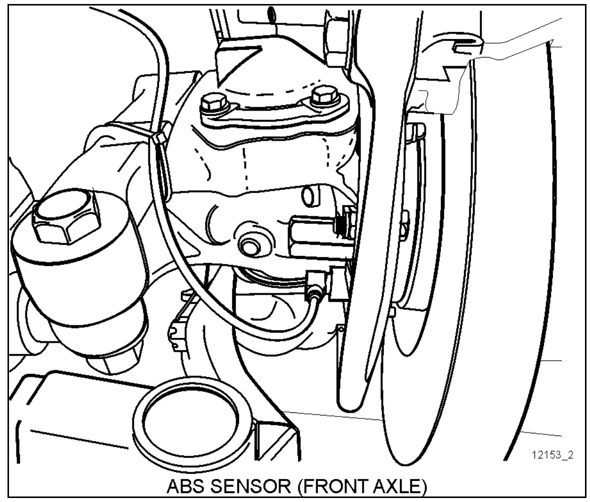


FIGURE 58: ABS SENSOR LOCATION

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.

20.4.1 Spring clip

The spring clip retains the sensor in its mounting bracket close to the toothed pulse wheel. The gap between the sensor end and teeth is set automatically by pushing the sensor in the clip hard up against the tooth wheel, and the latter knocks back the sensor to its adjusted position (Figure 59).

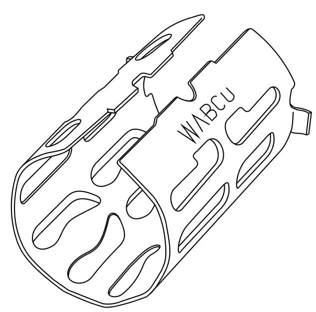


FIGURE 59: SPRING CLIP 12161

Maintenance

The spring clip requires no specific maintenance.

MAINTENANCE

ABS & ELECTRONIC STABILITY CONTROL SYSTEMS

Check the proper functioning of ABS and ESC systems at the intervals specified by the Lubrication And Servicing Schedule in Section 24A. To do so, perform the “Component Test” using Bendix ACom Diagnostics software.

Bendix ACom Diagnostics software is available for download at www.bendix.com.

21. 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 ESP EC-80 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 ESP EC-80 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.

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.**

CAUTION

Even with ESC-equipped vehicles, the driver remains responsible for ensuring vehicle stability during operation.

21.1 COMPONENTS

The EC-80 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-40QR);
- Dash-mounted vehicle ABS Indicator Lamp;
- Service brake relay valve;
- Dash-mounted trailer ABS Indicator Lamp.

The EC-80 controller's ATC function utilizes the following components:

- Drive axle traction control valve;
- TCS status/indicator icon in the DID;
- Dash-mounted TCS Mud/Snow switch;
- J1939 serial communication to engine control module.

The EC-80 controller's ESC/RSP function utilizes the following components:

- Front Axle Traction Control Valve integral to the service brake relay valve;
- Dash-mounted ESC 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);
- An additional Modulator Valve (Bendix® M-40QR™ Pressure Modulator Valve) that controls pressure applied to the trailer brakes during system intervention.

21.2 BENDIX M-40QR PRESSURE MODULATOR VALVE

This Bendix M-40QR (quick release) Pressure Modulator Valve (PMV) is operated by the EC-80 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 EC-80 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.

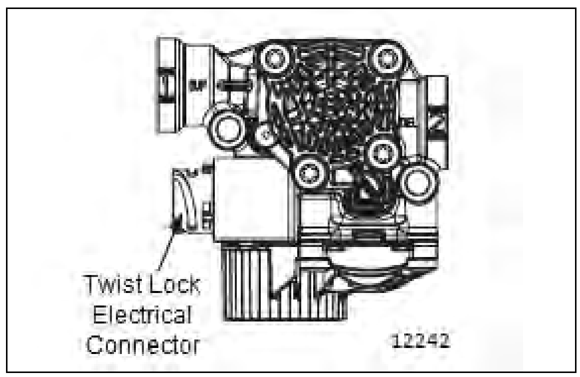
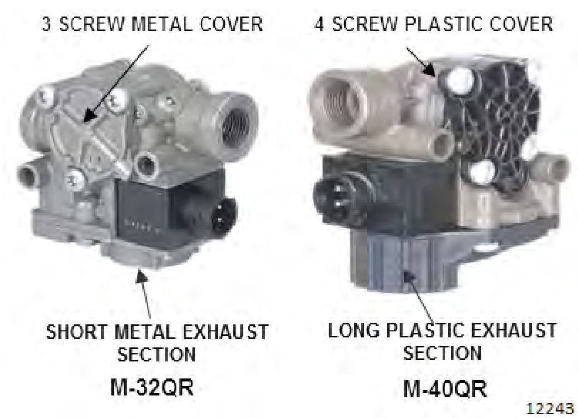


FIGURE 60: M-40QR PRESSURE MODULATOR VALVE

Maintenance

NOTE
On older vehicles, when replacing for the first time the older modulator valve M-32QR by the newer M-40QR modulator valve, it is important to replace both left and right valves on the vehicles drive axle or front suspension.
Modulator valve model can be easily identified by their different side cover and exhaust section.

Mixing valve type on the left and right sides of the vehicle may result in slight pull to one side when braking.

Maintenance, removal and installation information of this valve is supplied in Bendix booklet, found on your Technical Publications USB flash drive, under reference number SD-13-4958.

21.3 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 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. 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.

21.4 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.

21.4.1 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.

Diagnostics:

The steering angle sensor is only operational in conjunction with an EC-80 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.

TORQUE: 9-12 lb-in (1.02-1.36 Nm)

3. Reconnect the steering column U-joint.

TORQUE: 35-39 lb-ft (47-53 Nm)

4. Reconnect the connector. Ensure that there will be no force applied to the sensor because the connector is pulling on the sensor body.
5. 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.
6. 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-70)" 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.

22. 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.

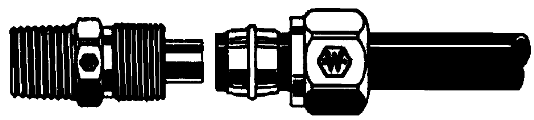


FIGURE 61: HOSE FITTING 12055

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).

23. SPECIFICATIONS

Air Compressor
Make....................Meritor Wabco
Model....................SS636
Capacity (at 1250 rpm)....................37.4 cfm (1,059 m^3/min.)

Air Dryer
Make....................Haldex

Model.. Gemini MDX Twin Air dryer
Cut in pressure.. 122 psi
Cut-out pressure.. 140 psi

Governor
Make.. Bendix
Model.. D-2
Cut in pressure.. 122 psi
Cut-out pressure.. 140 psi

Accessories Air Filter
Type.. 5 micron
Port.. 1/4PF NPT

Flip-Flop Control Valve
Make.. Bendix
Model.. TW-1
Type.. On-Off

Emergency/Parking Brake Control Valve
Make.. Bendix
Model.. PP-1
Automatic release pressure.. 60 psi (414 kPa) nominal

Emergency/Parking Brake Overrule Control Valve
Make.. Bendix
Model.. RD-3

Dual Brake Application Valve
Make.. Bendix
Model.. E-8P

Spring Brake Valve
Make.. Bendix
Model.. SR-7

Brake Relay Valve
Make.. Bendix
Model.. R-14

Antilock Traction Relay Valve
Make.. Bendix
Model.. ATR-6

Antilock Modulator
Make.. Bendix
Model.. M-32QR

Pressure Protection Valve
Make.. Bendix
Model.. PR-4
Nominal closing pressure.. 70 psi (482 kPa)
Prevost number.. 641137

Pressure Reducing Valve
Make.. Bendix

Model...RV-3

Inversion Valve
Make...Bendix
Model...TR-2, TR-3

Inline Quick Release Valve
Make...Bendix
Model...QR-L

Shuttle-Type Double Check Valve
Make...Bendix
Model...DC-4

Air Pressure Regulator
Make...Norgren
Adjustable output range .... 0-80/85 psi (0-552/586 kPa)

Air Filter Element
Make...Norgren

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

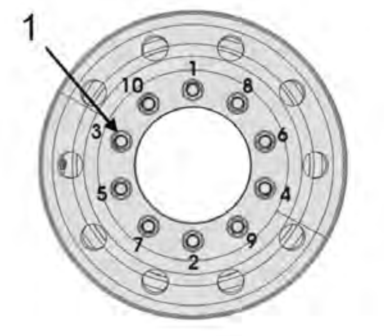
CONTENTS

SECTION CHANGE LOG

	DESCRIPTION	DATE
1	Front and tag axle wheel hub insertion tool part numbers added	Jan 2022
2		
3		
4		
5		
6		

1. TORQUE TABLES

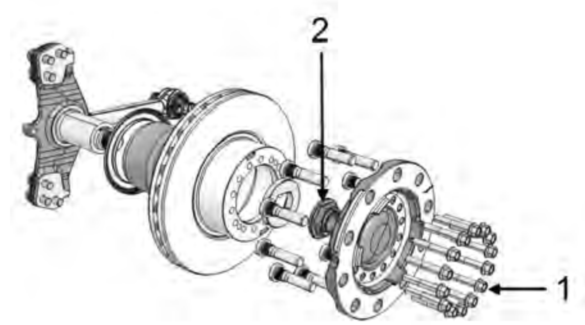
1.1 WHEEL NUTS



WHEEL NUTS (ALL TYPES) – STEEL/ALUMINUM WHEELS		
No	DESCRIPTION	TORQUE
1	Wheel nuts (M22x1.5 threads)*	450-500 lb-ft (610-678 Nm)

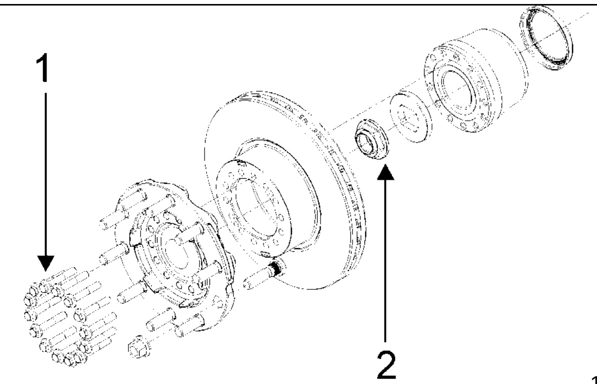
*Torque following sequence shown

1.2 TAG AXLE



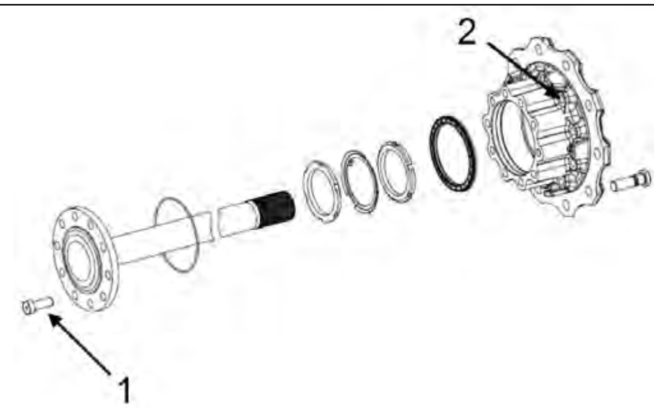
TAG AXLE		
No	DESCRIPTION	TORQUE
1	Tag axle hub flange cap screws	161-197 lb-ft (218-267 Nm)
2	Tag axle hub nut	563-687 lb-ft (763-931 Nm)

1.3 FRONT AXLE



FRONT AXLE		
No	**DESCRIPTION**	**TORQUE**
1	Front axle hub flange cap screws	174-192 lb-ft (236-260 Nm)
2	Front axle hub nut	575-625 lb-ft (780-847 Nm)

1.4 ZF A132 DRIVE AXLE



ZF DRIVE AXLE		
No	**DESCRIPTION**	**TORQUE**
1	Drive shaft flange bolts cap screw M18x1.5x50mm G10.9	325 lb-ft (441 Nm)
2	Hub cap screw Torx M16x1.5x60	221 lb-ft (300 Nm)

2. WHEELS

The vehicle is equipped with hub-mounted wheels, all studs and nuts have right-hand threads. Steel wheels are installed on the vehicle and are mounted with radial tubeless tires.

All wheel dimensions are 22.50 X 9.0 inches (571.5 X 228.6 mm) for 315/80 R22.5 tires

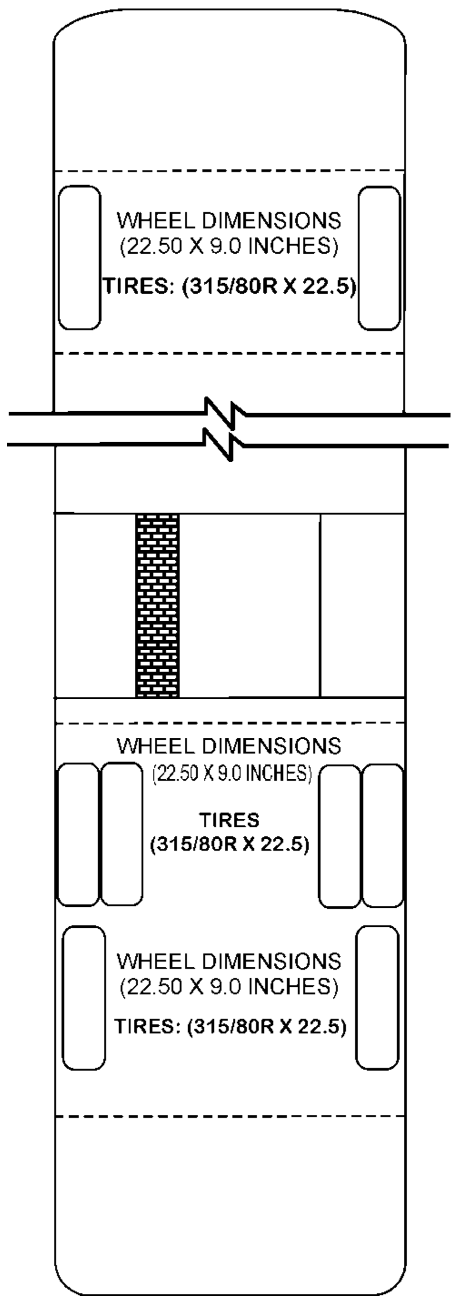


FIGURE 1:STEEL WHEEL ARRANGEMENT 13001

3. WHEEL MAINTENANCE

Wheel maintenance consists of periodic inspections. Check all parts for damage and make sure that wheel nuts are tightened to the proper torque. In the case of a new vehicle, or after a wheel installation, stud nuts should be tightened every 100 miles (160-km) for the first 500 miles (800-km) to allow setting in of clamping surfaces.

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.

It is recommended to add some rust protection lubricant on the outside 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 3 for the suggested tightening sequence.

3.1 INSPECTION

Tighten stud nuts progressively as shown in Figure 3. The final tightening should be done with a torque wrench.

TORQUE : 450-500 lb-ft (610-678 Nm)

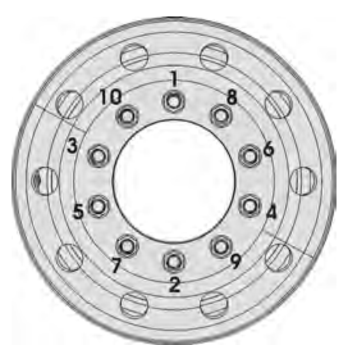


FIGURE 2: TIGHTENING SEQUENCE 13018

3.2 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.

3.3 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 3 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 3. The final tightening should be done with a torque wrench.

TORQUE : 450-500 lb-ft (610-678 Nm)

> **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.

4. DUAL WHEELS

4.1 OUTER WHEEL REMOVAL

Same as described in *"Single Wheel Removal"* procedure described previously.

4.2 INNER WHEEL REMOVAL

1. Remove outer wheel;
2. Remove inner wheel.

4.3 INNER WHEEL INSTALLATION

Mount the wheel over studs, being careful not to damage stud threads;

4.4 OUTER WHEEL INSTALLATION

With inner and outer wheels installed, tighten the stud nuts progressively as shown in Figure 3. The final tightening should be done with a torque wrench.

TORQUE: 450-500 lb-ft (610-678 Nm)

> **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 180º apart in order to have access to both the inner and outer valves.*

4.5 INSPECTION

1. Loosen a hex stud nut three turns (Figure 4);
2. Retighten the hex stud nut.

TORQUE: 450-500 lb-ft (610-678 Nm)

Repeat for each of the 10 *"hex stud nuts"* according to the tightening sequence in figure 3.

CAUTION

The actual length of thread engagement present in an assembled wheel cannot always be determined by visual inspection of measurement of a tightened assembly. The relationship of the wheel cap nut seat to the end of the stud may vary. If there is any doubt that enough thread engagement is present, the number of engaged threads may be counted. Tighten all nuts in the regular manner, then loosen one to hand-tightness. The number of turns to disengage a 1-1/8-inch nut should be at least five full turns.

At least seven full turns should be required to disengage a ¾-inch nut or a M22 nut. Ideally, when torqued to the proper load, the stud should be flush with the face of the nut. The face of the nut may be recessed in nuts that are taller for improved wrenching. With most of the nuts in present use, a few unengaged threads at the outer end will cause no problem provided at least 5-7 full turns are required to disengage the nut depending on thread size.

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 4, then rotate the wheel by hand one full turn. As the wheel turns, note any variation on the dial gauge;

CAUTION

Damage to the dial gauge could occur if it strikes a wheel balancing weight.

3. If the variation in lateral run-out exceeds 0.0625 inch (1,6 mm), the wheel must be replaced.

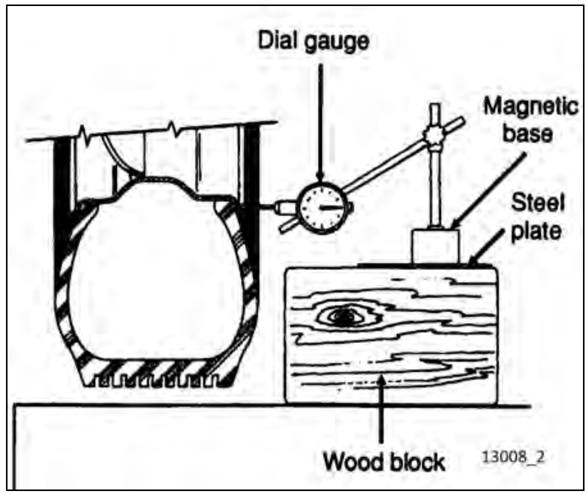


FIGURE 3: DIAL GAUGE INSTALLATION

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.

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.

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: 450-500 lb-ft (610-678 Nm)

60 nuts

6.1 DRIVE AXLE WHEEL STUDS

Hub-mounted wheels are mounted with M22x1.5 studs and an M22 flange nut.

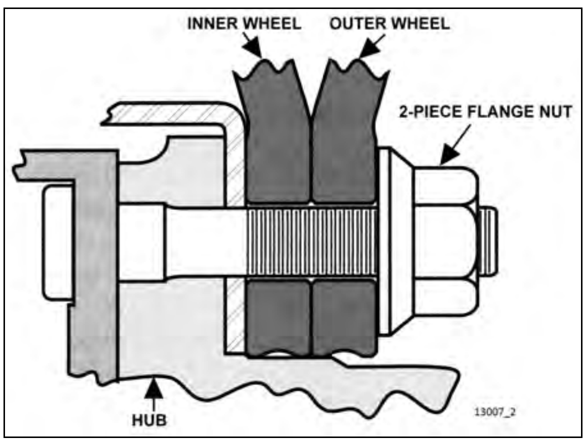


FIGURE 4: DRIVE AXLE WHEELS

6.2 FRONT AND TAG AXLE WHEEL STUDS

Wheel is hub mounted on front and tag axle (M22x1.5 thread).

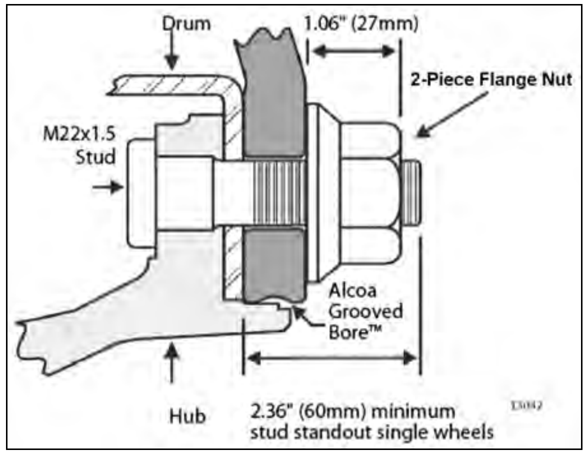


FIGURE 5: SINGLE WHEEL

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. Do not use power tools or long bars for tightening. Tighten wheel nuts alternately as shown in figure 3.

TORQUE: 450-500 lb-ft (610-678 Nm)

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 torque has occurred, retighten. Relaxation of initial torque may occur because of the “bedding down” of the hub and wheel surfaces.

NOTE
Torque relaxation occurs when wheel ends are hot but should revert to original setting when cool. Retightening when hot will produce a higher torque reading than recommended.

7.1 CARE OF WHEELS

Check for cracks in wheels, especially around the fixing holes, studs, nuts and washers. If in doubt, renew.

Do not simply retighten very loose wheel fixings or wheels that are continually becoming loose. Find out why they are loose and whether any damage has been caused.

Use trained personnel and keep records of all attention to wheels and fixings, including which parts were renewed and when.

8. TAG AXLE WHEEL HUBS

The FAG unitized hub bearings used on the tag axle 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

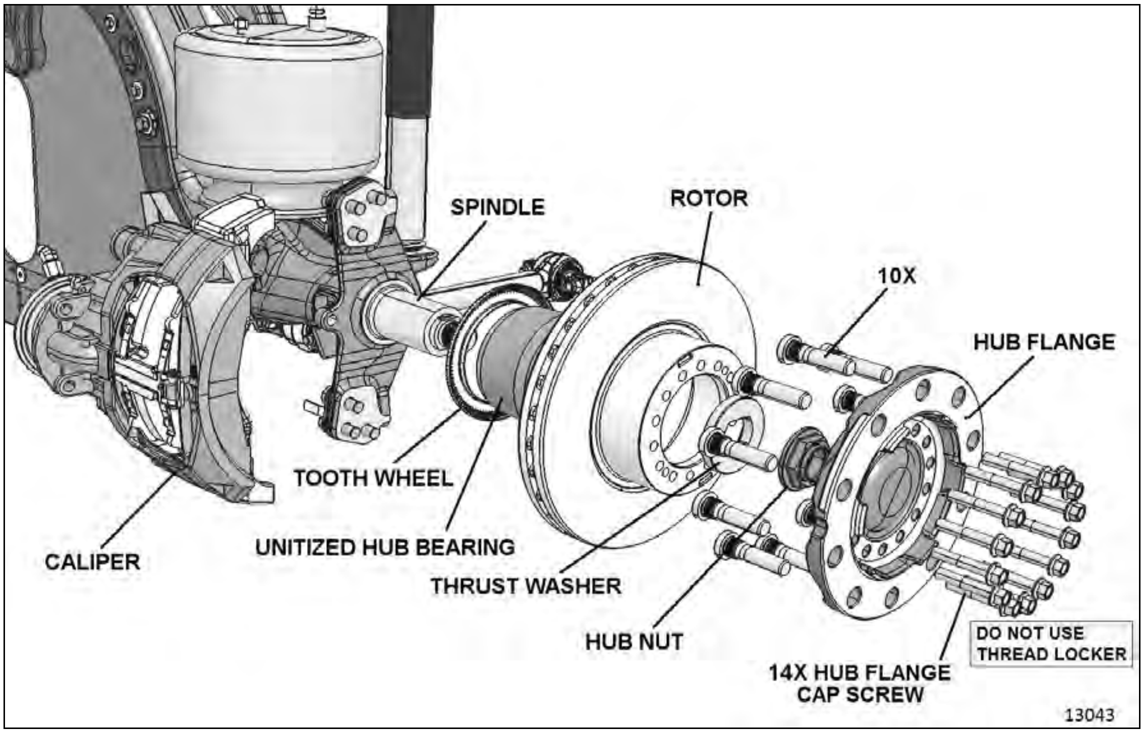


FIGURE 6: TAG AXLE HUB AND ROTOR ASSEMBLY

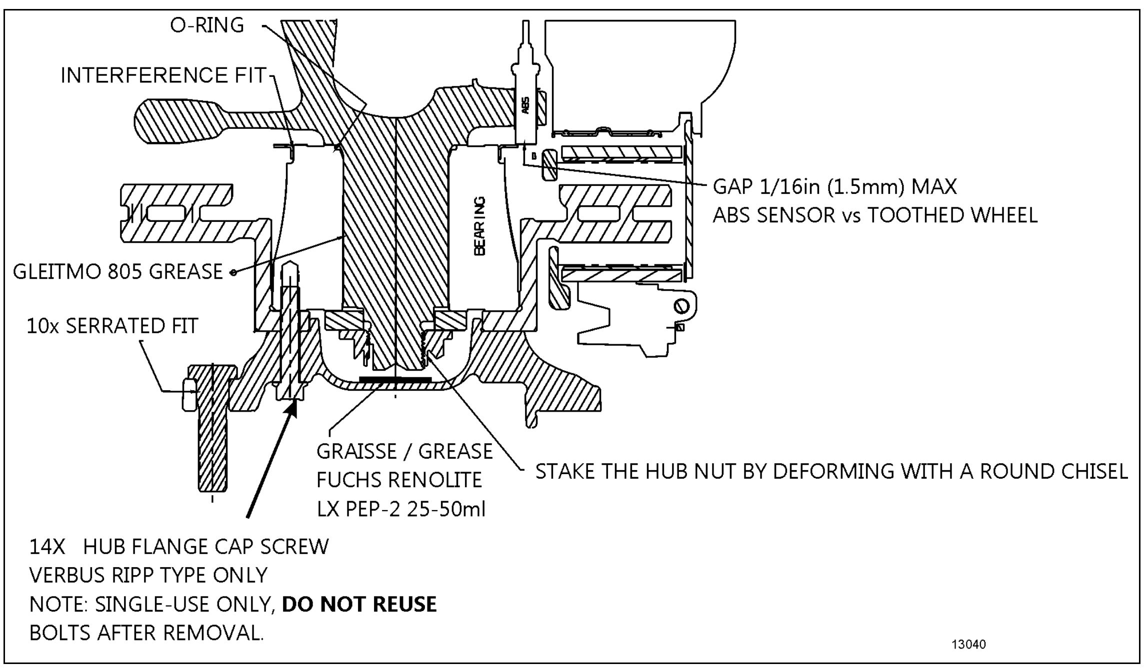


FIGURE 7: TAG AXLE UNITIZED BEARING & WHEEL HUB

8.1 TAG AXLE HUB UNITIZED BEARING INSPECTION

MAINTENANCE

Tag axle unitized bearing

Unitized bearing inspection should be made at the intervals specified by the Lubrication And Servicing Schedule in Section 24: LUBRICATION & SERVICING..

1. Apply parking brake, raise wheels off the ground and support axle on stands.
2. When the wheels are raised, they should revolve quite freely without roughness.
3. 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.
4. With dial indicator in position pull hard but steadily on hub flange and oscillate at same time until a steady reading is achieved.
5. Without releasing the pressure, turn bearing so that dial indicator stem contacts marked spot and note reading on indicator.
6. Push bearing flange hard and oscillate as before until a steady reading is achieved.
7. Without releasing the pressure, turn bearing so that indicator stem again contacts the marked spot and note new reading on indicator.
8. The difference between readings is the amount of mounted end play in bearing unit.
9. Refer to the following table for allowed end plays:

New Tag Axle Unitized Hub Bearing Axial Endplay	
Maximum axial clearance/end play	0.0024 inch (0.061mm) based on clamp load of 20000 lbf (90 kN).
Tag Axle Unitized Hub Bearing Axial Endplay In Service	
• If the endplay is between 0 – 0.002 in (0 – 0.05 mm), the inspection is complete. • If the endplay is greater than 0.002 in (0.05 mm), but less than <u>0.008 in (0.20mm)</u>, check and retighten the wheel bearing adjusting nut. Again check endplay to make sure that the clamping process is done properly. • If the endplay is equal to or greater than 0.008 in (0.20mm), replace the unitized hub bearing as soon as possible since the hub assembly may not be safe to operate.	

8.2 TAG AXLE HUB BEARING 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 10 wheel hex stud nuts and remove the wheel.
5. Unscrew 14 hub flange hex cap screws.

Applicable to the tag axle serrated screws: discard hub flange cap screws (single-use only).

NOTE: The following steps are similar to the front axle hub bearing removal procedure. The following images are generic images and do not show the tag axle hub but they remain representative of the following steps.

6. Loosen but do not remove the hub flange bolts.
7. Remove 2 diametrically opposed hub flange bolts.

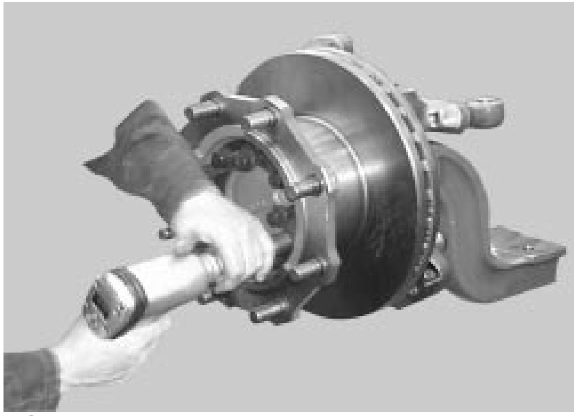


FIGURE 8

8. Replace 2 diametrically opposed hub flange bolts with 2 studs (loosely fitted).

NOTE: Replacement studs should protrude beyond front face of hub flange to aid removal.

9. Gently tap hub flange outwards using a hide faced hammer.
10. Support weight of hub flange and remove hub flange retaining bolts.

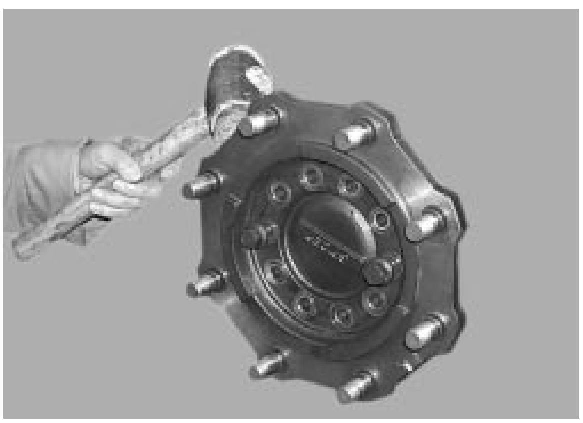


FIGURE 9

11. Remove the hub flange and place on a suitable workbench.
12. Inspect wheel stud and replace the ones that are found defective.
13. Once the hub flange has been removed, insert two bolts into brake disc extraction holes.
14. Tighten to free brake disc from hub bearing.

FIGURE 10

15. Support weight of brake disc and carefully slide along dummy studs to remove.

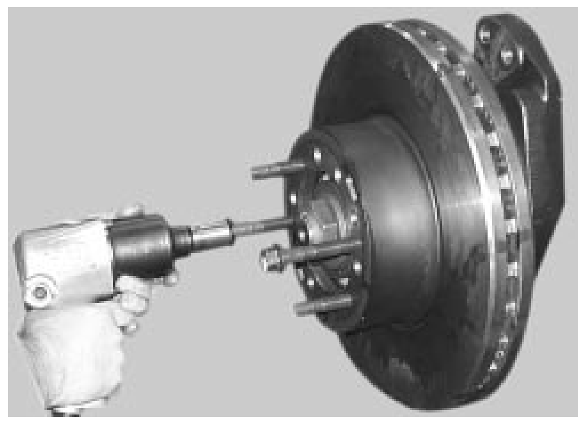


FIGURE 11

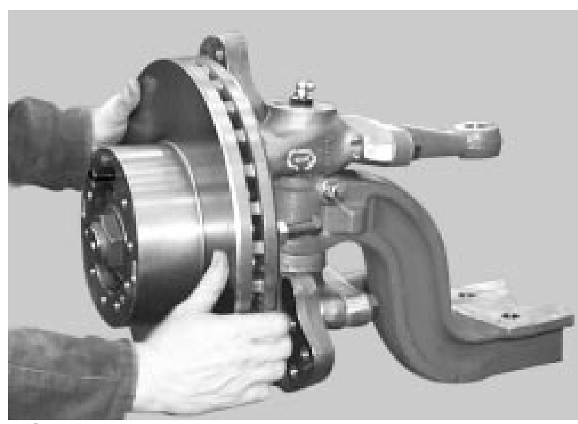


FIGURE 12

16. Using a small ended chisel, pry off the staking on the hub nut.

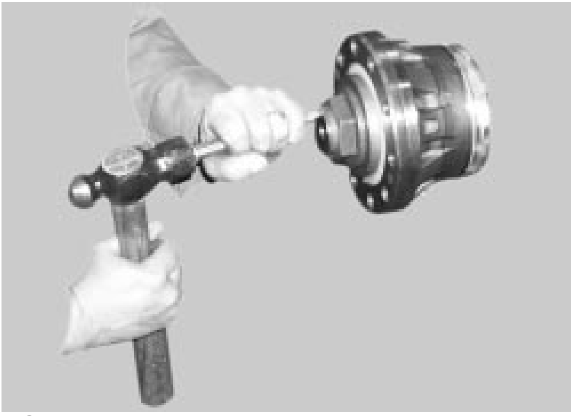


FIGURE 13

17. Unscrew hub nut and discard.

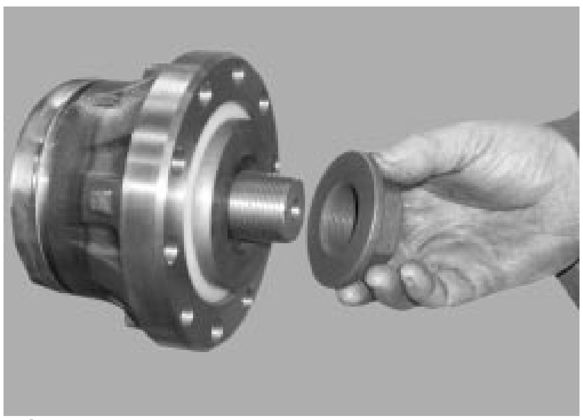


FIGURE 14

18. Remove the thrust washer.

FIGURE 15

19. Screw insertion tool onto spindle (Figure 16).

insertion tool tag axle	G32950
insertion tool front axle	491115

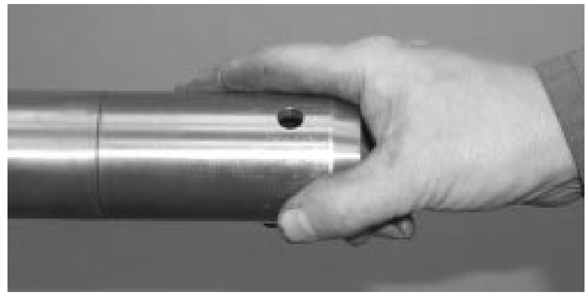


FIGURE 16: INSERTION TOOL

20. Carefully pull unitized bearing assembly and remove.

8.3 TAG AXLE HUB BEARING INSTALLATION

1. Clean spindle using EFX degreaser (Prevost #685313).
2. Screw insertion tool onto spindle (Figure 17).

insertion tool tag axle	G32950
insertion tool front axle	491115

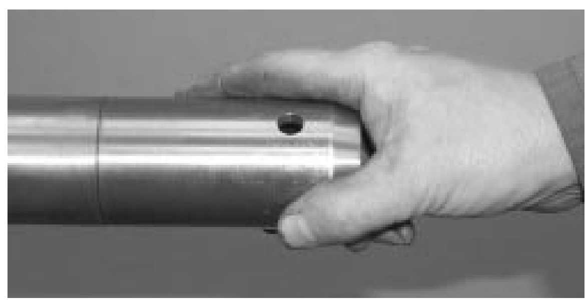


FIGURE 17: INSERTION TOOL

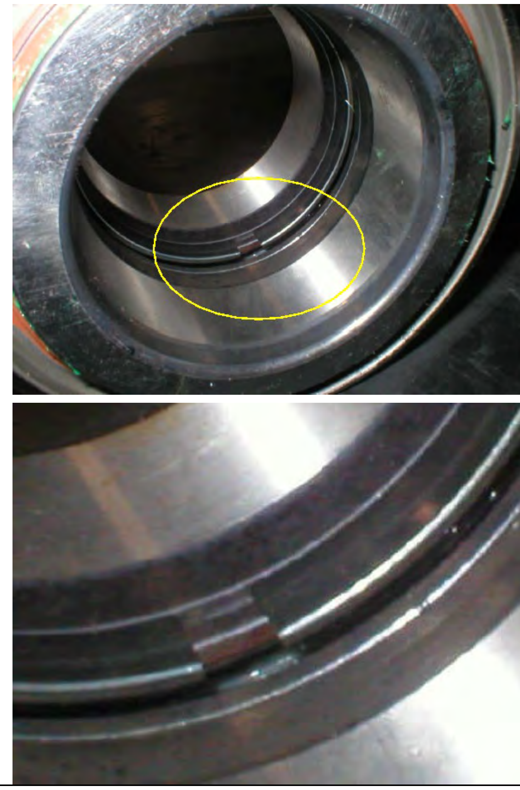
3. Apply a thin layer of antifriction/antifretting lubricant on spindle where bearing will be located (use Gleitmo 805 grease, Prevost #685274).

FIGURE 18: APPLY GLEITMO 805 GREASE

4. Slip unitized hub bearing over spindle.
5. Make sure the O-ring is present, see Figure 7.

FIGURE 19: SLIP UNITIZED HUB BEARING OVER SPINDLE

NOTE
If the inner rings are not properly guided (i.e. not in line to spindle) there may occur a seizing between inner ring and spindle before the assembly be completed. By pushing abruptly the hub unit back, there is a risk of separation of inner rings. The clip can be dislodged as per the two pictures below. *Always use an insertion tool*



6. Remove the insertion tool.
7. Clean thrust washer both sides and hub nut using a good quality degreaser or brake cleaner.
8. Install thrust washer hub nut then torque hub nut.

TORQUE: 563-687 lb-ft (763-931 Nm)

NOTE: Rotate bearing, minimum 10 revolutions necessary (simultaneous rotation till final clamp torque is achieved).

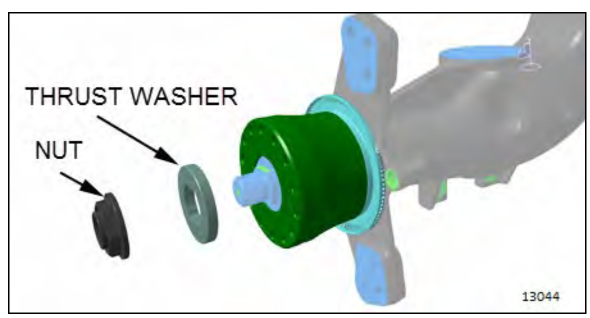


FIGURE 20: INSTALL THRUST WASHER AND HUB NUT

9. Make sur there is no play between the bearing and the spindle shoulder.

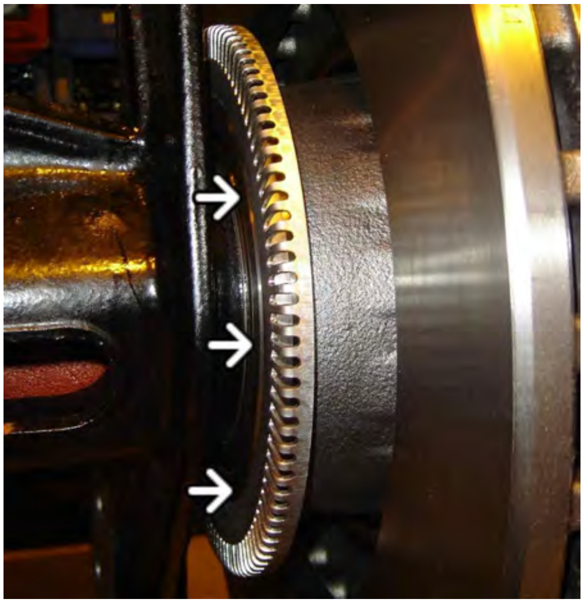


FIGURE 21: NO PLAY BETWEEN THE BEARING AND THE SPINDLE SHOULDER

10. Check the unitized bearing end play. Refer to paragraph *9.1 Tag Axle Bearing Inspection*.
11. Stake the hub nut by deforming with a round nosed chisel.

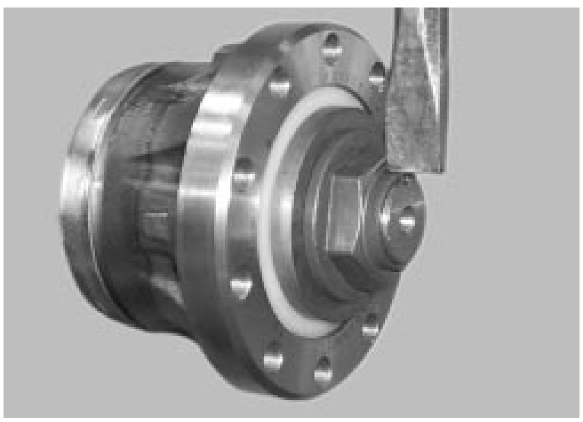


FIGURE 22

FIGURE 23: CORRECT - PREVENTS THE NUT FROM GETTING LOOSE

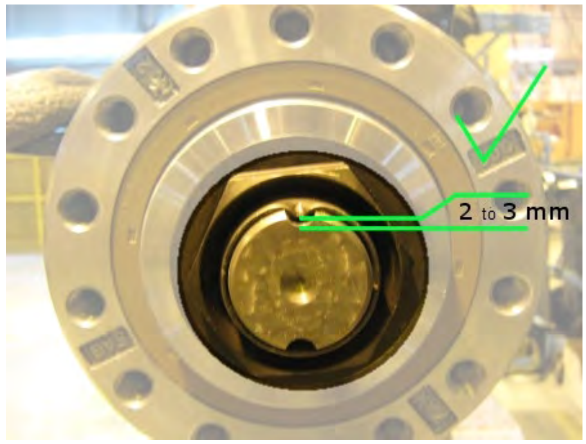


FIGURE 24: CORRECT – 2 to 3 mm / 0.078 to 0.118 in

FIGURE 25: BROCKEN OR TORN LIP – REJECTED

FIGURE 26: LIP INADEQUATELY PRESSED IN – REJECTED

12. Clean hub bearing, rotor and hub flange clamping surfaces using a good quality degreaser or brake cleaner.

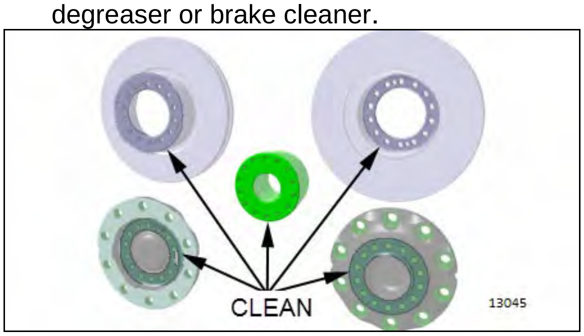


FIGURE 27: CLEANING HUB BEARING, ROTOR AND HUB FLANGE CLAMPING SURFACES

13. Install two guide studs on the unitized bearing.

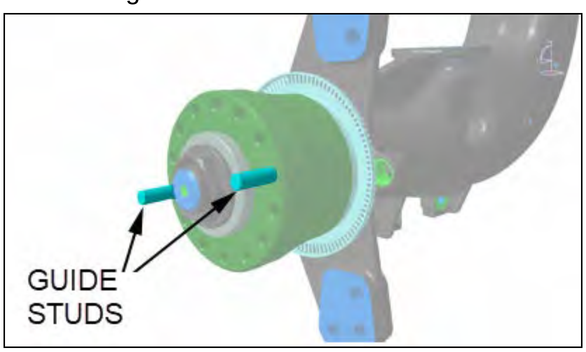


FIGURE 28

14. Install rotor onto hub bearing.

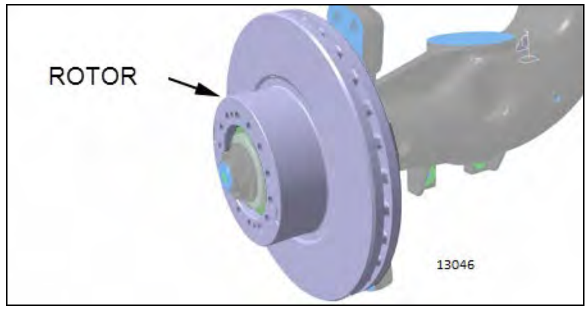


FIGURE 29: ROTOR

15. 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.

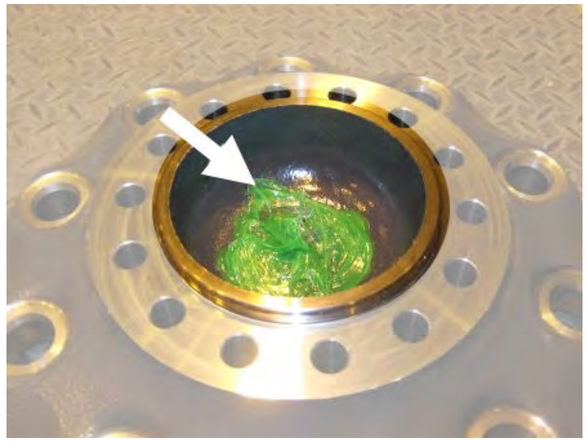


FIGURE 30

16. Secure hub flange and rotor to unitized hub bearing using 14 new cap screws (single-use only). Refer to Figure 32 for tightening sequence.

TORQUE: 161-197 lb-ft (218-267 Nm)

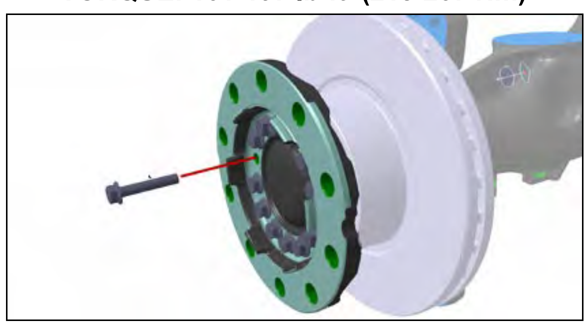


FIGURE 31: HUB FLANGE HEX CAP SCREW

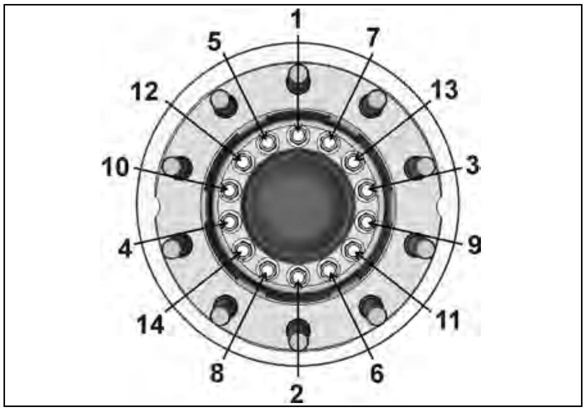


FIGURE 32 HUB FLANGE HEX CAP SCREW TIGHTENING SEQUENCE

17. Once the hub flange has been correctly fitted; it is necessary to check the axial run out of the brake disc.
18. Position a dial test indicator onto the axle in a suitable position.

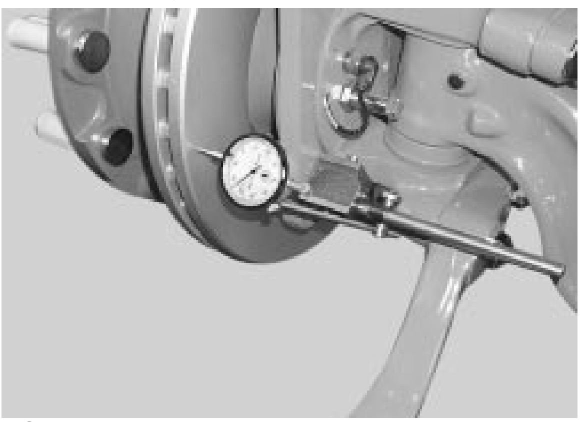


FIGURE 33

19. Position the stylus of dial test indicator onto brake disc as shown.

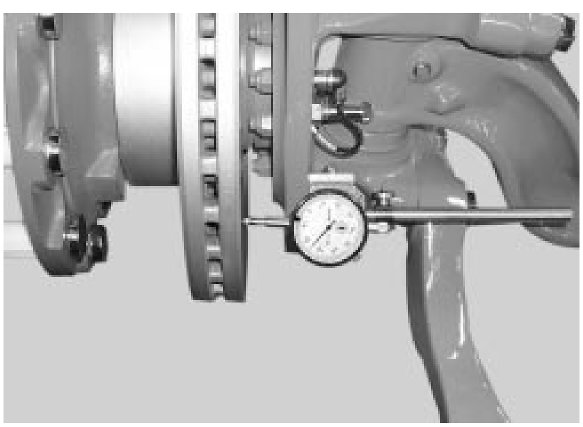


FIGURE 34

20. Rotate the hub through 360° and note any movement of the dial test indicator.

THE MAXIMUM RUNOUT IS 0.1 mm / 0.004 in

21. Remove and check out of specification disc to ensure no damage has occurred to the mounting faces, or that no dirt is present.
22. Remove any dirt found on the mounting faces and refit and re check disc.
23. Should it be found that a cleaned and refitted disc is still out of specification; it must be replaced.
24. Mount the brake caliper. Refer to Knorr Bremse manual.
25. Mount the wheel over studs, being careful not to damage stud threads.
26. 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.
27. Tighten stud nuts progressively as shown in Figure 3. The final tightening should be done with a torque wrench. Tighten stud nuts.

TORQUE: 450-500 lb-ft (610-678 Nm)

9. FRONT AXLE WHEEL HUBS

The FAG 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.

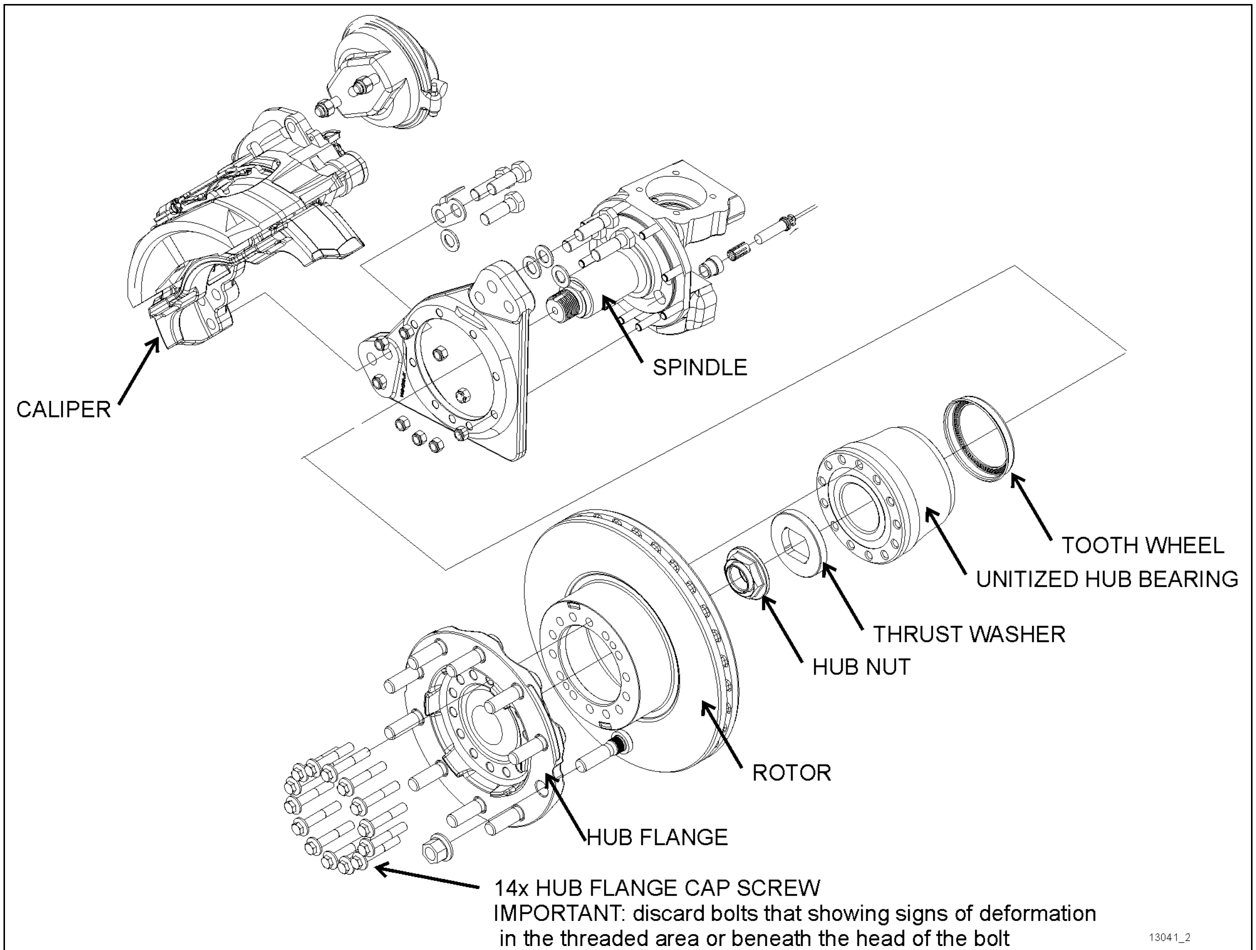


FIGURE 35: FRONT AXLE HUB AND ROTOR ASSEMBLY

9.1 FRONT AXLE HUB BEARING INSPECTION

MAINTENANCE

Front axle unitized bearing

Unitized bearing inspection should be made at the intervals specified by the Lubrication And Servicing Schedule in Section 24: LUBRICATION & SERVICING..

1. The front axle hub bearing inspection procedure is similar to the tag axle hub bearing inspection. Refer to 8 TAG AXLE WHEEL HUBS.

The mounted Unitized hub bearing axial endplay should not exceed:

- **0.050 mm (0.002")** for a new bearing,
- **0.20 mm (0.008")** for a bearing which has been in service.

NOTE
If original bearing unit is re-fitted, and end-float is measured at 1 mm, with hub not fully tightened to specified torque, then the retaining clip within the unit is damaged and a new unit must be fitted.

9.2 FRONT AXLE HUB BEARING REMOVAL

The front axle hub bearing removal procedure is similar to the tag axle hub bearing removal. Refer to *8.2 tag axle HUB BEARING REMOVAL*.

You can also find detailed information on front axle wheel hub bearing removal, refer to the following manual included on your vehicle Technical Publications USB flash drive in PDF format:

Dana Parts & Service Instructions S84U Steer Axle HUB BEARING REWORK_ Manual NO 1963 A+B iss A.

See OVERHAUL PROCEDURES, HUB END DISASSEMBLY, pages No. B3, B4, B5 & B6.

9.3 FRONT AXLE HUB BEARING INSTALLATION

The front axle hub bearing installation procedure is similar to the tag axle hub bearing installation. Refer to 8.3 *tag axle HUB BEARING INSTALLATION*.

You can also find detailed information on front axle wheel hub bearing removal, refer to the following manual included on your vehicle Technical Publications USB flash drive in PDF format:

Dana Parts & Service Instructions S84U Steer Axle HUB BEARING REWORK_ Manual NO 1963 A+B iss A.

See OVERHAUL PROCEDURES, HUB END REASSEMBLY, pages No. B23 up to B30.

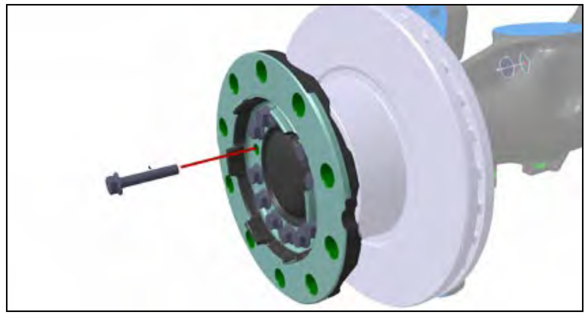


FIGURE 36: HUB FLANGE HEX CAP SCREW

Secure hub flange and rotor to unitized hub bearing using 14 hub flange cap screws. Refer to Figure 37 for tightening sequence.

TORQUE: 174-192 lb-ft (236-260 Nm)

NOTE: discard bolts that start to show signs of deformation in the threaded area or beneath the head of the bolt.

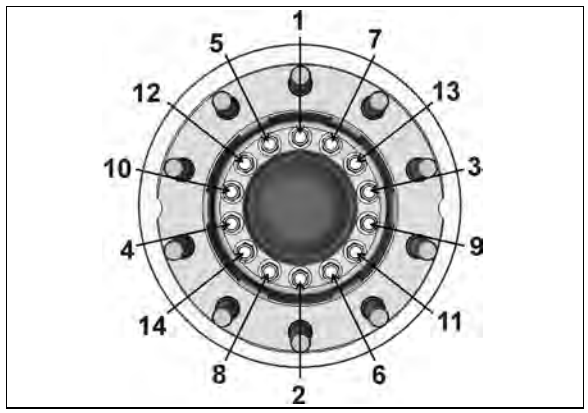


FIGURE 37: HUB FLANGE HEX CAP SCREW TIGHTENING SEQUENCE

10. ZF DRIVE AXLE WHEEL HUBS

The ZF A132 hypoid single reduction drive axle hub (**FIGURE 38**) is fitted with unitized bearing known as compact bearing in ZF's literature.

10.1 COMPACT BEARING (HUB UNIT) AXIAL PLAY CHECK

Check the compact bearing (hub unit) axial play at the intervals specified by the Lubrication And Servicing Schedule in Section 24: LUBRICATION & SERVICING. Furthermore, the bearing must be checked in case of brake disk change, ABS fault message and rising noise level at increasing speed.

Perform compact bearing (hub unit) axial play check as described in paragraph 6.2 HOW TO CHECK THE AXIAL PLAY of the following manual: OPERATING INSTRUCTIONS ZF AXLE A132 (version with US hub) #5871 207 982 EN.

MAINTENANCE

Compact bearing (hub unit) axial play

Check the bearing axial play at the intervals specified by the Lubrication And Servicing Schedule in Section 24: LUBRICATION & SERVICING.

10.2 COMPACT BEARING (HUB UNIT) GREASE CHANGE

When grease is changed within the scope of the maintenance, it is necessary to completely remove the compact bearing.

Perform compact bearing (hub unit) grease change as described in paragraph 7.3 GREASE CHANGE IN THE HUB of the following manual: OPERATING INSTRUCTIONS ZF AXLE A132 (version with US hub) #5871 207 982 EN.

MAINTENANCE

Compact bearing (hub unit) grease change – ZF Lubricant class 12H

The compact bearing grease must be change at the intervals specified by the Lubrication And Servicing Schedule in Section 24: LUBRICATION & SERVICING.

The list of approved Lubricant Class 12H grease types is found in ZF's list of lubricants TE-ML 12.

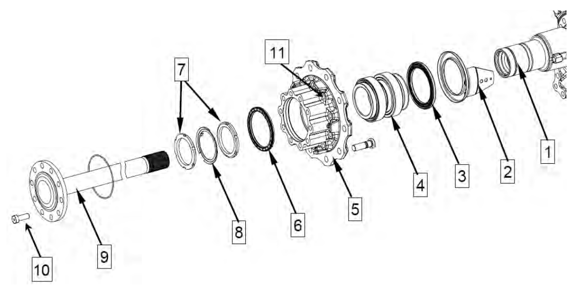


FIGURE 38: ZF A-132 DRIVE AXLE HUB ASSEMBLY

1 hub carrier
2 screen sheet
3 shaft seal (with impulse disc)
4 compact bearing (hub unit)
5 hub
6 shaft seal
7 slotted nut
8 locking plate
9 flange shaft
10 cap screw M18x1.5x50mm G10.9
TORQUE= 325 lb-ft (441 Nm)
(use 14mm hex socket driver "Allen")

14mm hex socket driver "Allen"

11	cap screw Torx M16x1.5x60, **TORQUE= 221 lb-ft (300 Nm)** (use E20 Torx socket)  E20 Torx socket

11. TIRE MAINTENANCE

The most critical factor in tire maintenance is proper inflation (Figure 39). 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.

NOTE
VIP & Converted Bus Shells vehicles are not at their maximum weight before their conversion and tire pressures are adjusted at lower level than the maximum allowed appearing on the DOT plate. Tires pressure must be re-adjusted once converted.

An under inflated tire builds up heat that can cause sudden tire destruction, resulting in improper vehicle handling and possible loss of vehicle control. At least once a week, before driving (when tires are cold), check inflation pressure on all the tires, including the spare tire. This is especially important in cases when different drivers operate the vehicle.

⚠ **WARNING**
Failure to maintain correct tire inflation pressure may result in sudden tire destruction, improper vehicle handling, and will cause rapid and irregular tire wear. Inflation pressure should be checked weekly and always before long distance trips.

11.1 INFLATION PRESSURE

The condition and pressure of the tires can greatly affect both useful tire life and road safety.

At regular intervals, verify the tire pressures. Use an accurate tire pressure gauge when checking inflation pressures. Never exceed the maximum inflation pressure specified on each tire.

NOTE
Inflation pressure should be checked when tires are cold. Cold tire inflation pressure can be measured when a vehicle has not been driven for at least 3 hours or less than 1 mile (1.6 km). Driving, even for a short distance, causes tires to heat up and air pressure to increase. Check inflation pressure on all tires (including the spare tire) using an accurate tire gauge.

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 left side control panel. For special tire selection, a “PREVOST COACH SPECIAL SPECIFICATION” chart is supplied with the vehicle and is affixed on the left wall near the driver’s seat. Remember, tire inflation pressure must be adjusted according to vehicle loading - see table in "Coach Final Record"

⚠ **CAUTION**
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".

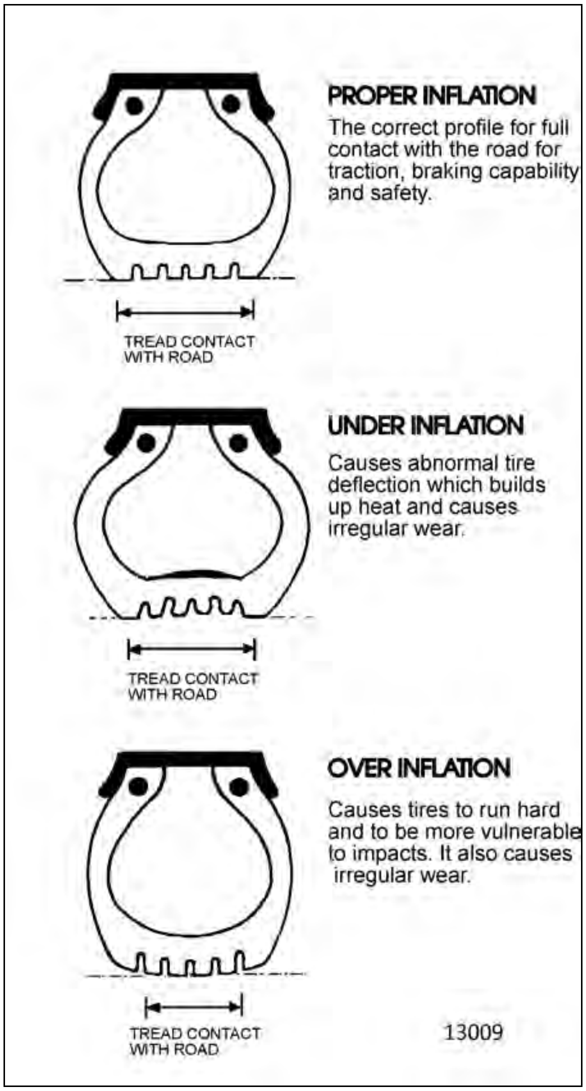


FIGURE 39: TIRE INFLATION

> ⚠ **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).

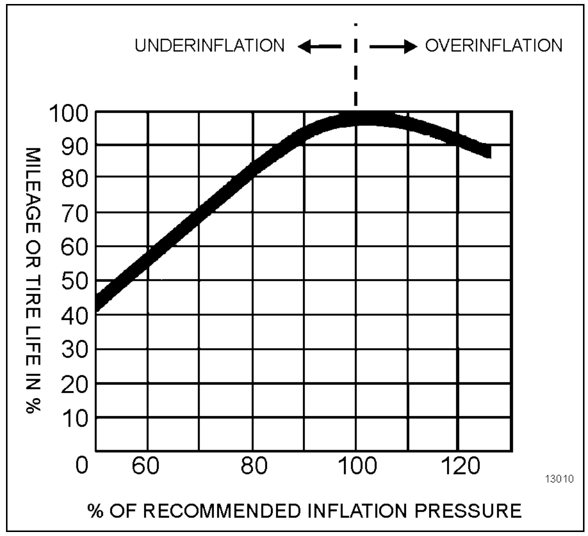


FIGURE 40: TIRE LIFE / INFLATION PRESSURE

> ⚠ **WARNING**
>
> Recommended tire inflation pressures and maximum allowable loads apply to speeds up to 65 mph (105 km/h). 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.
>
> Incorrect tire pressures cause increased tire wear and adversely affect road holding of the vehicle, which may lead to loss of vehicle control.

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, It is recommended 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 run-out 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

Wheel size.. 9.0" X 22.5"

Tire size.. 315/80 R 22.5

RECOMMENDED TIRE INFLATION PRESSURE AT MAXIMUM LOAD (cold)

NOTE
Vehicle is delivered with the specific inflation pressure certification plate according to the tire selection. For more information consult section 11 "Technical information" of the Owner's/Operator's manual under "DOT Certification Plate".

WARNING
Special tire selection may lower maximum allowable speed limit, even below posted speed limit. For maximum safety, check with tire manufacturer.

WARNING
Recommended tire inflation pressures and maximum allowable loads apply to speeds up to 65 mph (105 km/hr). Do not drive vehicle at a higher speed than 65 mph (105 km/h) or above the posted speed limit.

CONTENTS

SECTION CHANGE LOG

	DESCRIPTION	DATE
1		
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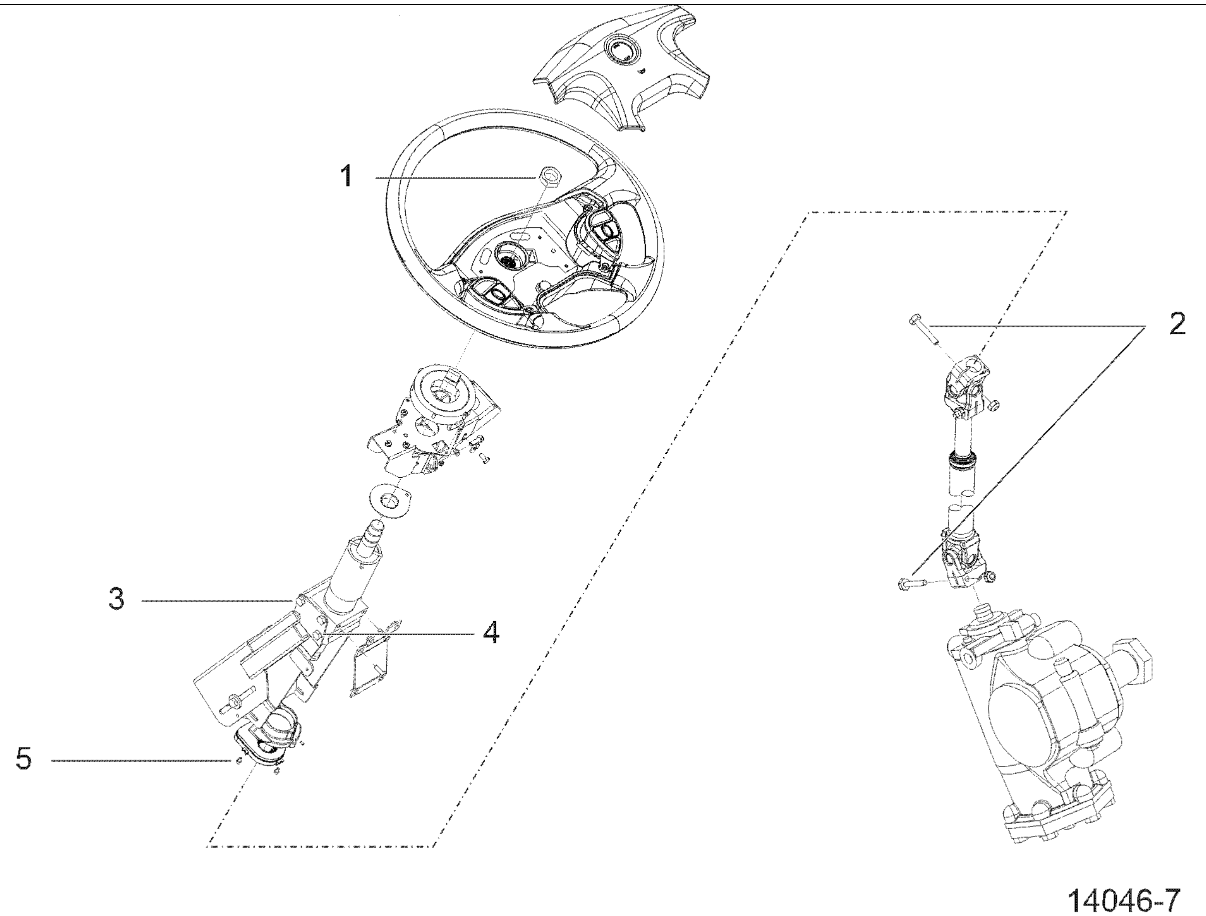
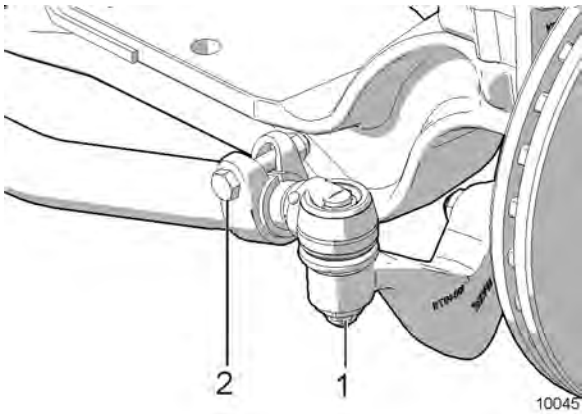
1 TORQUE TABLES

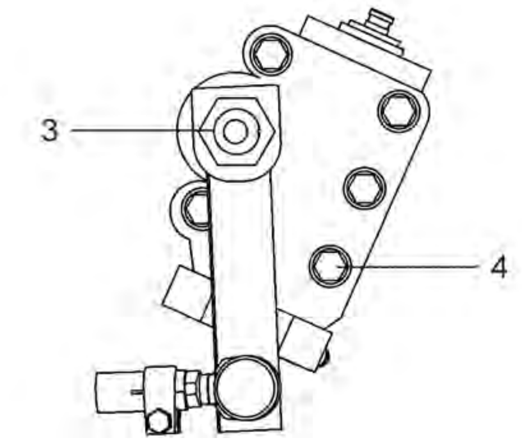
1.1 STEERING COLUMN



STEERING COLUMN		
No	DESCRIPTION	TORQUE
1	Steering Wheel Nut	35-45 lb-ft (47-61 Nm)
2	U-Joint Clamp Nut	48 lb-ft (65 Nm)
3	Column Support Fore Bolts	11-13 lb-ft (15-18 Nm)
4	Column Support Aft Bolts	15-19 lb-ft (20-26 Nm)
5	Steering Angle Sensor Mounting Screws	9-12 lb-in (1.02-1.36 Nm)

1.2 MISCELLANEOUS TORQUES





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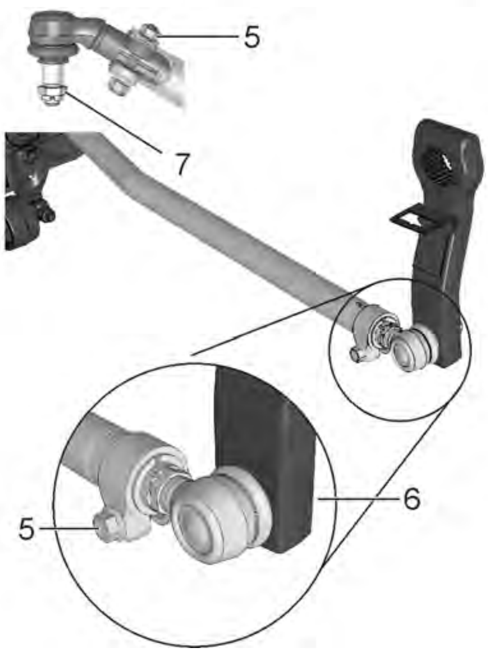

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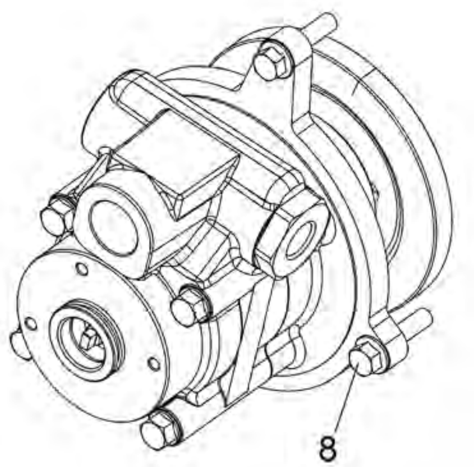


MISCELLANEOUS		
No	DESCRIPTION	TORQUE
1	Tie rod end ball pin self locking nuts - I-Beam Axle	155-170 lb-ft (210-230 Nm)
2	Tie rod end clamp bolts - I-Beam Axle	118-133 lb-ft (160-180 Nm)
3	Pitman Arm Fixing Nut	470-570 lb-ft (637-773 Nm)
4	Steering Gear Mounting Bolts	365-405 lb-ft (495-549 Nm)
5	Drag Link Clamp Bolts - I-Beam Axle	118-133 lb-ft (160-180

		Nm)
6	Drag Link Ball Joint Stud Nut (Fore) - I-Beam	165-236 lb-ft (224-320 Nm)
7	Drag Link Ball Joint Stud Nut (Aft) - I-Beam	140-200 lb-ft (190-271 Nm)
8	Power Steering Pump Housing	15-21 lb-ft (20-28 Nm)

2 STEERING SYSTEM DESCRIPTION

The steering system consists of the steering wheel and column assembly, a vane-type hydraulic pump, tank, 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;
3. Hydraulic tank and hoses.

The steering stabilizer reduces road shocks and vibrations in the system. The steering gearbox is self-powered and provides movement with power assistance to the left wheel.

Steering stability and tire wear are influenced by wheels, hubs, tires, air suspension, brakes, front suspension and front end alignment which are all covered in their respective sections in this manual.

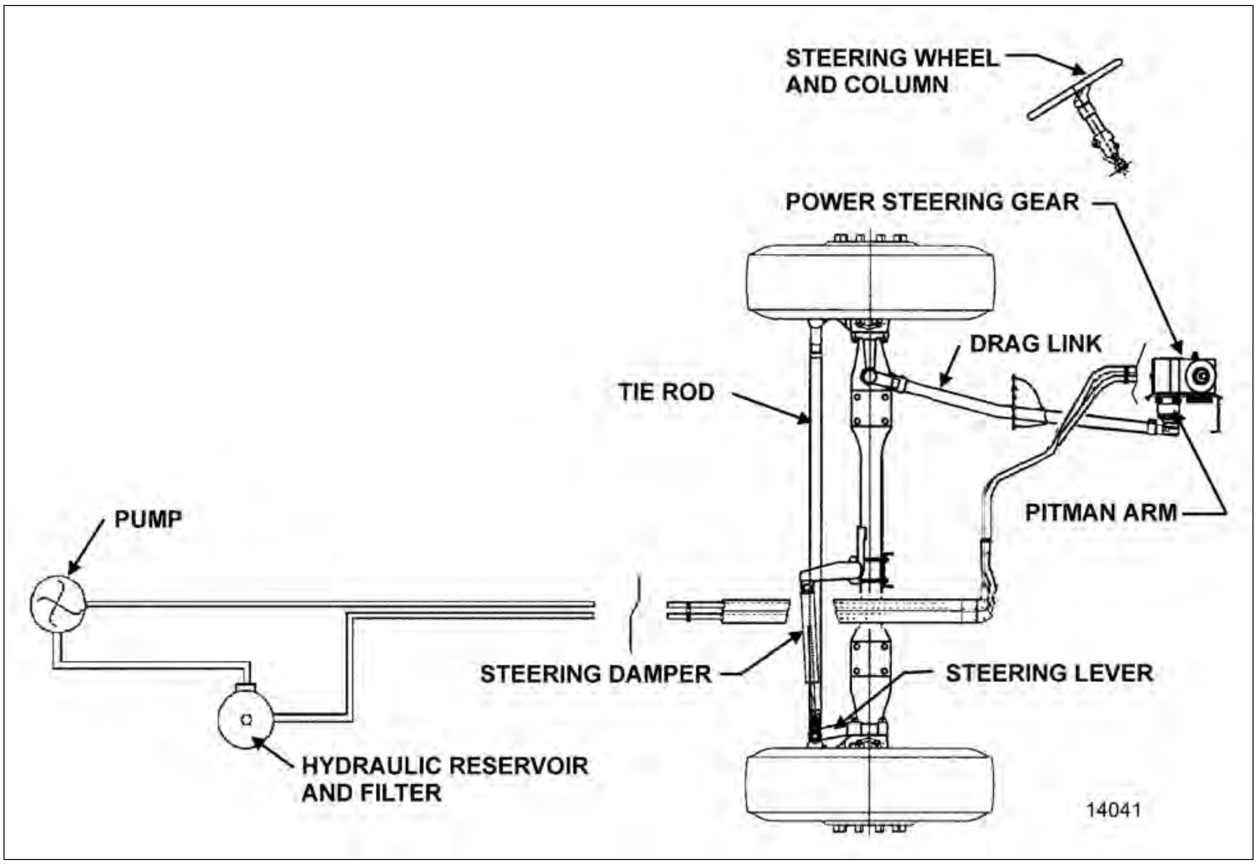


FIGURE 1: I-BEAM AXLE STEERING SYSTEM SETUP 14041

14076

3 POWER STEERING GEAR

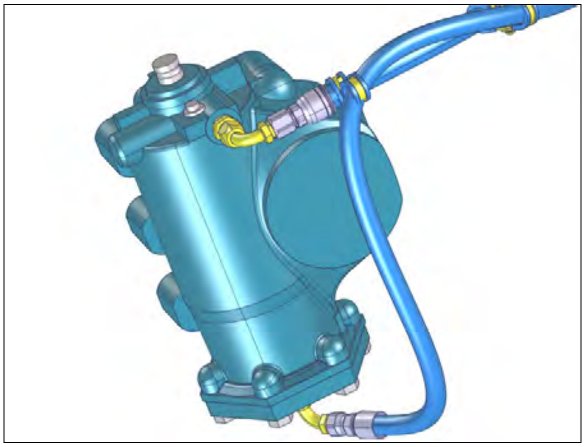


FIGURE 2: POWER STEERING GEAR 14035

3.1 DESCRIPTION

The power steering gear is located in the lower part of front service compartment (Figs. 3 & 4). The housing of the ZF/Robert Bosch-Servocom contains a control valve, working cylinder and a complete mechanical steering gear. The pressure oil for the steering is delivered by a motor-driven oil pump which is supplied with oil from an oil tank.

The housing is designed as a cylinder for the piston, which converts the rotation of the steering shaft and the worm into an axial movement and transfers this to the steering worm sector shaft. The serration of the sector shaft is straight-cut with a high surface quality in such a way that it is only possible to set a unique setting without play on installation in the straight-ahead driving area by means of the two eccentrically designed lateral housing covers.

The piston and worm are connected via a ball chain. When the worm is turned, the balls are collected by a circulating pipe at one end of the chain and fed in again at the other end, thus producing an endless ball chain.

The control valve consists of the valve slide in a needle bearing in the worm, with six control grooves on the circumference and the control sleeve on the worm, which also has six control grooves. The valve slide, designed with steering shaft connection, turns together with the worm as the steering wheel is turned.

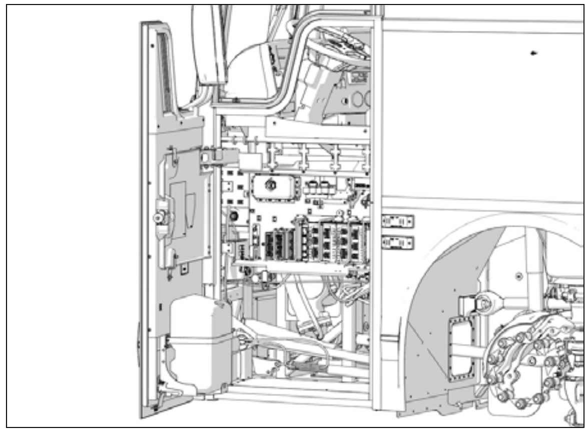


FIGURE 3: FRONT SERVICE COMPARTMENT 18611

A torsion bar, which is pinned with the valve slide and the worm, keeps the control valve in the neutral position as long as no opposing force is applied to the steering wheel. The steering housing contains a pressure relief valve, which limits the discharge pressure of the oil pump to the maximum value required. A replenishing valve can also be used, through which oil is sucked from the return if steering is not hydraulically boosted.

Compared with constant ratio, steering versions with variable ratio are more directly designed in the center area than outside the center area. The resulting smaller steering corrections benefit steering behavior in straight-ahead driving. At the same time, the indirect transmission means that there is a higher hydraulic torque available at the steering arm in parking movement. If the hydraulic assistance fails, the operating forces on the steering wheel are correspondingly lower in this area. This is achieved through a piston/steering worm sector shaft serration with differing modulus and angle of pressure.

Upon transfer of a torque from the steering shaft to the worm, or vice versa, the torsion bar is deformed in the elastic area so that there is torsion between the valve slide and the control sleeve. When the steering wheel is released, the torsion bar ensures that the valve is returned to the neutral position.

Refer to the *"ZF-SERVOCOM Repair Manual"* and "*RB Robert Bosch Servocom - Service Manual (8090)"*, found on your Technical Publications USB flash drive, for the functional aspects and maintenance procedure of the steering gear.

3.2 POWER STEERING GEAR REMOVAL

> **WARNING**
>
> The steering gearbox weighs approximately 100 lbs (45 kg) dry. Exercise caution when handling.

1. Put a container into place, and then disconnect both the inlet and outlet hoses from the power steering gear. Cover fittings to prevent fluid contamination.
2. Mark both the pitman arm and sector shaft with a line, then remove pitman arm. Refer to *"11.1 Pitman Arm Removal"* procedure.
3. Mark both the steering shaft universal joint yoke and steering gear input shaft with a line, then disconnect universal joint.
4. Unscrew and remove the power steering gear.

3.3 POWER STEERING GEAR INSTALLATION

Reverse *"Power Steering Gear Removal"* procedure paying particular attention to the following:

1. Tighten fasteners as recommended.

TORQUE: 365-405 lb-ft (495-549 Nm)

2. Bleed air from the system as per paragraph 0 (Bleeding power steering hydraulic system).

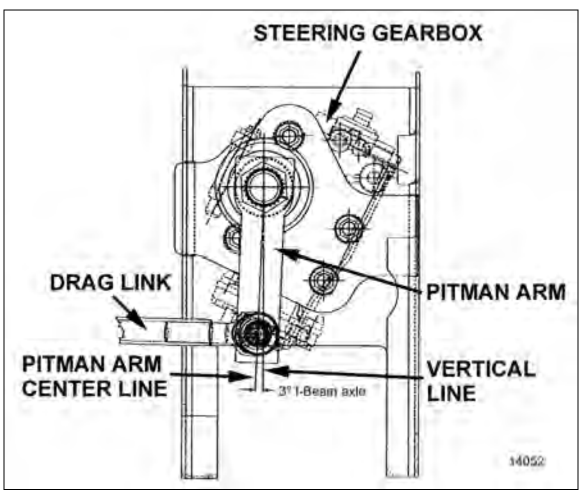


FIGURE 4: PITMAN ARM ADJUSTMENT

3.4 TROUBLESHOOTING

Perform troubleshooting of the steering gear as outlined in the *"ZF-SERVOCOM Repair Manual"* and "***RB Robert Bosch Servocom - Service Manual (8090)***" found on your Technical Publications USB flash drive.

4 BLEEDING POWER STEERING HYDRAULIC SYSTEM

To bleed the power steering hydraulic system, refer to “*RB Robert Bosch Servocom - Service Manual (8090)”*, found on your Technical Publications USB flash drive, under heading *"Setting and Functional Test"*.

5 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"*.

NOTE
Vehicle is equipped with ZF-SERVOCOMTRONIC (speed sensitive) unit, refer to repair manual ZF-SERVOCOM supplement.

6 POWER STEERING HYDRAULIC PUMP

The power steering pump is a 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.

6.1 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.

NOTE
Only unfasten the bolts marked with arrows.

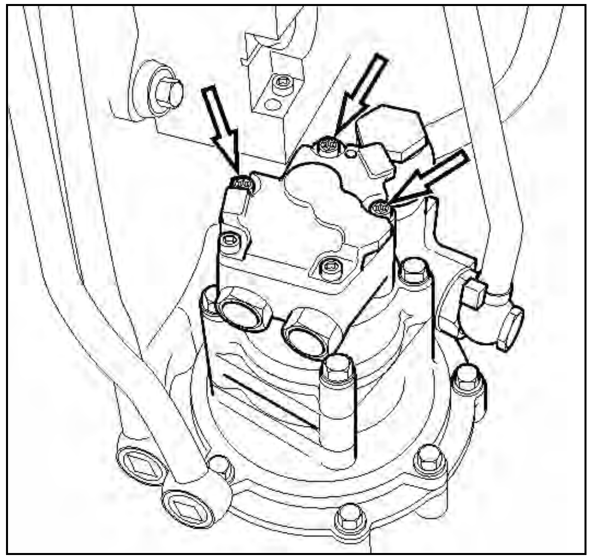


FIGURE 5: FUEL PUMP REMOVAL

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.

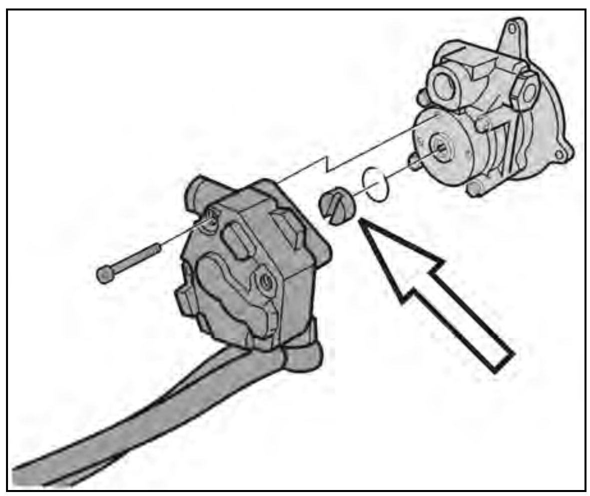


FIGURE 6: FUEL PUMP DRIVE AXLE

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 3 power steering pump bolts.

NOTE

Only unfasten the bolts marked with arrows.

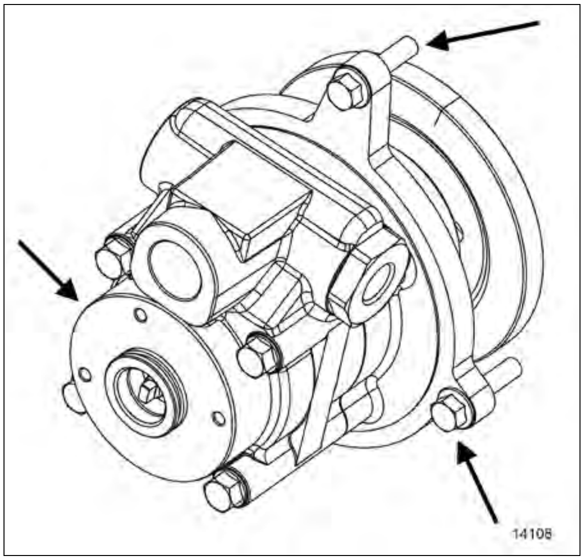


FIGURE 7: POWER STEERING PUMP REMOVAL

8. Install the new power steering pump. Tighten bolts to specification.

TORQUE: 15-21 lb-ft (20-28 Nm)

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, refer to *"Section 03 Fuel System"*.

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.

7 STEERING COLUMN REMOVAL

To disassemble the steering column from system, refer to Figure 8 & Figure 9. 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:

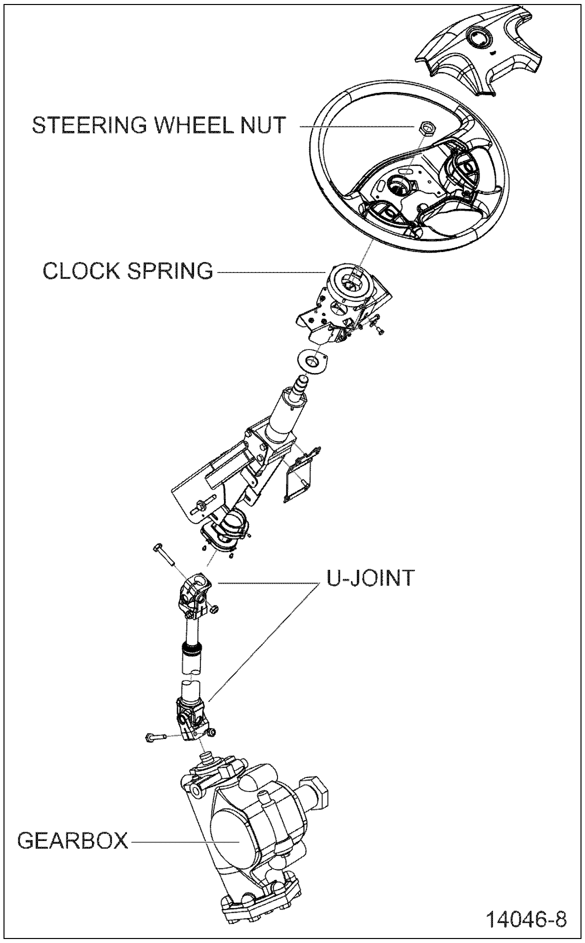


FIGURE 8: STEERING COLUMN

1. From the front driver's compartment area, remove the three plastic fasteners on steering column lower cover. Remove the lower cover (Figure 9).
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.

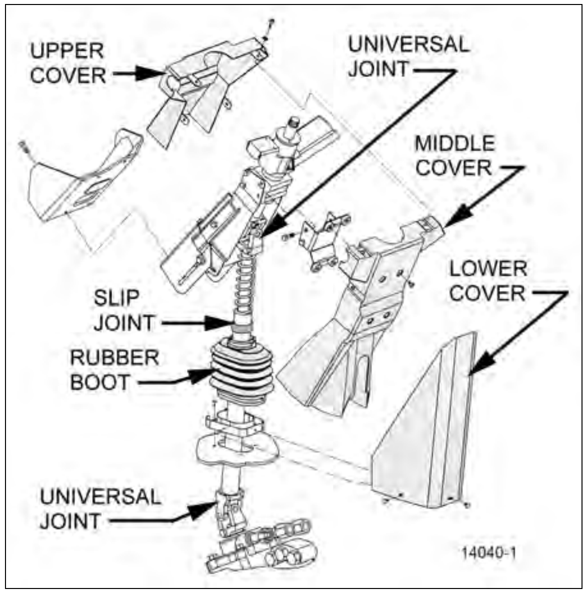


FIGURE 9: STEERING COLUMN COVERS

8 STEERING WHEEL

8.1 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 rear electrical compartment to the *"OFF"* position.
2. Pull the horn pad straight up gently to detach it from the steering wheel (Figure 10).
3. Disconnect the horn wire (white) connected to the horn pad and the steering wheel harness 4-pin connector.

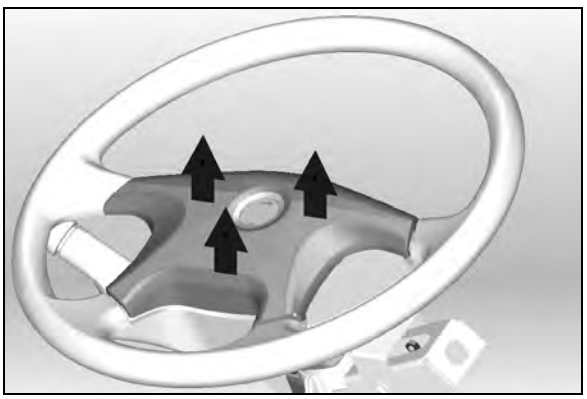


FIGURE 10: REMOVING THE HORN PAD

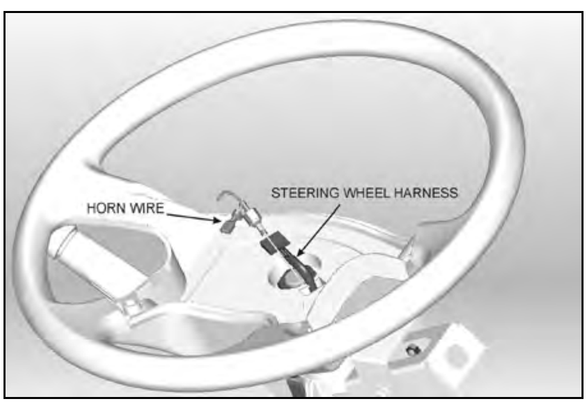


FIGURE 11: STEERING HARNESS & HORN WIRE

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.
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 12).

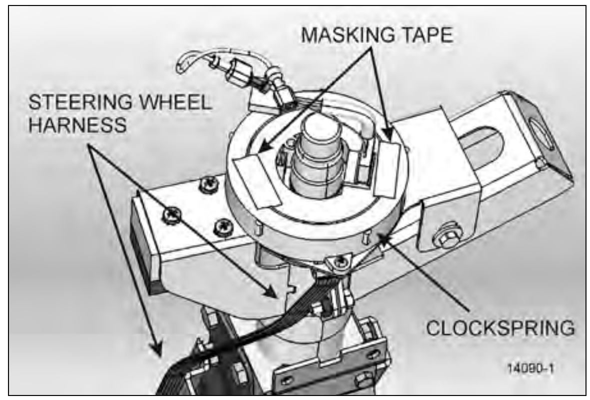


FIGURE 12: LOCKING THE CLOCKSPRING IN PLACE

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.

8.2 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 steering wheel retaining nut.

TORQUE : 35-45 lb-ft (47-61 Nm)

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.

8.3 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 (Figure 13). If necessary, remove the steering column covers.
3. Route the new clockspring harness through the opening in the clockspring support (Figure 13). Plug the connector at the base of the steering wheel column and fix harness along the steering wheel column.

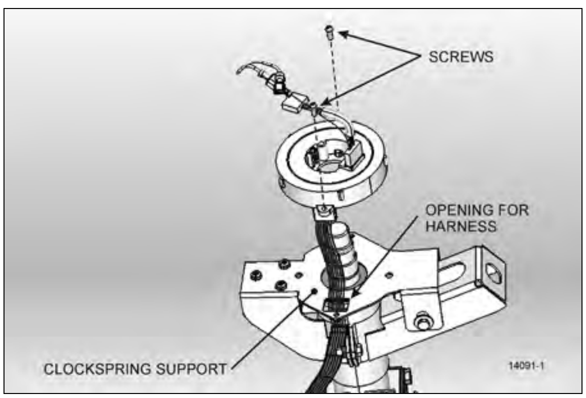


FIGURE 13: CLOCKSPRING INSTALLATION

4. Mount the clockspring in place with 2 screws.
5. Break the paper seal and rotate the center part of the clockspring about 50° clockwise (Figure 14). This step is necessary for the installation of the steering wheel.

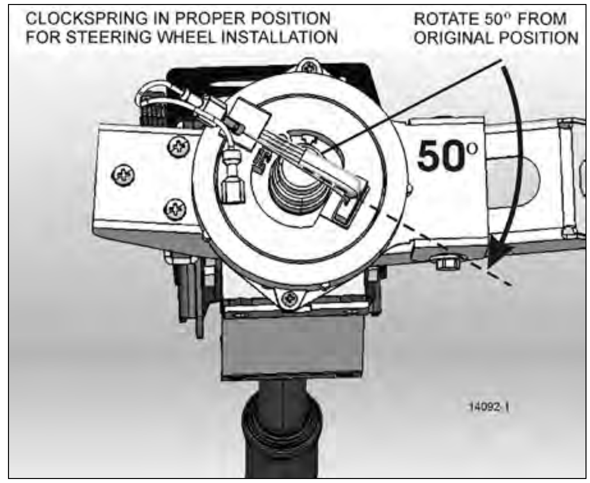


FIGURE 14: PROPER CLOCKSPRING POSITION

6. Reinstall the steering wheel.

9 TURNING ANGLE ADJUSTMENT

The maximum turning angle is set through two (2) steering stop screws installed on the knuckles, above the ABS wheel sensors. 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".*

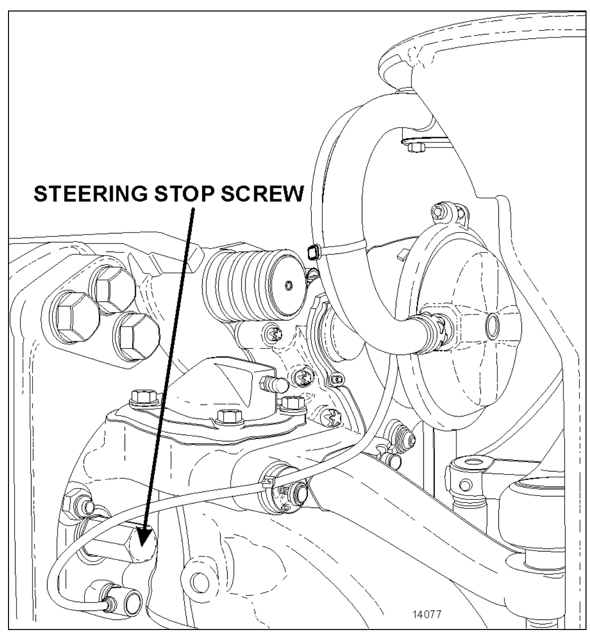


FIGURE 15: STEERING STOP SCREW ON I-BEAM AXLE

CAUTION

To prevent the steering damper from interfering with the adjustment of turning angles on vehicles equipped with I-Beam axle, make sure its fixing bracket is at correct location on the axle (refer to paragraph 13.5 "Steering Stabilizer Cylinder (Damper)).

CAUTION

Never maintain the relief pressure for more than 5 seconds, since damage to the power steering pump may occur.

CAUTION

*Reduce or shut off the power steering hydraulic pressure before the boss on the knuckle touches the stop screw. If not, the components of the front axle will be damaged (refer to "ZF-SERVOCOM Repair Manual" and "**RB Robert Bosch Servocom - Service Manual (8090)**", found on your Technical Publications USB flash drive, under heading "Setting The Steering Limiter" or* ***"Setting the hydraulic steering limitation").***

10 STEERING LINKAGE ADJUSTMENT

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.

The steering linkage includes the pitman arm, drag link, steering arm, tie rod arms and tie rod.

CAUTION

Front wheel alignment should be checked and adjusted if necessary, any time a component of the steering system is repaired, disassembled or adjusted. Refer to section 10 "Front Axle" *under heading* 6. "Front Wheel Alignment".

11 PITMAN ARM

11.1 REMOVAL

1. Remove cotter pin, nut and washers from drag link ball stud at pitman arm.
2. Disconnect drag link from pitman arm, using jaw style pullers (pressure screw type).

WARNING

Always wear approved eye protection when operating pullers.

CAUTION

Do not drive (hammer in) pitman arm on or off pitman shaft as this can damage the steering gear.

CAUTION

Heating of components to aid in disassembly is not allowed because it has a detrimental effect on axle components and steering linkages.

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.

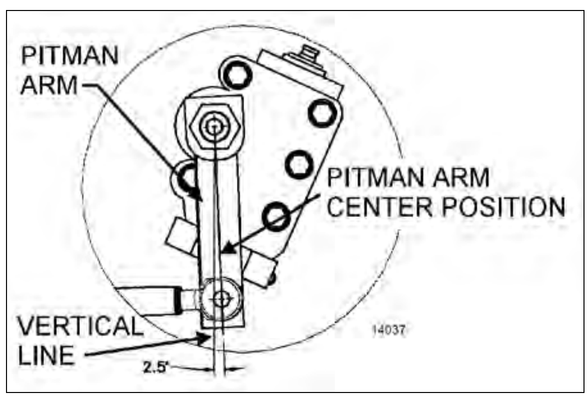


FIGURE 16: I-BEAM FRONT AXLE PITMAN ARM ADJUSTMENT

6. Add reference marks to the arm and shaft if necessary to ensure correct alignment at reassembly.
7. Use a suitable puller and remove pitman arm.

11.2 INSTALLATION

1. Position pitman arm on sector gear shaft with reference marks aligned.
2. Install fixing nut.

TORQUE: 470-570 lb-ft (637-773 Nm)

NOTE
Use a new nut if the previously removed nut was punched.

1. Lock nut with sector shaft using a punch mark into the groove (Refer to Figure 17).

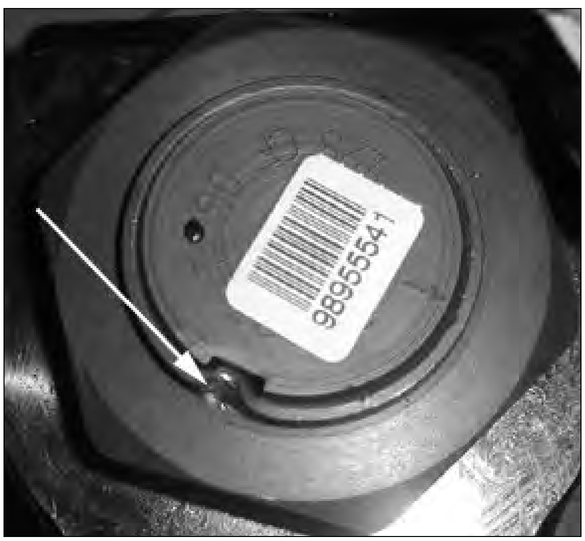


FIGURE 17: FIXING NUT PUNCH MARK 16098

2. Connect drag link to pitman arm while ensuring that rubber stabilizer is in place on the rod end. Install washers. Tighten nut and install a new cotter pin. Depending on axle type, select the appropriate torque,

TORQUE: 165-236 lb-ft (224-320 Nm)

⚠ **CAUTION**
Input shaft marks must be aligned before adjusting pitman arm.

11.3 ADJUSTMENT

1. Disconnect the drag link from pitman arm. Center steering wheel by dividing the total number of steering wheel turns in two. Scribe a reference mark on steering gearbox at the center previously determined.
2. Using a protractor, check the angle of the pitman arm (refer to Figure 16 for details).
3. The pitman arm should be adjusted with reference marks aligned or to an angle of 2.5º towards front of vehicle (I-Beam axle) in relation with the vertical axis. 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 tighten

TORQUE: 470-570 lb-ft (637-773 Nm)

11.4 TAG AXLE UNLOAD - SWITCH ADJUSTMENT

1. Make sure vehicle wheels are straight and facing forward.
2. Line up switch lever with reference to the bracket center (Refer to Figure 18).

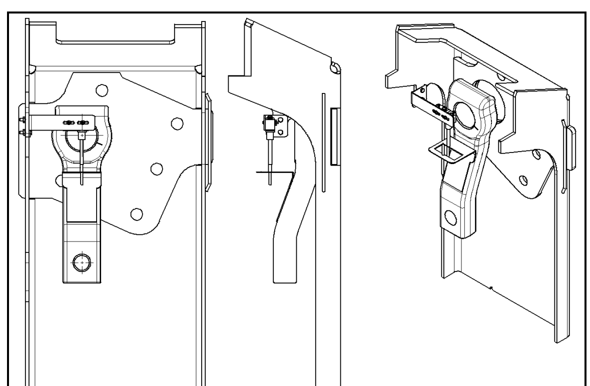


FIGURE 18: TAG AXLE UNLOADING SWITCH ADJUSTMENT 14061

12 DRAG LINK

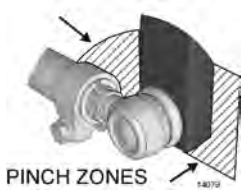
The draglink on the vehicle connects the steering gear pitman arm to the front axle’s steering arm.

For additional details, refer to ZF assembly instructions LMN404-3 *and* Lemförder service information leaflet for the fine adjustment system.

PINCH HAZARD

Keep hands and fingers clear of pinch zones around pitman arm.

Pinch zones are between pitman arm and clamp, and between front of pitman arm and vehicle structure.



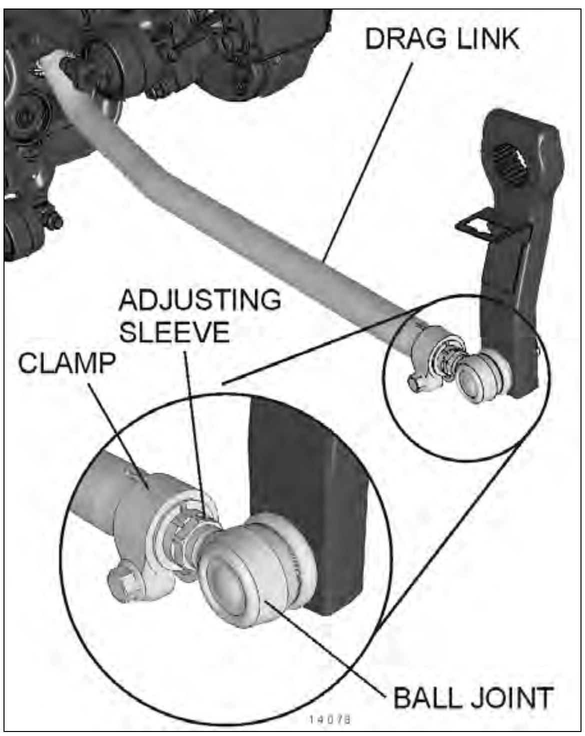


FIGURE 19: DRAG LINK

12.1 LENGTH 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.

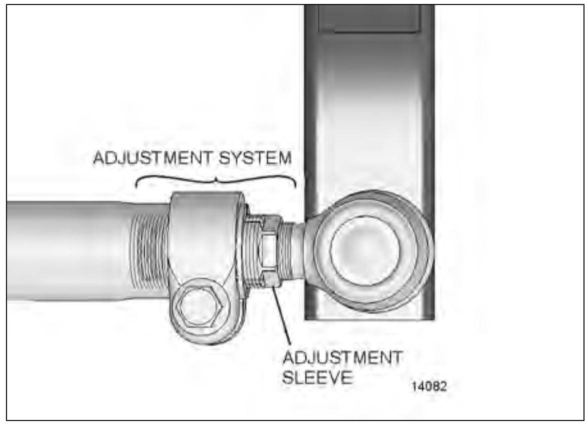


FIGURE 20: DRAG LINK ADJUSTMENT SYSTEM

CAUTION

Too little pressure on the clamp can destroy the threaded adjustment system sleeve.

Apply the recommended torque for clamp nut.

TORQUE: 118-133 lb-ft (160-180 Nm)

Fine adjustment of the drag link length should be performed exclusively by turning the adjuster sleeve.

Refer to maintenance information MI19-05 for detailed draglink length adjustment instructions.

12.1.1 Adjustment System Thread Lengths

When assembling the adjuster sleeve or ball joint, be sure to assemble the parts within the following prescribed thread lengths and values.

Lengths V and W should be measured prior to removal to restore the steering system to its original state.

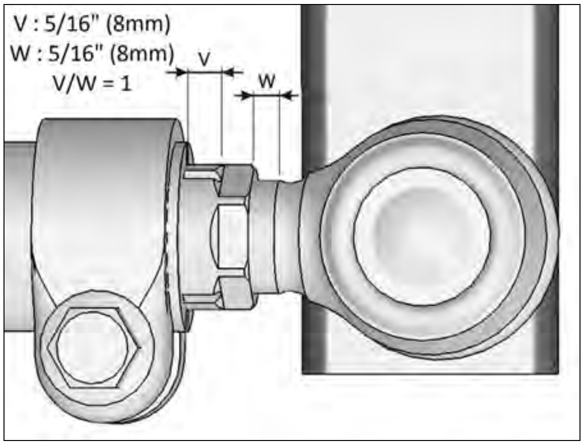


FIGURE 21: DRAG LINK ADJUSTMENT SYSTEM

- Dimension V and W should be equal: V/W = 1
- Dimension V: *5/16″ (8mm)*
- Dimension W: *5/16″ (8mm)*

WARNING

To preserve the integrity of the adjusting system, length V and W should *never* exceed 5/8″(16mm) ± 1 thread pitch.

Length V and W should be equal within ± 1mm

13 STEERING SYSTEM 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 appropriate power steering fluid.

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 paragraph 0*: "BLEEDING POWER STEERING HYDRAULIC SYSTEM".*

CAUTION
Do not operate the pump without fluid in the power steering fluid tank.

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 24A of this manual. The intervals given in the schedule are recommended for normal service. More frequent intervals may be required under severe operating conditions.

13.1 POWER STEERING FLUID CONDITION

The power steering fluid tank is filled with Automatic Transmission Fluid (ATF) (refer to FLUIDS & LUBRICANTS TABLE in Section 24A: Lubrication & Servicing). A periodic power steering fluid change is not required. Change the power steering fluid only if the steering gear unit was repaired, replaced or if the visual inspection of the fluid shows that a change is necessary.

MAINTENANCE
Check power steering fluid condition at the intervals specified by the Lubrication And Servicing Schedule in Section 24A: LUBRICATION & SERVICING

13.1.1 Power Steering Fluid Visual Inspection

The color of the power steering fluid can give you an idea of the fluid’s condition and tell you that it needs to be changed. ATF gets darker with age, this process doesn’t necessarily indicate a problem. If the fluid has darkened significantly, it may indicate that the power steering system is running hotter than normal and the fluid is overheating. Troubleshoot the overheating and have the fluid changed.

Get a sample of power steering fluid using the gauge located on top of the tank. Wipe it on a clean white rag. Check the fluid color, smell and consistency. Use the color chart below to determine if the power steering fluid needs to be changed.

POWER STEERING FLUID CONDITION COLOR CHART	
	Translucent red **New fluid**
	Semi-translucent dark red/light brown, thick oily consistency, relatively odorless **Normal fluid**
	Opaque dark brown, appears to be thin **Dirty, change fluid**
	Dark brown/black with burnt smell **Bad condition** *(internal damage may have already occurred)*

13.2 POWER STEERING FLUID CHANGE

Please, refer to **Oil Change and Bleeding** in "*RB Robert Bosch Servocom - Service Manual (8090)"* found on your Technical Publications USB flash drive.

Replace the filter element simultaneously with the fluid change. See 13.3.2 Filter Element Replacement.

13.3 POWER STEERING FLUID TANK & FILTER

The power steering tank is located at the upper right side of the engine compartment, accessible by the engine compartment door.

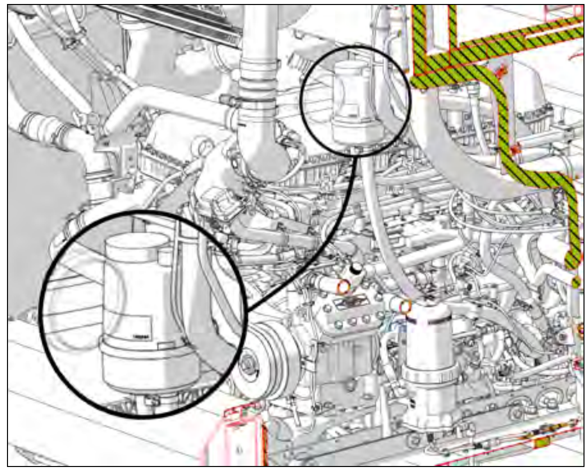


FIGURE 22: POWER STEERING TANK

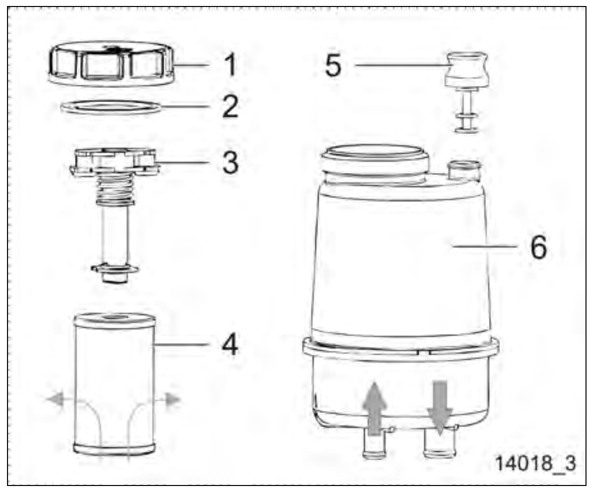


FIGURE 23: POWER STEERING FLUID TANK

1) Cap
2) Gasket
3) Filter screw
4) Filter
5) Breather cap
6) Tank

13.3.1 Fluid Level Check

1. Stop the engine.
2. Open the engine compartment door.
3. Thoroughly clean the tank and its immediate vicinity to protect the fluid from being soiled by impurities.

4. Check fluid level through the clear bowl and compare with the MIN & MAX marking affixed on the bowl.
5. Remove the breather cap and top up level to "MAX" mark.
6. Reinstall the breather cap.

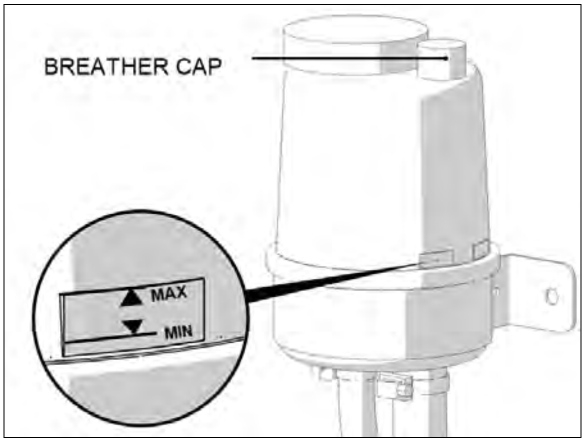


FIGURE 24: POWER STEERING TANK LEVEL GAUGE

MAINTENANCE

At regular intervals, fluid level should be checked in the tank and filter assembly. Furthermore, the oil filter element in the power steering tank should be replaced at the intervals specified by the Lubrication And Servicing Schedule in Section 24A: LUBRICATION & SERVICING.

13.3.2 Filter Element Replacement

NOTE

Note: Before taking the power steering fluid tank cover off, thoroughly clean the tank and caps to prevent the ingress of impurities into the hydraulic fluid.

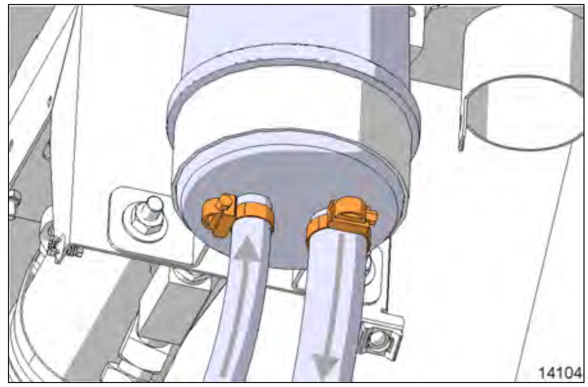


FIGURE 25: HOSE CLAMPS

FIGURE 26: FILTER REMOVAL

1. Remove the cap
2. Prepare an appropriate container.
3. Disconnect the larger suction hose first.
4. Disconnect the inlet hose.
5. Drain all fluid from the tank.
6. Press down and unscrew the filter.
7. Lift up the old filter and keep one finger under the filter's center hole, to prevent the impurities from the filter from entering the oil tank.
8. Drain any remaining oil.
9. Clean tank.
10. Transfer the screw to the new filter and insert it into the oil tank.
11. Check that the filter is positioned correctly and is locked in place securely.

12. Reconnect the hoses.

    Tighten the clamps to **30 lb-ft (41 Nm)**

13. Top up with fresh oil to the MAX marking.
14. Double check cleanliness of cap and install.
15. Discard the oil collected during the filter change.

CAUTION

Protect the fluid from being soiled by impurities

When removing the old filter element, make sure that power steering fluid doesn't flush back particles into the tank. If this situation occurs, contaminated fluid must be drained and the tank must be cleaned.

13.4 STEERING SYSTEM PLAY INSPECTION

Basically, the steering system play is checked with the engine running and the front wheels in the straight ahead driving position. The steering wheel is slowly turned in one direction until there is a perceptible movement of a front wheel. If a point on the steering wheel rim moves more than the value indicated below before perceptible return movement of the wheel under observation, there is excessive free play in the steering system.

Steering wheel travel covered

Maximum value:	1.732 inch (44mm) with Prevost 18-inch steering wheel

NOTE

*The <u>full procedure</u> is described under paragraph **Checking the Steering Gear Play** in RB Robert Bosch Servocom - Service Manual (8090 manual).*

Take note that the maximum travel covered value specified in the Servocom manual doesn't apply to the Prevost design which uses a 18-inch steering wheel.

If the maximum value is exceeded, the steering system should be thoroughly inspected for worn or loose components, beginning with the steering linkage. If the steering linkage is in good condition, then the steering column and the steering gear should be inspected.

MAINTENANCE

I-BEAM FRONT AXLE

Perform the steering play inspection at the intervals specified by the Lubrication And Servicing Schedule in Section 24A: LUBRICATION & SERVICING

13.5 STEERING STABILIZER DAMPER

The steering damper is located on R.H. side, aft of front axle (Figure 27).

The cylinder is non-adjustable and non-repairable. Check for oil leaks or lack of resistance. Disconnect the cylinder from axle, and then carefully attempt to extend and collapse it manually.

MAINTENANCE

Steering damper ball joint (rod end) is provided with grease fitting for pressure lubrication. Under normal conditions, it should be serviced at the intervals specified by the Lubrication And Servicing Schedule in Section 24A: LUBRICATION & SERVICING.

Check the ball joint for wear, and replace if necessary. Good quality lithium-base grease NLGI No. 2 like Shell Retinax LX is recommended.

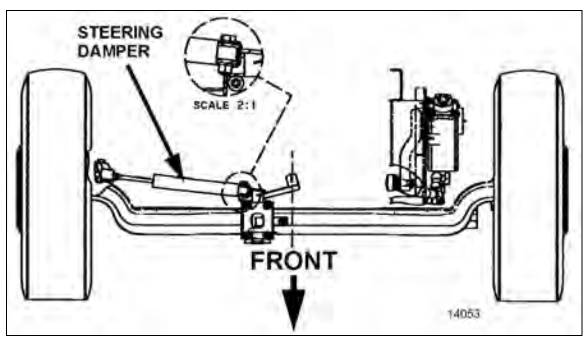


FIGURE 27: STEERING STABILIZER (DAMPER)

13.6 DRAG LINK MAINTENANCE

Visually inspect drag link components for broken, corroded or deformed clamps, loose, bent or corroded nuts and gauges on tube from rubbing parts.

On vehicles equipped with I-beam front axle, the drag link features **lubricated for life** ball joints and a compact fine adjustment system.

Although the ball joints do not require greasing, they do require regular inspection, refer to the following sections for ball joint maintenance.

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.

Adjustment System 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:

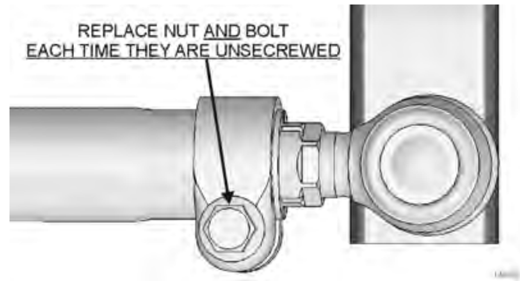
- Visual inspection
- Place a finger on the separation line from the adjuster sleeve to the threaded ball joint shaft.
  Keep fingers clear of pinch zones.
- Use a dial gage clamped to the tube and feelers aligned on the ball joint to indicate any play

When play is discovered in the adjusting system, replace the complete drag link.

CAUTION

Do not re-use clamp hardware.

Bolt and nut should be replaced every time they are unscrewed.



While assembling the clamp, make sure the bolt does not touch the draglink tube.

FIGURE 28: I-BEAM FRONT AXLE DRAG LINK

13.7 FRONT I-BEAM AXLE TIE ROD

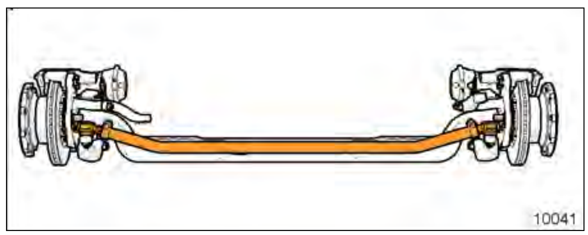


FIGURE 29: I BEAM AXLE TIE ROD

The tie rod includes a fine adjustment sleeve on one side.

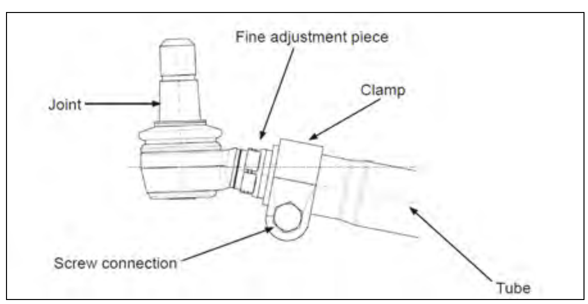
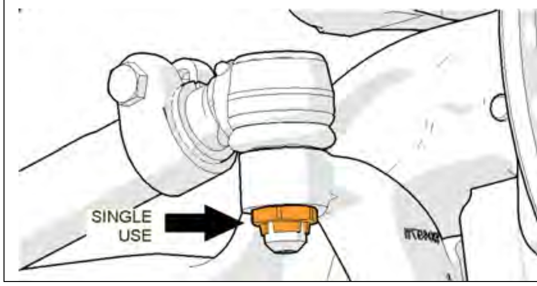


FIGURE 30:TIE ROD COMPONENTS

CAUTION

Do not re-use tie rod joint nut.

Joint nuts should be replaced every time they are unscrewed.



For additional details, refer to supplier information:

TRW Front Axle Steering Bar Service Information XSZ143

13.8 TIE ROD INSPECTION PROCEDURE

The steering tie rod assembly requires several visual and functional inspections. If any of the described conditions are found, a complete replacement of the tie rod assembly or individual ball joints may be required.

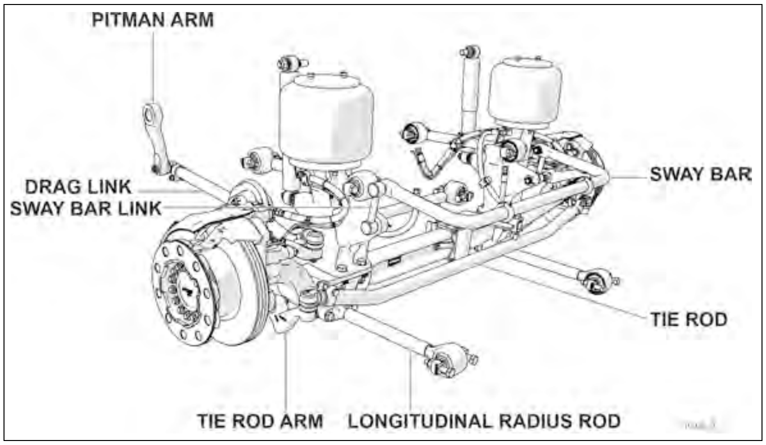


FIGURE 31: FRONT I-BEAM AXLE

MAINTENANCE
Inspect the tie rod at the interval specified by the Lubrication And Servicing Schedule in Section 24A: LUBRICATION & SERVICING

13.8.1 Tube inspection

Check the tube for damage. If there are signs of deformation, replace the tie rod assembly.

13.8.2 Ball joint play inspection – component group 33 X-Cap

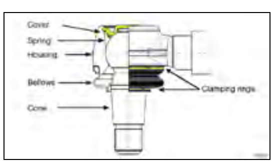


FIGURE 32 TIE ROD BALL JOINT

To inspect joint wear and play, turn the wheels alternately left and right until the wheels move. Perform this with the axle loaded normally. During this process, the ball stud must not deflect axially any more than **0.020" (0.5 mm)** into the housing. Replace the joint if the movement of the ball stud exceeds **0.020"** (**0.5 mm)** *axially* in the housing.

Measure the distance with a caliper (Figure 33).

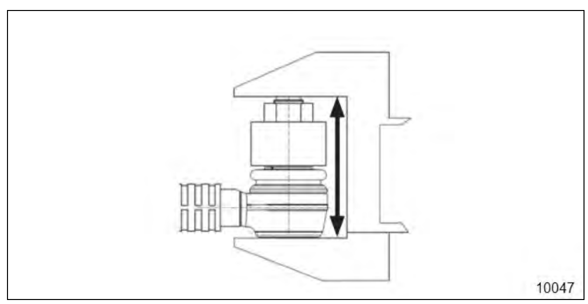


FIGURE 33: MEASURING AXIAL PLAY, TIE ROD JOINTS

13.8.3 Fine adjustment sleeve play inspection

Turn the wheels alternately left and right while keeping a finger on the threads to feel any movement in the threads. (Figure 34). If there is too much play in the sleeve, replace the tie rod.

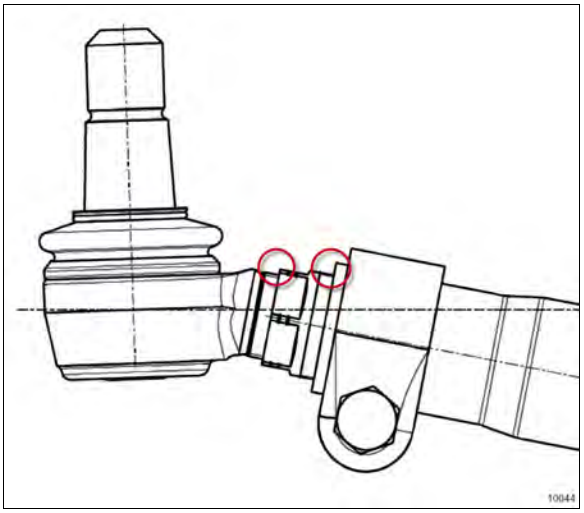


FIGURE 34:

13.8.4 Tie rod ball joint inspection for corrosion

MAINTENANCE

Inspect tie rod ball joints for corrosion once a year.

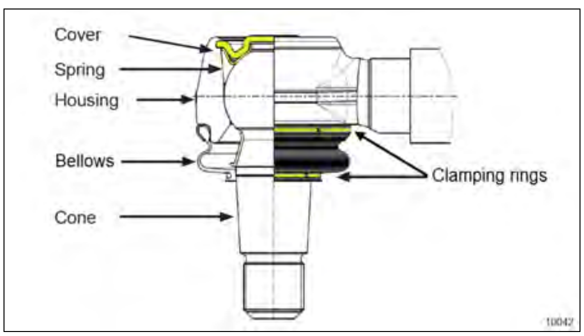


FIGURE 35: TIE ROD BALL JOINT CONSTRUCTION

1. Carefully clean the sealing boot contact area to ensure that no contaminants can get under the sealing bellows during the inspection procedure. Do not use cleaning agents or solvents, only use dry cloth or cotton wool.
2. **Housing:** The housing must not show any signs of deep rusting (depth of no more than approx. 1mm). Pay particular attention to the roll edge and cover, they must be rust free.

   Clean corrosion on the axle steering lever contact faces also.
3. **Bellows**: They must be in perfect condition to protect from corrosion. Squeeze the bellows by hand and make sure no grease is expelled from the opening. Make sure the bellows is in good condition, without any holes, tears, scratches of chafing marks. Replace the joint if inspection result is not OK.

   Tension rings and clamping rings must be well seated in their groove.

   It must always be possible to turn the bellows on the housing by hand (do not use any tools). Hold the bellows in the area of the clamping ring and turn with a lot of manual force. Replace the tie rod if the result is not OK.

13.9 DRAG LINK BALL JOINT 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 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 inspection procedure. Do not use cleaning agents or solvents, only use dry cloth or cotton wool.
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.
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 with Lithium grease and push seal back into its properly seated position.

When dismantling the drag link, ensure that no damage is caused to the sealing boots, dirt seals or ball joint housings.

13.10 STRAIGHT BODY TYPE BALL JOINT

This type includes ball joints where the threaded shank is slightly bent like those that are found on the tie rod and draglink.

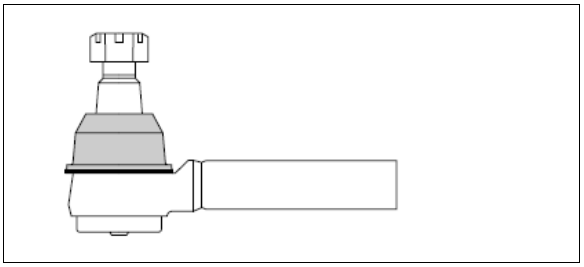


FIGURE 36: STRAIGHT BODY TYPE BALL JOINT

13.10.1 Visual Inspection

- Visually inspect for missing or damaged grease fittings and replace if required.
- Damaged sealing boot or improper sealing requires seal replacement or complete replacement.
- Check ball joint connection for missing cotter pins.
- Check for looseness in the ball/socket assembly.

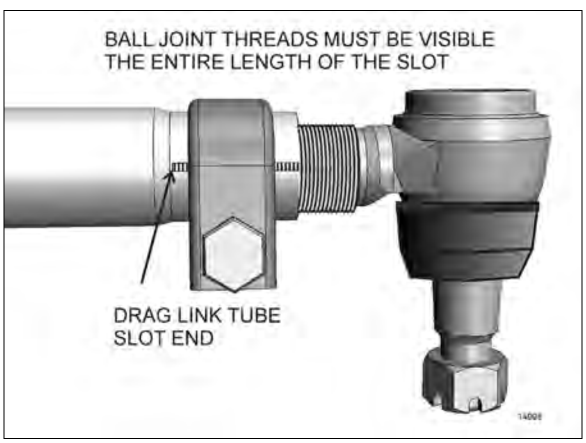


FIGURE 37: ADEQUATE CLAMPING CONDITION

For adequate clamping, the ball joint threads must be visible the entire length of the tube slot. If not, the tube 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 components).

No heavy corrosion is accepted for the clamps or screws.

Nuts and screws must be firmly in place.

13.10.2 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 will require the replacement of the ball joint.**

> **CAUTION**
>
> Do not use a wrench or other object to apply leverage when inspecting ball joint. Applying leverage with tools can give distorted results and damage components.

14 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.*

15 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.

15.1.1 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.

15.1.2 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 15.1.1, *"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.

15.1.3 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 15.1.1, *"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 15.1.7 "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.

15.1.4 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:

15.1.5 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 paragraph 13.5)

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.

15.1.6 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.

15.1.7 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"* found on your Technical Publications USB flash drive, under heading *Setting and Functional Test*

15.1.8 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 (Figure 38).

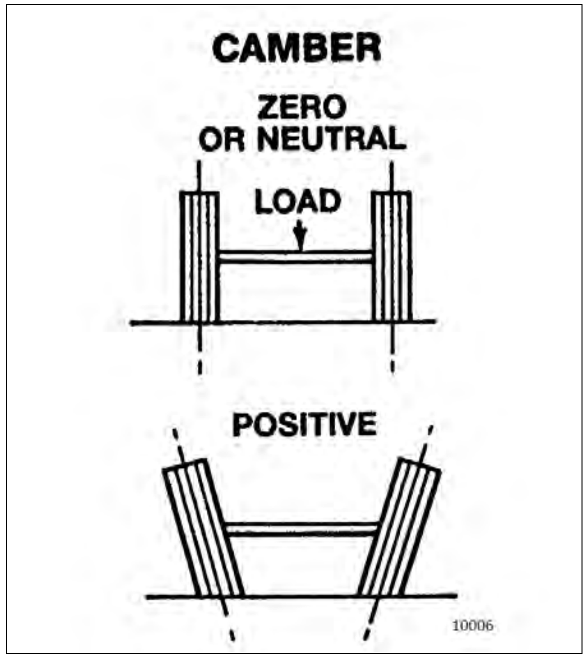


FIGURE 38: CAMBER

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.

15.2 CAMBER CHECK

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 specifications, verify the steering knuckle pins and axle center.
3. See instructions in “DANA SPICER Maintenance Manual Model NDS and Maintenance Manual NDS Axles”.
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).

15.2.1 Front Axle Caster

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 (Figure 39). 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).

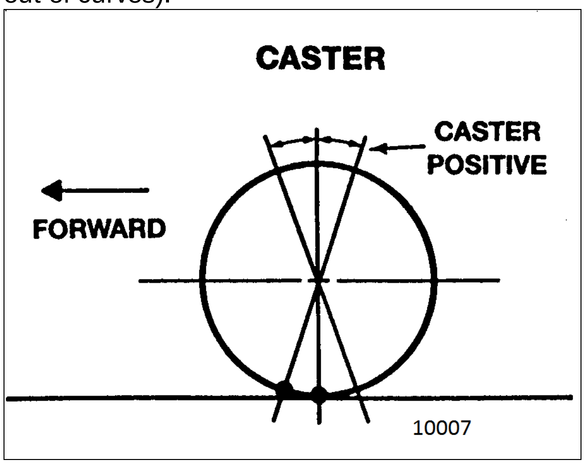


FIGURE 39: CASTER

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.

15.3 FRONT WHEEL TOE-IN

Wheel toe-in is the degree (usually expressed in fractions of an inch) where 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 Figure 40).

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

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

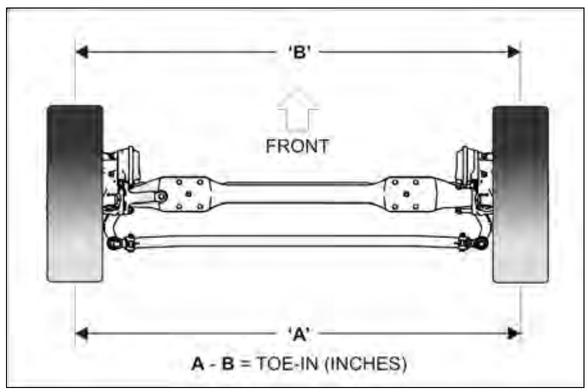


FIGURE 40: TOE-IN MEASUREMENT

For toe-in specifications, refer to the FRONT WHEEL ALIGNMENT SPECIFICATIONS table 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.

15.3.1 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 on the right hand (curb side) tie rod end where the adjuster sleeve is located.
   b. Turn the adjuster sleeve (Figure 41) until the specified toe-in measurement is obtained.
   c. Tighten the pinch bolt nuts

      TORQUE: 118-133 lb-ft (160-180 Nm)

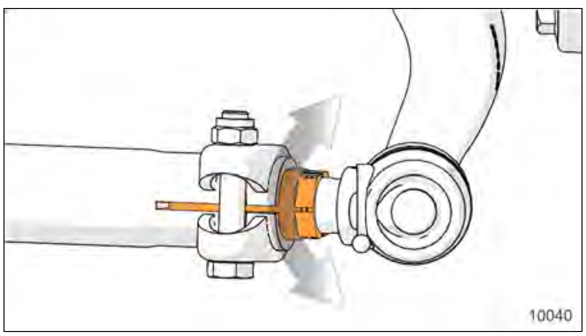


FIGURE 41: FINE ADJUSTER SLEEVE ON TIE ROD

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	**Minimum**	**Nominal**	**Maximum**
Camber R.H. and L.H. (degrees)	-0.250	0.125	0.375
Caster R.H. and L.H. (degrees)	2	2.75	3.5
Total toe (A minus B) (degrees)	0.04	0.06	0.08

16 TROUBLESHOOTING

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

17 SPECIFICATIONS

Power Steering Gear

Make ....ZF/ROBERT BOSCH-SERVOCOMTRONIC
Type ....Speed Sensitive
F.E.W..16,600 lbs (7 545 kg)
Pressure rating ....2,175 psi (150 Bar)
Gear ratio (center) ....22.2 : 1
Gear ratio (extremities) ....26.2 : 1
Minimum pump flow for 1.5 hwt/sec..4.22 gpm (16 lpm)

Power steering tank

Oil capacity ....1.6 US qts (3.17 pt)

Steering Stabilizer Cylinder (Damper)

Extended length ....32.73±0.12"
Collapsed length..20.26±0.12"
Stroke..12.47±0.12"

Front I-Beam Axle

Make ....DANA SPICER EUROPE
Model S84U
Front Track..84.4 inches (2 145 mm)
Rated load capacity ....16,500 lbs (7 500 kg)

MAINTENANCE INFORMATION

MI19-05A

DATE : February 2019	SECTION : 14 STEERING
SUBJECT : **660865, 660699 DRAGLINK ADJUSTMENT**	

Revision: A Added X3-45 commuter & US built vehicles 2019-02-28

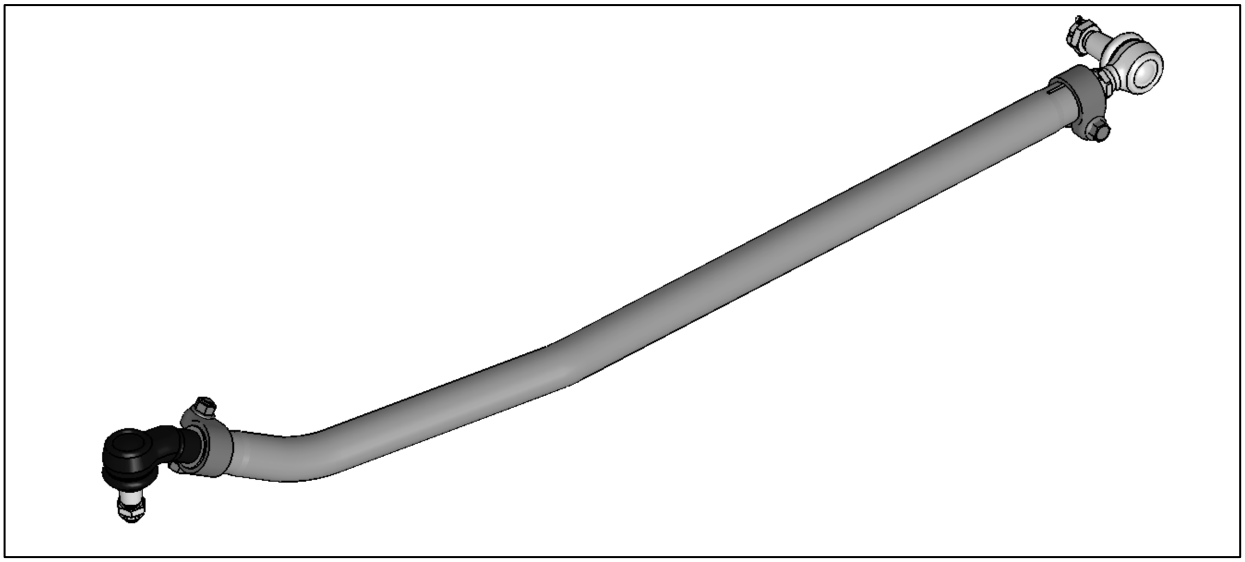
IMPORTANT NOTICE
This modification is recommended by Prevost to increase your vehicle's performance. Note that no reimbursement will be awarded for carrying out this modification.

APPLICATION

Model	**VIN** 
H3-41, H3-45 coaches Model Year : 2014 -	From 2PCH3349X**E**C71**2505** up to …
X3-45 coaches Model Year : 2014 -	US built from: 4RKG33495**F**973**7000** up to …
	Canadian built from: 2PCG33497**E**C73**5526** up to …
X3-45 Commuter Model Year : 2017 -	US built from: 4RKJ33498**H**973**7386** up to …
	Canadian built from: 2PCJ33493**J**C73**6317** up to …

DESCRIPTION

For vehicles equipped with I-beam axles, follow these instructions to adjust the length of the draglink. This applies to model year 2014 and onward.



MATERIAL

H series

Part No.	Description	Qty
660865	DRAG LINK ASSEMBLY, H SERIES	1
502104	COTTER PIN 5/32 X 2	1

X series

Part No.	Description	Qty
660699	DRAG LINK ASSEMBLY, X SERIES	1
502104	COTTER PIN 5/32 X 2	1

Other parts that may be required, depending on condition

Part No.	Description	Qty
660018	COLLAR ASSY / W/BOLT & NUT	2

NOTE
Material can be obtained through regular channels.

PROCEDURE

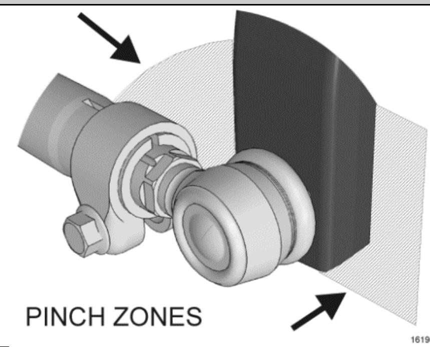
⚠ CAUTION
CONFORM TO THE PRESCRIBED TORQUES AND FOLLOW ASSEMBLY GUIDELINES TO ENSURE VEHICLE SAFETY.

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

PINCH HAZARD

Keep hands and fingers clear of pinch zones around pitman arm.

Pinch zones are between pitman arm and clamp, and between front of pitman arm and vehicle structure.



REMOVAL OF EXISTING DRAG LINK

CAUTION

Heating of components to aid in disassembly is not allowed because it has a detrimental effect on axle components and steering linkages.

CAUTION

Do not drive (hammer in) pitman arm on or off pitman shaft as this can damage the steering gear.

1. Raise the vehicle by the wheels using mobile column lifts. Doing so will prevent a change in direction of the knuckles and preserve the relative positions of the steering components involved i.e. the steering arm and the pitman arm.
2. Remove cotter pin and nut from drag link ball joint stud at pitman arm.
3. Disconnect drag link from pitman arm, using jaw style pullers (pressure screw type).
4. Remove cotter pin and nut from drag link ball joint stud at the steering arm (near knuckle) and then disconnect the drag link.

ADJUSTING THE DRAG LINK TO PROPER LENGTH - ELBOW BALL JOINT (KNUCKLE SIDE)

5. Adjust the length of the draglink. To do so, try to install it between the steering arm and the pitman arm. If the length is not adequate, it must be adjusted to the required length. Use dimension “A” and steps below to adjust the length of the replacement drag link or you may use the replaced drag link for length reference.

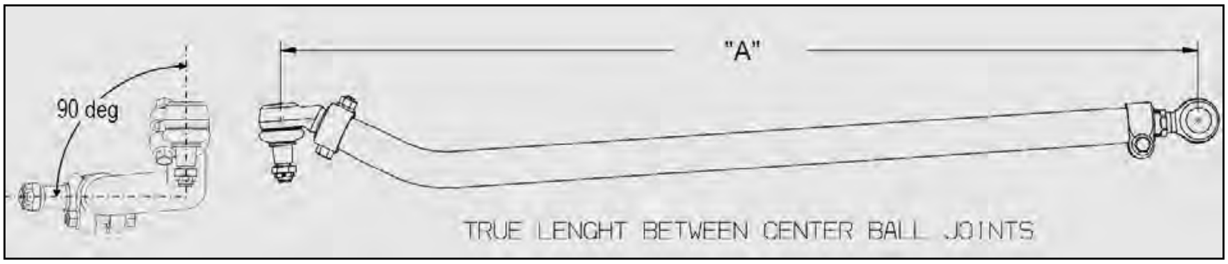


FIGURE 1: HSERIES LENGTH

H Series: Length A = 55” 7/8”± 1/16” (1420mm ± 2mm)

X Series: Length A = 53” 3/8”± 1/16” (1356mm ± 2mm)

6. Screw the drag link <u>elbow ball joint</u> (knuckle side) <u>fully</u> in drag link tube.

FIGURE 2

7. Unscrew the *drag link elbow* ball joint by **(not more than 1 turn)** so the tapered shank *points down* as shown on FIGURE 3.
   This will be the *initial / reference* position for next step.

FIGURE 3

8. Next, unscrew the *drag link elbow* ball joint back out.

   H Series: **Five (5) full turn** from the *initial / reference* position.

   X Series: **One (1) full** turn from the *initial / reference* position.

The tapered shank must point down as shown on (FIGURE 4).

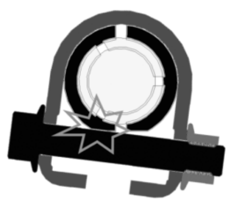
FIGURE 4

9. To prevent interference between the ball joint clamp bolts and other components of the steering system, the clamp bolt must be positioned vertically as shown on FIGURE 6. **Tighten the clamp nut to 118-133 lbf-ft**.

CAUTION

Do not re-use clamp hardware.

Bolt <u>and</u> nut should be replaced every time they are unscrewed. While assembling the clamp, make sure the bolt <u>does not touch</u> the drag link tube.



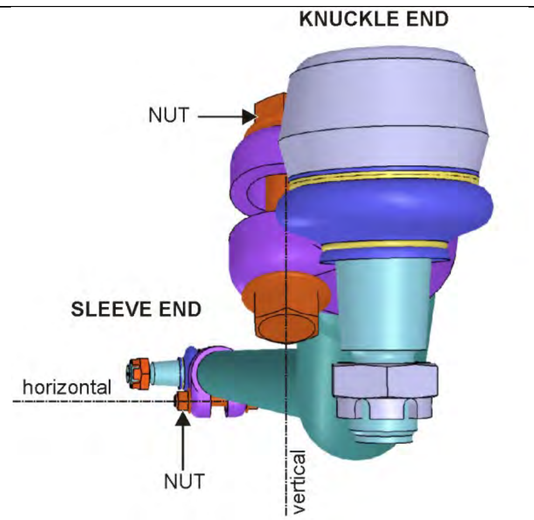


FIGURE 5: NOTE THE VERTICAL ORIENTATION OF THE CLAMP BOLT AT THE KNUCKLE END AND ON WHICH SIDE THE NUT MUST BE POSITIONED

SLEEVE ADJUSTMENT PARAMETERS

10. On the drag link front end you will find an adjustment sleeve which has internal and external left and right threads.

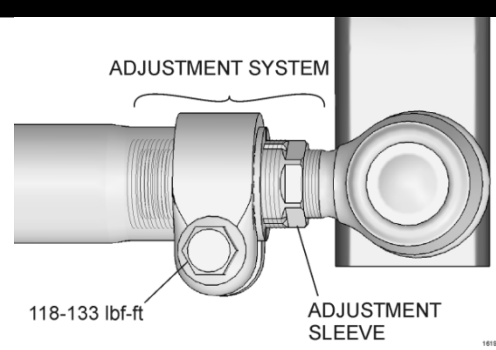


FIGURE 6

11. Fine adjustment of the drag link length if required should be performed exclusively by turning the adjustment sleeve while preventing the tube and joint from rotating.

The only part rotating should be the sleeve

- To extend, turn the sleeve clockwise.
- To retract, turn counter clockwise.

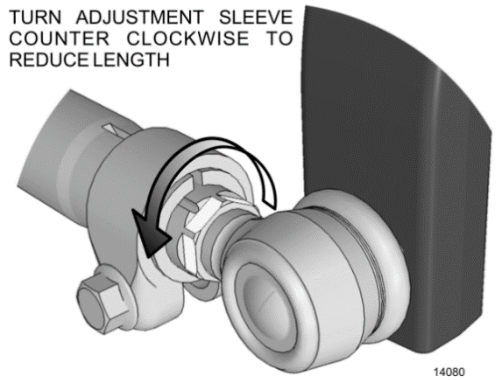


FIGURE 7

GENERAL LIMITATIONS OF THE ADJUSTMENT SLEEVE

Do not exceed the following maximum thread lengths and values.

- Max dimension **V** : 5/8" (16mm) ± 1 thread pitch
- Max dimension **W** : 5/8" (16mm) ± 1 thread pitch
- Max dimension **X** : 1" (25mm)
- Dimension **V** and **W** should be equal (V/W = 1)

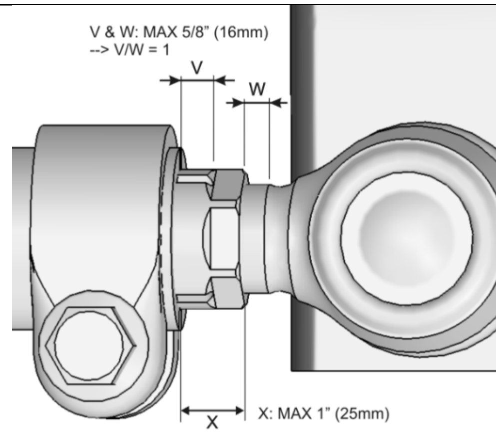


FIGURE 8

SLEEVE ADJUSTMENT

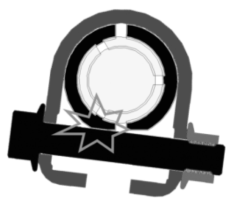
12. Adjust sleeve to the values of FIGURE 10.

    10/32"=8mm

13. Once the proper length adjustment is done, tighten the sleeve end ball joint clamp. To prevent interference between the ball joint clamp bolts with other components of the steering system, the clamp bolt must be positioned horizontally as shown on FIGURE 11. **Tighten the clamp nut to 118-133 lbf-ft**.

CAUTION

Do not re-use clamp hardware.



Bolt and nut should be replaced every time they are unscrewed. While assembling the clamp, make sure the bolt does not touch the drag link tube.

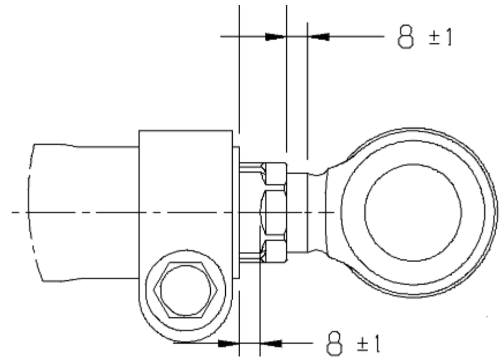


FIGURE 9

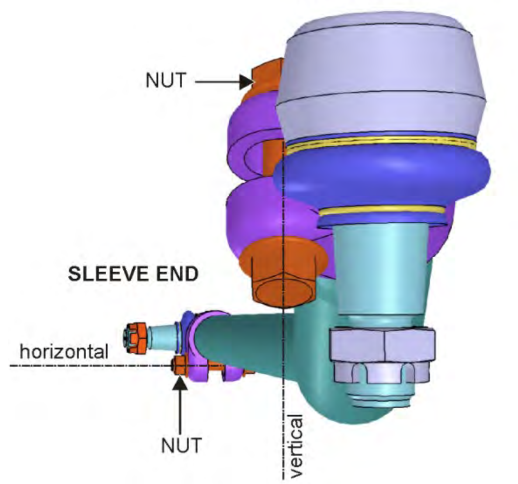
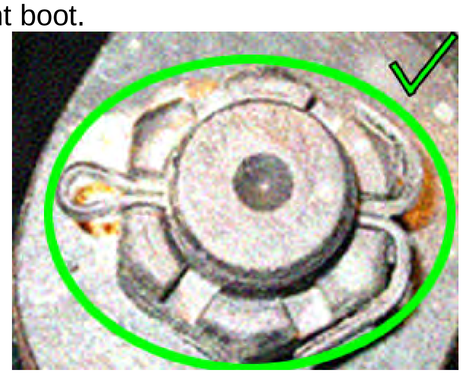


FIGURE 10: NOTE THE HORIZONTAL ORIENTATION OF THE CLAMP BOLT AT THE SLEEVE END AND ON WHICH SIDE THE NUT MUST BE POSITIONED

DRAG LINK INSTALLATION

14. Install the drag link.
15. Ball joint castellated nut on both ends should be tightened to **150-200 lbf-ft**.
16. Install cotter pin **p/n 502104** and bend to lock bolt in place (see an example of a correct installation of a cotter pin on the image below).
17. Apply a small amount of anti-seize compound on all exposed threads for corrosion protection. Be sure to avoid smearing the ball joint boot.



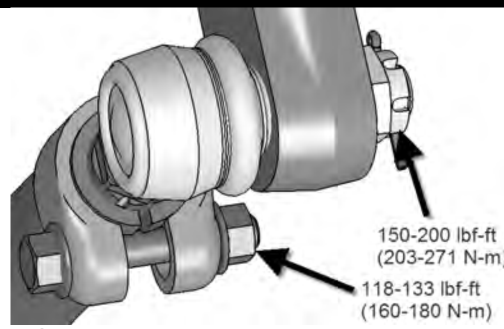


FIGURE 11

18. Make sure there is no binding or interference of the draglink with the vehicle structure by turning wheels fully in each direction. Min gap: 1/4” (6mm)
19. Inspect the gap between *tire* and *draglink* turning wheels *right*: Min gap 3/8” (9.5mm).

PARTS / WASTE DISPOSAL

Discard according to applicable environmental regulations (Municipal/State[Prov.]/ Federal)

Access all our Service Bulletins on http://techpub.prevostcar.com/en/
Or scan the QR-Code with your smart phone

Are you a Vehicle owner?
*E-mail us at **technicalpublications_prev@volvo.com** and type “ADD” in the subject to receive warranty bulletins applicable to your vehicle(s) by e-mail.*

PREVOST

Instruction Sheet IS-20913A

POWER STEERING 20 ft STAINLESS STEEL PIPE REPAIR PROCEDURE

This instruction sheet is applicable to the following:

DOB Bus Number Series 1300 – 1606: power steering pipe #160089

Revision A	Addition of ORS plug in Other Material	**Apr-24-2020**

MATERIAL

Abutment repair:

Part No.	Description	Qty
501157	ORS-TF REPAIR KIT FF90146-10S *1x ORS-TF NUT FC1851-10S* *1x ORS-TF FERRULE FF90102-10S* *1x ORS-TF SLEEVE FF90103-10S*	1
501156	ORS-ORS ADAPTER #10 MALE/#10 MALE FF2000T-1010S	1
507023	O-RING, HIGH TEMP (spare)	2

Along the pipe repair:

Part No.	Description	Qty
501157	ORS-TF REPAIR KIT FF90146-10S *1x ORS-TF NUT FC1851-10* *1x ORS-TF FERRULE FF90102-10* *1x ORS-TF SLEEVE FF90103-10*	2
501156	ORS-ORS ADAPTER #10 MALE/#10 MALE FF2000T-1010S	1
507023	O-RING, HIGH TEMP (spare)	2

NOTE
Material can be obtained through regular channels.

OTHER MATERIAL	
EATON AEROQUIP ORS PLUG FF9767-10S 	Qty: 2
TORQUE SEAL	
OIL DRAIN PAN	
MOBIL DEXRON-VI ATF (AUTOMATIC TRANSMISSION FLUID)	As required

TOOLS TO BE USED	
HACKSAW or CUTTING WHEEL & POWER TOOL  	
ADJUSTABLE HEAVY-DUTY WRENCH 	**RATCHET AND SOCKET SET – METRIC/SAE** 
TORQUE WRENCH 	**1-1/8 TORQUE WRENCH CROWFOOT ADAPTER** 
OPEN END WRENCH SET **1-1/8, 1-1/16** 	PAIR of **LOW PROFILE JACK STANDS** with **POSITIONING HANDLE** 
STAINLESS STEEL PIPE REAMER – INNER/OUTER 	**CARBIDE BURRS & POWER TOOL** 

PERSONAL PROTECTIVE EQUIPMENT

Wear your personal protective equipment, including but not limited to the followings:

Safety shoes

Safety goggles

General purpose gloves

DANGER

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

DANGER

Wear protective glasses when striking objects to avoid injury to your eyes. Chips or other debris can fly off objects that are struck. Make sure no one can be injured by flying debris before striking any objects.

PROCEDURE

DANGER

Park vehicle safely, apply parking brake, stop the engine. Prior to working on the vehicle, set the ignition switch to the OFF position and trip the main circuit breakers equipped with a trip button. On Commuter type vehicles, set the battery master switch (master cut-out) to the OFF position.

Lock out & Tag out (LOTO) must be performed during set-up, maintenance or repair activities. Refer to your local procedure for detailed information regarding the control of hazardous energy.

The ORS-TF tube fitting utilizing the ORS-TF nut, ferrule and sleeve can be joined directly to steel tubing. It provides the advantage of repetitive use. It is a compression type fitting.

ABUTMENT TUBE REPAIR

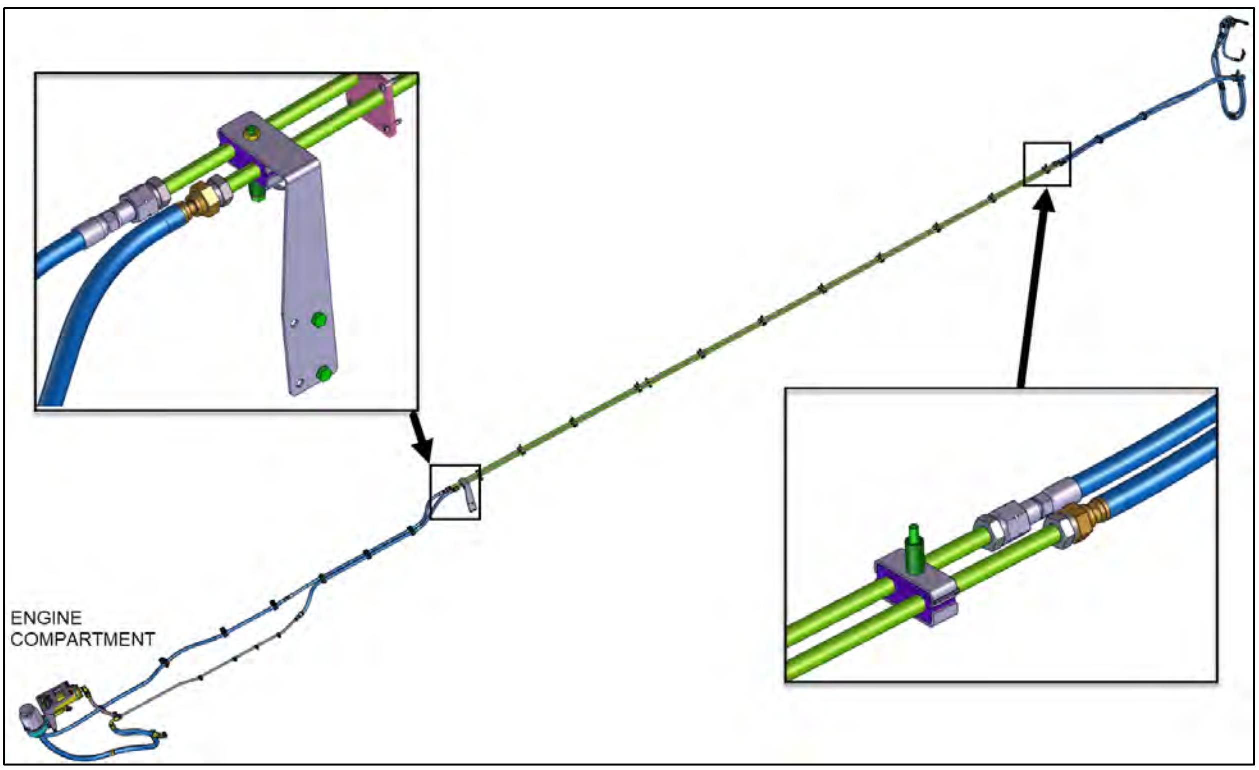


FIGURE 1

1. The power steering pressure and return pipes (green pipes on Figure 1) measure 20 ft long and are made of stainless steel. They are 5/8 OD.
2. To prevent skin burns, make sure that steering fluid has sufficiently cooled before starting the next steps.

3. Disconnect the blue power steering hoses at each end of the defective pipe. Have a container, as power steering fluid will drip from the pipe and hose.
4. Plug each blue hose with an ORS plug FF9767-10S.
5. Purge the stainless steel pipe using pressurized air.
6. Locate the defective fitting at the end of the pipe. Cut the tubing squarely (±1°) close to the fitting. Use a hacksaw or abrasive cutting wheel.

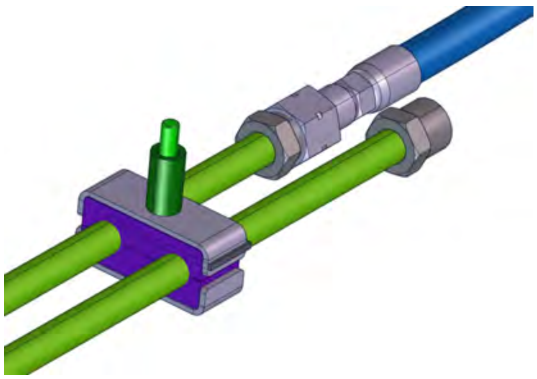


FIGURE 2: ABUTMENT REPAIR – BEFORE CUT

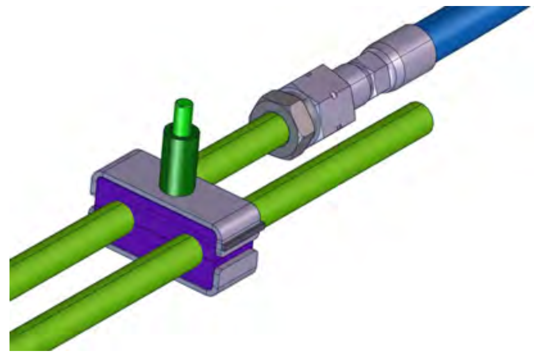


FIGURE 3: ABUTMENT REPAIR - AFTER CUT

7. Using one ORS-TF REPAIR KIT #501157 and one ORS-ORS ADAPTER FF2000T-1010S #501156, install the replacement fitting as described in section **ASSEMBLY INSTRUCTION ORS-TF TUBE FITTING**.
8. Connect the blue power steering hoses to the pipe. Tighten hose fitting to a torque of: **46-50 lbs-ft**. Apply a **torque seal** mark across the fitting.
9. Refill the power steering system and bleed. Refer to the appendix A at the end of this document.

ALONG THE PIPE REPAIR

1. The power steering pressure and return pipes (green pipes on Figure 1) measure 20 ft long and are made of stainless steel. They are 5/8 OD.
2. To prevent skin burns, make sure that steering fluid has sufficiently cooled before starting the next steps.
3. Disconnect the blue power steering hoses at each end of the defective pipe. Have a container, as power steering fluid will drip from the pipe and hose.
4. Plug each blue hose with an ORS plug FF9767-10S.
5. Purge the stainless steel pipe using pressurized air.
6. Locate the puncture on the pipe (Figure 4). Have a clean container, as power steering fluid will drip from the pipe once cut. DO NOT REUSE this fluid.
7. Cut the tubing squarely (±1°) both sides of the puncture. Use a hacksaw or abrasive cutting wheel.

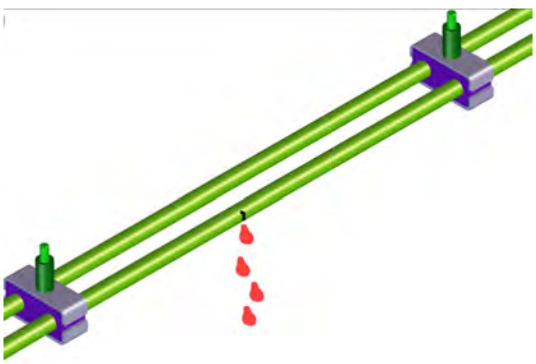


FIGURE 4: ALONG THE PIPE REPAIR - BEFORE CUT

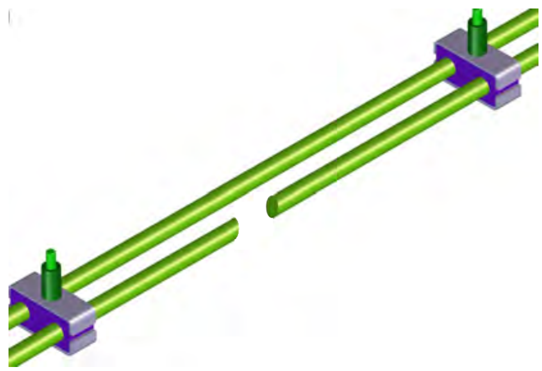


FIGURE 5: ALONG THE PIPE REPAIR - AFTER CUT

8. Loosen all the pipe and hose clamps (Figure 6) from the cut up to the front of the vehicle.

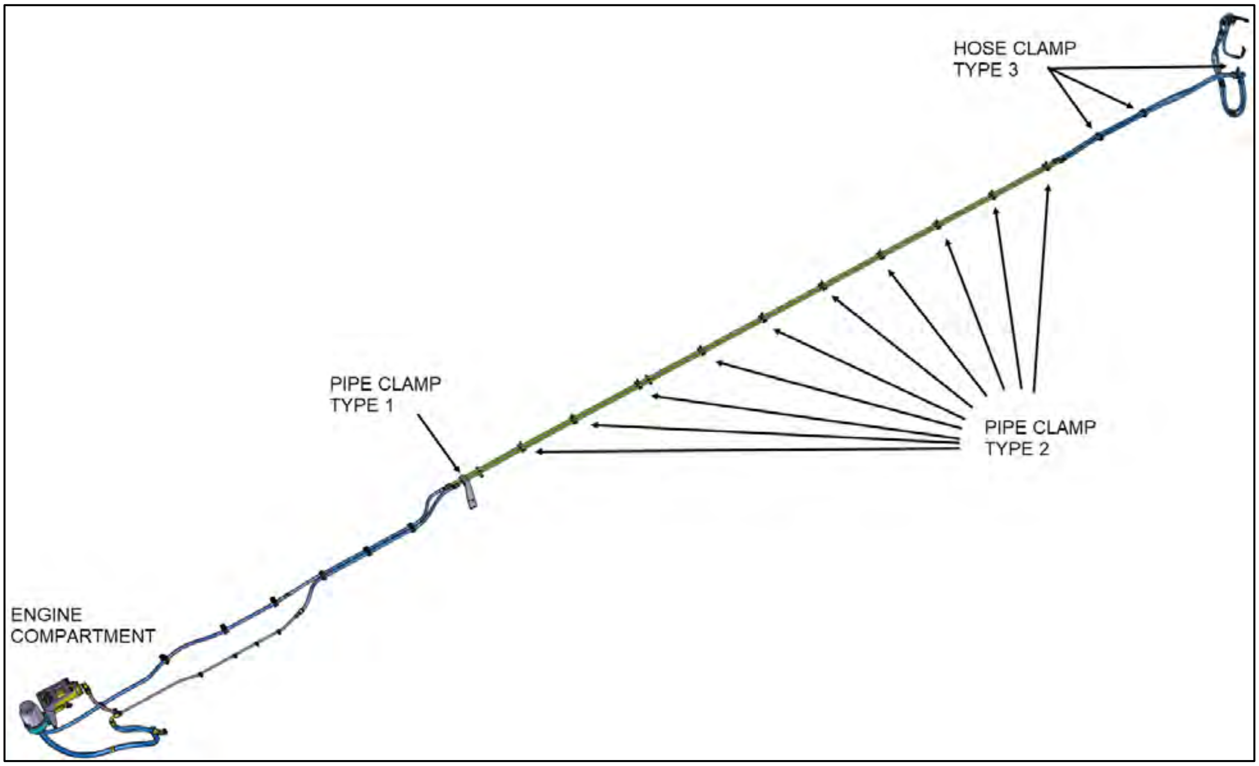


FIGURE 6: PIPE CLAMPS LOCATION & TYPE

9. Using two ORS-TF REPAIR KIT #501157 and one ORS-ORS ADAPTER FF2000T-1010S #501156, install the repair fittings as described in section **ASSEMBLY INSTRUCTION ORS-TF TUBE FITTING**.
10. At the front of the vehicle, pull on the blue power steering hose to take up the slack as the ORS-ORS adapter adds 43 mm to the total length of the line.
11. Tighten all the pipe & hose clamps previously loosen. See Figure 7 to Figure 9 for appropriate torque. Add a **torque seal** mark once properly tighten.

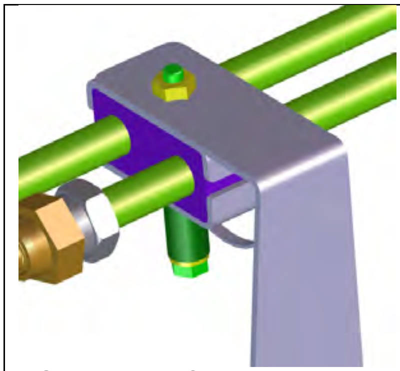


FIGURE 7: PIPE CLAMP TYPE 1
Torque 13 lbf-ft

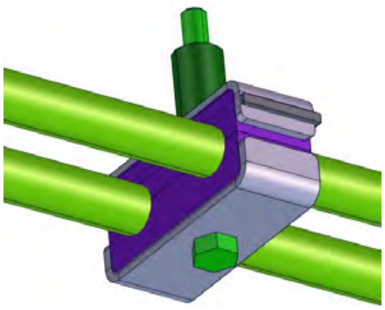


FIGURE 8: PIPE CLAMP TYPE 2
Torque 13 lbf-ft

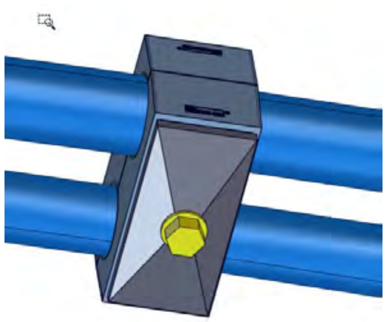


FIGURE 9: HOSE CLAMP TYPE 3
Torque 8 lbf-ft

12. Refill the power steering system and bleed the system. Refer to the appendix A at the end of this document.

FIGURE 10

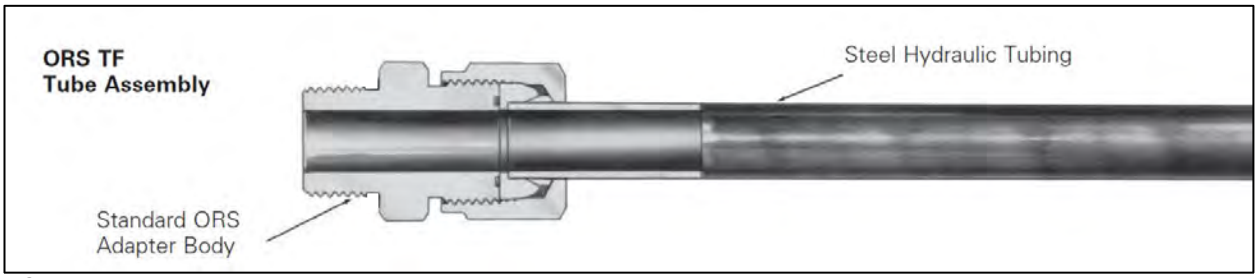


FIGURE 11: ABUTMENT REPAIR

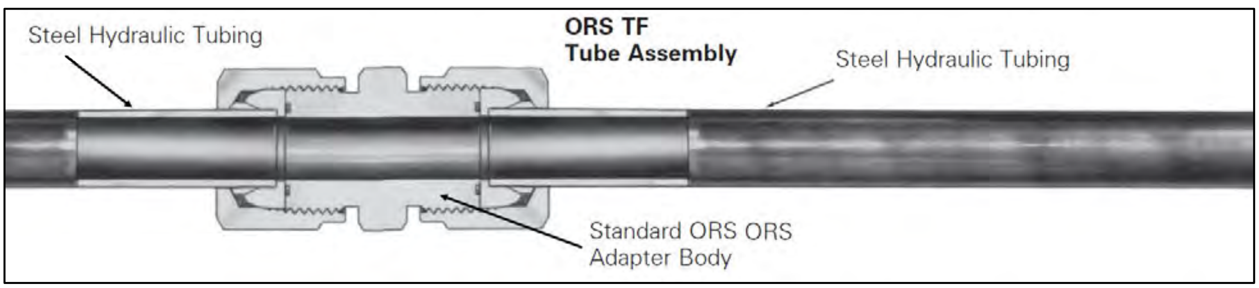


FIGURE 12: ALONG THE PIPE REPAIR

1. Inspect the tubing to insure that no scratches, gouges, burrs or other surface defects like welding bead are present.
2. Cut the tubing squarely (±1°). Use a hacksaw or abrasive cutting wheel.
3. Deburr the tube end with a deburring tool or fine cut file. After deburring, be sure to remove all contaminants and dirt from the interior and exterior of the tube.

Deburring

*All cut tubes should be deburred (*Figure 13 & Figure 14*). However, deburring is even more important if the tubing was cut with a hacksaw or abrasive wheel. Remove any burrs, both internally and externally, with a deburring tool, emery paper or fine file. Clean the tube before assembly. Clean all dirt and grit from the I.D. and O.D. of the tube.*


FIGURE 13: DEBURR THE TUBE END - INNER


FIGURE 14: DEBURR THE TUBE END - OUTER

4. Inspect ORS-ORS adapter and ORS-TF components for damage. Assure sealing surfaces are free from all surface gouges, scratches, dirt and contaminants. Inspect O-ring to make sure that it is properly seated in the groove and is free from damage. Apply a thin film of compatible lubricant (clean power steering fluid) to the O-ring prior to installation.
5. Place a nut, ferrule and sleeve onto tubing, assuring that the identification groove of the ferrule is toward the nut (Figure 15). Assemble the nut to the ORS-ORS adapter until handtight with the tubing fully inserted into the fitting until bottomed out. Mark the nut in relation with the ORS-ORS adapter and tighten **1 ½ turns** with a wrench (Figure 16 to Figure 18). The ORS-TF sleeve cannot be used to preset multiple tube assemblies. It may be used once for presetting.

⚠ **CAUTION**
Tubing must be fully inserted into the fitting and the nut tightened as specified above to ensure performance and to prevent leakage and potential fitting blow-off. Excessive tightening of the nut beyond the recommended level may affect performance.

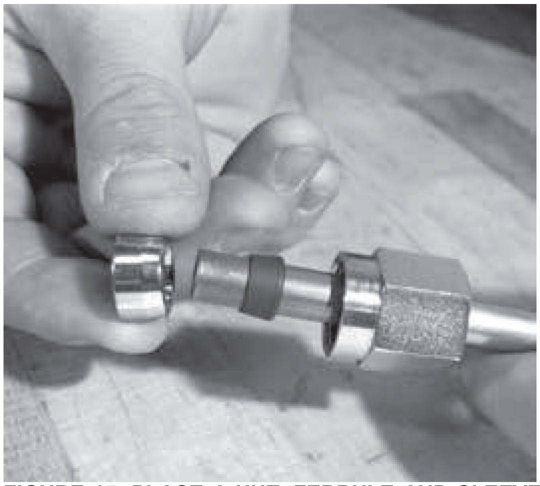


FIGURE 15: PLACE A NUT, FERRULE AND SLEEVE ONTO TUBING

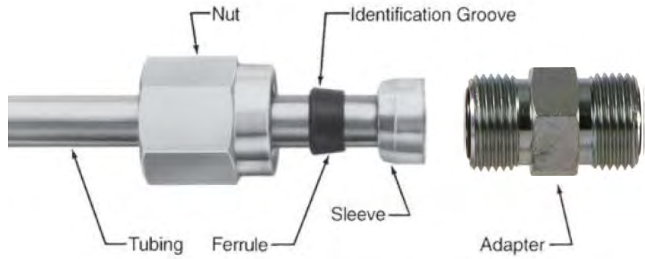


FIGURE 16

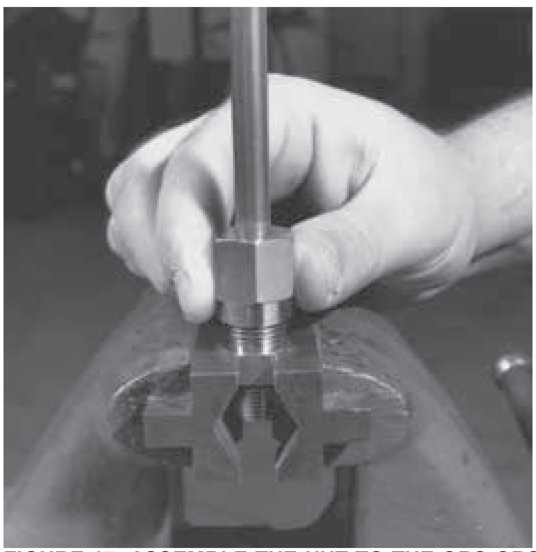


FIGURE 17: ASSEMBLE THE NUT TO THE ORS-ORS ADAPTER UNTIL HANDTIGHT (IMAGE NOT SHOWING REAL BUS CONDITION)

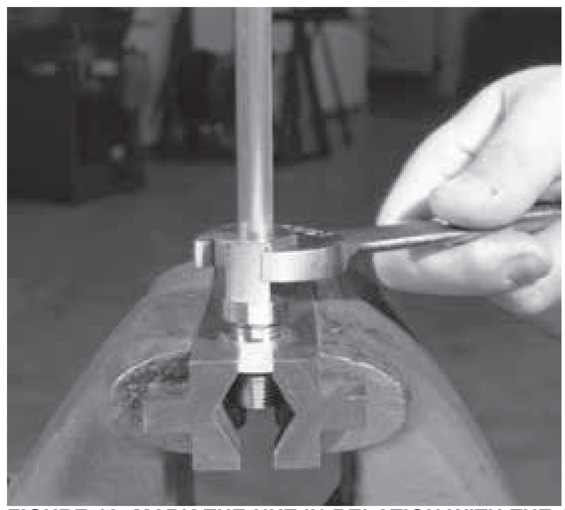


FIGURE 18: MARK THE NUT IN RELATION WITH THE ORS-ORS ADAPTER AND TIGHTEN 1 ½ TURNS WITH A WRENCH (IMAGE NOT SHOWING REAL BUS CONDITION)

6. Add a **torque seal** mark across the fittings once properly tighten.

NOTE
The ORS-TF tube assemblies are designed for re-use and can be reinstalled by tightening the nut until a sharp increase in resistance is felt (approximately 1/4 turn beyond “hand-tight”).

PREVOST

APPENDIX A

FILLING AND BLEEDING THE SYSTEM

FLUID FILLING

1. In the engine compartment, on engine curbside, remove the tank cover and place the nut on the spring to maintain normal pressure on the filter in the tank.

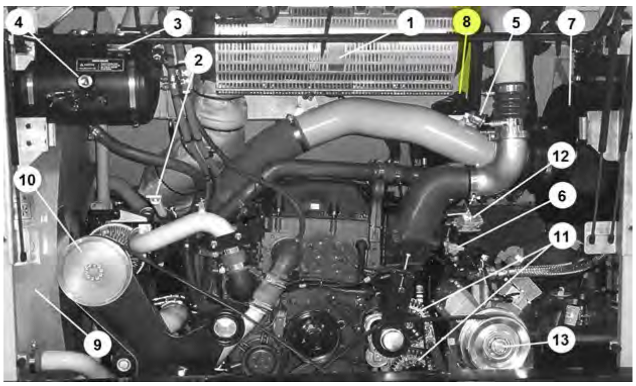


FIGURE 19: POWER STEERING FLUID TANK, ITEM 8 ON PICTURE ABOVE

2. Fill the tank with fresh Mobil Dexron-VI ATF fluid up to 2 inches from the top of the tank (only to prevent spills).

FIGURE 20: POWER STEERING FLUID TANK

3. Start the engine and have it run at idling speed to fill the steering system with fluid. During this operation, the fluid level in the tank will drop. Therefore, to avoid any suction of air, the fluid tank has to be topped up constantly.

BLEEDING

FOR STEERING GEAR VERSIONS WITH AUTOMATIC BLEEDING

Steering gear versions with automatic bleeding do not have any bleed screws. These steering gears automatically bleed any air remaining within the steering system. Proceed as follows :

a) Lift the front of the vehicle from **under the axle** so that the wheels are not on the ground and can be turned with the steering wheel.

Use a pair of low profile jack stands to support the front axle beam.

Always place safety stands when working under the vehicle. Refer to Maintenance Instruction *MI14-01B Hoisting and Towing Procedure for NYCT X3-45 Commuter Buses* for further details on lifting procedures and safe lifting practices.

b) Start the engine and have it run at idling speed for 2-3 minutes. Ask a colleague to turn the wheel from one knuckle stop to the other until the effort needed is constant, so the air will be evacuated by the steering fluid reservoir. Monitor the fluid level in the tank.

c) After bleeding, fill the tank up to 1" from the top of the tank. Check the fluid level with the dipstick.

DANGER

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

WARNING

Never attempt adjustments while the engine is running unless otherwise specified for the service procedure. To help prevent an accident caused by moving parts, work carefully around them. Guards, covers and shields should be in place whenever maintenance is not being performed. Keep objects away from moving fan blades. They will throw or cut any object or tool that falls or is pushed into them.

STEERING GEAR WITH BLEEDER/BLEEDER SCREW

Refer to paragraph **5.4.3 Bleeding** of RB Robert Bosch Servocom Service Manual (8090) available on the Technical Publications site.

https://techpub.prevostcar.com/en/download?id=352&type=publications

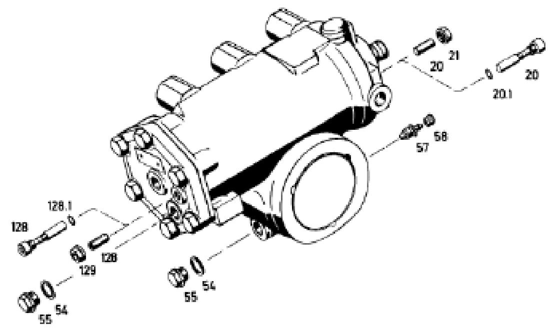


FIGURE 21 : BLEEDER (item 57) & BLEED SCREWS

1. Check the good operation of the system by performing a test drive.

PARTS / WASTE DISPOSAL

Discard waste according to applicable environmental regulations (Municipal/State[Prov.]/ Federal)

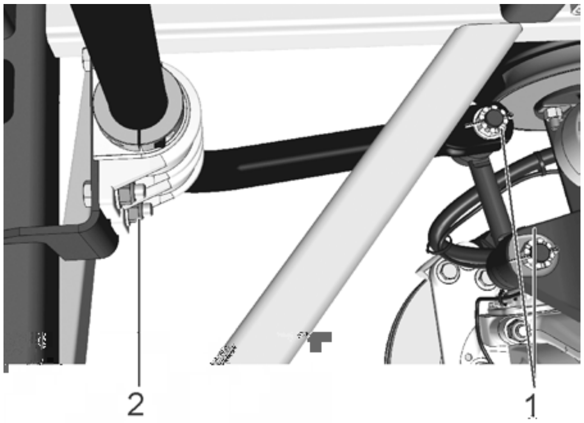
CONTENTS

SECTION CHANGE LOG

	DESCRIPTION	DATE
1		
2		
3		
4		
5		
6		

1. TORQUE TABLES

1.1 FRONT I-BEAM AXLE AND RELATED COMPONENTS



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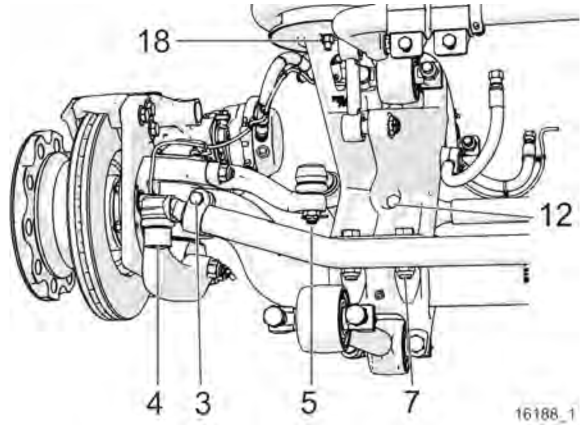

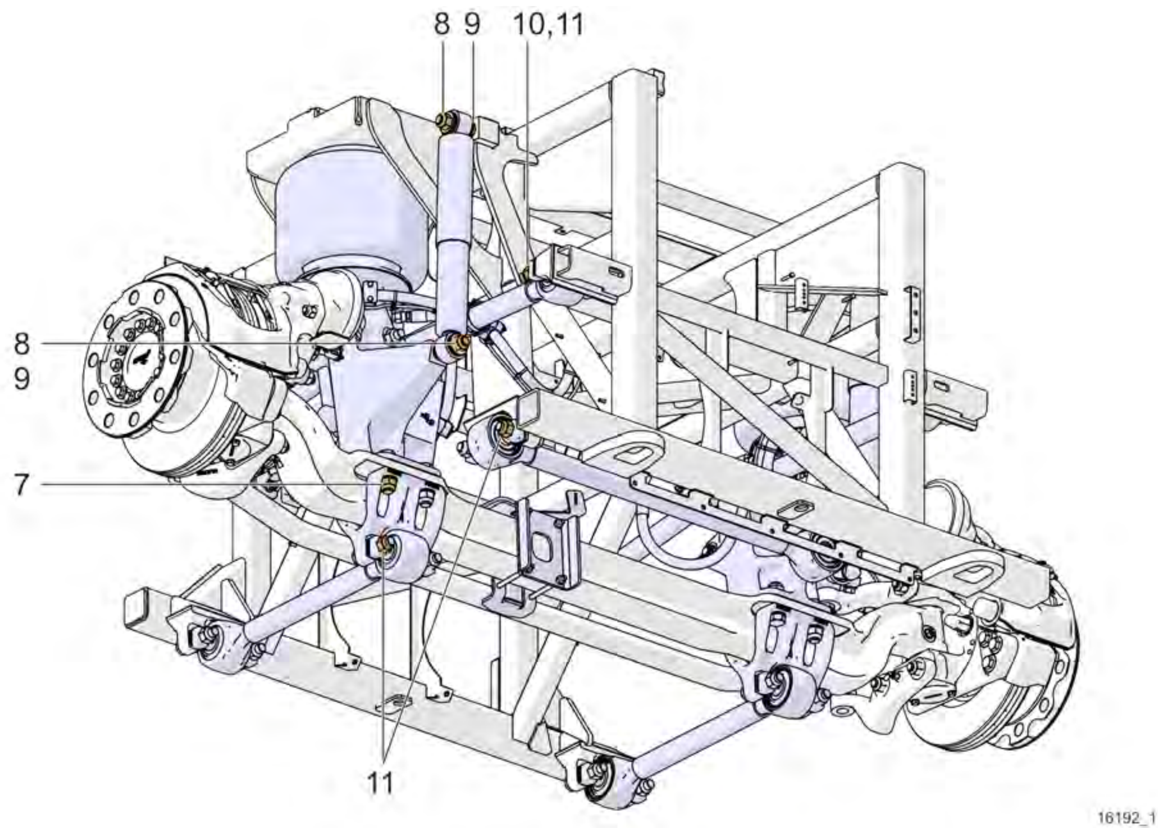

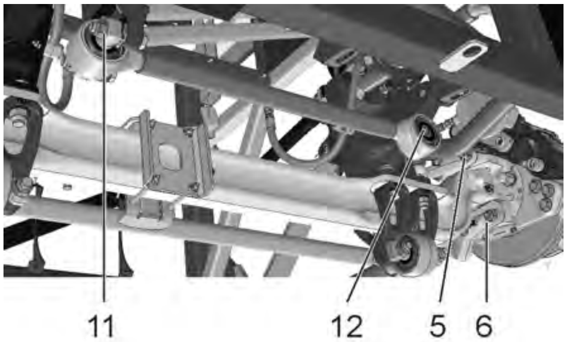

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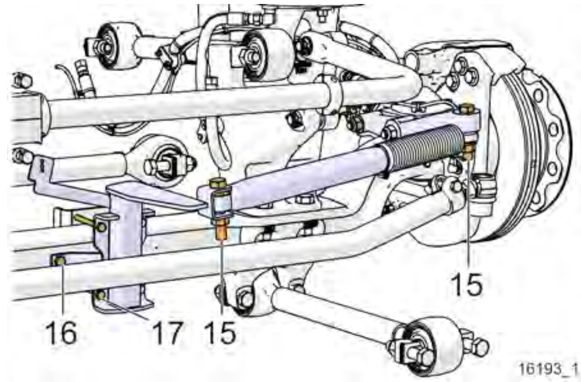
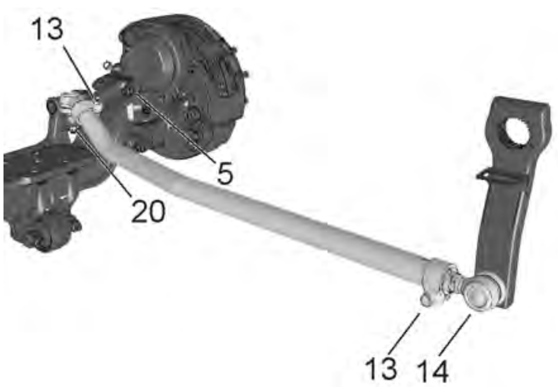


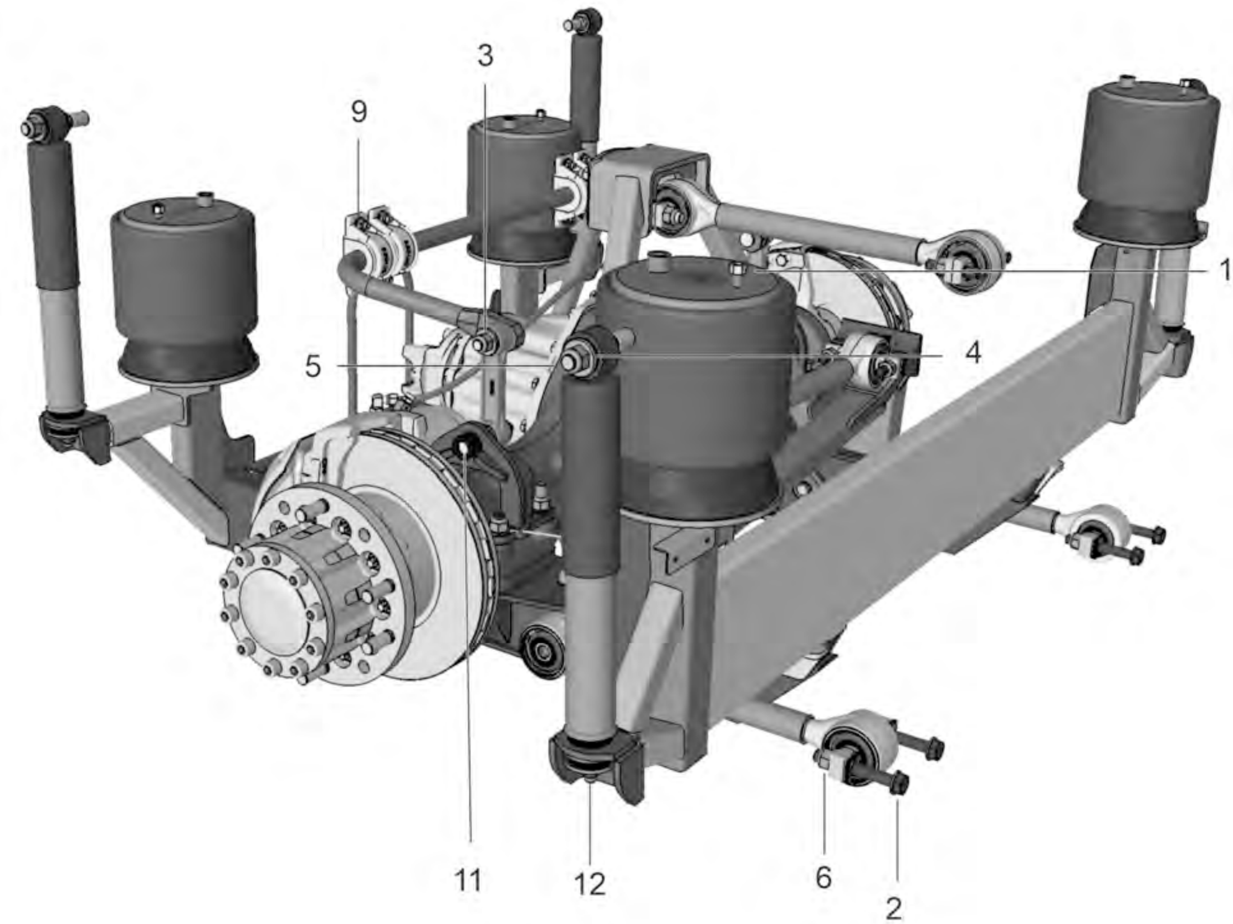


16194_1

FRONT I-BEAM AXLE			
No	DESCRIPTION	QTY	TORQUE (dry)
1	Sway bar link, upper and lower nuts	4	165-200 lb-ft (224-271 Nm)
2	Sway bar bushing collars (front suspension)	8	80-100 lb-ft (108-136 Nm)
3	Tie rod end clamp nuts	2	118-133 lb-ft (160-180 Nm)
4	Tie rod end ball pin nuts	2	155-170 lb-ft (210-230 Nm)
5	Steering arm stud nuts	2	285-315 lb-ft (386-427 Nm)
6	Tie rod arm stud nuts	4	285-315 lb-ft (386-427 Nm)
7	I-beam axle mount nuts	8	230-280 lb-ft (312-380 Nm)
8	Shock absorber upper & lower mounting nuts	2	99-121 lb-ft (134-164 Nm)
9	Shock absorber pins, upper & lower *	2	350-400 lb-ft (475-542 Nm)
10	Radius rod retaining studs	4	90-110 lb-ft (122-149 Nm)
11	Radius rod retaining nuts	18	225-255 lb-ft (305-346 Nm)
12	Transverse radius rod taper pin screw	1	206 lb-ft (279 Nm)
13	Drag link clamp bolts	2	118-133 lb-ft (160-180 Nm)
14	Drag link ball joint stud nut, fore	1	165-236 lb-ft (224-320 Nm)
15	Steering damper nuts	2	100-120 lb-ft (136-163 Nm)
16	Steering damper bracket bolt	1	39-45 lb-ft (53-61 Nm)
17	Steering damper bracket nuts	4	30-36 lb-ft (41-49 Nm)
18	Air spring nut	4	25 lb-ft (34 Nm)
19	Steering damper arm nuts	2	285-315 lb-ft (386-427 Nm)
20	Drag link ball joint stud nut, aft	1	140-200 lb-ft (190-271 Nm)

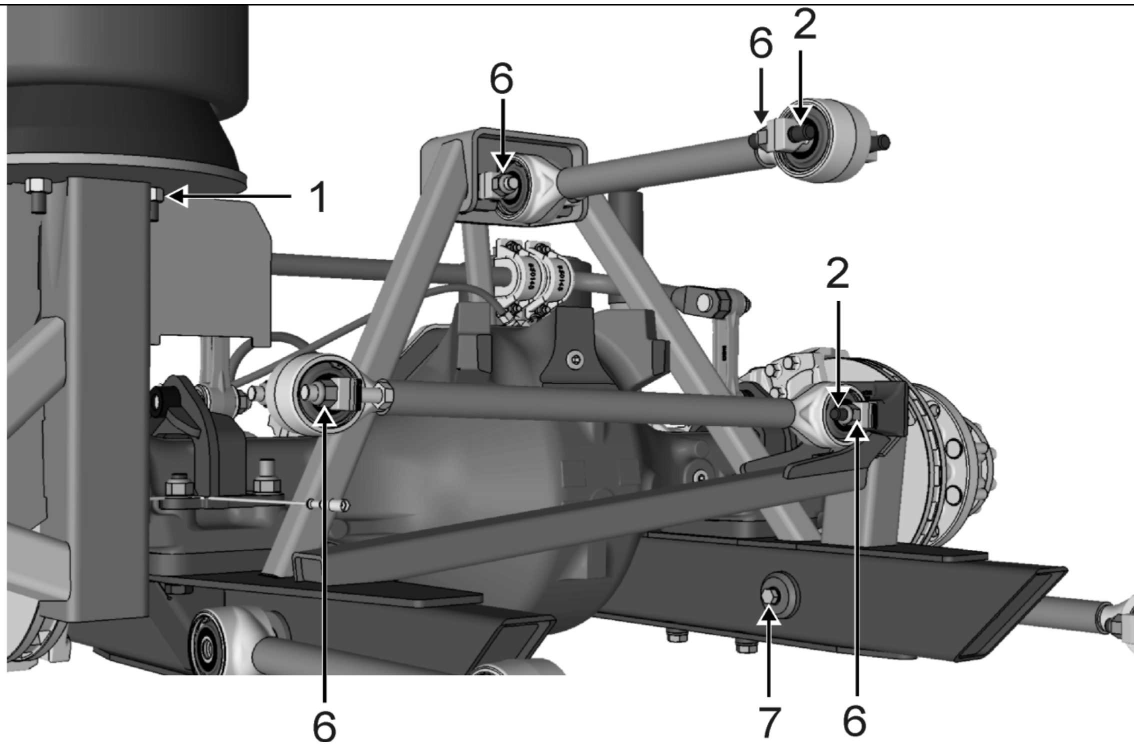
* Use medium strenght thread locker on threads (Loctite 243 or equivalent)

1.2 REAR SUSPENSION



16206: ZF drive axle

16159_B



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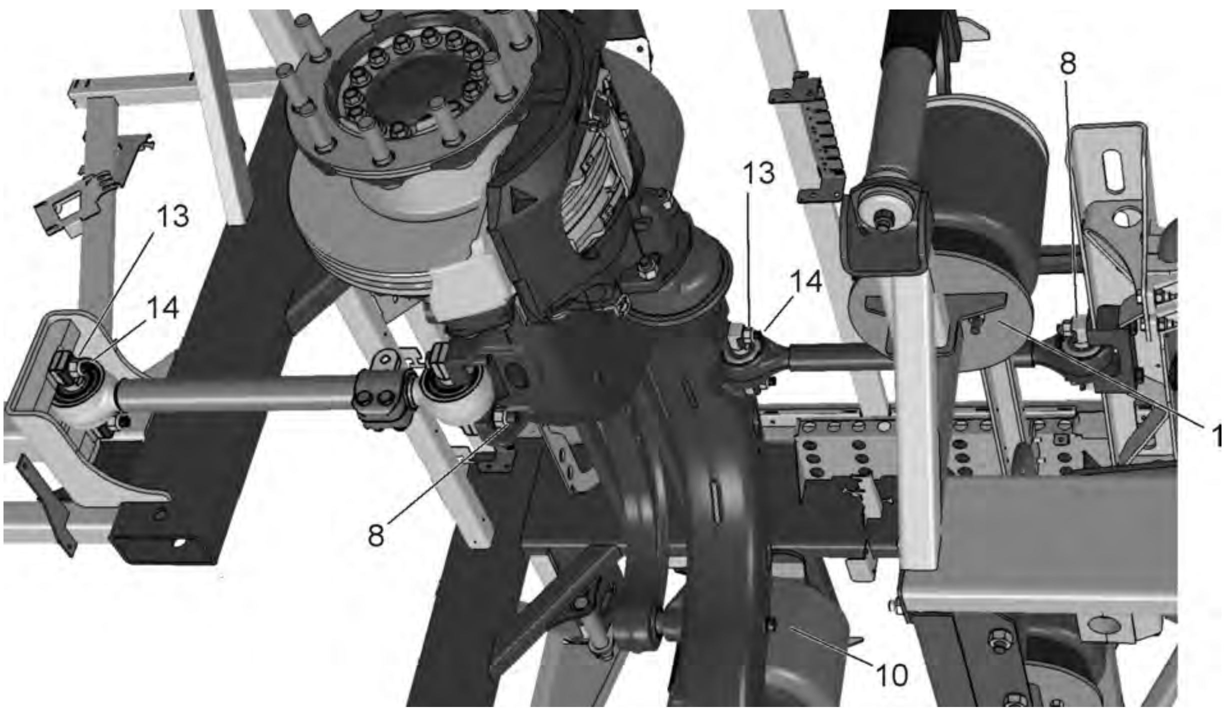

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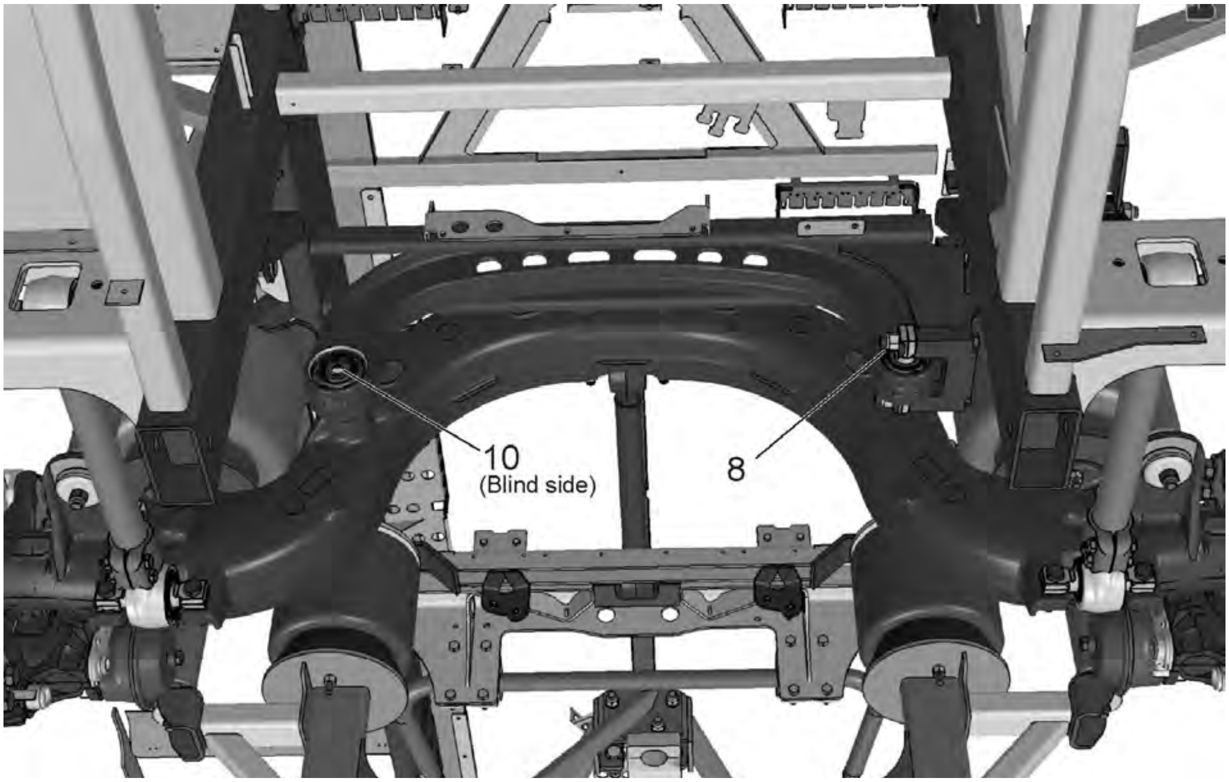


16161_B

REAR SUSPENSION			
No	DESCRIPTION	QTY	TORQUE (dry)
1	Air Spring Upper & Lower Stud Nut	*12*	31-38 lb-ft (42-52 Nm)
2	Drive & Tag Axle Radius Rod stud	*12*	90-110 lb-ft (122-149 Nm)
3	Sway Bar Link Upper & Lower Nut	*4*	99-121 lb-ft (134-164 Nm)
4	Shock Absorber Pin Nut	*6*	99-121 lb-ft (134-164 Nm)
5	Shock Absorber Pin *	*6*	350-400 lb-ft (475-542 Nm)
6	Drive axle Radius Rod Nut/bolt	*6*	225-255 lb-ft (305-346 Nm)
7	Drive Axle Longitudinal Radius Rod Retaining Bolt	*2*	185-227 lb-ft (251-308 Nm)
8	Tag Axle Radius Rod Nut	*6*	228-252 lb-ft (309-342 Nm)
9	Sway Bar Bushing Collar Bolt	*8*	80-100 lb-ft (108-136 Nm)
10	Tag Axle Transversal Radius Rod (Casting) Retaining Bolt	*1*	185-227 lb-ft (251-308 Nm)
11	Sway Bar Link Pin Stud	*4*	350-400 lb-ft (475-542 Nm)
12	Shock Absorber Lower Nut	*6*	60-75 lb-ft (81-102 Nm)
13	Tag Axle Radius Rod Nut	*6*	158-193 lb-ft (214-262 Nm)
14	Tag Axle Radius Rod Stud	*6*	90-110 lb-ft (122-149 Nm)

* Use medium strength thread locker on threads (Loctite 243 or equivalent)

NOTE
Apply corrosion-protective compound on exposed threads.

2. 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 (Figure 1 to Figure 7). The system operation is fully automatic and maintains a constant vehicle height regardless of load, or load distribution.

The vehicle is also equipped with front kneeling function to quickly lower the front end.

3. FRONT I-BEAM AXLE SUSPENSION

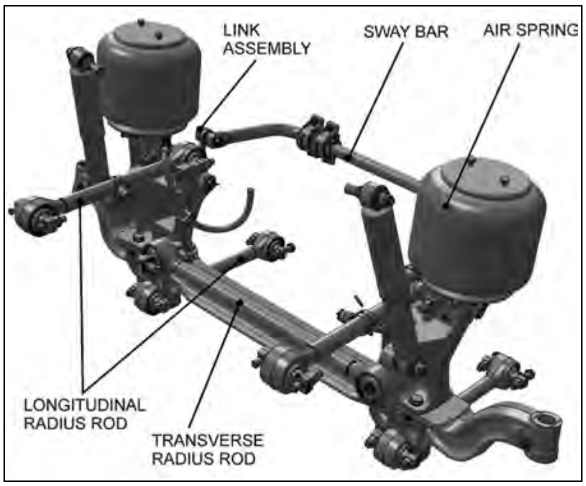


FIGURE 1: FRONT I-BEAM AXLE SUSPENSION 16105

3.1 AIR SPRINGS

The air spring bellows 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.

3.1.1 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 (122 - 140 psi (841 - 965 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.

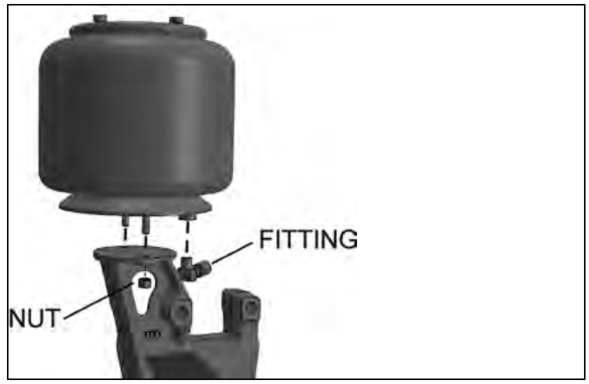


FIGURE 2: AIR SPRING 16052

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.

3.1.2 Removal

NOTE

Front suspension air springs can be removed without removing the entire axle assembly.

1. Safely support vehicle at the recommended body jacking points. To gain access to a given air spring, the corresponding wheel can be removed as follows:

   a) Jack vehicle until the tire clears the ground, and place safety supports underneath body.

CAUTION

Only the recommended jacking points must be used as outlined in Section 18, “Body”.

   b) Support the axle with a suitable hydraulic floor jack at the recommended jacking 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 control arm to ensure all air is exhausted from air springs.

NOTE
While performing this step, do not change the height control valve control arm 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. Unscrew the two air spring lower mounting nuts.
6. Rotate the air spring clockwise (Figure 3) to free the upper attachments from the mounting plate.
7. Remove the air springs.

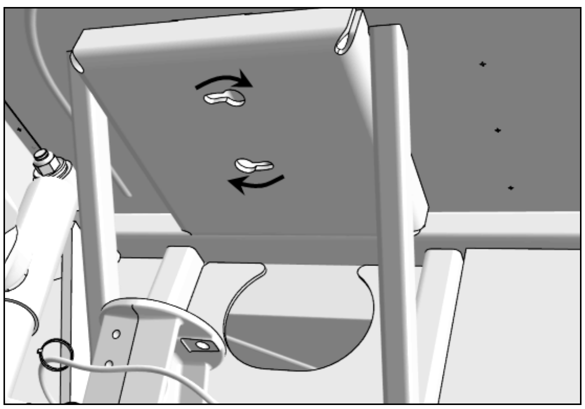


FIGURE 3: AIR SPRING UPPER MOUNTING PLATE

3.1.3 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 counterclockwise.
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.

TORQUE: 31-38 lb-ft (42-52 Nm)

5. Install elbow (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 (122 - 140 psi (841 - 965 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.

3.2 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 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.

3.2.1 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.

3.2.2 Removal

1. Remove nuts and washers from shock absorbers on upper and lower mounting pins, taking care to identify the inner and outer washers to ease reinstallation. Refer to Figure 4 for details.
2. Remove the shock absorber assembly from pins.
3. Remove the two inner bushings from the shock absorber and discard them.

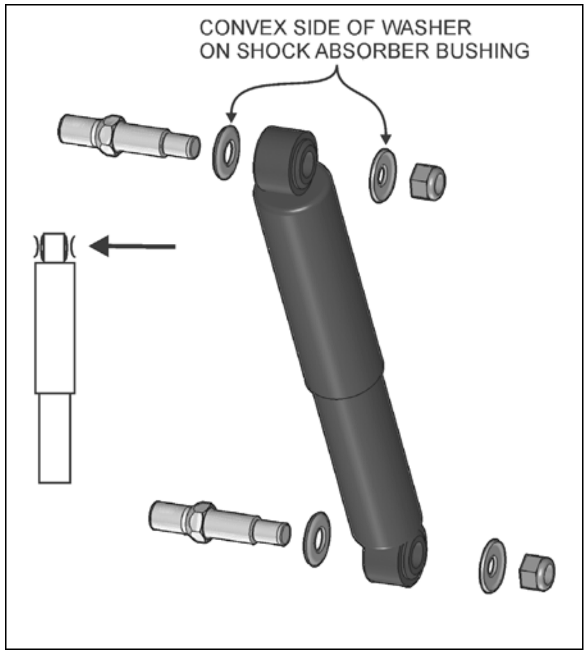


FIGURE 4: SHOCK ABSORBER 16008

3.2.3 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 absorber rubber bushing) on each shock extremity.

NOTE
If shock absorber pins are removed, they must be reinstalled using medium strength thread locker (Loctite 243 or equivalent).

5. Place the lower and upper mounting pin stud nuts and torque to specifications.

UPPER & LOWER PINS

TORQUE: 350-400 lb-ft (475-542 Nm)

UPPER & LOWER NUTS

TORQUE: 99-121 lb-ft (134-164 Nm)

3.3 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 Figure 1 and Figure 5 for details. These rods transmit both braking and driving forces from the axles to the vehicle body.

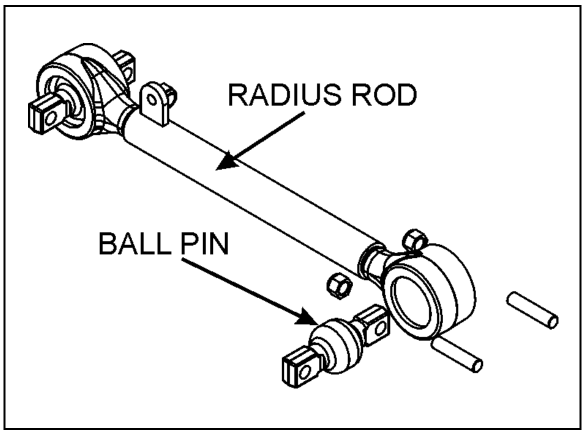


FIGURE 5: RADIUS ROD SETUP 16010

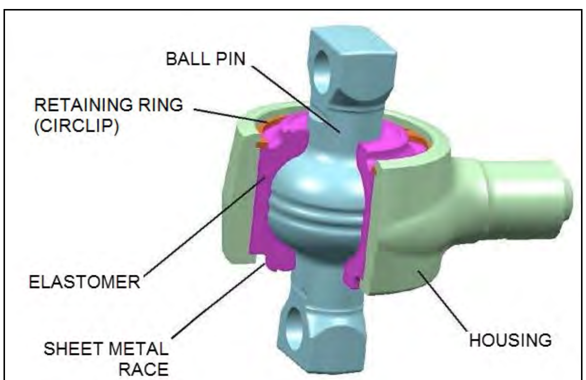


FIGURE 6: BALL PIN JOINT CONSTRUCTION 16186

3.3.1 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.

Take off the load from the ball joint by lifting the vehicle. Apply a load on the joint in all six degrees of freedom (axial, radial, etc) with a suitable lever bar. 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 must be replaced:

- Free play between ball pin and housing;
- Radial cracking of the external sheet-metal race (Figure 6 & Figure 7)
- Any crack or fracture of a metal part
- Permanent 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.

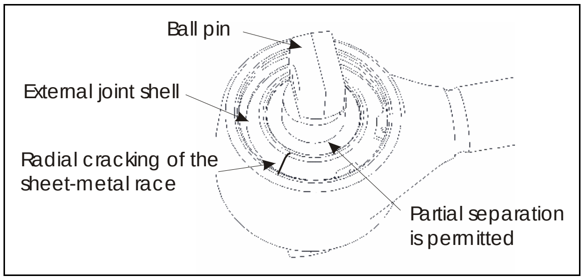


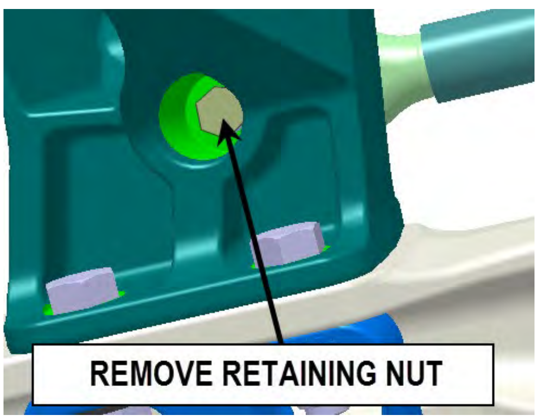
FIGURE 7: BALL PIN BUSHING

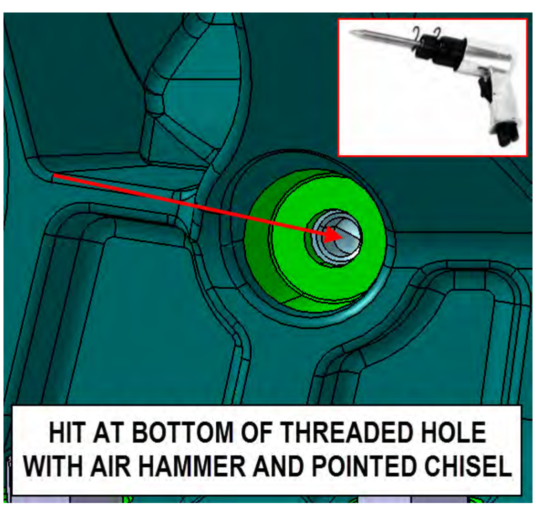
3.3.2 Radius Rod Removal

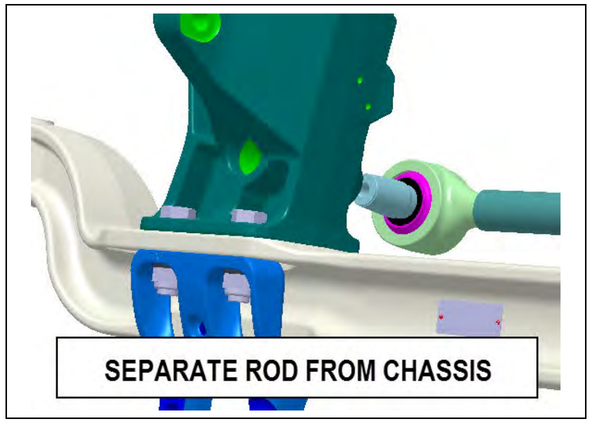
1. Unscrew the nuts (or bolts) at each extremity of the radius rod.
2. Remove the radius rod.

NOTE

One end of the transversal radius rod is fitted with a conical (taper) pin that will require the use of an air hammer and a pointed 13mm (1/2inch) diameter chisel to remove it from the chassis (after the retaining nut is removed from the rod end). ***Care must be taken not to damage the rod pin threads.***







CAUTION

Do not hit the cast parts of the chassis to disengage taper radius rods; this could lead to cracking and/or deformations of the cast parts.

3.3.3 Stripping Down

Strip down the defective joint by removing the Circlip, and ball pin/bushing assembly.

Clean out housing bore and Circlip groove.

3.3.4 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. For this reason, 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 lubrication 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 the assembly matrix.
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.

3.3.5 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 studs nuts or bolts to specification.

RADIUS ROD NUT/BOLT

TORQUE: 225-255 lb-ft (305-346 Nm)

RADIUS ROD STUD

TORQUE: 90-110 lb-ft (122-149 Nm)

TRANSVERSAL RADIUS ROD (CONICAL)

TORQUE: 185-227 lb-ft (251-308 Nm)

CAUTION
It is extremely important upon reconnection of the rods that the proper clearance height between the axle and body be maintained. Otherwise, the rubber bushings in radius rod ends will become preloaded, thus reducing their life span.

3.4 SWAY BAR

A sway bar is connected to the front axle to increase vehicle stability. It controls lateral motion (swaying movement) of the vehicle (Figure 8).

3.4.1 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.

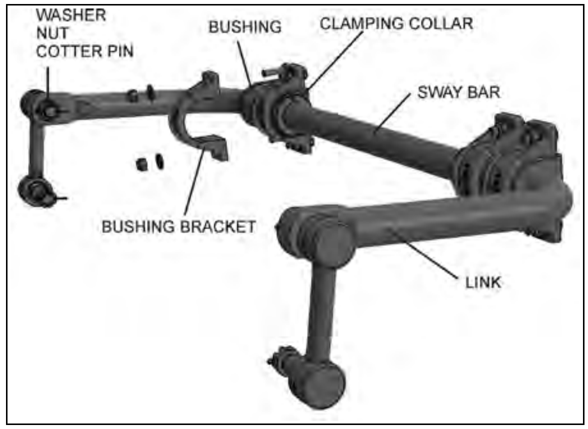


FIGURE 8: SWAY BAR 16028

NOTE
Sway bar bushings are slit to ease their removal.

3.4.2 Installation

1. Loosely install the sway bar.
2. Tighten the eight bushing brackets nuts according specifications.

TORQUE: 80-100 lb-ft (108-136 Nm)

3. Tighten sway bar link upper nuts and lower nuts according to specifications & install a cotter pin on each nut.

TORQUE: 165-200 lb-ft (224-271 Nm)

4. REAR SUSPENSION

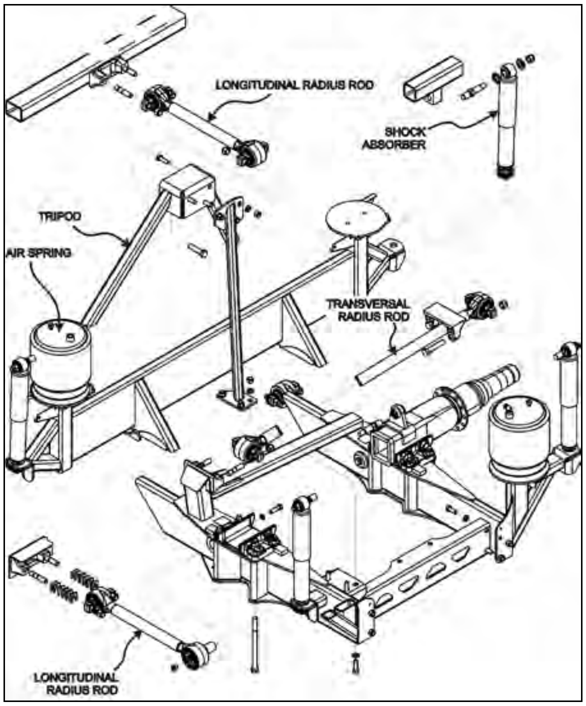


FIGURE 9: DRIVE AXLE, REAR SUSPENSION 16106

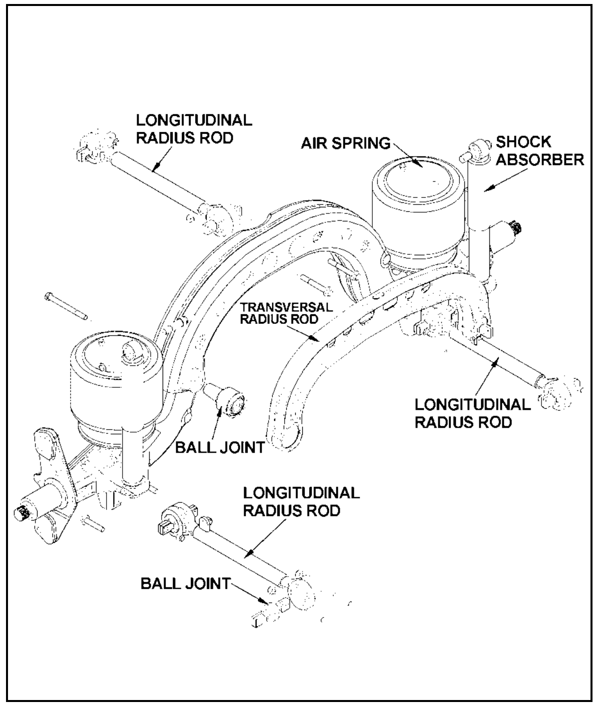


FIGURE 10: TAG AXLE SUSPENSION

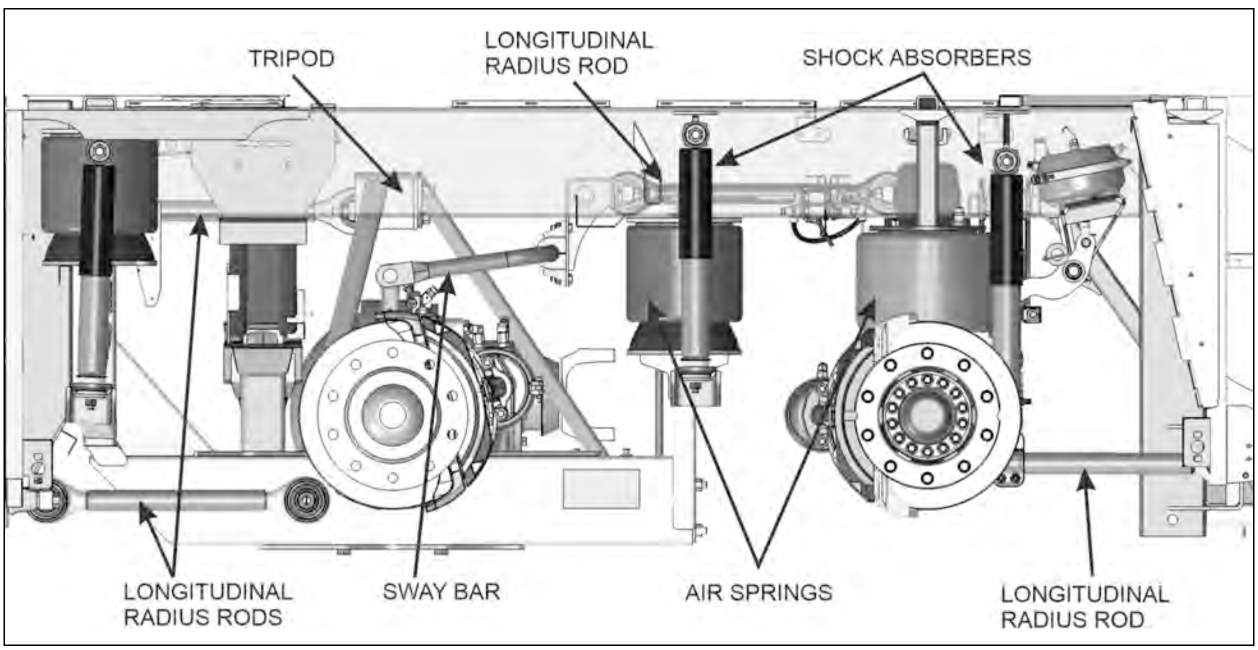


FIGURE 11: REAR SUSPENSION COMPONENTS 16184.2.1

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.

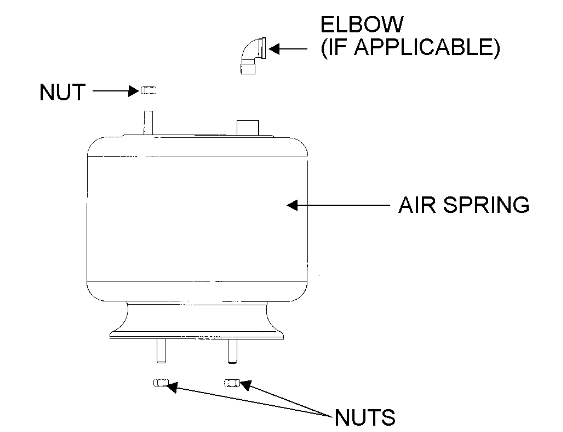


FIGURE 12: AIR SPRING 16052

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 (122 - 140 psi (841 - 965 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 control arm to ensure all air is exhausted from air springs.

NOTE
While performing this step, do not change the height control valve control arm adjustment.

4. Disconnect air line from air spring, remove elbow (if applicable), and cover both the line end and fitting to prevent the entry of foreign matter.
5. Remove the air spring upper nut, and then the two lower nuts. Remove air spring.

4.1.3 Installation

1. Compress air spring as necessary, then aligning studs with their holes, position air spring between both the lower and upper supports. Thread the lower nuts and the small upper nut a few turns.

NOTE
To facilitate air spring installation, compress it manually then put a piece of tape over the air line threaded fitting. This prevents air from getting back into the bag and keeps it compressed, thus enabling to place the bag in between the mounting plates and greatly easing installation.

2. Tighten and torque the lower stud nuts.

TORQUE: 31-38 lb-ft (42-52 Nm)

3. Install elbow (if applicable), then connect air line.
4. Connect the height control valve link.
5. Build up air pressure in system.

NOTE
To accelerate this operation, air reservoirs can be filled from an exterior air supply connected to the accessory tank fill valve or to the emergency fill valve.

7. Check operation of bellows, and with the primary air system at normal operating pressure (122 - 140 psi (841 - 965 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 (Figure 13).

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) 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 13 for details.
2. Remove the shock absorber assembly from pins.
4. Remove the two rubber joints from the shock absorber and discard them.

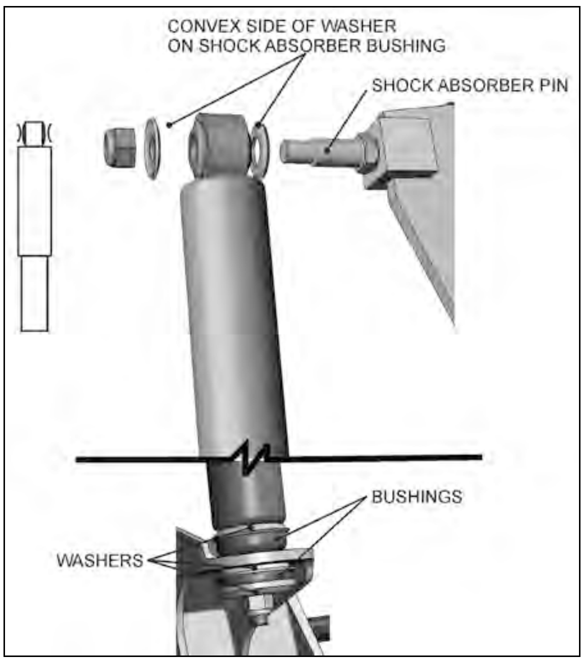


FIGURE 13: TYPICAL SHOCK ABSORBER SETUP 16009

4.2.3 Installation

1. Ensure that the shock absorber mounting pin is tight and that the threads are not stripped.
2. Install new upper rubber mounting bushings on shock absorber.
3. On the lower mounting, take care to install the rubber joints with the wide end of the tapered hole as shown in Figure 14.

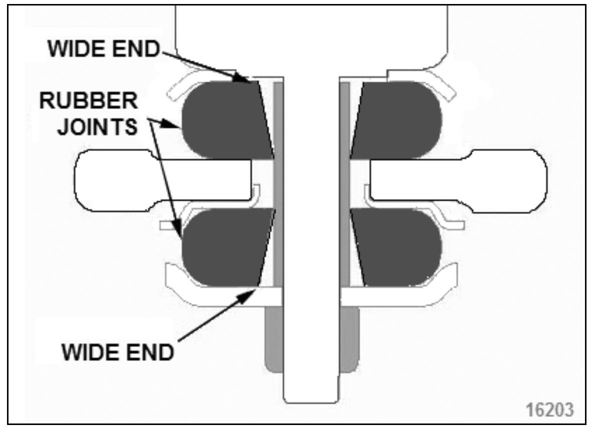


FIGURE 14: LOWER SHOCK MOUNTING BUSHINGS

4. At the upper mounting pin, place the inner washer with washer convex side facing the shock absorber rubber bushing.
5. Install the shock absorber eyes over the mounting pin, then the outer washers (with washer convex side facing the shock absorber rubber joints.

NOTE
If shock absorber pins are removed, they must be reinstalled using medium strength thread locker (Loctite 243 or equivalent).

6. Place the lower and upper mounting pin stud nuts and torque to specification.

UPPER PIN
TORQUE: 350-400 lb-ft (475-542 Nm)

UPPER NUT
TORQUE: 99-121 lb-ft (134-164 Nm)

LOWER NUT
TORQUE: 60-75 lb-ft (81-102 Nm)

4.3 RADIUS RODS

Radius rods are used to secure the axles in the proper transversal and longitudinal positions. Four radius rods are provided on the drive axle suspension (three longitudinal and one transversal) and 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 behind the front axle. 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. Performing these procedures will allow substandard performance to be discovered before the condition becomes bad enough to cause operator complaints or failure during operation.

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.

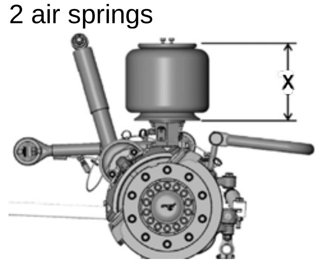
To adjust suspension height, refer to Maintenance Information MI16-14 SUSPENSION HEIGHT ADJUSTMENT USING HEIGHT CONTROL VALVES included at the end of this section.

6.1 NORMAL RIDE HEIGHT

The normal ride height is obtained by measuring and adjusting air spring height of front and rear suspension.

FRONT SUSPENSION (I-BEAM AXLE)

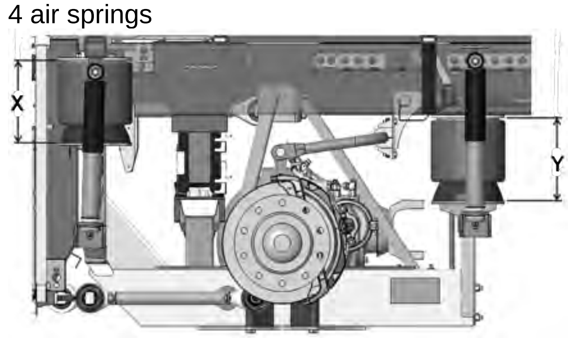
2 air springs



X = 11 ¾ ± ¼ inch (297 ± 6 mm)

REAR SUSPENSION

4 air springs



FORE AIR SPRINGS

X = 11 ½ ± 1/16 inch (292 ± 1.5 mm)

AFT AIR SPRINGS

Y = 11 ½ ± 1/4 inch (292 ± 6 mm)

6.2 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 control arm 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 control arm 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 control arm commands the height control valve to release air from air springs.

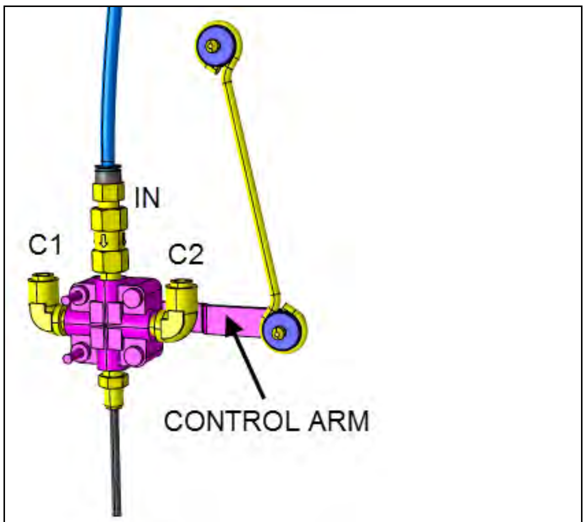


FIGURE 15: HEIGHT CONTROL VALVE 16093

6.3 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.

6.3.1 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.

   Note: The height control valve bolts equipped with a nylon insert should be replaced after the third (3rd) tightening.

Reverse removal procedure to replace height control valve. After installation, check for leakage using a soap and water solution.

6.3.2 Air leakage test

NOTE
The following procedure applies when valve assembly has been removed from vehicle.

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 full of water, and watch for air bubbles when the control arm 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 control arm 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.

7. 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 in front of the I-beam front axle (for exact position, refer to Section 12, *"Brake and Air System").*

This tank provides sufficient air supply to the kneeling system for some successive operations. The system is provided with two safety features; first, a speed switch will enable the kneeling system to work only 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.

7.1 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 KNEELING)

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.

7.2 MAINTENANCE

For diagnosis and understanding of the system, refer to wiring diagrams and Section 06, *"Electrical System"*, and to the appropriate air system schematic diagram annexed to Section 12, *"Brake and Air System".*

7.3 AIR SPRING CONTROL SOLENOID VALVES (REMOVAL & 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.

⚠ **CAUTION**
Always adjust on "fill cycle". If it is necessary to lower vehicle height, release sufficient air to be well below height, then adjust to height.

7.4 ACCESSORY 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 service compartment.

Moreover, purge all tanks by their bottom drain valves at specified intervals refer to Section 12, *"Brake and Air System"* for more information regarding air tanks location and function.

8. TROUBLESHOOTING

Condition	Cause	Correction
Air springs deflate over time	1. Defective check valve assembly. 2. Defective exhaust valve assembly. 3. Leak in air line and/or air springs. 4. Defective valve cover, rubber O-rings or gasket.	1. Replace check valve assembly. 2. Replace exhaust valve assembly. 3. Replace air line or air springs. 4. Replace valve cover, O-rings or gasket.
Air springs raise to full height and fail to exhaust air pressure	1. A clogged exhaust screen in height control valve assembly. 2. A combination clogged exhaust screen and defective air inlet valve assembly.	1. Remove and clean screen. 2. Clean exhaust screen and replace air inlet valve assembly.
Erratic valve action	1. Dirt or foreign matter in the air valve lever chamber. 2. Defectives valves.	1. Remove valve cover and blow out dirt. Install cover using new gasket. 2. Overhaul height control valve assembly
Vehicle body fails to level to satisfactory ride height	1. Improper height control valve control arm adjustment	1. Adjust lever as directed.

9. SPECIFICATIONS

Front I-Beam axle air springs and tag axle air springs

Make..Goodyear Tire and Rubber
Model……………………………………………… ………………………………………………………..1200
Type .... Mae West
Nominal diameter .... 12” (304 mm)

Drive axle air springs

Make..Goodyear Tire and Rubber
Type .... Double Flare
Nominal diameter .... 11.5” (279 mm)

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)

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)

Bellows control and exhaust solenoid valve assembly

Make.. Norgren

Coil

Voltage .... 24 V DC

Current draw... 29 amperes

MAINTENANCE INFORMATION

MI16-14

DATE :	JUNE 2016	SECTION : 16 - Suspension
SUBJECT :	**SUSPENSION HEIGHT ADJUSTMENT USING HEIGHT CONTROL VALVES**	

APPLICATION

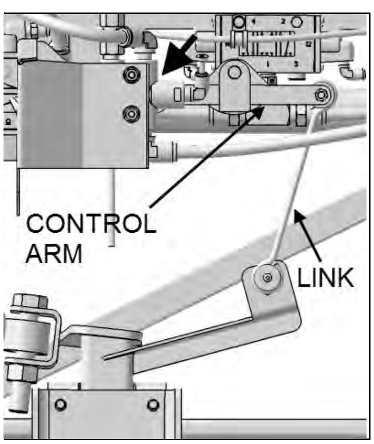
Model	
All models Model Year : From 2014	

DESCRIPTION

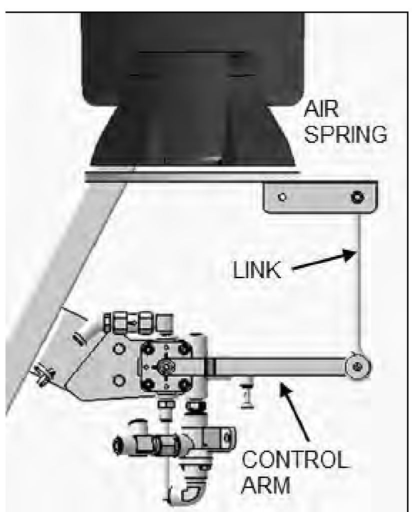
Use this procedure when a suspension height check or adjustment must be performed.

HEIGHT CONTROL VALVES

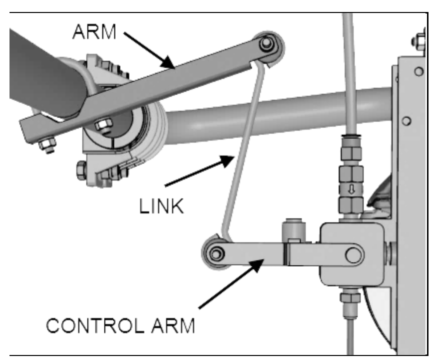
Three height control valves automatically control air volume in the suspension air springs at three separate locations to maintain a constant vehicle height regardless of load or load distribution.



FRONT SUSPENSION HEIGHT CONTROL VALVE (I-BEAM AXLE)



REAR SUSPENSION HEIGHT CONTROL VALVE – UNDER FORE UNDERFRAME AIR SPRINGS



INDEPENDENT FRONT SYSTEM HEIGHT CONTROL VALVE

The **two rear suspension height control valves** are mounted to the chassis and connected to the fore air springs of the rear underframe through a control arm and link.

One front suspension valve is mounted to the chassis and connected to the front axle through a control arm and link.

On IFS, one height control valve is located on the center of the front sway bar.

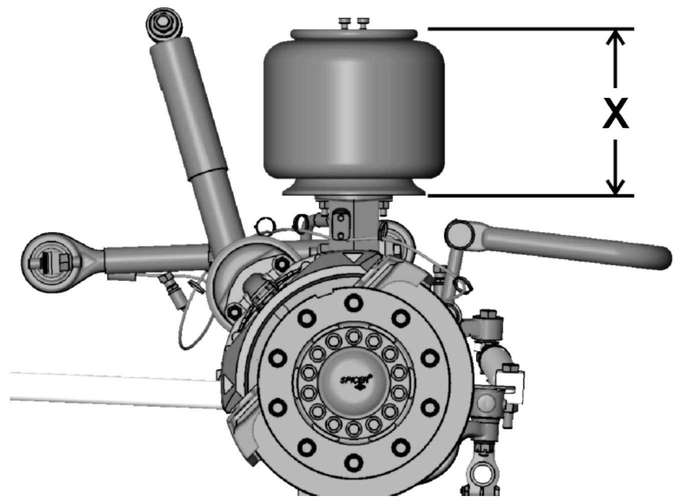
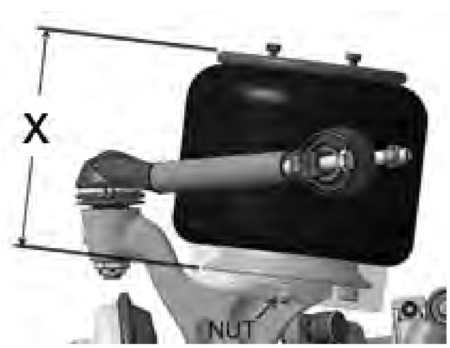
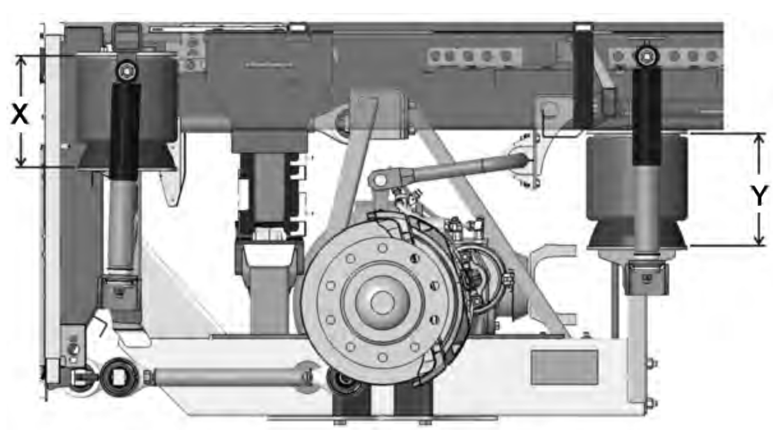
If an adjustment is required, change the position of the control arm. The control arm should be moved up to supply air and raise vehicle height and should be moved down to release some air from air springs and lower vehicle height. Make sure that air pressure is greater than 90 psi.

The appropriate vehicle body height is checked by measuring the clearance of all the air springs installed on the front and rear suspension. The tag axle, by its nature, doesn’t need to be adjusted.

If an adjustment is required, begin with the rear suspension.

NORMAL RIDE HEIGHT

The normal ride height is obtained by measuring and adjusting **air spring** height of front and rear suspension.

TABLE 1 – PRESCRIBED AIR SPRING HEIGHTS		
FRONT SUSPENSION (I-BEAM AXLE) 2 air springs		
INDEPENDENT FRONT SUSPENSION (IFS) 2 air springs	X = 12 7/8 ± 1/4 inch (327 ± 6 mm)	
REAR SUSPENSION 4 air springs	FORE AIR SPRINGS X = 11 ½ ± 1/16 inch (292 ± 1.5 mm) AFT AIR SPRINGS Y = 11 ½ ± 1/4 inch (292 ± 6 mm)	

PROCEDURE

DANGER

Park vehicle safely, apply parking brake, stop engine. Prior to working on the vehicle, set the ignition switch to the OFF position and trip the main circuit breakers equipped with a trip button. On Commuter type vehicles, set the battery master switch (master cut-out) to the OFF position.

REAR SUSPENSION AIR SPRINGS ADJUSTMENT

Measurement

1. Make sure that the air system pressure is at least **90 psi**.
2. Measure the drive axle air springs clearance **(all four air springs)**. To do so, measure the clearance between the round metal plate found above the air spring and the other round metal plate found under the air spring.
3. The clearance should be in accordance with the value of Table 1.

Air spring height adjustment

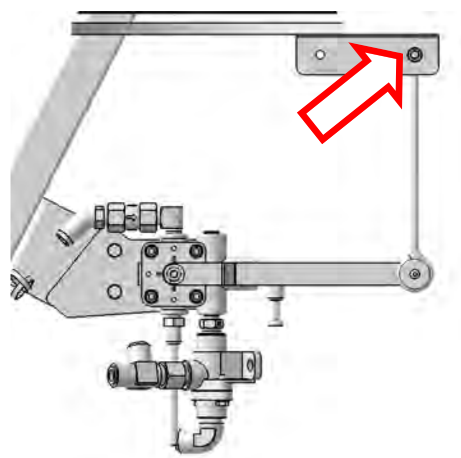
While proceeding with one side of the vehicle at a time, adjust the air springs clearance with the height control valve

4. It is necessary to adjust clearance on *"fill cycle"*.

   a) Disconnect the link. This link is equipped with a rubber bushing that allows easy disconnection.

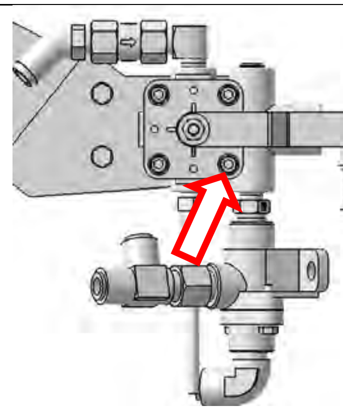
   b) Lower the control arm to release some air from air springs.

   c) Raise the control arm to fill the air springs (the valve is now in "fill cycle") and connect the link back in place.



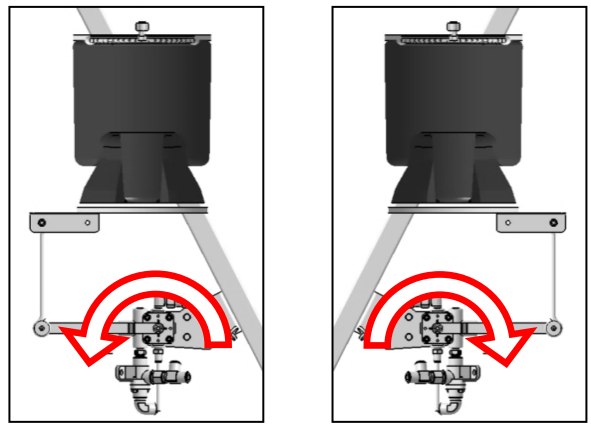
5. Loosen the lower mounting bolt shown.

   Take note that the bolt is equipped with a nylon insert. The bolt should be replaced after three (3) tightenings.



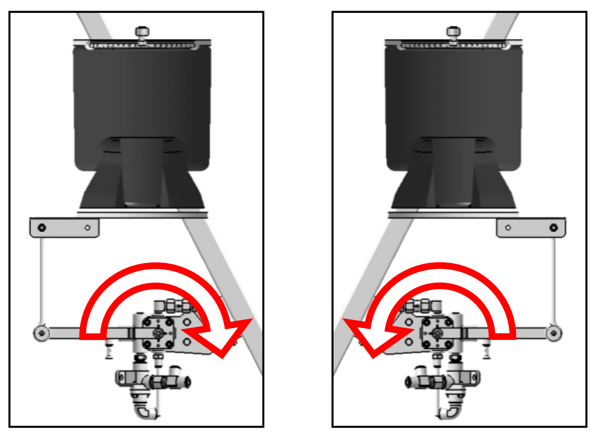
6. Rotate the valve body to increase or decrease the clearance as shown (the mounting bracket has a slotted hole).
7. Allow 15 minutes to the air system to settle before measuring the resulting clearance. Repeat previous step if necessary.
8. Tighten the lower mounting bolt once adjustment is done.
9. Repeat this procedure with the rear suspension height control valve located on the other side of the vehicle.

INCREASING CLEARANCE



STREET SIDE **CURB SIDE**

DECREASING CLEARANCE



STREET SIDE **CURB SIDE**

FRONT SUSPENSION AIR SPRINGS ADJUSTMENT (I-BEAM AXLE)

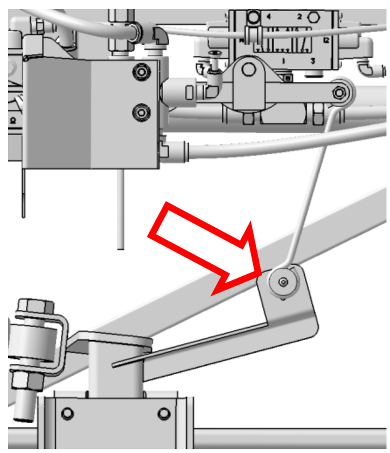
Measurement

1. Make sure that the air system pressure is at least **90 psi**.
2. Measure the front axle air springs clearance **(two air springs)**. To do so, measure the clearance between the support above the air spring and the lower end of the air spring *(if needed, use a small metal ruler to reach the lower end of the air spring)*.
3. The clearance should be in accordance with the value of Table 1.

Air springs height adjustment

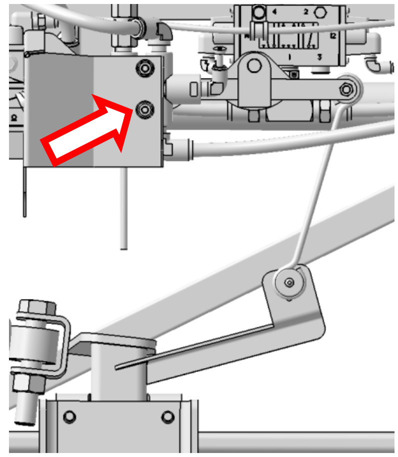
Adjust the air springs clearance with the height control valve

4. It is necessary to adjust clearance on *"fill cycle"*.
    a) Disconnect the link. It is equipped with a rubber bushing that allows easy disconnection.
    b) Lower the control arm to release some air from air springs.
    c) Raise the control arm to fill the air springs (the valve is now in “fill cycle”) and connect the link back in place.



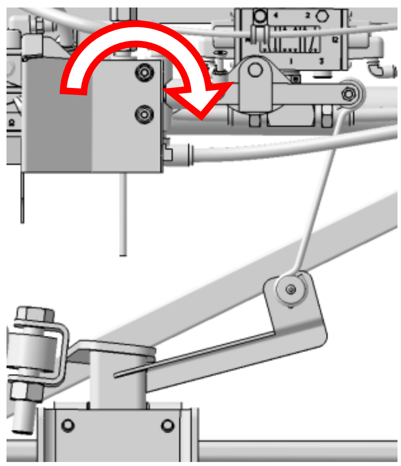
5. Loosen the lower mounting bolt shown.

Take note that the bolt is equipped with a nylon insert. This bolt should be replaced after three (3) tightenings.

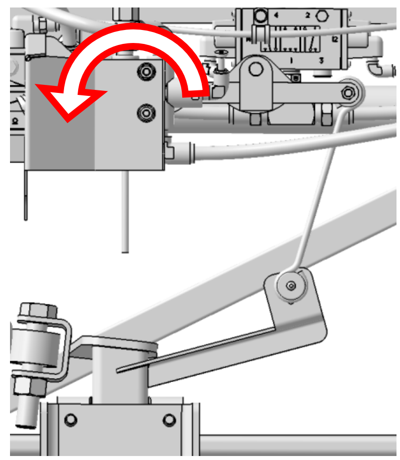


6. Rotate the valve body to increase or decrease the clearance as shown (the mounting bracket has a slotted hole).
7. Allow 15 minutes to the air system to settle before measuring the resulting clearance. Repeat previous step if necessary.

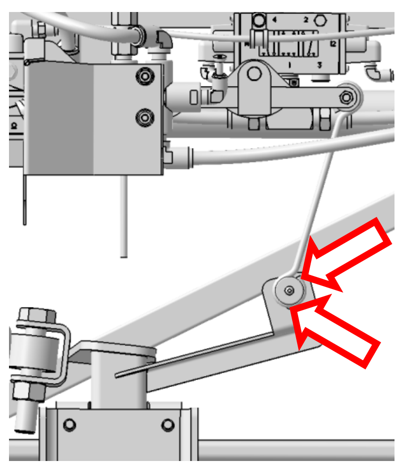
INCREASING CLEARANCE



DECREASING CLEARANCE



8. If rotation of the control valve is not enough to obtain the required adjustment, you can use one of the two (2) other holes.
9. Tighten the lower mounting bolt once adjustment is done.

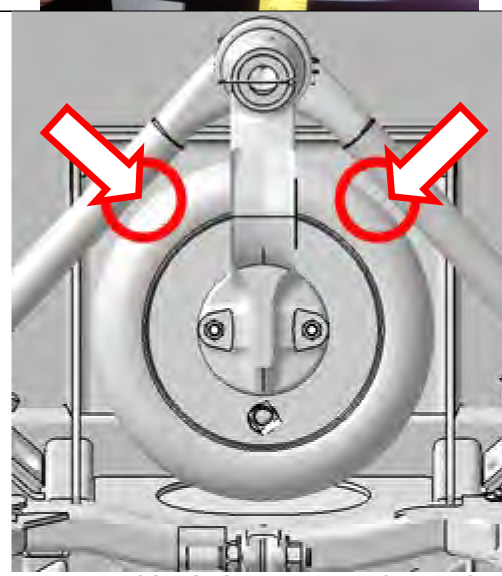


INDEPENDENT FRONT SUSPENSION ADJUSTMENT

Measurement

1. Make sure that the air system pressure is at least **90 psi**.
2. Measure that the air springs clearance **(two air springs)**. To do so, measure the clearance between the support found above the air spring and the lower end of the air spring *(if needed, use a metal ruler to reach the lower end of the air spring)*.
3. The clearance should be in accordance with the value of Table 1.

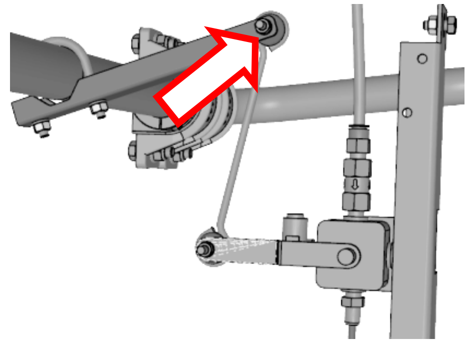
4. Take the measurement where indicated on the image preferably.



PREFERRED POSITIONS WHERE TO PLACE THE MEASURING TAPE

Air springs height adjustment

Adjust the air springs clearance with the height control valve

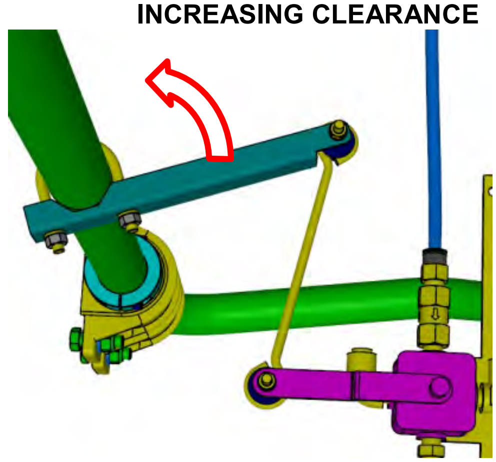


5. It is necessary to adjust clearance on *"fill cycle"*.
    a) Disconnect the link. It is equipped with a rubber bushing that allows easy disconnection.
    b) Lower the control arm to release some air from air springs.
    c) Raise the control arm to fill the air springs (the valve is now in “fill cycle”) and connect the link back in place.

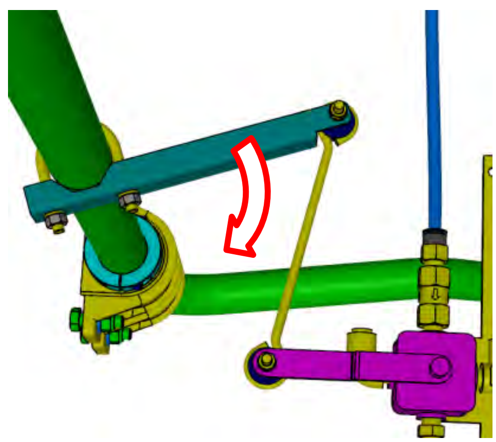
---

6. Using a hammer, tap gently on the arm secured to the sway bar. Even if the fasteners are properly tightened, it will rotate around the sway bar. Rotate the arm secured to the sway bar to increase or decrease the clearance as shown.
7. Allow 15 minutes to the air system to settle then measure the new clearance. Repeat previous step if necessary.

INCREASING CLEARANCE



DECREASING CLEARANCE



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1 SECTION CHANGE LOG

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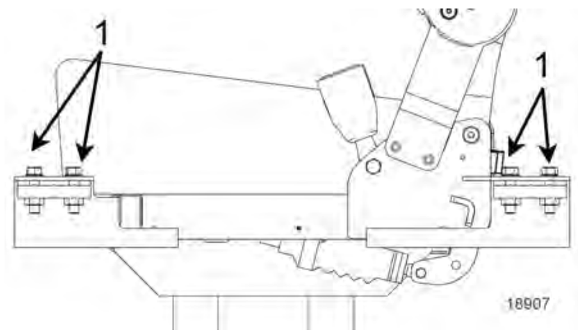
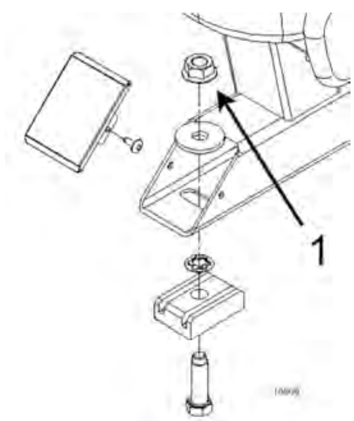
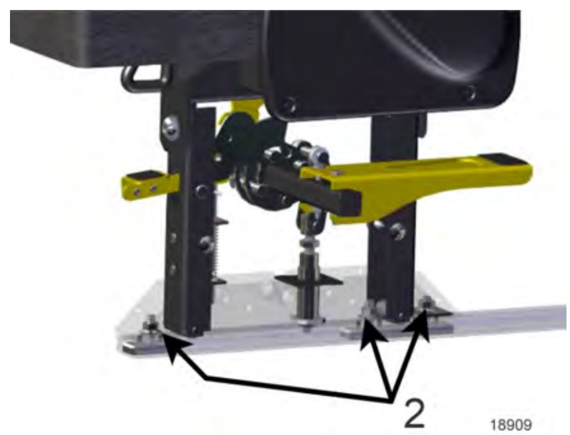
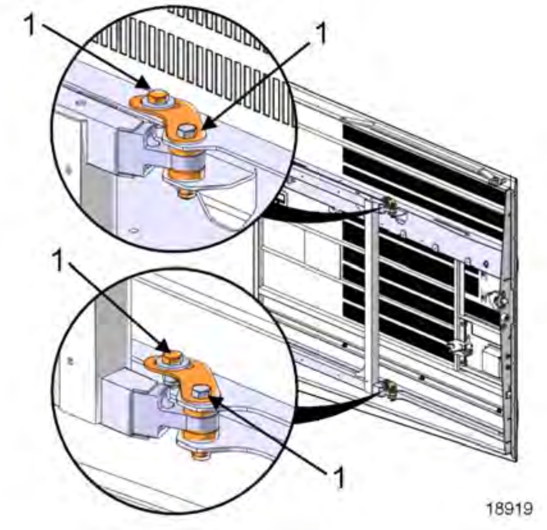
2 TORQUE TABLES

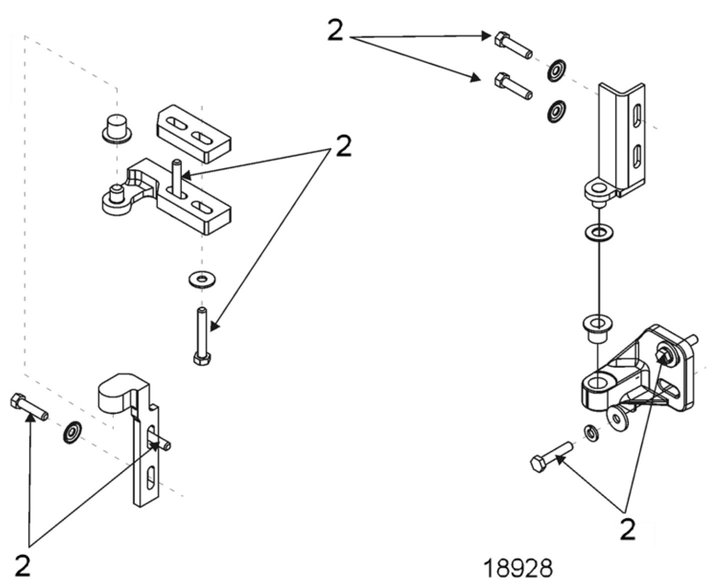






BODY INTERIOR		
No	DESCRIPTION	TORQUE
1	Passenger fixed seat mounting nuts (sidewall/pedestal)	27 lb-ft (37 Nm)
2	Passenger sliding seat mounting nuts to pedestal	15-20 lb-ft (20-27 Nm)





BODY EXTERIOR		
No	DESCRIPTION	TORQUE
1	Compressor door arm adjustment bolts	14 lb-ft (19 Nm)
2	Radiator door hinges bolts	68 lb-in (8 Nm)

3 VEHICLE EXTERIOR

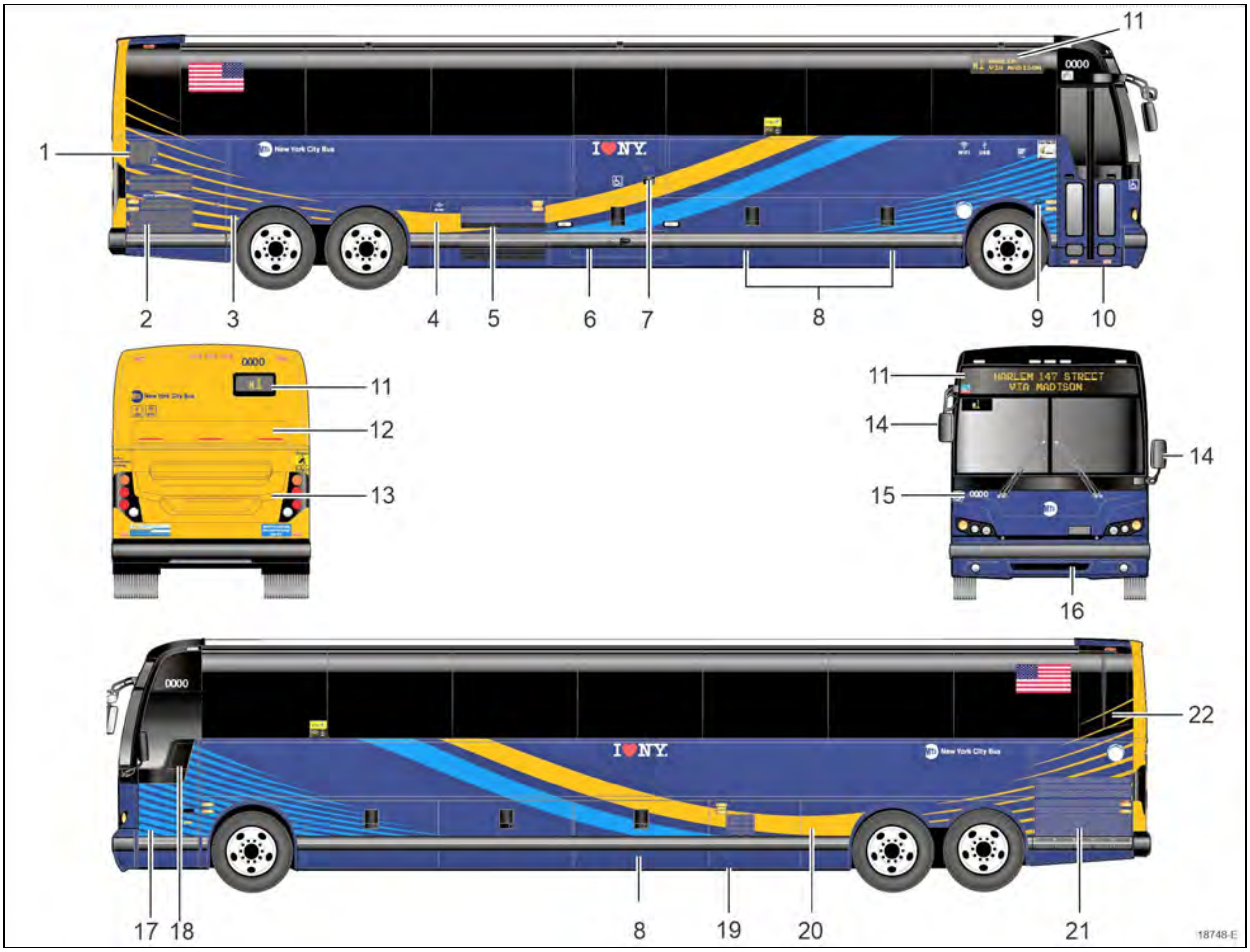


FIGURE 1: EXTERIOR VIEW

1. Engine air filter intake grill
2. Engine compartment curbside door
3. Hinged rear fender
4. Fuel filler neck & DEF filler neck door
5. Condenser compartment
6. Wheelchair Lift mechanism access door
7. Wheelchair access door
8. Baggage compartment
9. Entrance door control switch
10. Entrance door
11. Electric destination sigh or route number
12. Exhaust after-treatment system access door
13. Engine compartment rear door
14. Rear-view mirrors
15. Transmission retarder OFF indicator light
16. Tow truck connector & air supply quick coupling fittings
17. Front electrical and service compartment
18. Driver's power window
19. Evaporator compartment
20. Air dryer compartment
21. Radiator door
22. SCR converter access door

4 VEHICLE JACKING POINTS

For detailed instructions, refer to Maintenance information MI18-18, available on the technical publications USB flash drive and website.

5 TOWING THE VEHICLE

For detailed instructions, refer to Maintenance information MI18-18, available on the technical publications USB flash drive and website.

6 VEHICLE STRUCTURE

The body of the vehicle is an integral structure made of 14, 16 and 18 gauge welded and braced high tensile steel and stainless steel members. All stainless exterior panels are glued to anti-corrosion coated members. The complete structure is protected against corrosion prior to assembly. The front and rear caps are made of molded fiberglass. The main roof is made of high tensile aluminum panels riveted to the roof structure. The floor is made of 2 layers of ½" (13 mm) thick plywood separated by a 1/8" (3 mm) insulation to reduce power train and road noises.

Welding

Since welding is a procedure that may be carried out either as specific instructions from 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 PRIOR WELDING” in this manual.
4. Always wear the appropriate safety equipment.
5. Weld in clean and well-ventilated area, and always have an appropriate fire extinguisher within your reach.

7 VEHICLE EXTERIOR MAINTENANCE

Regular washing to remove dust and dirt is recommended. See *"Operating Manual"* for more details on washing and cleaning your vehicle.

7.1 CORROSION PREVENTION

Preventive maintenance is a key factor in avoiding corrosion and must be considered as part of the regular service intervals. The entire underside of the vehicle is sprayed with a heavy application of asphalt base undercoating.

The operating environment the vehicle is subjected to will largely influence the amount of dirt and corrosion that will accumulate over a given period. Corrosion is one of the most costly factors of part failure and shortened part life. It is, however, an item that can be controlled when it is conscientiously looked after and the proper steps are taken in a timely manner.

Certain areas of the coach are more vulnerable to corrosion than others, and it is these areas that should be addressed. For example, the rear baggage compartment bulkhead in the rear wheelhousing area contains many key components and should be examined regularly for corrosion. Other areas include the front wheelhousing area and the engine compartment.

Road splash will affect undercarriage, condenser coil and engine compartment. These areas must be thoroughly cleaned to remove dirt accumulations from flanges, channels and ledges. These places accumulate dirt and salt and hold it in direct contact with steel and aluminum surfaces. Use an understructure high pressure spray as part of a regular wash. Damaged undercoating or paint should be promptly repaired before corrosion can start.

Frequency of wash periods depends on operating conditions. During periods of exposure to salt, daily washing as described above is recommended. If underbody parts show evidence of rust or corrosion, treat as follows:

1. Remove dirt, grease and oil by solvent washing.

2. Remove corrosion as well as all loose coating by cleaning with a wire brush or sandblasting.

⚠ CAUTION

Sandblasting can be used for cleaning bulkheads, brackets and other structural members. It should not be used for exterior side paneling. Extreme care should be taken not to sandblast excessively.

3. Apply correct primer, paint and undercoating after removing all corrosion to prevent further damage.

7.2 PREVENTIVE MAINTENANCE SCHEDULE

NOTE
TECTYL 185 GW rust inhibitor may have been applied on your vehicle underbody as an option, if this is the case, follow this procedure thoroughly. For future application of product, refer to paragraph 3.3 in this section.

DESCRIPTION	INTERVALS		MAINTENANCE	CORRECTIVE ACTION	REFERENCE
	MONTHS	KM MILES			
BODY, EXTERNAL WINDOW FRAME	6	40 000 25 000	VISUALLY INSPECT SEALING BEADS CONDITION	REPAIR OR REPLACE SEALING BEADS IF NECESSARY	
VEHICLE UNDERBODY	12	100 000 60 000	USE A LOW PRESSURE SPRAY TO CLEAN UNDER-STRUCTURE AND VISUALLY INSPECT FOR CALCIUM DEPOSIT, CORROSION OR ANY DIRT ACCUMULATED ONTO EXPOSED SURFACES. VISUALLY INSPECT SEALING BEADS CONDITION. VISUALLY INSPECT IF UNDERFLOOR IS PEALING. 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 UNDER-STRUCTURE	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.

7.3 RUST INHIBITOR APPLICATION

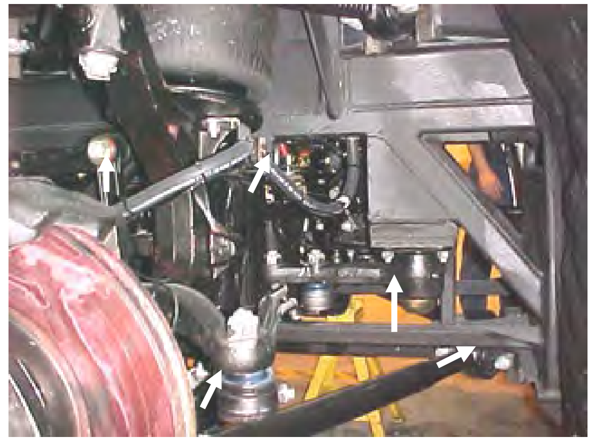
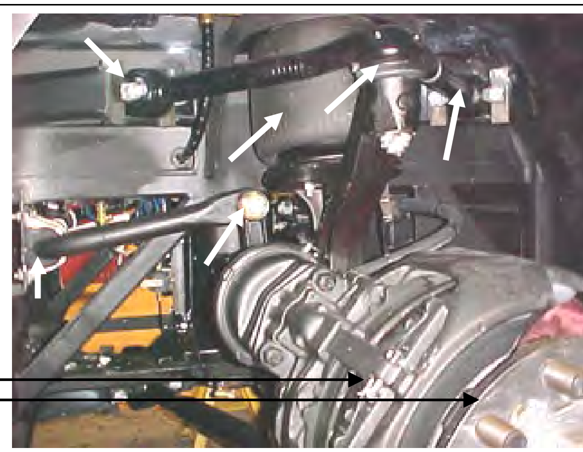
Material: Tectyl 185 GW   R1KG21

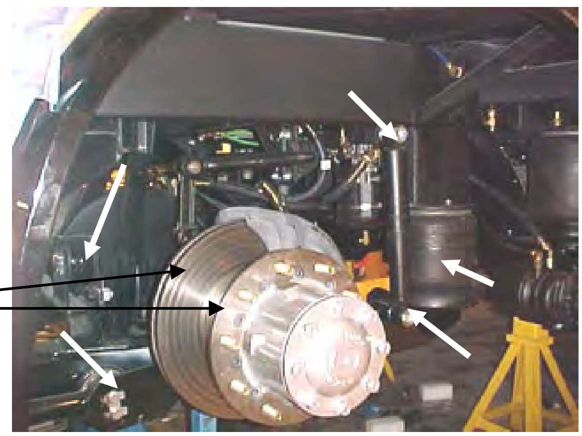
Safety Rules: Use safety glasses

Supplied air hood

Solvent-resistant rubber gloves

1.0 Wash both wheelhousing mechanical parts before masking.	A water-hose nozzle is recommended. Water may be hot to reduce washing time especially during winter. If parts are soiled with oil, clean using R1KG21. Avoid rubber parts.
2.0 Dry all water sprayed parts. Surface temperature and dew point must be respected before applying rust inhibitor.	Air pressure system may be used, refer to annex 1 for surface temperature and dew point.
3.0 **Front wheelhousing** a) Mask all rubber joints. Braking system must also be protected (refer to arrows). Commercial aluminum foil may be used for masking.	
3.1 **Front wheelhousing** Front view	

3.2 **Front wheelhousing**	
3.3 **Front wheelhousing** (Entire braking system)	
4.0 **Rear wheelhousing** a) Mask all rubber joints. Braking system must also be protected (refer to arrows). Commercial aluminum foil may be used for masking (Entire braking system)	

4.1 **Rear wheelhousing** (Entire braking system)	
4.2 **Rear wheelhousing** (Entire braking system)	
4.3 **Rear wheelhousing**	
5.0 Close off wheelhousing using masking paper.	Prevent rust inhibitor from coming in contact with paint. To close off wheelhousing, a polythene sheet may be used.
6.0 Apply TECTYL 185 GW black rust inhibitor onto wheelhousing mechanical parts.	A spray gun and pumping system are required to apply the rust inhibitor. If the application is done inside a paint

	room, select high speed ventilation. **Minimum required thickness is 10 mils wet or 5 mils dry**.
7.0 Remove all masking material 30 minutes after application.	

ANNEX 1

1. Check and confirm that dew point and surface temperature are in accordance with the following criteria, *Use the following table to determine dew point*.:

   Surface temperature > 10°C

   Surface temperature > or = to dew point + 3°C

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

8 COMMON FIBERGLASS REPAIR PROCEDURE

All repairs to fiberglass parts consist of filling the damaged area with fiberglass cloth and resin or strand fiberglass and resin. The repair is allowed to harden, and then finishing operations may be performed. Use of the various materials is determined by the type of repair to be made. Large holes, torn sections and separate joints require the adhesive qualities of the resin and the reinforcing qualities of the fiberglass. Small dents, scratches or pits can be repaired using resin and strand fiberglass and filler mixed into paste. Instructions for either mix are explained under their respective headings in this section. For best results when making repairs, temperature should be between 70 and 75 ºF (21-24 ºC). 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.

8.1 REPAIR USING FIBERGLASS CLOTH

Where necessary, sand paint away around damaged area and scrape away undercoating, if any, and wipe clean with solvent. Grind or file the damaged area to form a "V" at the broken or cracked portion. Sides of "V" should have a shallow pitch for maximum bonding area.

NOTE
Roughening the surface improves adhesion of resin.

If part is warped from original shape, use clamping equipment to straighten the surface. Preheat area to be repaired with one or two heat lamps placed 18 to 24 inches (450-610 mm) from repair.

CAUTION
Temperature should not exceed 140 ºF (60 ºC) during 30 minutes in order to avoid distortion.

Cut fiberglass cloth with scissors or tin snips, 1 to 3 inches (25-75 mm) larger than area to be repaired. Build area to desired height.

Mix resin and hardener following instructions on their containers. Saturate layers of fiberglass with mixture and place laminates over damaged area. Smooth out wrinkles and make sure general contour of area is maintained. Bubbles and wrinkles can be eliminated with a roller.

CAUTION
The pot life of the mix is approximately 15 minutes. Any accidental contamination to the skin, clothing, tools, etc. must be removed within this period. Use acetone to remove uncured resin.

Heat resin material again by placing heat lamps 18 to 24 inches (450-610 mm) from repaired area. Allow 12 to 15 minutes for repair to cure. After repair is cured, grind, file or sand to contour. Files other than body files may be more suitable. Featheredge and finish sanding.

If small pits or irregularities appear after making repair, correct by using a liberal amount of chopped strand or filler mixed with resin to form a paste. Refer to heading *"Repair using Fiberglass Paste"* in this section.

8.2 REPAIR USING FIBERGLASS PASTE

Fiberglass paste is used for repairing small dents, scratches, and pits. Paste is made by mixing resin, hardener and fiberglass strand or filler to the consistency of putty. Where it may be necessary, sand paint away around damaged area. On underside of coach, scrape away undercoating from damaged area, and wipe clean with solvent.

Preheat the area to be repaired using heat lamps. Mix desired quantities of resin and hardener according to manufacturer's instructions. Add powdered fiberglass strand into mixture to thicken it into a putty state.

NOTE
If repair is made on a vertical surface, adding powdered filler material to mixture will reduce the 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.

8.3 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 (Figure 2).

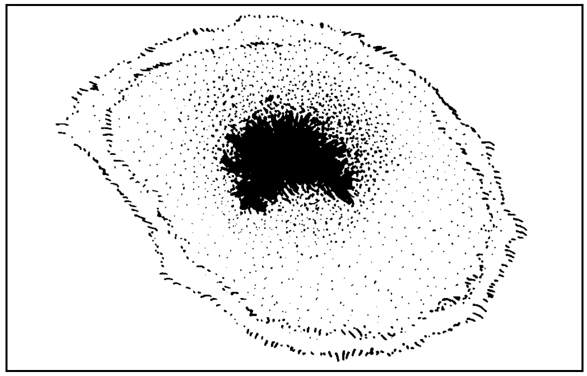


FIGURE 2: FIBERGLASS REPAIR 18089

Cut a piece of fiberglass mat slightly larger than area being repaired. Impregnate mat with general purpose polyester resin catalyzed normally. Use a clean paint brush to apply the polyester resin. Apply impregnated mat over hole and press onto surface with brush to obtain good adherence. Another coat of general purpose polyester resin can be applied at this time (Figure 3).

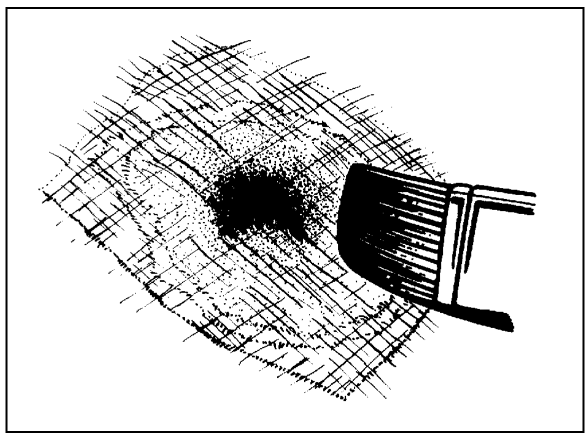


FIGURE 3: FIBERGLASS REPAIR 18090

NOTE
Remove all air between surfaces being joined. Allow area to harden and sand surface to remove any wax.

Apply another mat, followed by a cloth patch, and another mat. All layers must be thoroughly impregnated with polyester resin, brushed well and free of air. Apply more layers of mat and cloth as required until the desired strength and thickness is obtained, minimum two 1-½ oz (43 g) mats and one 9 oz (255 g) cloth (Figure 4).

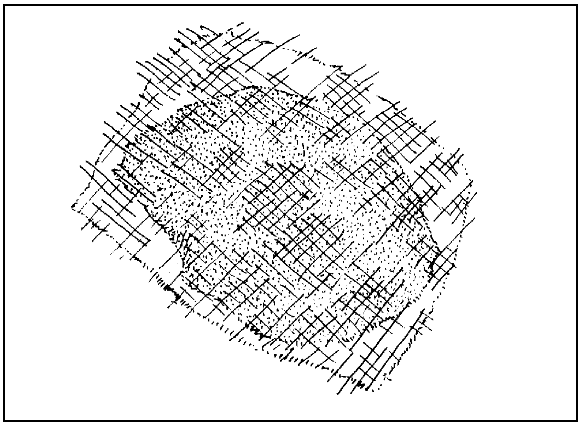


FIGURE 4: FIBERGLASS REPAIR 18091

Allow area to harden and contour the area with coarse sandpaper #100 (Figure 5).

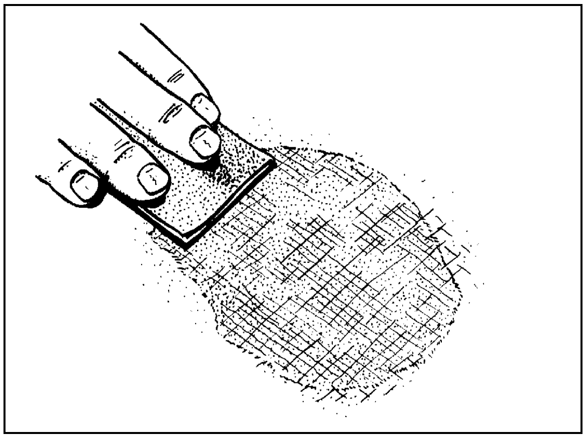


FIGURE 5: FIBERGLASS REPAIR 18092

Cover the area with a layer of resin putty and allow drying for approximately 15 to 20 minutes (Figure 6).

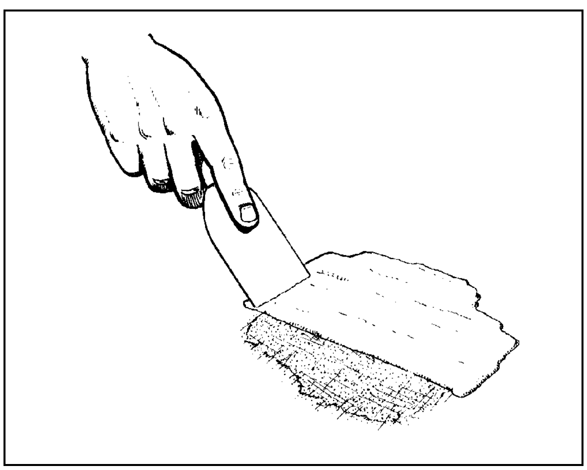


FIGURE 6: FIBERGLASS REPAIR 18093

Smooth off surface with coarse sandpaper #100 to desired shape. Further smooth surface with fine sandpaper #120 until repaired surface matches surrounding area paneling. Prime and paint the area to match surrounding paintwork.

9 COMMON PAINTING PROCEDURE

9.1 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.

9.2 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.

9.3 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.

9.3.1 Safety

Care should be exercised in storing, handling, mixing, and applying paint and chemicals listed in this manual. The topcoat, primer, solvent, catalysts, accelerators, and cleaners are highly volatile and/or toxic if not properly used. Observe all safety instructions marked on the different packaging, as well as the following:

1. Do not smoke in the paint room or in adjacent area exposed to residue fumes.
2. Wear respirators approved by the governing safety and health regulations.
3. Maintain adequate ventilation at all times.
4. Dispose of any leftover paint mix properly.
5. Wear rubber gloves, rubber apron, and face shield during all phases of paint and chemical handling

9.3.2 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-16203		
Priming	STANDOX Reactive Etch Primer ST-13908 * Wait 30 minutes then apply STANDOX HS primer ST-15161	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	Axalta Imron Clear 8430 S Allow 16 hours for drying		Refer to product Technical Data sheet for proper mixing

NOTE
Product listing above is based on factory applied products. Local VOC (Volatile Organic Compound) regulations may vary, consult your paint supplier and use a VOC compliant product that matches the factory recommendations if required to do so.

10 COACH EXTERIOR FINISHING AND BODY REPAIR

The following procedures cover repair, installation and replacement for various doors, panels and windows. The paragraph divides the vehicle into zones to facilitate the search; each zone is then sub-divided into components.

Refer to the appropriate zone and component for complete procedure.

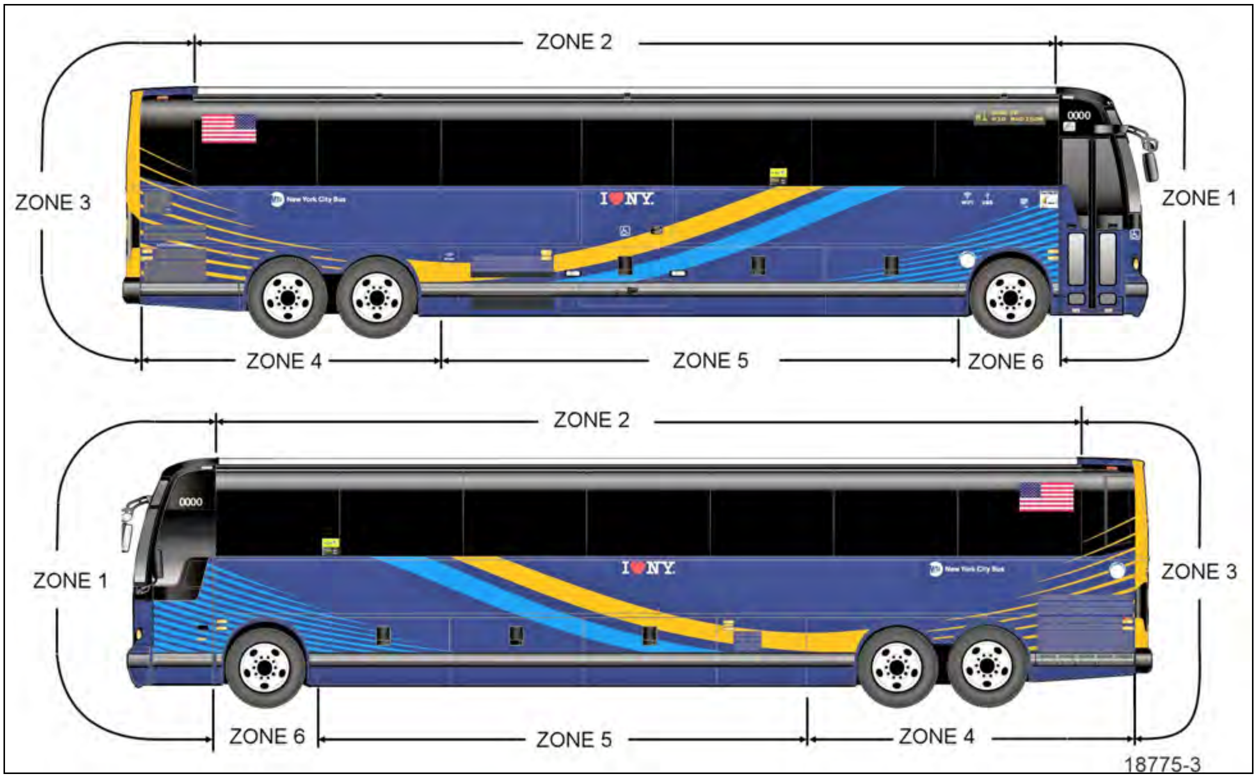


FIGURE 7: COACH ZONING

10.1 ZONE 1

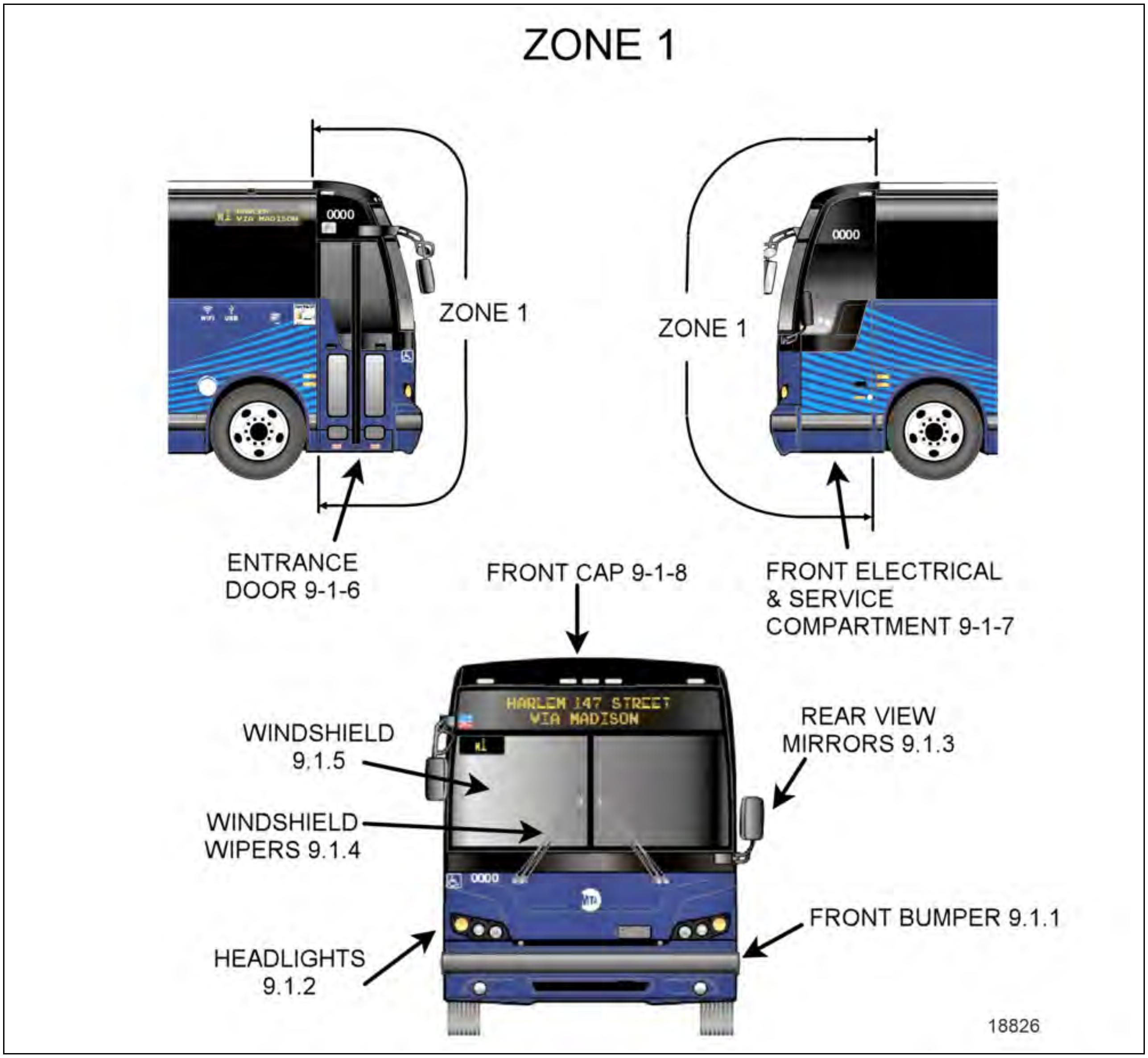


FIGURE 8: ZONE 1

10.1.1 Front Bumper

The front bumper is hinged to give access to the steering gear and to facilitate removal and installation. To remove the bumper, unscrew the top retaining bolts (2) and tilt down the bumper.

WARNING

Front bumper is heavy. Use proper lifting equipment to support the bumper during the removal and installation operations to avoid personal injury.

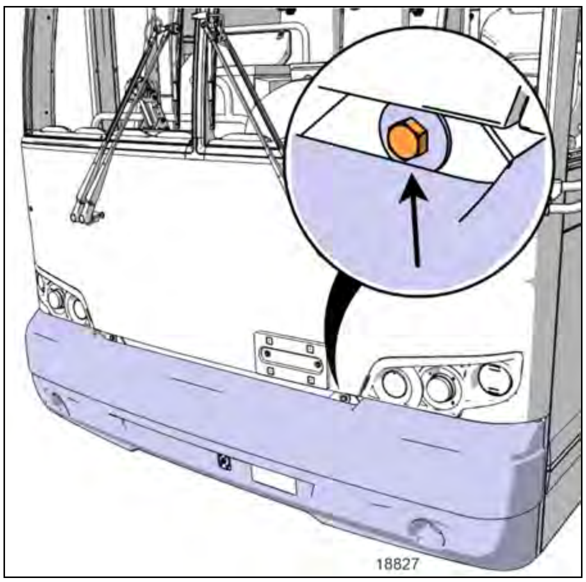


FIGURE 9: BUMPER TOP RETAINING BOLTS

Front bumper has the tow truck connectors to provide electrical supply from the tow truck to the rear clearance lights, the rear flasher lights, the tail lights and the stop lights. It also provides air for brakes and some vehicle equipment.

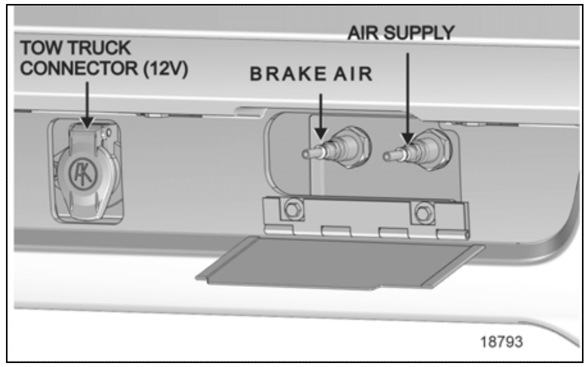


FIGURE 10: TOW TRUCK CONNECTORS

Disconnect electrical connector and both emergency air supply lines from the bumper (hoses are not pressurized).

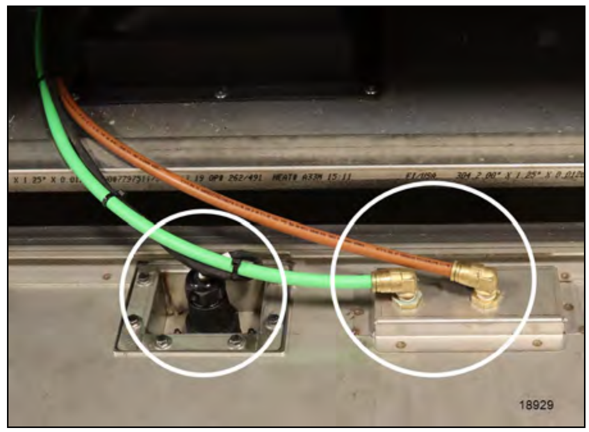


FIGURE 11: FRONT BUMPER AIR LINES AND ELECTRICAL CONNECTOR

Using the spring adjustment hex nut, remove bumper spring tension until the end hook can be disconnected from the bumper bracket.

NOTE

To facilitate spring tension adjustment during re-installation, take note of the spring hook length (taken from the adjustment nut face to the bumper bracket hole) before removal.

WARNING

Bumper spring is under heavy tension; do not pry out the spring hook without completely removing the spring tension.

FIGURE 12: FRONT BUMPER SPRING

Disconnect the bumper supporting arm.

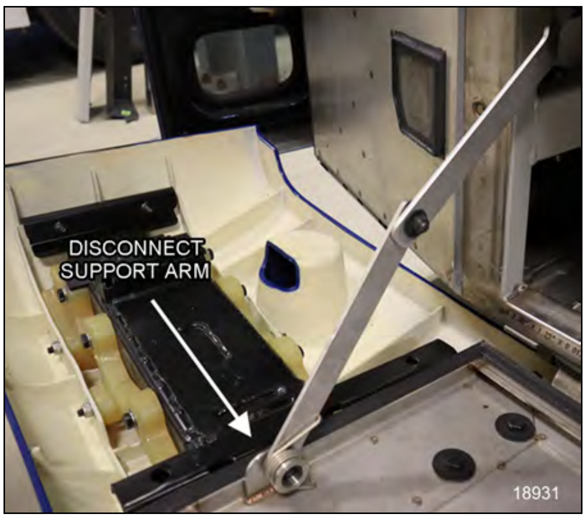


FIGURE 13: BUMPER SUPPORT ARM

Unscrew the four (4) hinge bolts that secure the bumper hinges to the vehicle and remove the bumper.

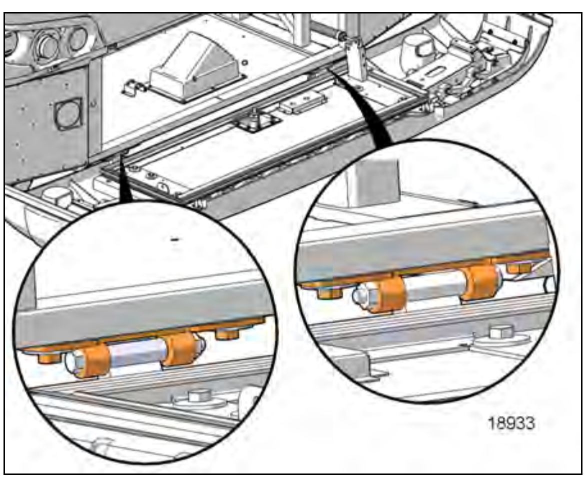


FIGURE 14: BUMPER HINGE BOLTS (4)

10.1.2 Headlights

Refer to Paragraph Headlights, included in Section 06: Electrical of the Maintenance Manual for complete information on headlights.

10.1.3 Rear View Mirrors

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.

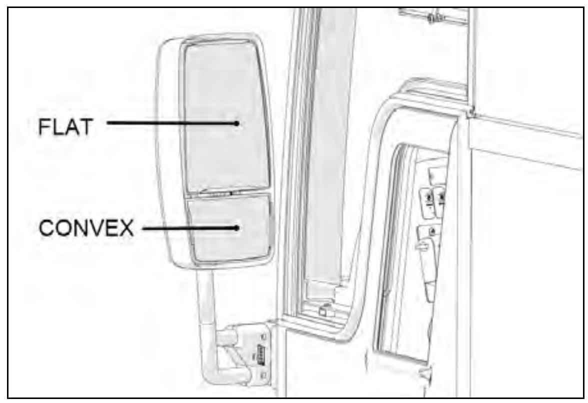


FIGURE 15: REAR VIEW MIRROR (ROSCO)

- **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 set screws on each side of the ball stub at the base of the mirror head to facilitate the adjustment.

- **Disassembly**

At the end of the mirror arm, loosen the set screws 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.

- **Assembly**

Mount the mirror arm base to the coach. Insert the ball stem into the mirror arm and tighten the socket set screws.

NOTE
Position the ball cup halves so the joint between them lies on the centerline of the arm. Ensure that the set screws are not on the joint between the cup halves.

- **Remote Controlled Rear View Mirrors**

The remote controlled external rear view mirrors attach to support arms using a pivot collar secured by set screws. Loosening the set screws 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.

- **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.

Choose the side to be adjusted by pressing the "L" (left) or "R" (right) button on the control pad. The flat mirror is then adjusted by pressing the "upper" button and the convex mirror by pressing the "lower" button. The selected mirror can now be adjusted left to right or up and down by using the arrow keys on the control pad. The R/H side round mirror is non-adjustable.

NOTE
The mirrors heater function (HTR button and LED indicator) is optional and not connected on this vehicle.

- **Disassembly**

At the end of the mirror arm, loosen the set screws 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.

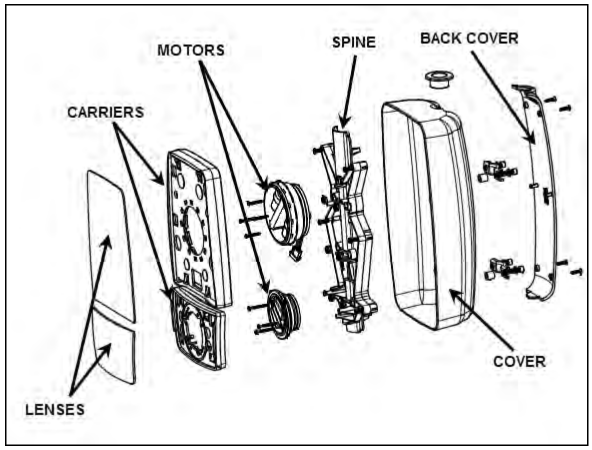


FIGURE 16: R/H OUTSIDE REAR-VIEW MIRROR 18694

Remove the four screws fastening the mirror arm base to the coach. Slide the harness free of the mirror arm base.

- **Assembly**

Attach a stiff wire (snake) to the end of the harness and insert the wire through the mirror arm base and arm, gently pull the harness through the arm and disconnect the "snake".

Connect the mirror head harness. Insert the harness connector back into the mirror arm.

Insert the ball stud into the mirror arm and tighten the socket set screws.

NOTE
Position the ball cup halves so the joint between them lies on the centerline of the arm. Ensure that the set screws are not on the joint between the cup halves.

- **Glass removal and installation**

Using a non-metallic flat wedge, insert the edge under the over-hang tab covering the mirror glass.

Raise the wedge to spread the over-hang tab. By continuing to raise the wedge, the glass will begin to pop out.

Do not force the glass further than half an inch outward. A secondary adhesive holds the glass. This adhesive is used to cushion the glass and dampen vibration. It is soft and can be cut fairly easily.

Slide a straight edge, such as a ruler, behind the glass and make a slicing motion back and forth. The mirror glass will come free.

Remove the glass after the adhesive has been cut. Some adhesive will remain on the mirror carrier. These adhesive spots are soft and pressure sensitive. They will adhere again when the glass is reinserted.

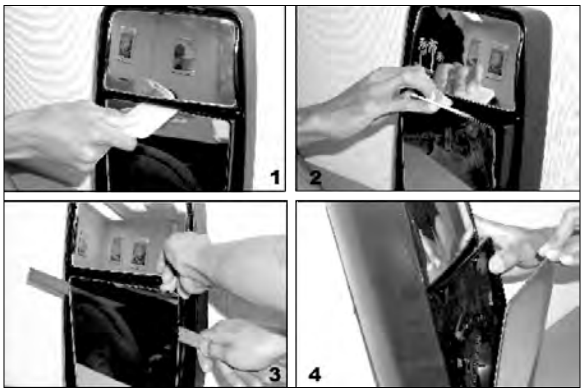


FIGURE 17: REAR VIEW MIRROR GLASS REMOVAL

To re-insert the glass, slide one side under the over-hang tab and spread the opposite over-hang tab with the wedge until the mirror glass is permitted to snap or drop in place.

10.1.4 Windshield Wipers

Refer to Paragraph "Windshield Wipers and Washers", included in Section 23: Accessories of the Maintenance Manual for complete information on windshield wipers.

10.1.5 Windshield

The windshield is single-glazed AS-1 laminated safety glass. Each windshield is secured to a flange around the front structure opening by a one-piece black rubber extruded gasket.

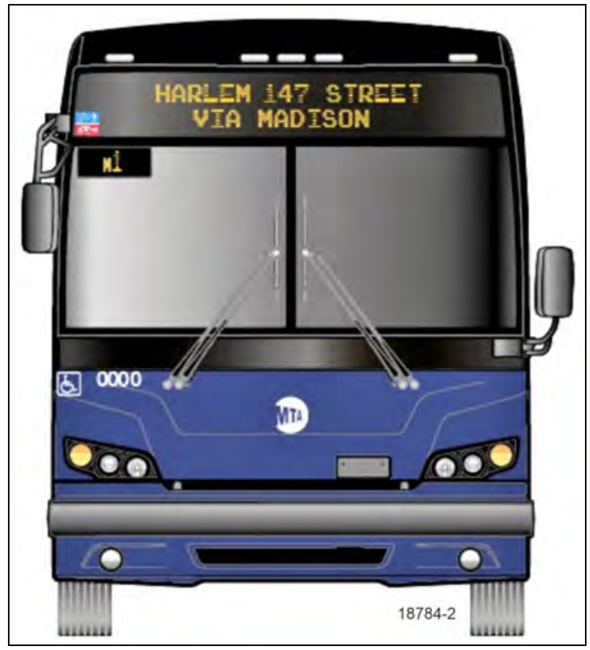


FIGURE 18: WINDSHIELD

A low profile gasket with a single locking strip is used on our vehicles.

Proper installation of the windshield ensures watertightness. Since glass varies in fit depending on the supplier, we recommend installing a replacement windshield obtained from Prevost Parts to ensure proper fit.

10.1.5.1 Hydrophobic Treatment on Side Windows

The new low profile window gasket creates an airflow that is closer to the vehicle. This reduces air drag but window soiling of the side windows becomes more likely.

A specific water repelling treatment is factory applied to the driver's and entrance door windows to counter this effect and prevent window soiling.

We suggest renewing the water repelling treatment each year or more frequently depending on operating conditions.

If you notice increased soiling on the driver's and entrance door windows after several months of operation, the water repelling treatment can be renewed by making an appointment with your nearest Prevost Service Center.

The Hydrophobic compound is specially formulated for Prevost and can only be applied by Prevost technicians in Prevost service centers.

10.1.5.2Removal of lower windshield

WARNING

Removal and installation must be performed by more than one person. Wear protective gloves when handling the windshield.

For the removal or installation of the windshield, you will need:

- A rope,
- A plastic spatula to lift the rubber seal lip,
- A metal rod or screwdriver to clean the seal groove,
- A filler insertion tool,
- Goggles and protective gloves.

1. For lower windshield, remove the wiper arms of the affected windshield.
2. To ease damaged windshield removal, remove the rubber locking strips from the rubber extrusion.
3. For the lower windshield, from inside the vehicle, push against the top L.H. side corner of the 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. For the upper windshield, from the inside, loosen the screws of the destination sign access panel with the square key, open the hinged door and push the windshield on the R.H. side.

FIGURE 19: DESTINATION SIGN ACCESS PANEL

5. At the same time, another person gradually lifts the rubber lip from the vehicle exterior using a plastic spatula from top to bottom.
6. Remove the entire damaged windshield and broken glass if applicable.
7. Clean the rubber extrusion channel with Standox anti-silicone.

NOTE

If the rubber extrusion is damaged, remove and discard it, then clean the windshield opening with Standox anti-silicone.

10.1.5.3Windshield Installation

This procedure is provided as a general guideline to install a new windshield with a new gasket on a clean structure. The method may vary depending on material aging and condition.

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 (Figure 20).

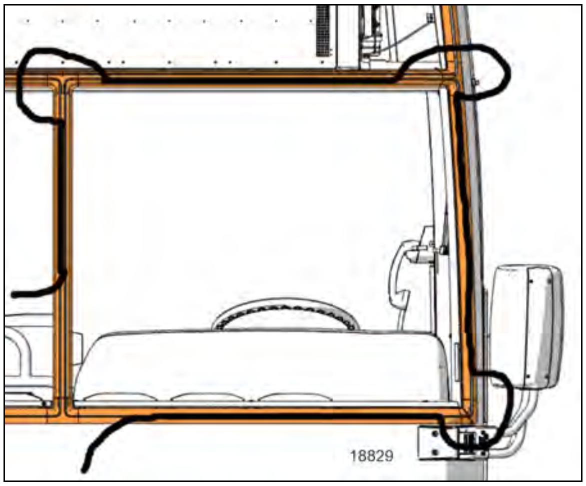


FIGURE 20: WINDSHIELD INSTALLATION USING ROPE

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. Follow the sequence shown below.

4. Push the windshield to the bottom of the rubber (steps 1, 2 then 3).

5. Push down the windshield (step 4)

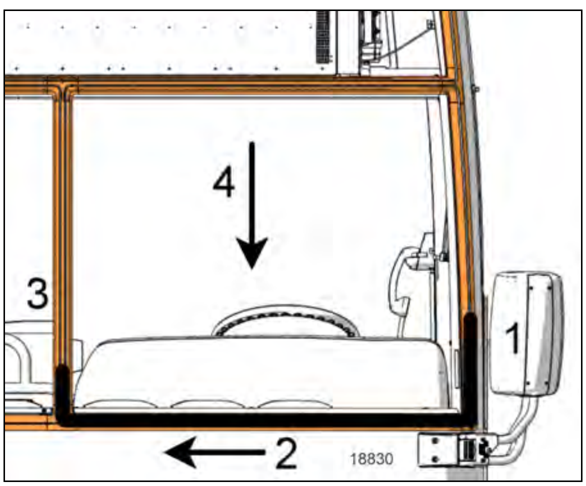


FIGURE 21: STEPS 1 TO 4

NOTE
Make sure windshield bottom edge is well inserted into the rubber extrusion groove before proceeding with the sides. Check the insertion inside and outside of the vehicle.

6. Pull the rope (steps 5 then 6).

7. Enter the windshield corner into the rubber (step 7).

8. Push the windshield toward the central pillar (step 8).

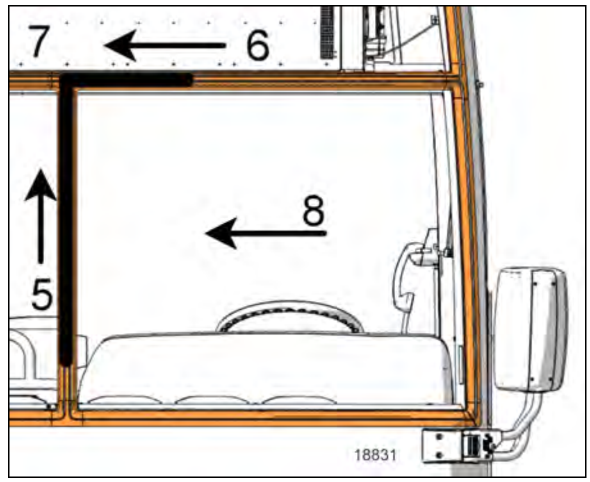


FIGURE 22: STEPS 5 TO 8

9. Pull the rope (step 9).

10. Pull the rope (step 10)

11. Enter the windshield corner into the rubber (step 11).

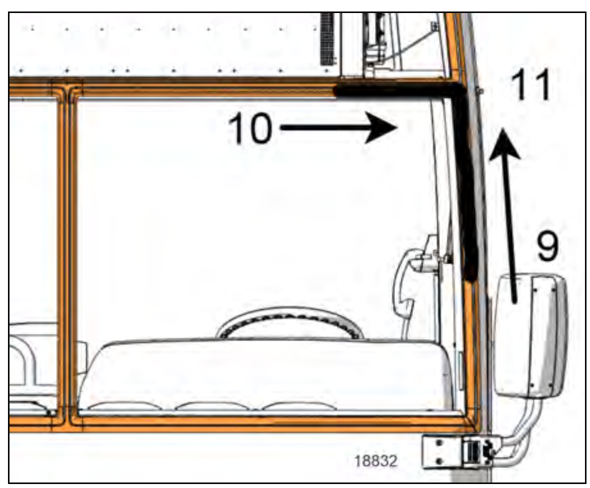


FIGURE 23: STEPS 9 TO 11

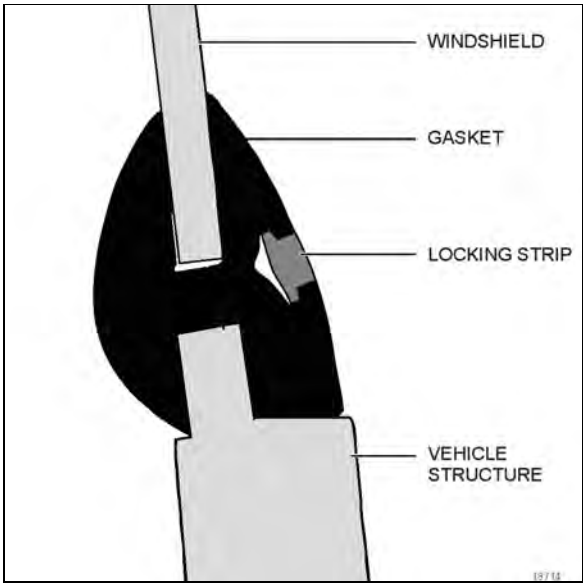


FIGURE 24: WINDSHIELD SECTION VIEW

9. Spray locking strip and rubber extrusion groove generously with soapy water.

NOTE
Locking strips retract with time. Install ends of locking strips as tight as possible in the V-channel.

10. Using insertion tool 680755, insert the strip into the rubber extrusion groove. Gradually insert strip making sure to leave a 2 inch excess length at the extremity.

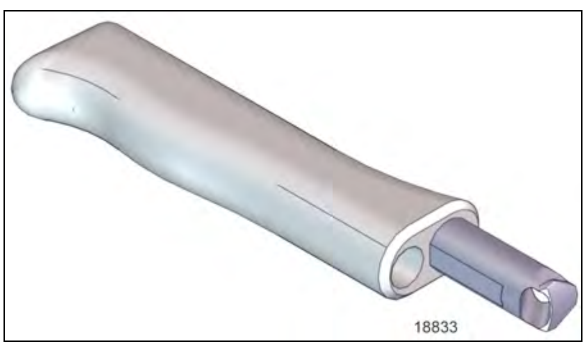


FIGURE 25: LOCKING STRIP INSERTION TOOL

11. IMPORTANT: Every 6 inches or so, slide backwards to compress the strip due to its tendency to contract during drying process.
12. When strip insertion is almost complete, cut end at a 45° angle leaving ¼" of excess length to prevent contraction over time then insert strip into groove.
13. Reinstall windshield wiper and destination sign if applicable.

10.1.5.4Installation of black seal

CAUTION

The black windshield seal fits correctly in only one position. Find the correct position of the seal now, and make reference marks with a marker to avoid searching for the correct position later in the procedure.

The black seal has different sections as shown in the following figures.

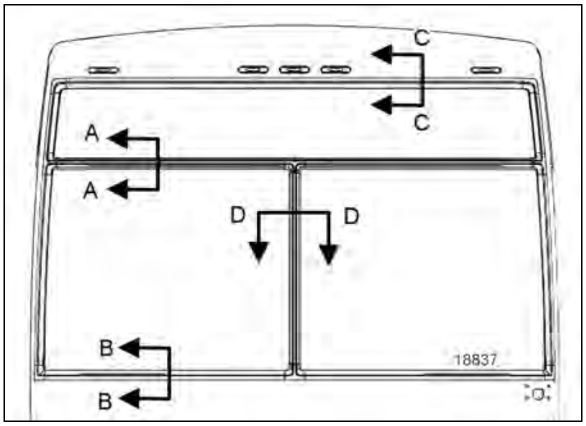


FIGURE 26: SEAL TYPICAL SECTION PLANS

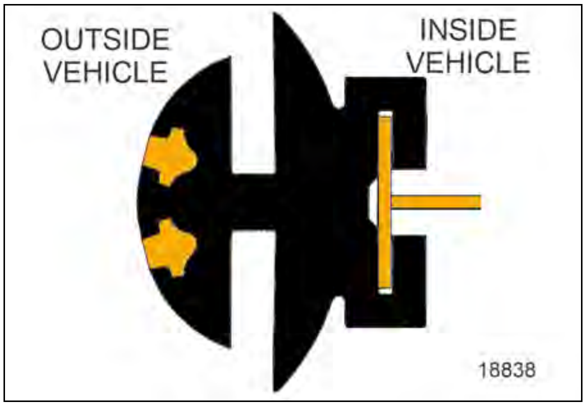


FIGURE 27: SECTION A-A

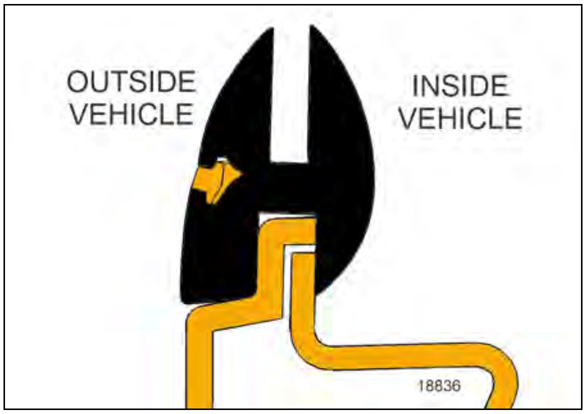


FIGURE 28: SECTION B-B

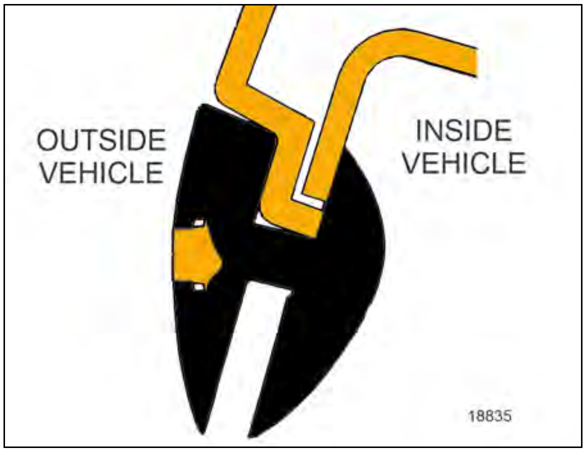


FIGURE 29: SECTION C-C

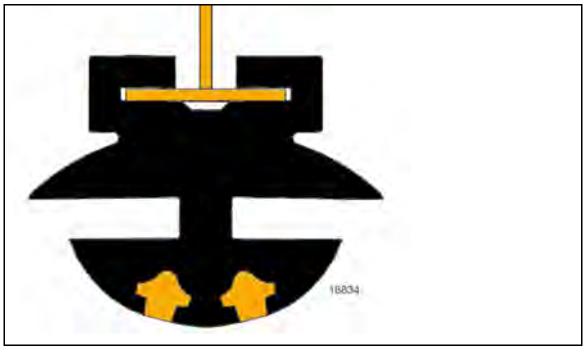


FIGURE 30: SECTION D-D

SEALANT APPLICATION

1. Clean the windshield opening sealing surfaces with anti-silicone and let dry.

2. Clean the seal groove with anti-silicone and let dry.

3. Prepare to apply bead of adhesive into the black seal grooves that are in contact with the fiber.

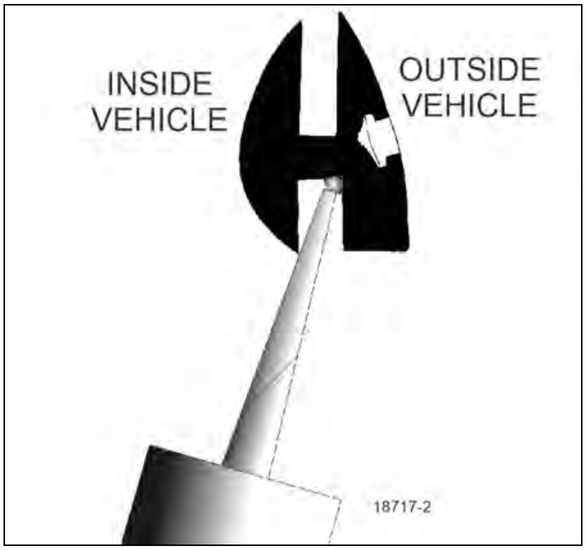


FIGURE 31: APPLICATION OF ADHESIVE

4. Apply a 1/8" bead of adhesive #684685 to the top, both sides and 8" in the bottom as shown in Figure 32. Apply adhesive before placing gasket on vehicle structure to control quality and continuity of the bead. This method helps achieve a watertight installation.

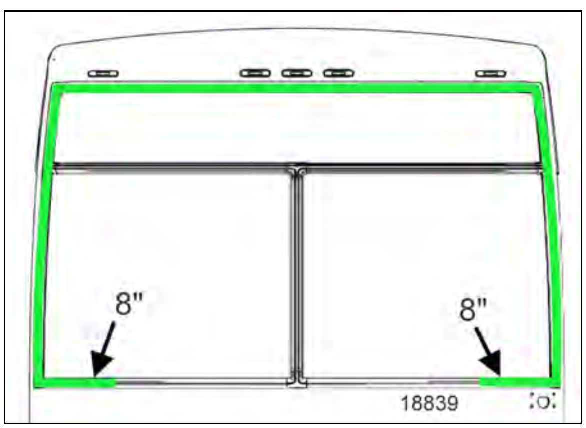


FIGURE 32: ADHESIVE LOCATION IN SEAL

5. Apply a 1/8" bead of adhesive on the fiber o the top and 8" on both sides as shown in Figure 33.

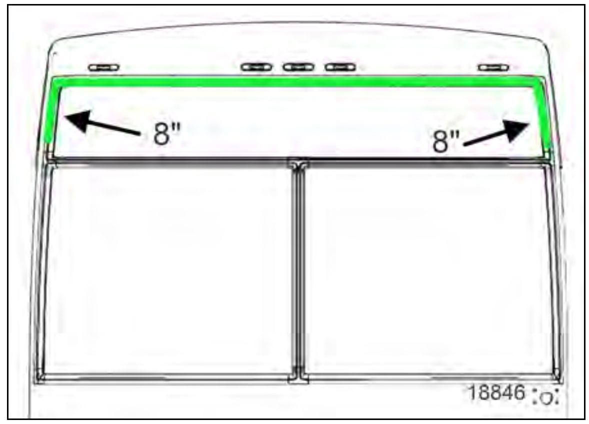


FIGURE 33: ADHESIVE LOCATION ON FIBER

6. Spread the adhesive as shown in Figure 34 and make sure to keep the layer around 1/16" thick.

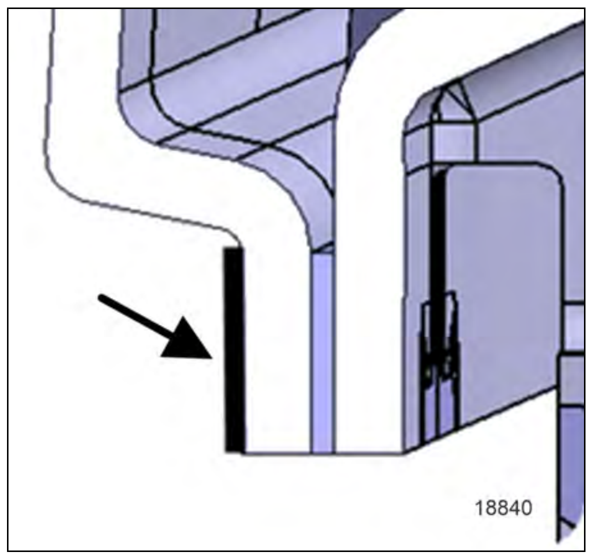


FIGURE 34: ADHESIVE SPREADING

BLACK SEAL INSTALLATION

7. Install black seal on the fiber in the center of the frame (step 1).

NOTE
Do not use soapy water for this step.

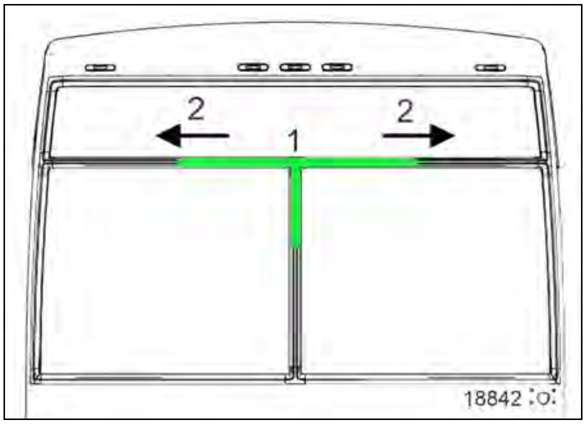


FIGURE 35: STEPS 1 AND 2

8. Bend the corner on both sides (step 3).

9. Fit the seal toward the center and downward (steps 4 and 5).

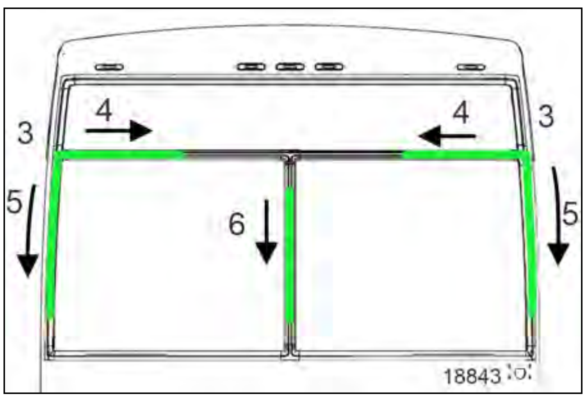


FIGURE 36: STEPS 3 TO 6

NOTE
Use soapy water for the next steps.

10. Fit the seal on the center pillar (step 6).

11. Insert the black seal in lower center (step 7).

12. Fit the seal toward the sides (step 8).

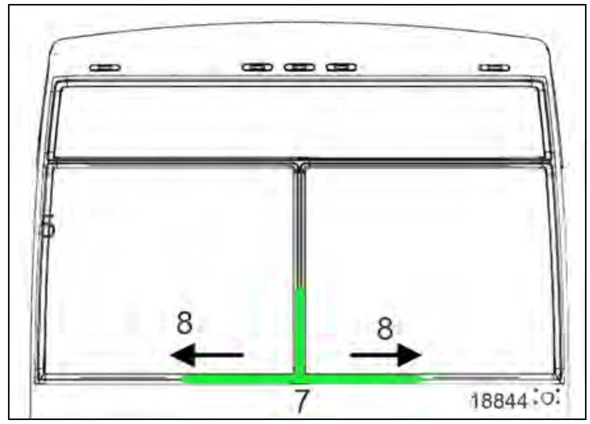


FIGURE 37: STEPS 7 AND 8

13. Bend the corners on both sides (step 9).

14. Complete installation of the lower part of the seal (steps 10 and 11).

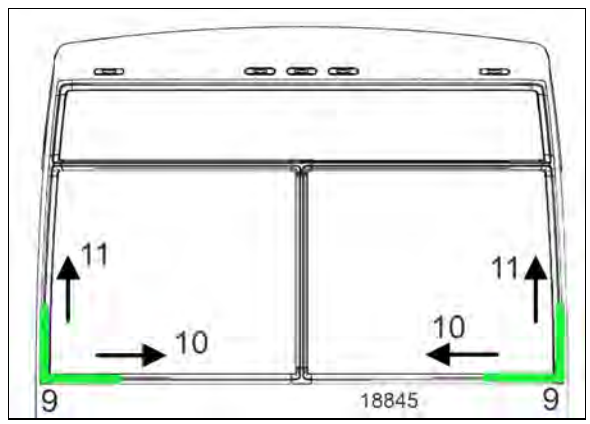


FIGURE 38: STEPS 9 TO 11

15. Bend corner on both sides of the upper section (step 12).

16. Complete installation of the upper section of the seal (steps 13 and 14).

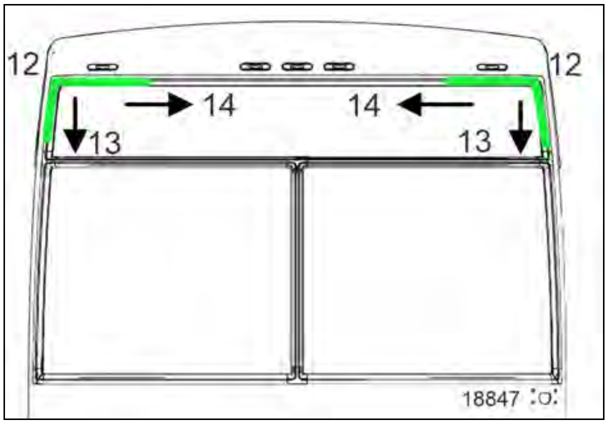


FIGURE 39: STEPS 12 TO 14

17. Install masking tape on the top seal of the upper section to keep the seal in position.

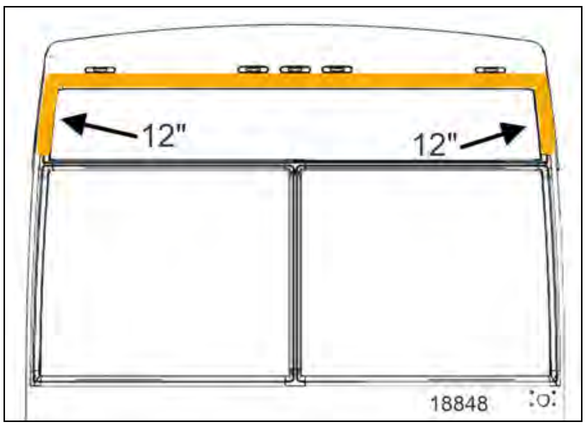


FIGURE 40: MASKING TAPE

18. Wait for adhesive to bond before installation of the windshields.

10.1.6 Entrance Door

An air operated entrance door, with an air door cylinder and damper assembly installed under the right hand dash for the R.H. door panel opening. Another air door cylinder is installed behind the wall to the right of the first curb-side passengers' seat for the L.H. door panel opening. The opening and closing door speed cycle is adjustable by a damper mounted in parallel with the R.H. door panel cylinder on the door hinge. Door activation is controlled by a panel (Figure 41), located near the defroster and wiper motors. The accessory air reservoir supplies air to this system.

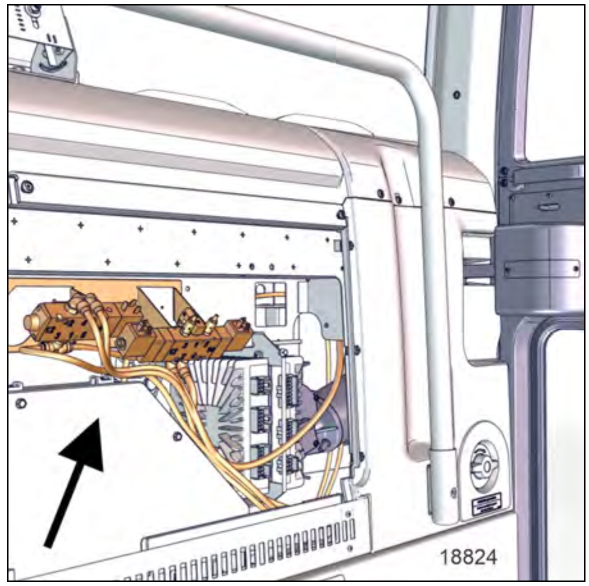


FIGURE 41: ENTRANCE DOOR & WIPER CONTROL PANEL

The door is held in the closed position during coach operation by a two air cylinder locking mechanisms (Figure 42).

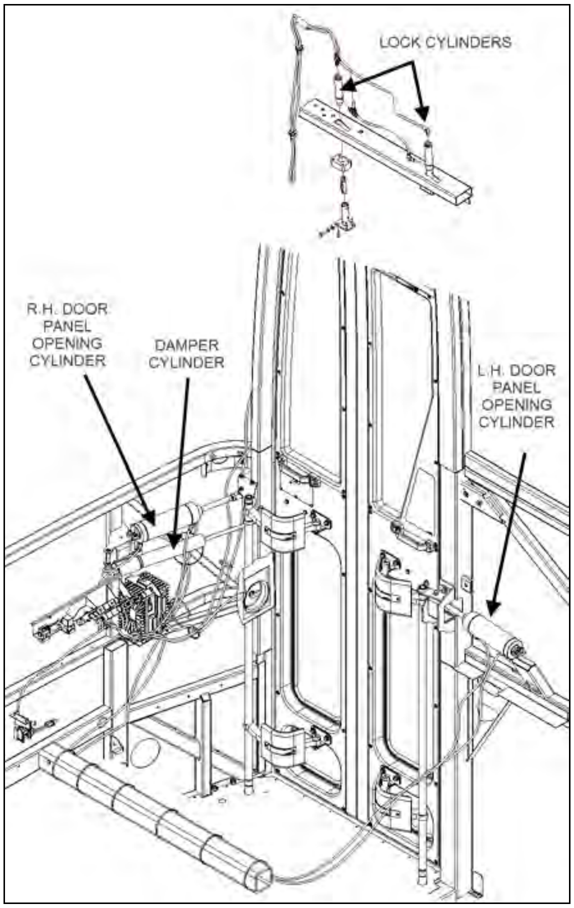


FIGURE 42: ENTRANCE DOOR - VIEW FROM INSIDE

Air cylinders with return spring in the cylinder body are used. Air cylinders are controlled by an electrically operated solenoid valve energized by a multiplex module located under the right hand dashboard.

To open the door, initial action from multiplex module output 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 cylinders, "the air cylinder close solenoid valve" exhausts air from the rod side of the cylinders.

To close the door, initial movement of the switch energizes the "air cylinder close solenoid valve" and air flows to the cylinders by their rod side ports. The "air cylinder open solenoid valve" exhausts air from cylinders. When the sensor signals the door as closed, the air lock solenoid valve is de-energized and loads the door lock cylinders. The cylinder moves the door lock in a position which engages a latch on the entrance door, holding the door positively closed.

Emergency exit valve, which opens the air valve circuit should be used only in emergencies, or when the door control system does not function properly.

Refer to the pneumatic diagram and to page 29.1 of the electrical diagram.

- **Operation**

Lock or unlock the entrance door from outside the vehicle by turning the key in the door lock (counterclockwise to lock, clockwise to unlock).

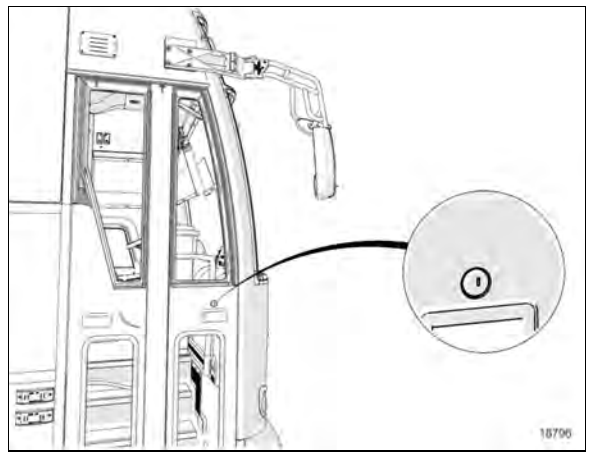


FIGURE 43: ENTRANCE DOOR LOCK

The entrance door can be unlocked from the inside using the small lever located on the door.

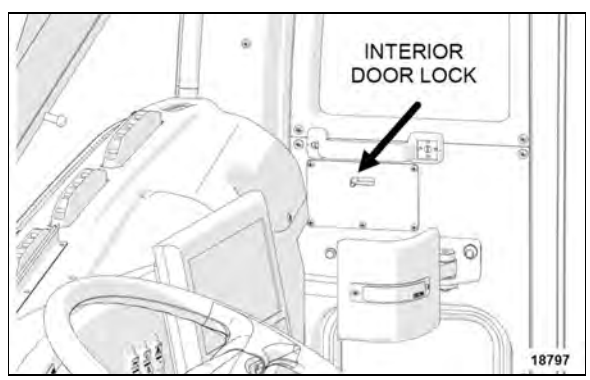


FIGURE 44: ENTRANCE DOOR INTERIOR LOCK

The air-operated door is controlled from inside the coach by a control switch located on the lateral control panel.

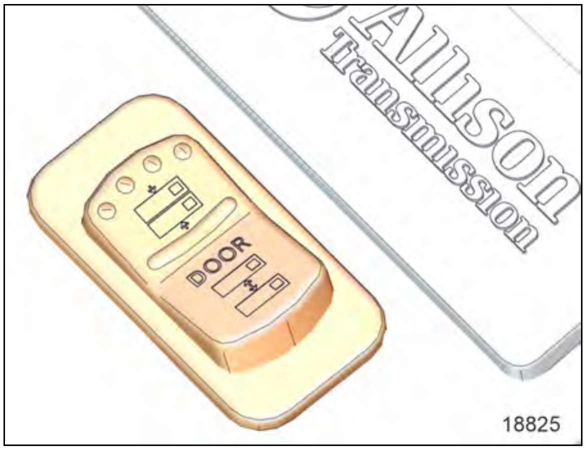


FIGURE 45: ENTRANCE DOOR OPERATING SWITCH

Use the GM key with the entrance door control switch to open or close the entrance door. The key can be remove in either position.

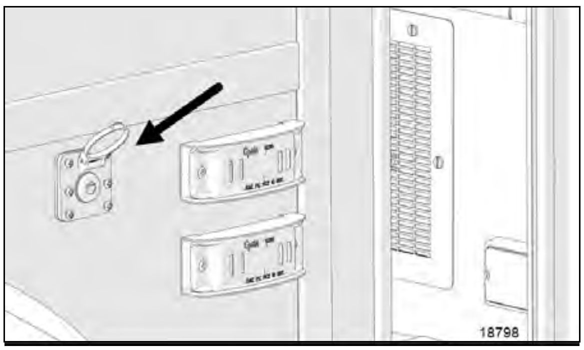


FIGURE 46: ENTRANCE DOOR OPERATION FROM ONTSIDE

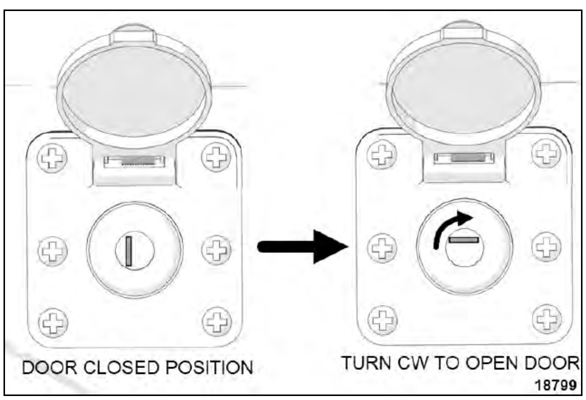


FIGURE 47: TO OPEN THE DOOR

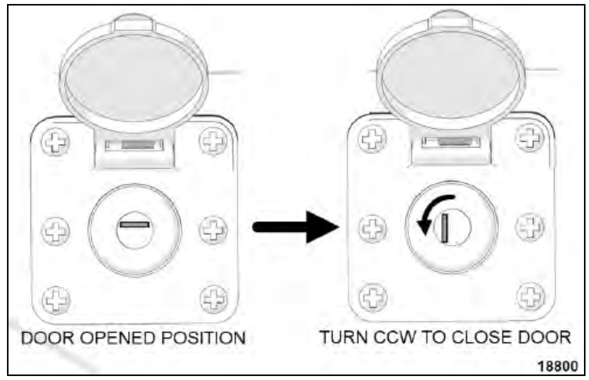


FIGURE 48: TO CLOSE THE DOOR

If the vehicle is in sleep mode, the key must be cycled first as shown below to wake up the multiplex system.

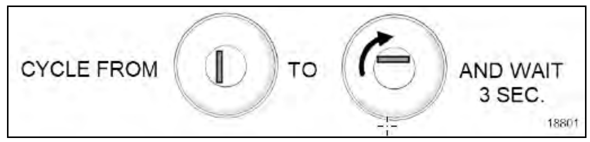


FIGURE 49: CYCLE THE KEY TO WAKE UP MULTIPLEX SYSTEM

- **Entrance Door Opening in Case of Emergency**

In case of an emergency, three relief valves are present on the vehicle to allow depletion of the entrance door cylinders and latching cylinders air pressure. Once the air pressure released, the entrance door can be opened by pushing or pulling with the hands.

NOTE
The entrance door must be unlocked to allow opening of the door manually. The door can be unlocked from the outside with the GM key (driver key) or from the inside with the locking lever located near the upper fore hinge.

Emergency Air Pressure Relief Valve On The Lateral Control Panel

To open the door in an emergency, pull the knob to release the air pressure. Push the lateral control panel relief valve down to reapply air pressure for normal operations.

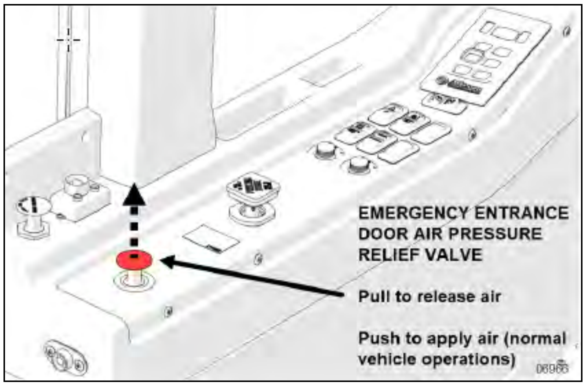


FIGURE 50: AIR PRESSURE RELIEF VALVE ON THE LATERAL

Emergency Air Pressure Relief Valve At The Entrance Steps

To open the door, turn the relief valve in the direction of the arrows (CW) and push the door open. Return the valve to its initial position (CCW) for normal operations.

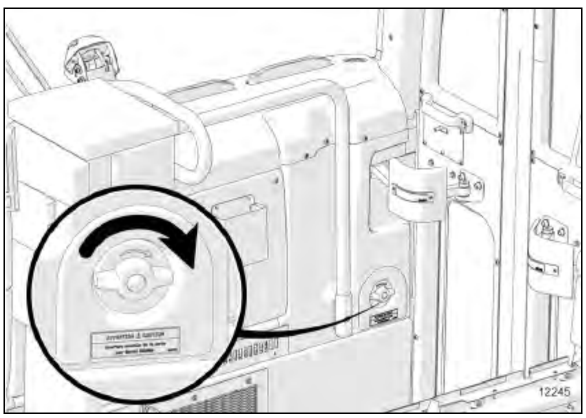


FIGURE 51: EMERGENCY AIR PRESSURE RELIEF VALVE AT THE ENTRANCE STEPS

Emergency Air Pressure Relief Valve In The Front Service Compartment

Another relief valve is located in the front service compartment to allow depletion of the entrance door air system from the outside.

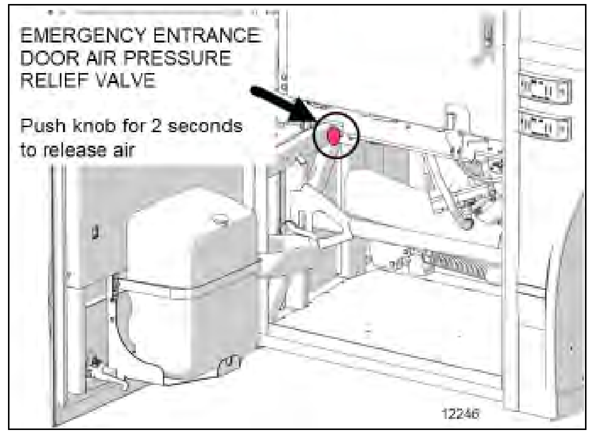


FIGURE 52: EMERGENCY AIR PRESSURE RELIEF VALVE IN THE

To open the door, push the knob for two seconds to release the air. The air pressure relief valve on the lateral control panel will pop out.

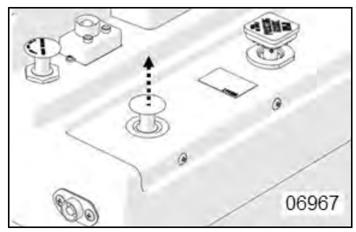


FIGURE 53: RELIEF VALVE ON THE LATERAL CONTROL PANEL

Push the lateral control panel relief valve back to reapply air pressure and return to normal operations.

- **Door Cycle Speed Adjustment**

To do any adjustment, remove the panels located next to the R.H door panel hinges.

⚠ CAUTION
It is important to make sure that damper does not reach end of stroke when the entrance door is completely closed or opened. The door cylinders must stop the door on opening. Screw or unscrew rod end to adjust if necessary.

To adjust opening and closing cycle speed on damper (Figure 54):

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 (Figure 54).

NOTE
In Figure 54, if there is an indentation (B) in the dust cap (C) and the cover shows two holes (A), the damper is fitted with a bump rubber (D). If so, fully extend the damper and insert a round bar or screwdriver through the holes. Push the bump rubber down and remove. Remove the split plastic collar (E) (if fitted) from the piston rod.

3. The damper may have already been adjusted. Therefore check whether the damper is adjusted or not by keeping it closed and gently turning further CCW, counting at the same time the half-turns until a stop is felt. Stop turning and do not force.

4. While keeping the damper closed, make two CW half-turns. In case of prior adjustment, add the number of half-turns previously counted. The total range is about five half-turns. Pull the damper out vertically without turning for at least 3/8" (1cm) to disengage the adjusting mechanism. The dust cap or piston rod may now be turned freely.

5. The damper can now be refitted in the vehicle.

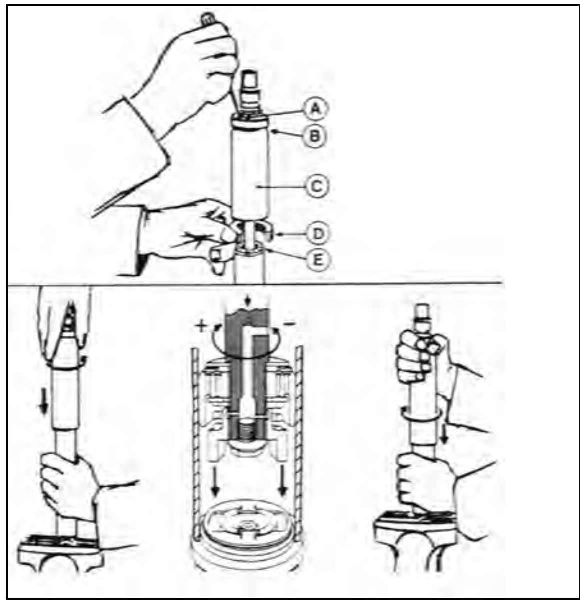


FIGURE 54: DAMPER 18643

NOTE
*Where a bump rubber was installed, refit same inside the dust cap and by fully closing the damper, the rubber will seat again at top of the dust cap. Refit the split plastic collar E (*Figure 54*).*

6. Reinstall panels and R.H. entrance door panel hinge cover.

- **Entrance Door Panel Adjustments**

Before attempting to correct any entrance 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:

  o Horizontal and vertical adjustment

1. Support the door panel with a wooden block and a hydraulic jack.

2. Unfasten the bolts fixing the door panel plates. See Figure 55

NOTE
Ask an assistant to help you to perform the following adjustments.

3. Adjust the door horizontally and vertically with the jack. Tighten the bolts. Remove the jack and the wooden block.

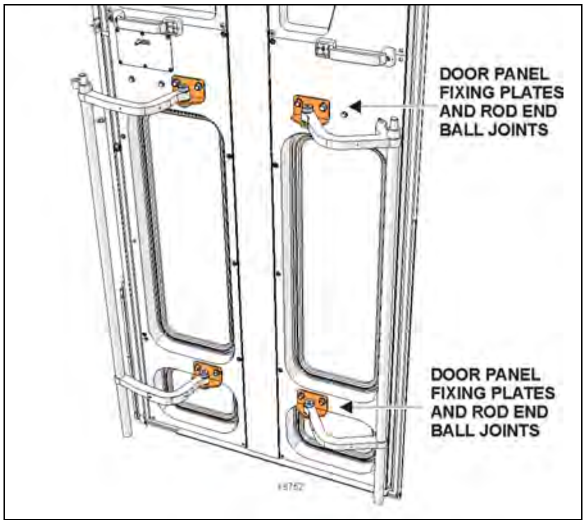


FIGURE 55: DOOR PANEL ADJUSTMENTS

- o Depth adjustment

1. Support the door panel with a wooden block and a hydraulic jack.
2. Unfasten and then disconnect rod ends from door panel fixing plates. Screw or unscrew rod end in order to adjust door panel depth.
3. Tighten the bolts. Remove the jack and the wooden block

- **Lubrication**

Part	Lubricant	Frequency
▪ Latches ▪ Upper door catch ▪ Door cylinder rod end with bearing grease fitting	*Low temperature grease*	Every six months
▪ Door locking mechanism	*White grease*	Every six months
▪ Key hole ▪ Damper pins ▪ Hinges	*Low viscosity oil*	Every six months

- **Troubleshooting**

SYMPTOMS	PROBABLE CAUSES	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 upper lock. Lubricate upper latch bolt. Adjust upper latch height.
DOOR LOCKS STAY ENGAGED WHEN DOOR IS OPEN.	Power supply is cut at solenoid.	Place switch in open position.
	Lock solenoid does not disengage.	Check voltage at solenoid lock when door is OPEN. If the voltage is 24 volts then replace solenoid #641217. Else, check circuit power and replace control relay.
DOOR LOCKS DO NOT LOCK WHEN DOOR IS CLOSED.	Emergency valve is open.	Close emergency valve.
	Lock solenoid stays electrified.	Check latch bolt ground on door frame. If needed clean locks for better contact. Check ground circuit.
	Lock solenoid works in reverse.	Reverse air hoses at solenoid locks.
	Relay does not function.	Replace relay.

10.1.7 Front Service Compartment Door

10.1.7.1Door skin Panel replacement

For the removal of front service compartment door skin panel, you will need:

Pneumatic hammer tool (Zip Gun);

Razor sharp window scraper.

SKIN PANEL REPLACEMENT

1. Open service door.
2. Remove rub rail fixing bolts, then remove rub rail.
3. Remove windshield washer reservoir, new reflector amber #930212, door lock, handle and power window connector.
4. Remove the vertical door mounting bolts (4) and install the door onto a work surface where it can be solidly fixed.

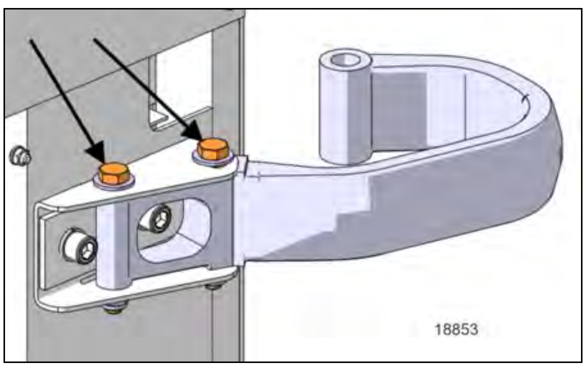


FIGURE 56: DOOR MOUNTING BOLTS

NOTE
For the next step, wear ear plugs during this operation.

5. Using the "**Zip Gun**", separate the skin panel from the door frame by cutting the Sika bead from each door frame edge.
6. Using a razor sharp window scraper, remove from door frame the Sika bead and double-face self-adhesive tape residue.
7. Clean door frame using anti-silicone.
8. Using a scratch pad "Scotch Brite", scratch the perimeter of the door frame where the adhesive will be applied.
9. Clean door frame again using anti-silicone.
10. Apply some Primer Terostat 450 #687959 onto door frame.

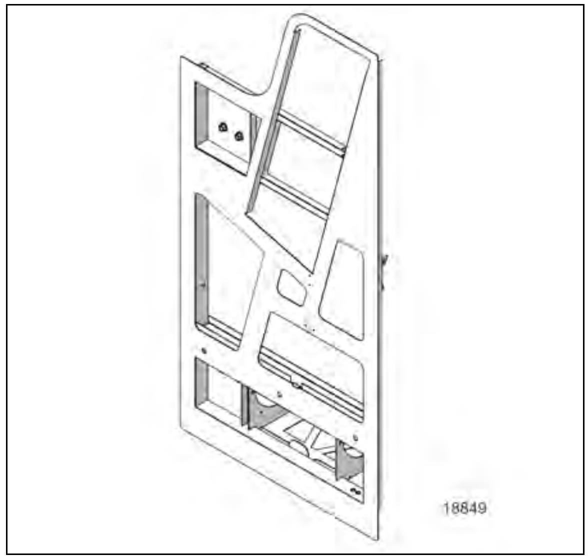


FIGURE 57: DOOR FRAME WITHOUT SKIN PANEL

11. Prepare new skin panel using a scratch pad "Scotch Brite".
12. Use a tack cloth to remove any dust or residue from the skin panel surface.
13. Clean skin panel using anti-silicone.
14. Apply some Primer Terostat 450 #687959 onto skin panel.

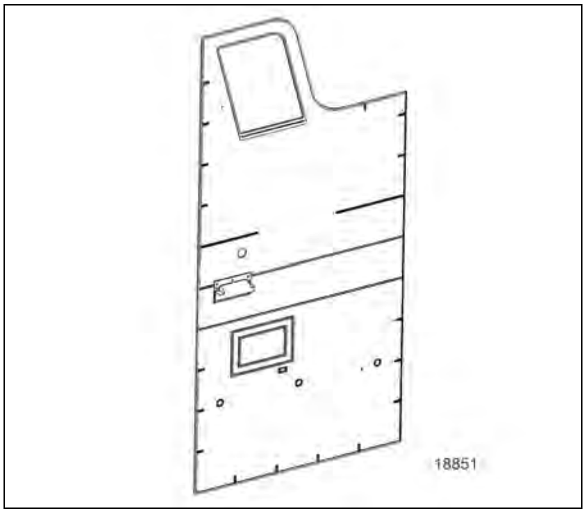


FIGURE 58: DOOR SKIN PANEL

15. Apply an even coat of glue Teroson MS 9399 onto the door frame following the layout shown in Figure 59.

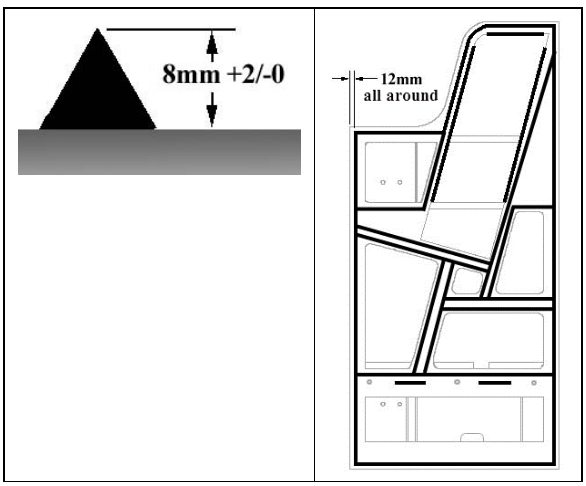


FIGURE 59: GLUE APPLICATION LAYOUT

16. Position skin panel onto door frame and compress with your hands.

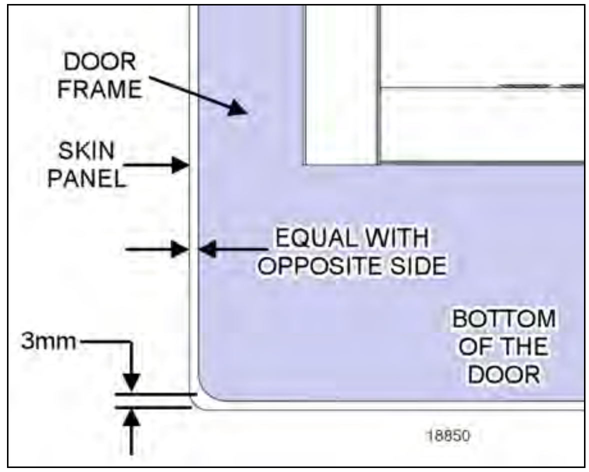


FIGURE 60: SKIN PANEL POSITIONNING

17. Install C-clamps with flat swivel all around the frame to keep pressure between the door frame and the skin and install weight in the center area. Keep the pressure for 90 minutes.

FIGURE 61: C-CLAMP

18. Check body panel flatness using a 2-foot ruler (must be within 2mm).

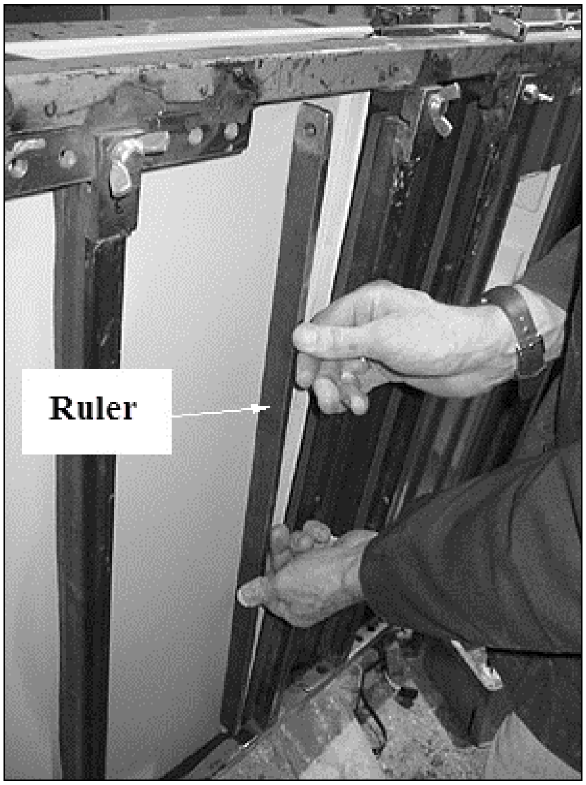


FIGURE 62: FLATNESS CHECK

19. Check proper power window sliding inside window frame.

20. If applicable, remove excess of adhesive all around door frame using Sika 208.

21. From the inside of the door, apply some sealant Sika 221 between door skin panel and frame and on welding spots as per Figure 63.

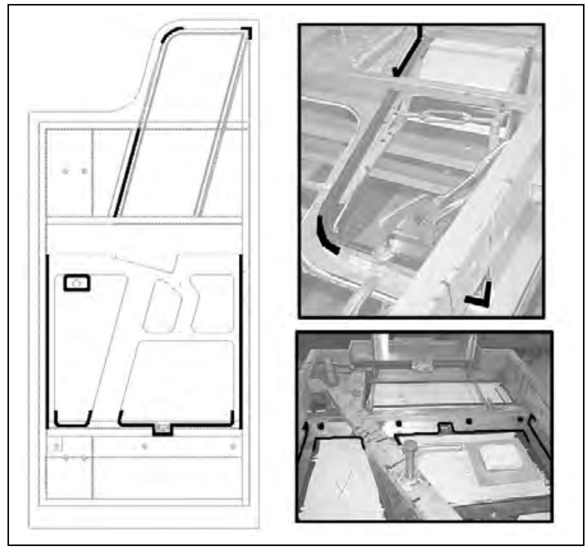


FIGURE 63: SEALANT APPLICATION

22. Apply some #680066 glue inside fiber glass groove and fix power window wiper.

NOTE
Anti-friction side must be on glass side.

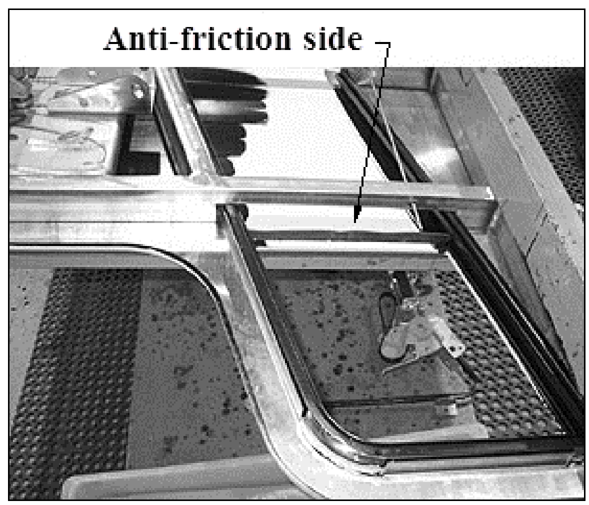


FIGURE 64: ANTI-FRICTION SIDE

23. From inside the door, apply some Sika 252 at the corners of window wiper.

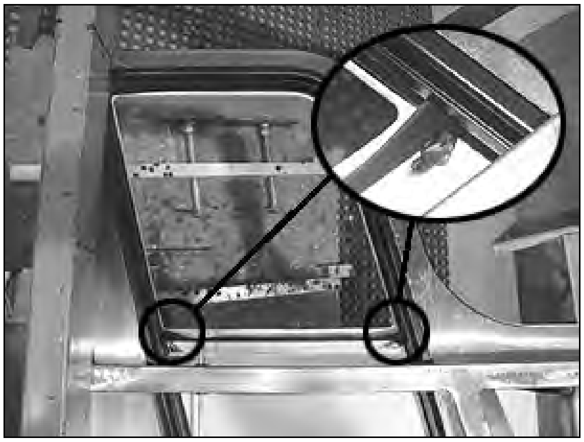


FIGURE 65: WINDOW WIPER CORNER

24. Apply some #680066 glue inside finishing panel groove and fix power window wiper.

NOTE
Anti-friction side must be on glass side.

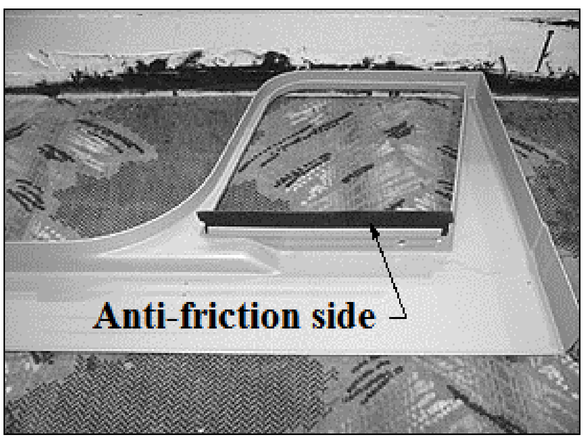


FIGURE 66: ANTI-FRICTION SIDE

25. Install rub rail with fixing bolts.

26. Install windshield washer reservoir, new reflector amber #930212, door lock, handle and power window connector.

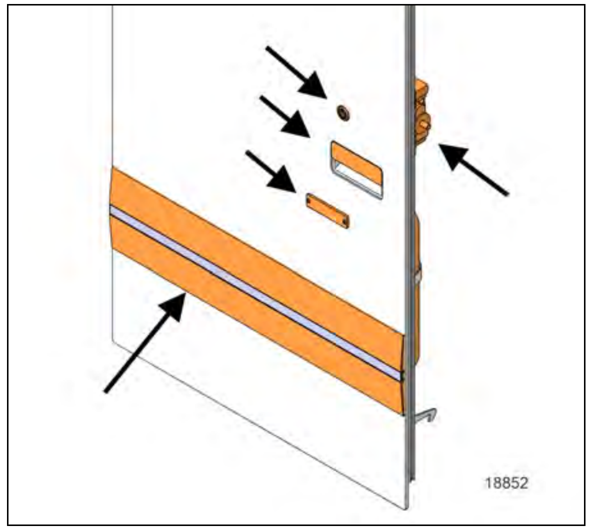


FIGURE 67: COMPONENTS REINSTALLATION

27. Reinstall the door on the vehicles with the mounting bolts (4).

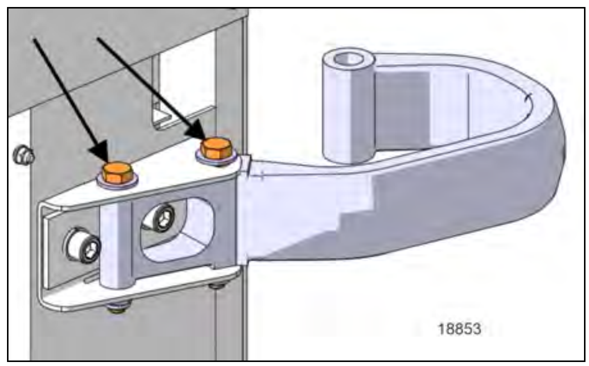


FIGURE 68: DOOR MOUNTING BOLTS

28. Tighten bolts to a torque value of 50 lbs-pi.

29. Make sure to keep a minimum of 4 mm and not very much between the door skin and the side panel.

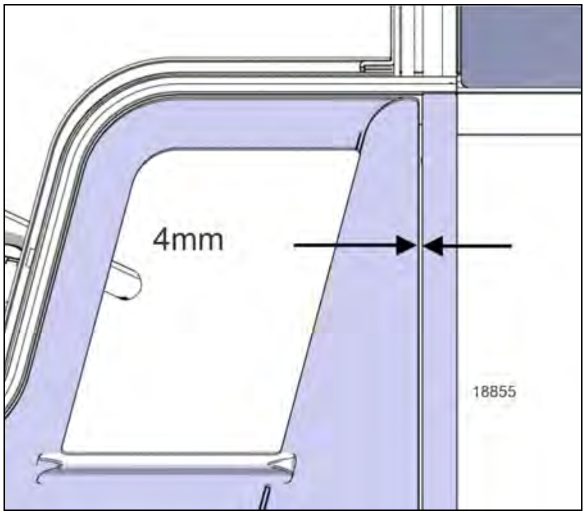


FIGURE 69: DOOR ADJUSTMENT

30. Discard waste according to applicable environmental regulations, use dangerous waste containers.

10.1.7.2Electrical Power Window

1. Insert 2 seals in the window frame.
2. Apply some #680066 glue at the intersection of the 2 seals and also sparingly in order to fix the seal to the window frame.

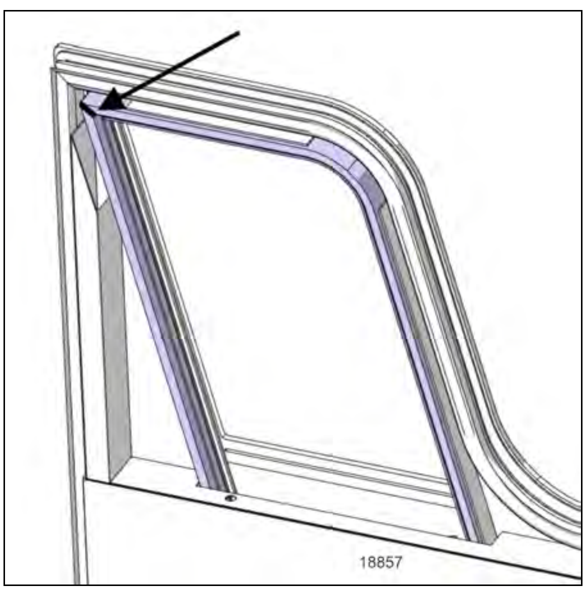


FIGURE 70: SEAL INTERSECTION

3. Clean window using window cleaner.
4. Insert window into frame.

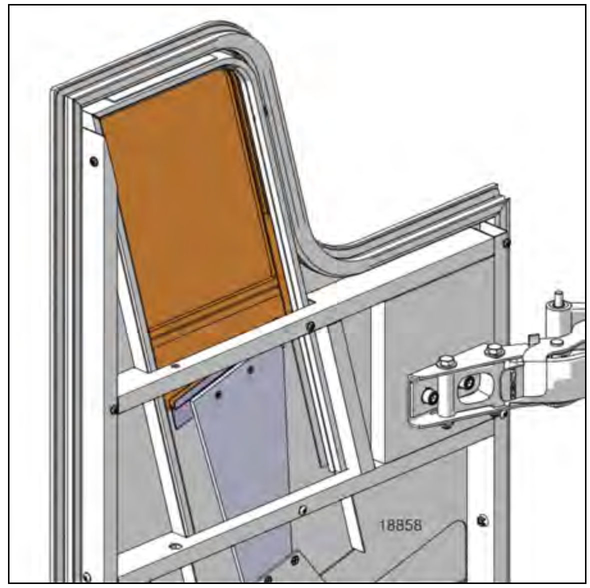


FIGURE 71: WINDOW INSTALLATION

5. Secure window pane to raising mechanism.

DRIVER'S WINDOW GUTTER

6. If applicable, remove plastic film at the bottom of driver's window.
7. Dry fit the gutter on the vehicle and straighten if necessary.

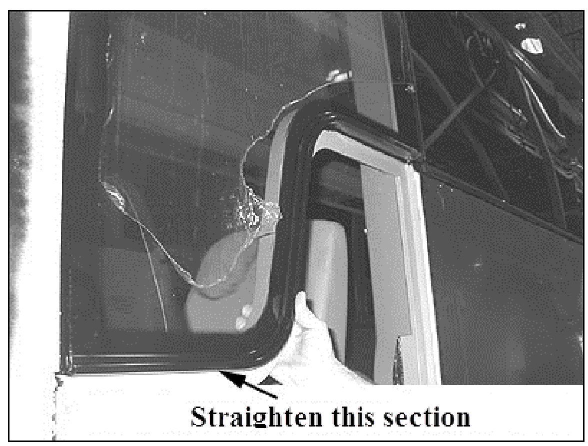


FIGURE 72: DRY FIT AND STRAIGHTENNIG

8. Remove excess of Sika underneath driver's window.
9. Clean bottom of driver's window using window cleaner.
10. Apply Sika Aktivator at the bottom of driver's window.

11. Install gutter under driver's window then compress in order to fix double face self-adhesive tape.

12. Install 3 clamps and allow curing for 4 hours.

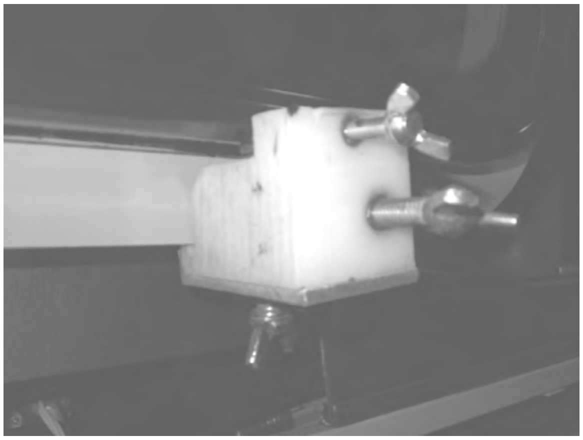


FIGURE 73: CLAMP FOR CURING

FIGURE 74: CLAMPS INSTALLATION

10.1.8 Front Cap

The fiberglass front cap does not need any maintenance except painting as needed. It is held in place with adhesive. If ever it has to be replaced, make an appointment at a Prevost service center near you. For minor damages, refer to paragraph 7 "COMMON FIBERGLASS REPAIR PROCEDURE" and paragraph 8 "COMMON PAINTING PROCEDURE".

10.2 ZONE 2

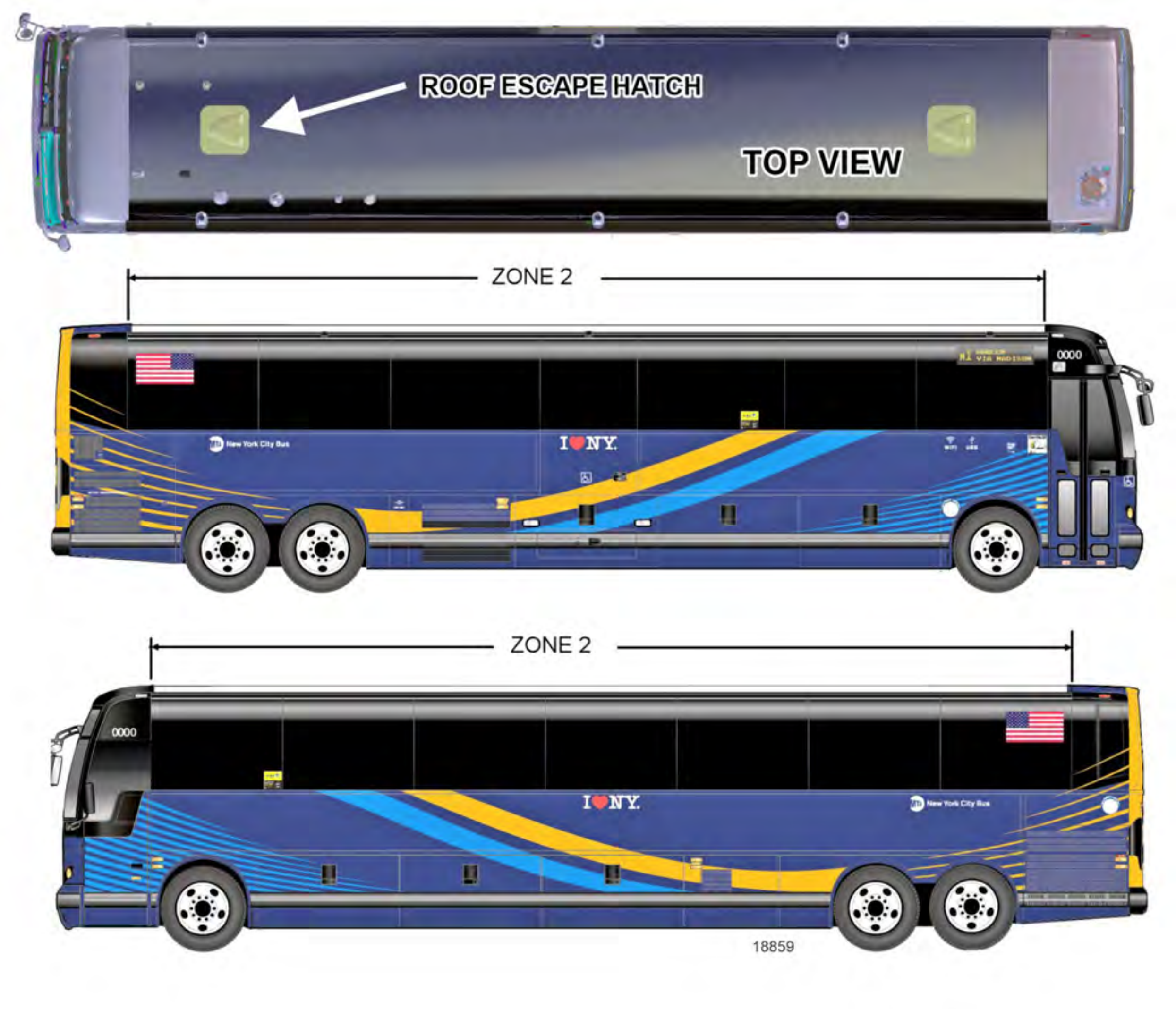


FIGURE 75: ZONE 2

10.2.1 Side Windows

Passenger side windows are installed on each side on the vehicle (7 on the driver side and 6 on the curb side). They are made 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 double-glazed windows are made of tinted tempered safety glass outside and clear tempered glass inside.

10.2.2 Emergency Exit Windows

Except for the top window edge, the three glass edges are unprotected. The workers must be extra 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 as support. It is recommended to use a wooden support, or even better, a padded surface.

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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 (Figure 76).

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.

- **Emergency Exit Release Bar**

The emergency exit release bar system is generally maintenance free. It has been designed to answer the twenty pound resistance criteria for opening the emergency window. If this handle should be replaced:

1. Remove the screws and bolts securing it to the emergency exit window;
2. Install a new release bar, reverse the procedure.

NOTE
Check the legal requirement of twenty pound maximum resistance to be sure to comply regulations.

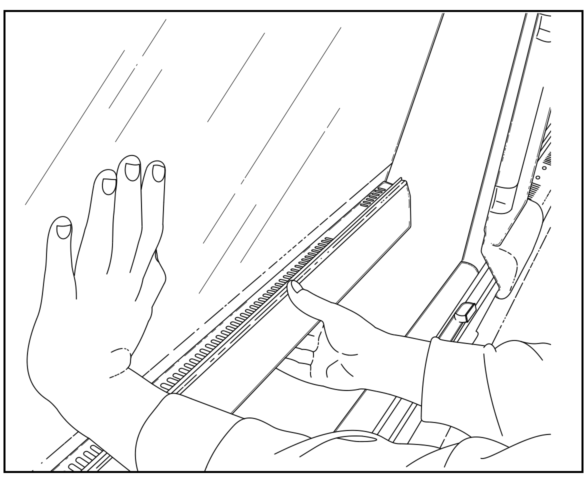

FIGURE 76: EMERGENCY EXIT WINDOW 18008

- **Emergency Exit Window Adjustment**

ergency 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.

- **Emergency Exit Window Replacement**

NOTE
Window is heavy and fragile. Use suction cup handles and help from teammates. Prepare a soft material surface to receive the removed window.

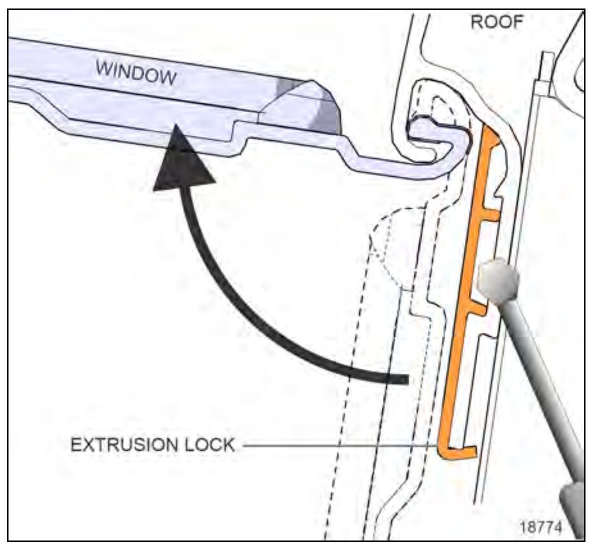

FIGURE 77: EMERGENCY EXIT WINDOW REMOVAL

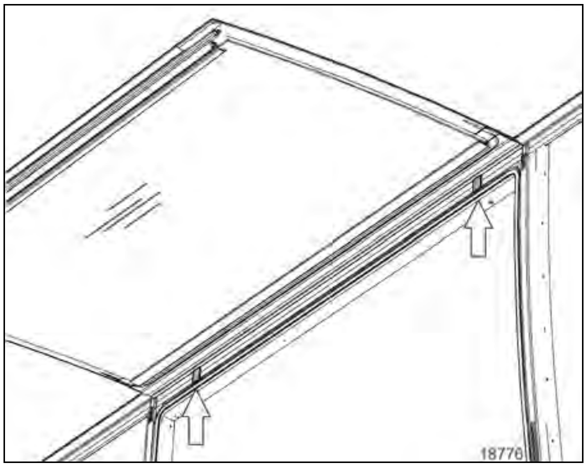

FIGURE 78: EXTRUSION LOCK LOCATION

1. Lift the bar release system;
2. Partly lift the window and support it so it stays open.
3. Remove the two extrusion locks with a flat screwdriver.
4. With the help of teammates, slowly rotate the window outward ninety degrees (90°). At this angle the window can be released by slightly pushing the window inward.

WARNING

Ask teammates to support the window else it may fall out.

5. The window is free and can be unhooked.

Reverse the procedure to install a new emergency exit window.

10.2.3 Roof Escape Hatch

The vehicle can be equipped with two escape hatches. The escape hatch is designed to provide years of reliable service with a minimum of maintenance. All components are rust proof, and moving parts are Teflon coated to eliminate need for lubrication. Should water infiltrate the vehicle from the escape hatch, refer to the heading "Sealing" in this paragraph for procedures on how to seal this area.

CAUTION

Use of lubricants, paints, or other coatings such as graffiti deterring sprays is not recommended.

Suggested maintenance includes periodic inspection of fasteners for evidence of loosening due to tampering, and regular cleaning with mild soap and water.

Although there are other cleaning solutions available, some contain solvents and other chemicals that can attack the high strength materials used in the production of the escape hatch.

CAUTION

Ensure that cleaning solutions are compatible with the materials used on the escape hatch.

Graffiti removing cleaners often contain acetone, ether, lacquer thinner or other solvents known to destroy the high strength properties of many plastics. Use of these cleaners must be avoided. Graffiti-resisting coatings often leave a sticky residue that interferes with smooth up/down movement of the hatch mechanism. Some of these coatings also contain solvents that will reduce the strength of certain components.

CAUTION

Use of these coatings is at considerable risk and should be avoided.

- **Repair**

All components used in the production of the escape hatch are available as service parts, except for one hinge that represents a possible hazard when improperly reattached to a hidden tapping plate, itself often damaged whenever the hinge is damaged. The tapping plate is permanently laminated between the inner and outer cover assemblies, and it cannot be inspected or replaced. It is therefore necessary to replace the entire assembly following damage to the hinge. See Figure 79.

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.

- **Sealing**

1. Open and tilt up the escape hatch cover.
2. Join the 2 ends of the rubber seal.

CAUTION

Seal joint should be toward rear of vehicle.

3. Apply rubber adhesive CA-40 (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.

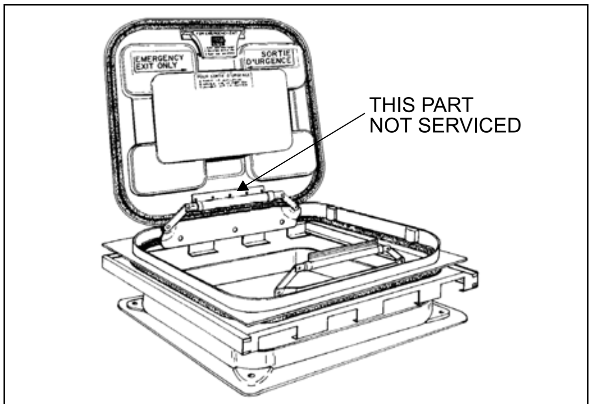

FIGURE 79: ESCAPE HATCH 18104

- **Escape Hatch Panel Assembly**

The frame of the escape hatch is riveted to the roof of the vehicle. The escape hatch panel assembly can be replaced as a unit and a new panel assembly installed in the existing frame. To remove the panel assembly, remove the 4 bolts fastening the 2 hinges to the escape hatch frame and retain the 4 flat washers. Reinstall the panel assembly by fastening the 2 hinges with the 4 bolts and flat washers removed earlier.

CAUTION

When installing, roof escape hatch's hinge must be toward the front of vehicle, to prevent the hatch from being ripped out if accidentally opened while vehicle is running.

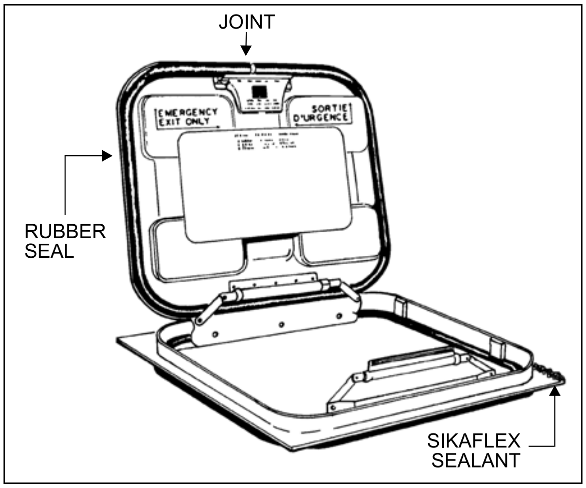

FIGURE 80: ESCAPE HATCH 18105

- **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.

10.3 ZONE 3

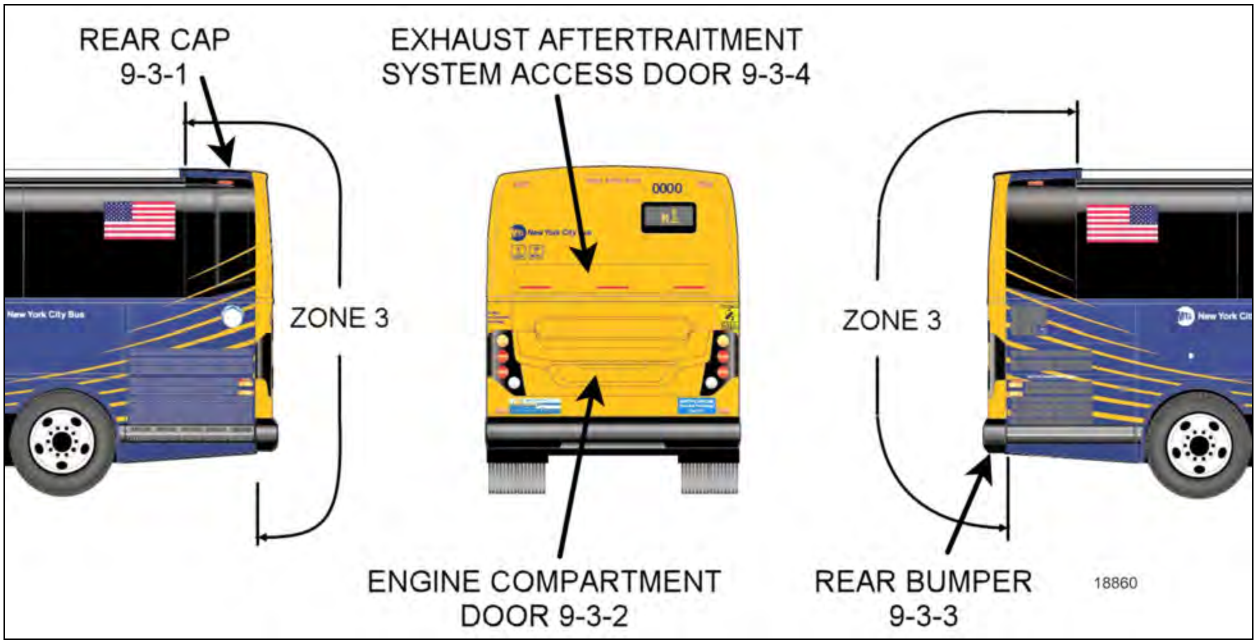

FIGURE 81: ZONE 3

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10.3.1 Rear Cap

The fiberglass rear cap does not need any maintenance except painting as needed. It is held in place with adhesive. If ever it has to be replaced, take an appointment at a Prevost service center near you. For minor damages, refer to Paragraph 4 "Common Fiberglass Repair Procedure" and Paragraph 5 "Common Painting Procedure".

10.3.2 Engine Compartment Door

The engine compartment door may be adjusted for proper fit by untightening support bolts:

NOTE
*Consult the “BODY PANEL AND WINDOW SPACING DIAGRAM” for proper door gaps adjustment. (*Figure 152*)*

1. To adjust the door VERTICAL position, loosen the bolts (4 on each side) holding the door supporting arm and gas springs bracket to the *vehicle structure* (**Erreur ! Source du renvoi introuvable.**).
2. To adjust the door LATERAL position, loosen the bolts (3 on each side) holding the door supporting arm and gas springs bracket to the *door* (**Erreur ! Source du renvoi introuvable.**).
3. Adjust the door FORE & AFT position by screwing/unscrewing the rubber door stops on each side of the door opening (**Erreur ! Source du renvoi introuvable.**).
4. Check that the door swings freely and close properly. *It may be necessary to adjust the door latch to get proper fit and operation*.

To adjust the latch mechanism and the striker pin:

1. Open the door to access the striker pin.
2. *Slightly* loosen the striker pin.

3. Using a hammer, adjust the striker pin to center it in the door latch mechanism.
4. Tighten the striker pin.
5. Check door fit and operation.

10.3.3 Rear Bumper

Remove three bolts on each side holding bumper to vehicle and remove bumper.

To install bumper, reverse the procedure.

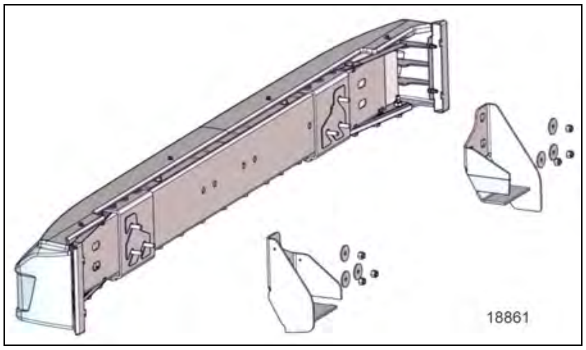


FIGURE 82: REAR BUMPER

10.3.4 Exhaust Aftertreatment System Access Door

1. Open exhaust aftertreatment system access door.
2. Loosen the screws holding the panel to hinge assembly.
3. Adjust the door position according to distance required between exterior finishing parts.
4. Tighten the nuts.
5. Check that the door swings freely and closes properly.

10.4 ZONE 4

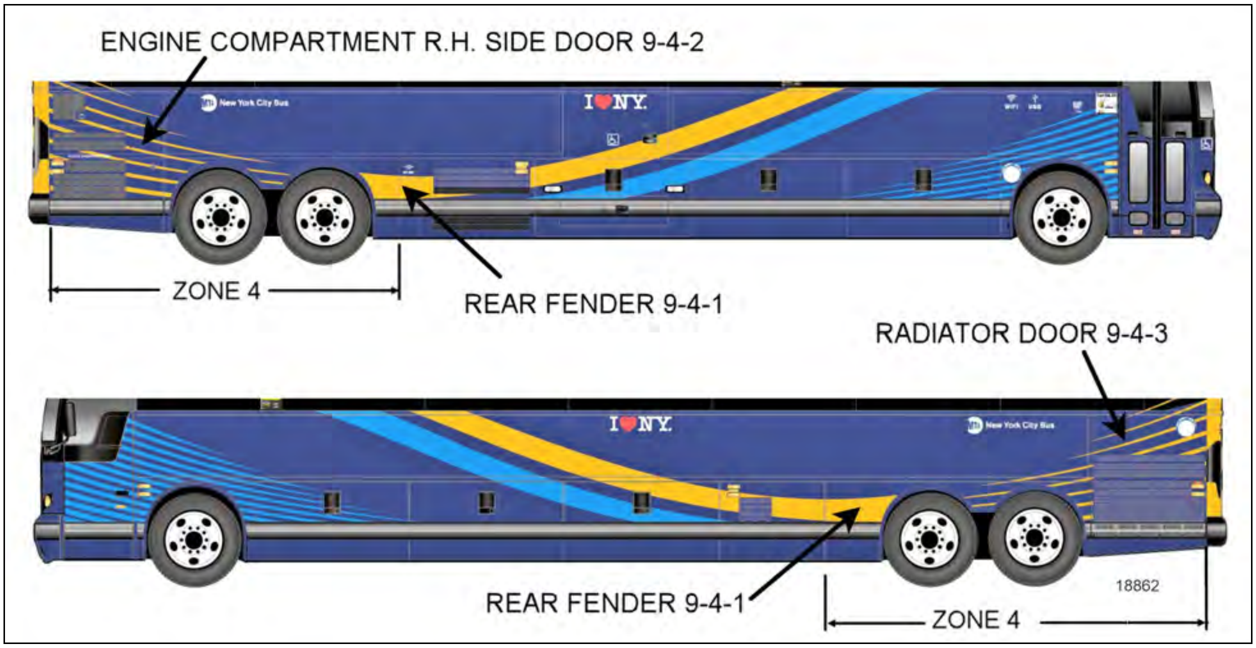


FIGURE 83: ZONE 4

10.4.1 Rear Fender

Rear fenders are hinged for maintenance on brakes and suspension. Each rear fender panel has two mechanical spring loaded holding devices fixing it to the vehicle's structure.

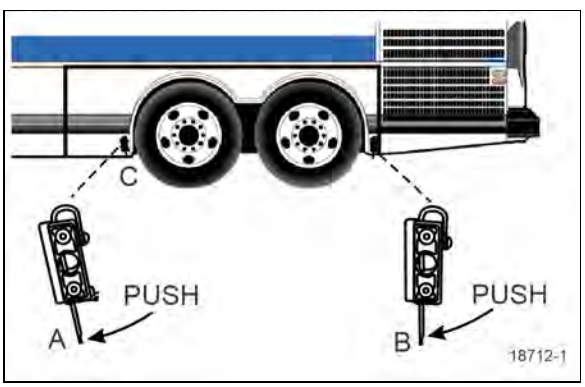


FIGURE 84: LEFT REAR FENDER LATCHES

To lift a rear fender:

1. Push rod sideways on latch A and B (image above);
2. Pull the secondary latch and then lift the fender.

NOTE
The vehicle is equipped with a secondary lock. Pull the handle to disengage the lock.

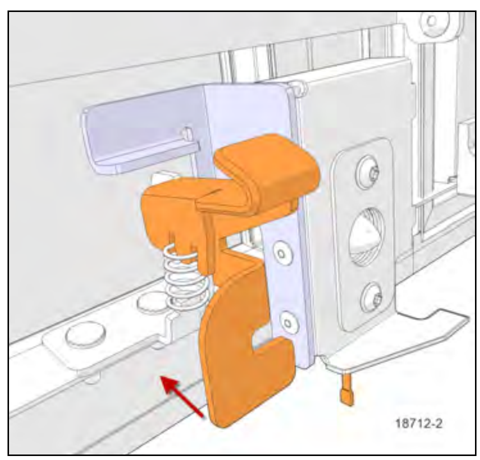


FIGURE 85: SECONDARY LATCH

10.4.2 Engine Compartment R. H. Side Door Adjustment

Engine compartment R. H. side door is adjusted for proper fit by following the steps below:

1. Loosen door roller support bolts (4)

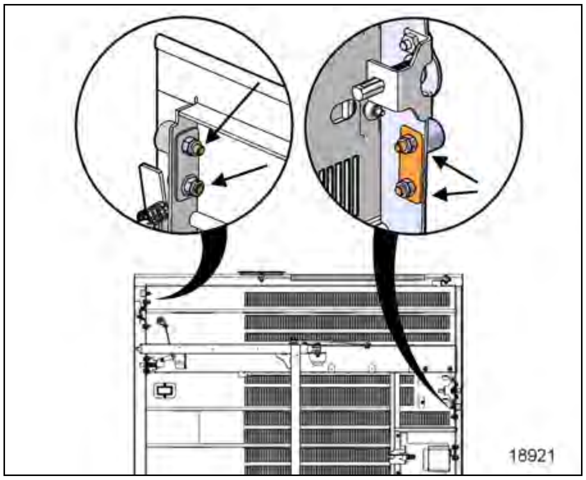


FIGURE 86: DOOR ROLLER SUPPORTS

2. Loosen balancing arm bolts (2).

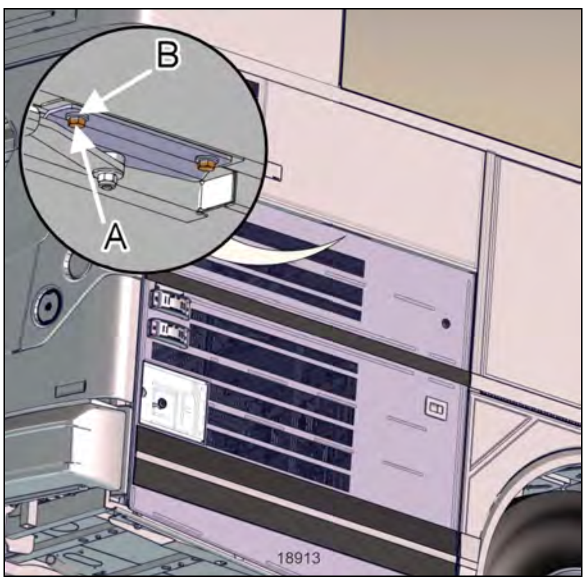


FIGURE 87: BALANCING ARM MOUNTING SCREWS

A) SCREWS

B) BELLEVILLE WASHERS

3. Loosen adjustment bolts of the latches (4).

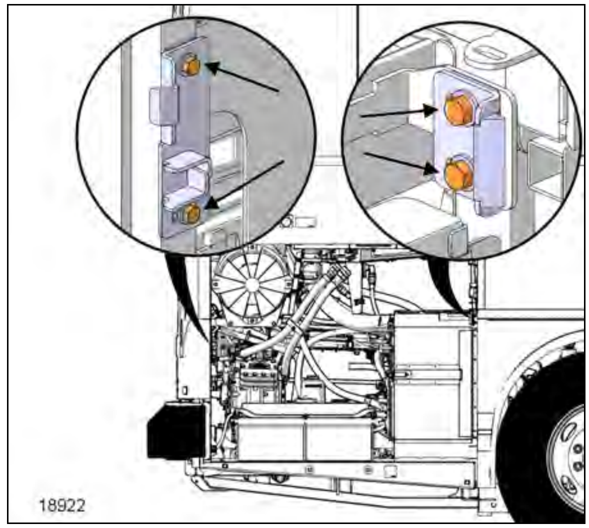


FIGURE 88: LATCH ADJUSTMENT BOLTS

4. Locate the door rubber stoppers (4).

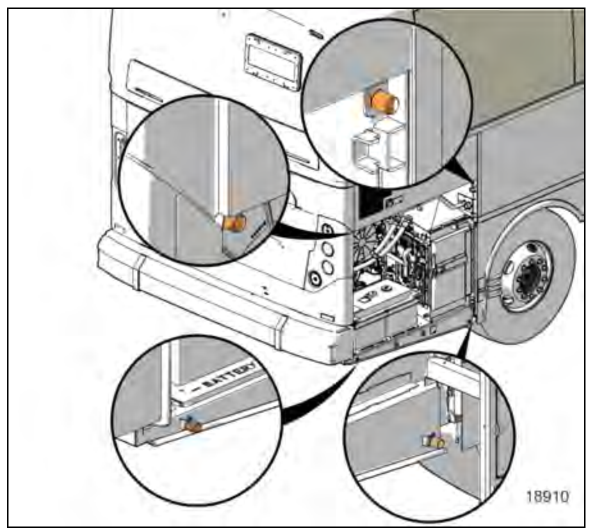


FIGURE 89: RUBBER STOPPERS

5. Make the initial adjustment of the stoppers at approximately 26 mm (1”) from the mounting face.

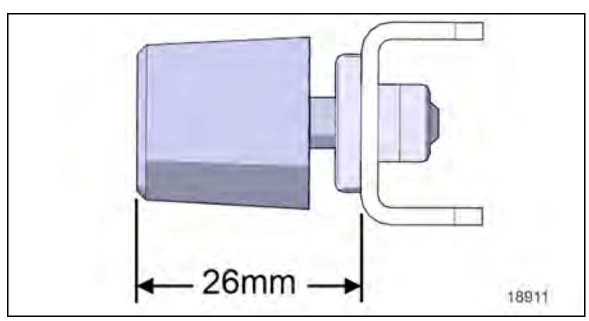


FIGURE 90: STOPPERS INITIAL ADJUSTMENT

6. Temporarily secure the secondary lock in the depressed position with a cable tie so it does not interfere with adjustments. Remove cable tie once completed.

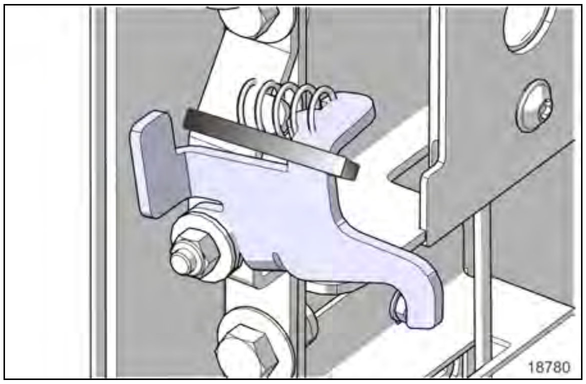


FIGURE 91: SECONDARY LOCK

7. Locate important components on the mechanism.

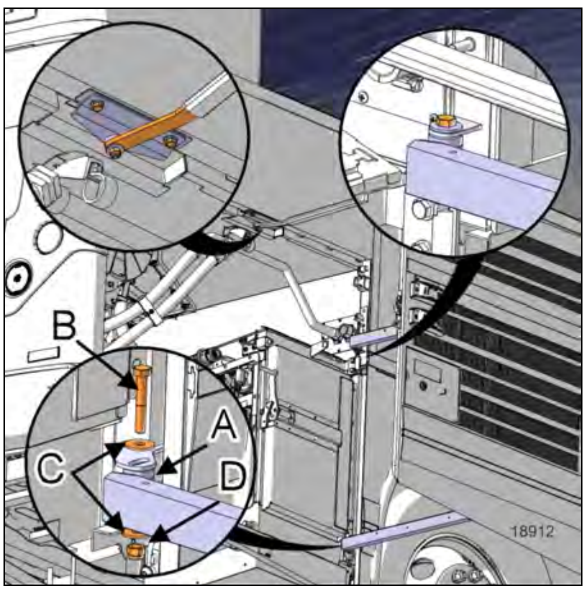


FIGURE 92: DOOR INSTALLATION

A) SPACERS

B) SCREWS

C) FLAT WASHERS

D) NUTS

8. Close the door gently.

9. Adjust the vertical angle of the door.

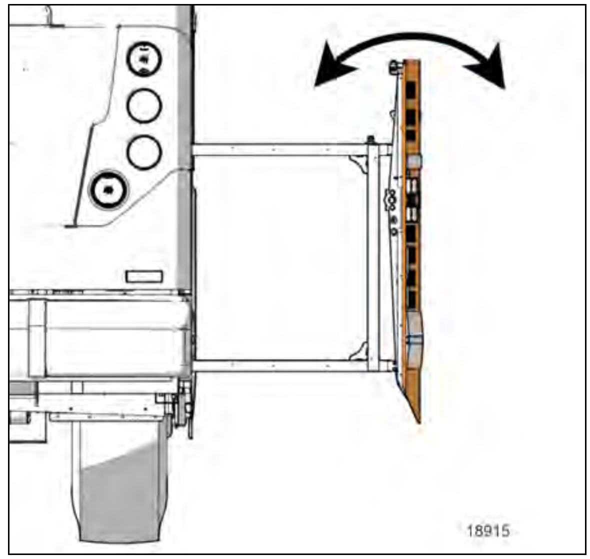


FIGURE 93: DOOR VERTICAL ANGLE

10. Use the adjustment screw between the upper arm and the structure to adjust the vertical angle of the door until it sits properly on the four rubber stoppers.

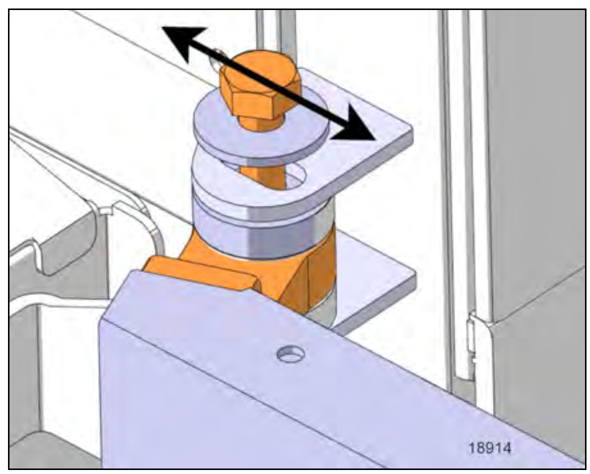


FIGURE 94: UPPER ARM ADJUSTMENT SCREW

11. Adjust the both rubber stoppers to make all the surfaces marked with an ''X'' in Figure 95 flush with the door surface within a tolerance of ±1mm.

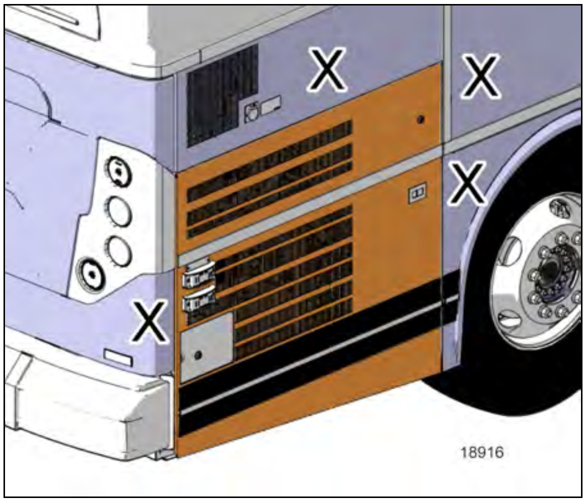


FIGURE 95: FLUSHED SURFACES

12. Adjust the bottom of the door flush with the bottom of the fender by using the screw on the lower arm.

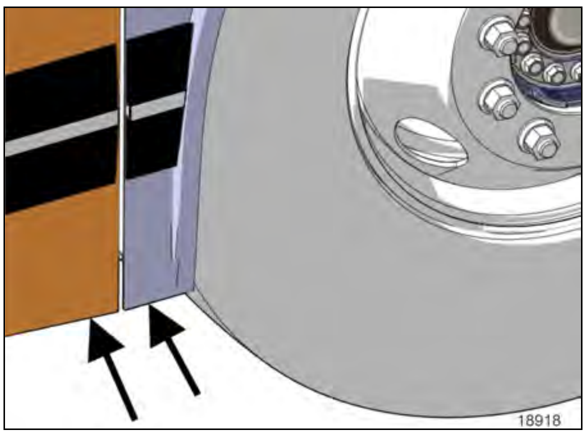


FIGURE 96: DOOR HEIGHT ADJUSTMENT

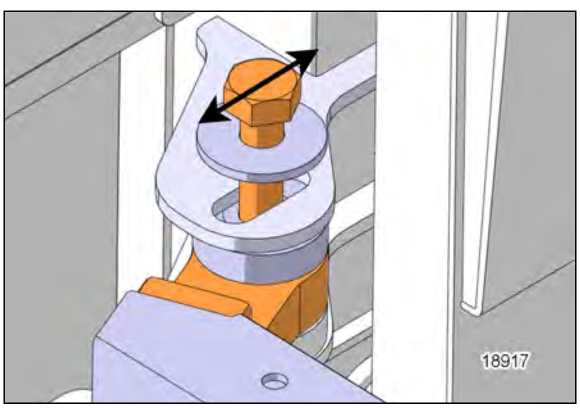


FIGURE 97: LOWER ARM ADJUSTMENT SCREW

13. If previous step does not allow enough adjustment, move to next step.

14. Use the arm attachments on the door to help for adjustment.

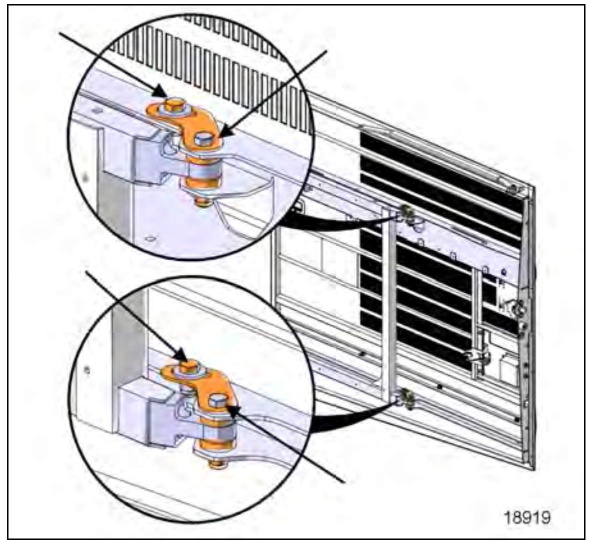


FIGURE 98: ARM TO DOOR ADJUSTMENT BOLTS

15. Adjust the longitudinal position with the attachment shown in Figure 98.

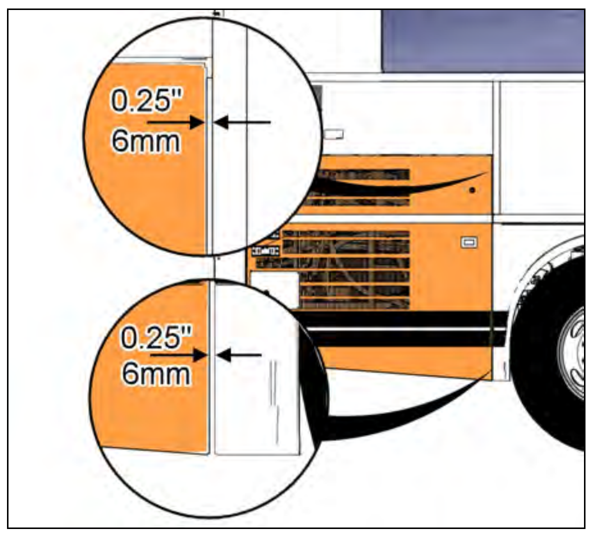


FIGURE 99: LONGITUDINAL ADJUSTMENTS

16. When adjustment is all done, tighten all bolts of arms to the following torque value:

14 lb-ft (19 Nm)

17. Adjust roller support and tighten bolts (4) with the roller in place (door closed).

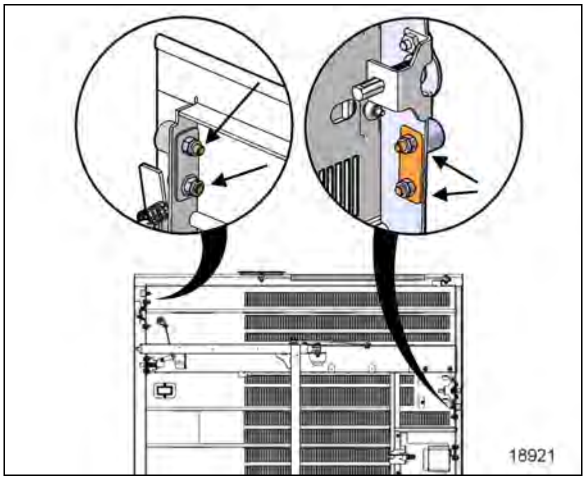


FIGURE 100: DOOR ROLLER SUPPORTS

18. Adjust the rear latch strike plate with the latch bolt in place.

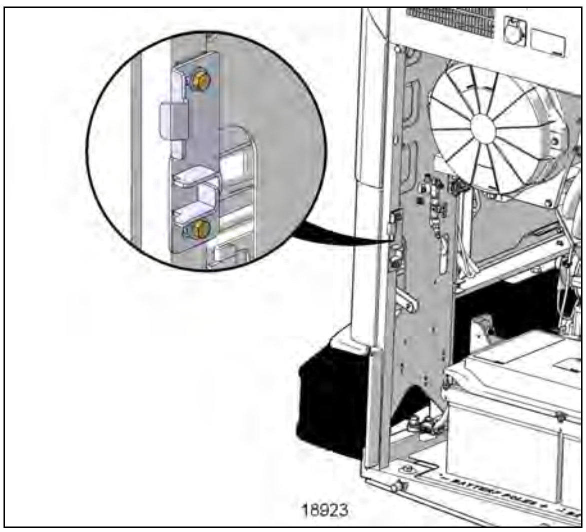


FIGURE 101: REAR LATCH ADJUSTMENT

19. The rear latch bolt must engage not less than 13/32" (10mm) behind the strike plate.

13/32" (10mm) min

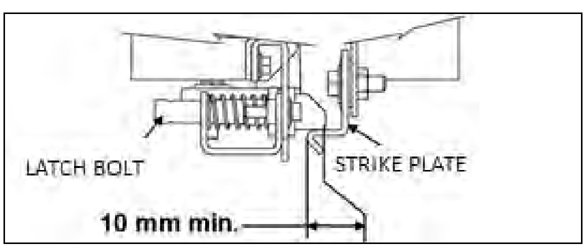


FIGURE 102: REAR LATCH ADJUSTMENT

20. Use spacer if necessary.

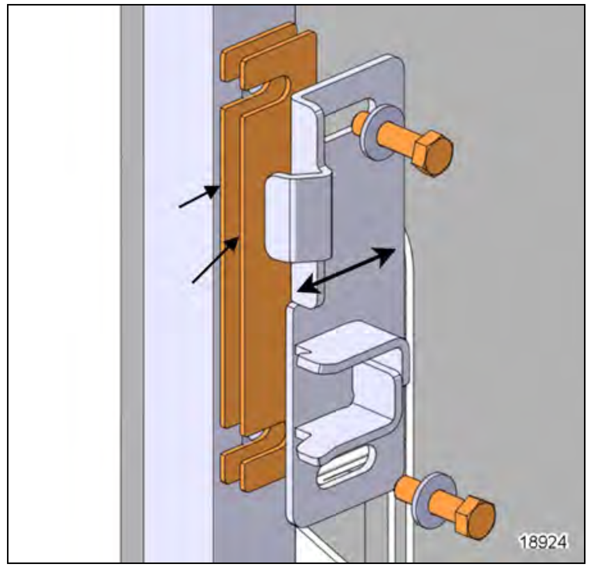


FIGURE 103: REAR LATCH SPACERS

21. Adjust the rear striking plate so that there is slight play with the latch once the door is closed and pressed against the rubber stops

22. Adjust the front latch strike plate with the latch bolt in place.

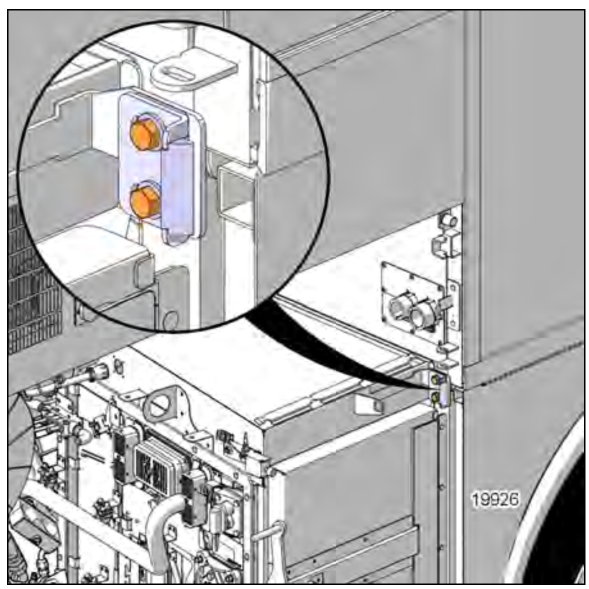


FIGURE 104: FRONT LATCH STRIKE PLATE

23. The front latch bolt has to be flush with the striker.

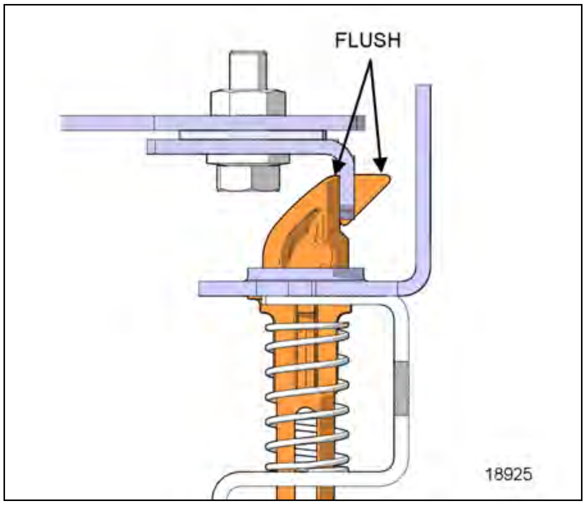


FIGURE 105: FRONT LATCH STRICKING POSITION

24. Adjust the front striking plate so that there is slight play with the latch once the door is closed and pressed against the rubber stops.

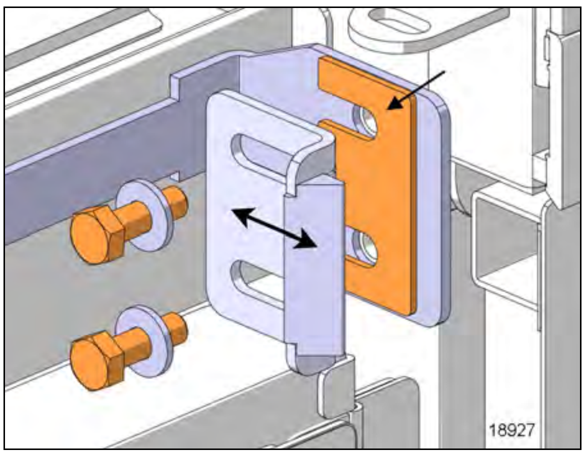


FIGURE 106: FRONT LATCH

10.4.3 Engine Radiator Door

Radiator door may be adjusted for proper fit by untightening hinge bolts:

1. Loosen the bolts, (“A” & “C”, Figure 108) holding the hinge to the vehicle structure to shift the door "LEFT or RIGHT".
2. Loosening the bolts (“B” and “D”, Figure 108) allows the door to be shifted "UP or DOWN".

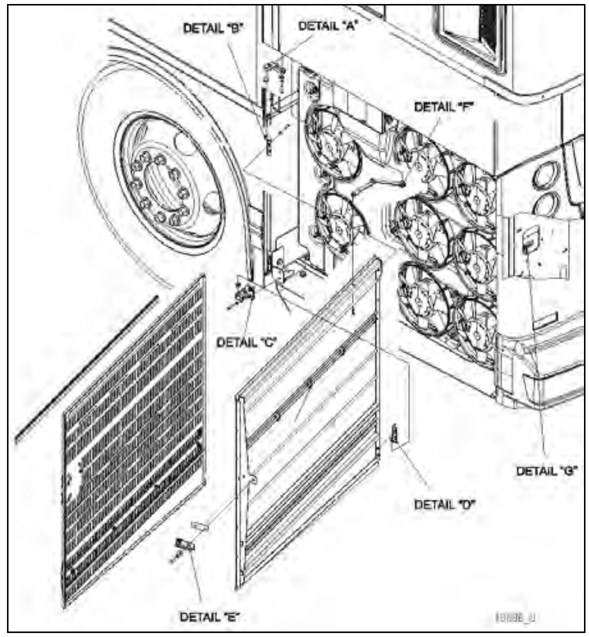


FIGURE 107: RADIATOR DOOR

3. Adjust the door position depending on the gap needed between exterior finishing panels.
4. Tighten the bolts

   Torque : 68 lb-in (8 Nm)

5. Check that the door swings freely and closes properly. It may be necessary to adjust the door latch tab to get proper fit and operation.

To adjust the latch mechanism (“E” and “G”, Figure 108) and the striker pin:

1. Open the door and slightly loosen the latch tab (“E”, Figure 108).
2. Place shims between tab and door frame to increase tab engagement length in the latch.
3. Move tab left or right to increase engagement depth in the latch.
4. Check door fit and operation.

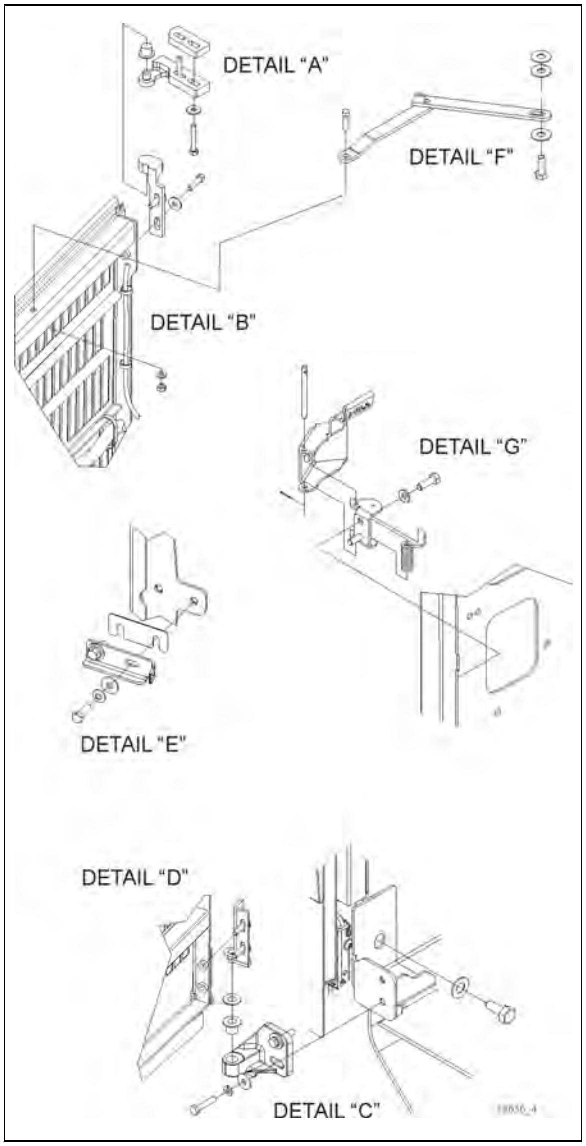


FIGURE 108: RADIATOR DOOR DETAILS

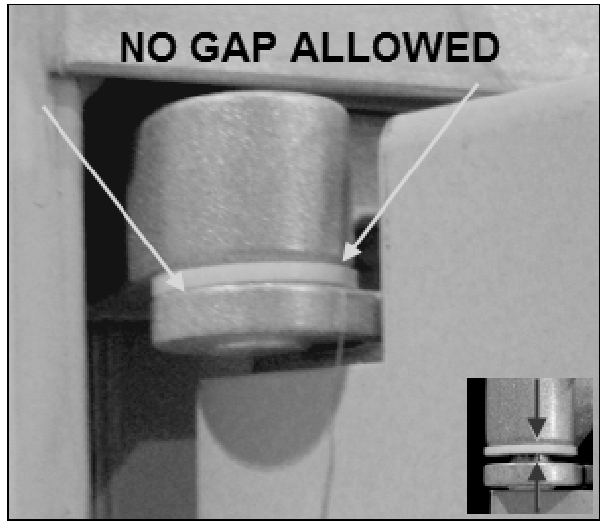


FIGURE 109: TOP HINGE WITH NO GAP

NOTE
The striker pin must engage at least 13/32" (10mm). Add spacers between the latch and the vehicle body to adjust the engagement.

NOTE
There should be no gap between the washer and the hinge upper and lower halves.

10.5 ZONE 5

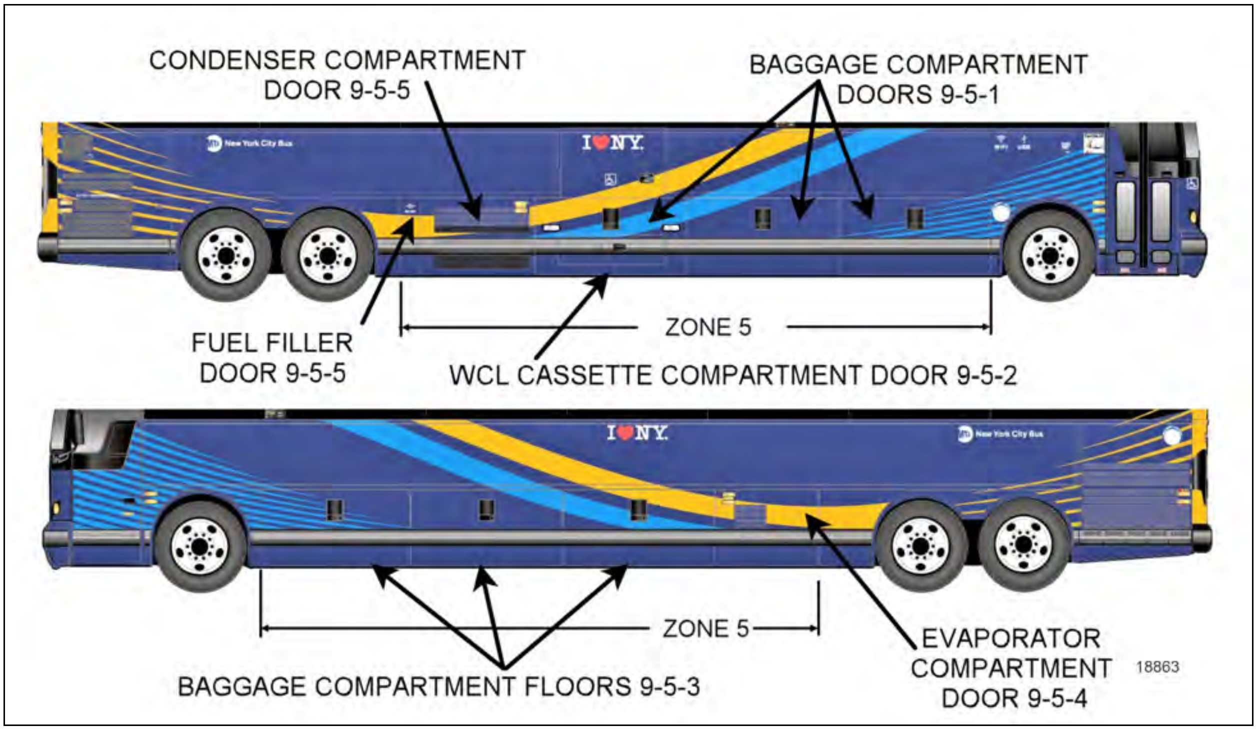


FIGURE 110: ZONE 5

10.5.1 Baggage Compartment Doors

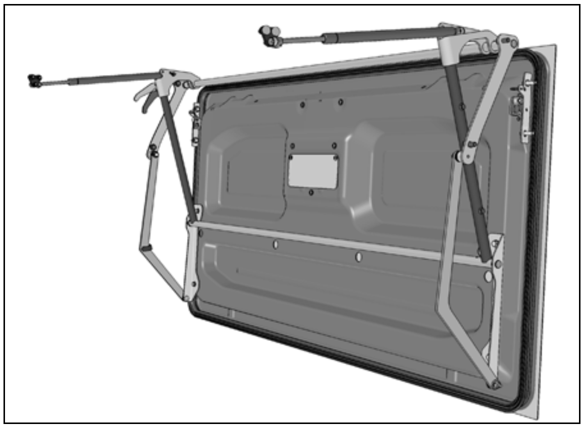


FIGURE 111: BAGGAGE COMPARTMENT DOOR

For the removal and installation of a baggage compartment door body panel, you will need:

A drill with drill bits;

Pneumatic hammer tool (Zip Gun);

Razor sharp window scraper or putty knife.

DOOR SKIN PANEL REPLACEMENT

1. Open damaged compartment door and unfasten rub rail fixing bolts. Remove rub rail.
2. Mark the position of the door bracket with a marker for reinstallation.
3. Unfasten bolts (2 each side) and disconnect cable if necessary in order to remove door from vehicle.

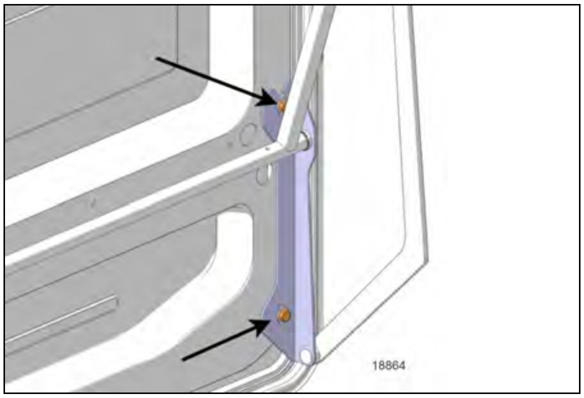


FIGURE 112: DOOR DISMOUNTING

4. Preferably install the door onto a work surface where it can be solidly fixed.
5. Refer to SAV10054-67.

Baggage Compartment Door Adjustment

6. Adjust door panel top to get a 6mm gap with the vehicle side panel bottom.
7. All adjustments are to be made with door closed and with the mounting screws shown in Figure 113.

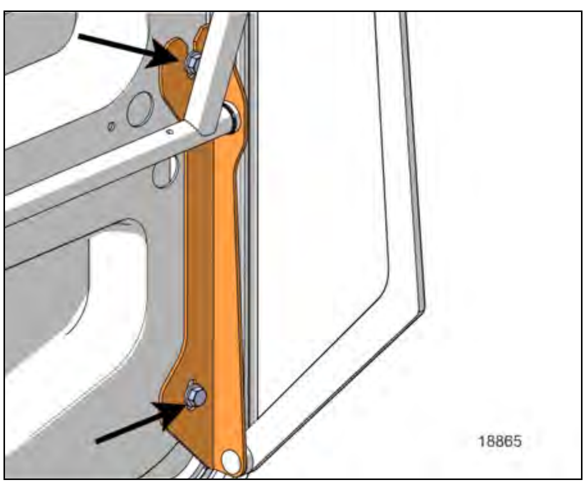


FIGURE 113: DOOR MOUNTING SCREWS

8. Center door in the opening using the retaining rings. Adjust the lateral position by adding or removing retaining rings in the location shown in Figure 114.

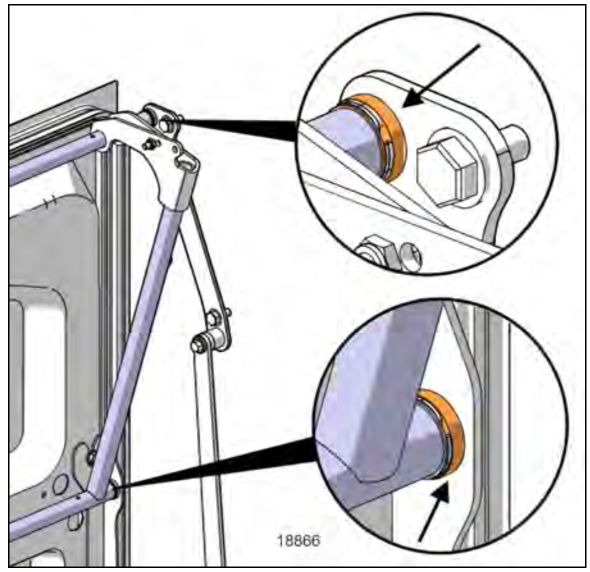


FIGURE 114: LATERAL ADJUSTMENT

9. Adjust door position and evenness with reference to adjacent panels and doors.
10. Adjust the door position by moving IN or OUT the locking plate. Adjust one corner at a time.

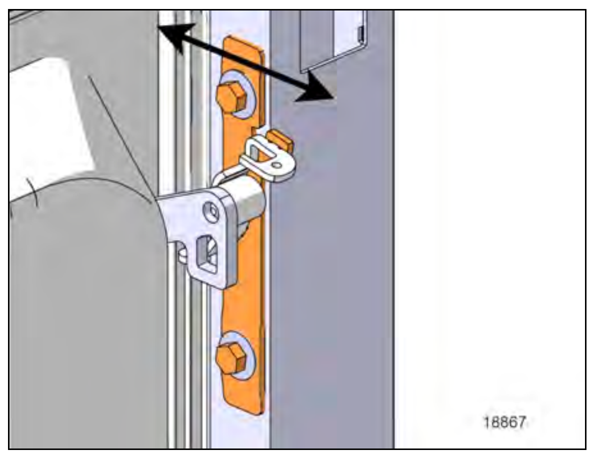


FIGURE 115: EVENNESS ADJUSTMENT

11. Check handle adjustment. Handle must remain tight against its plastic housing.

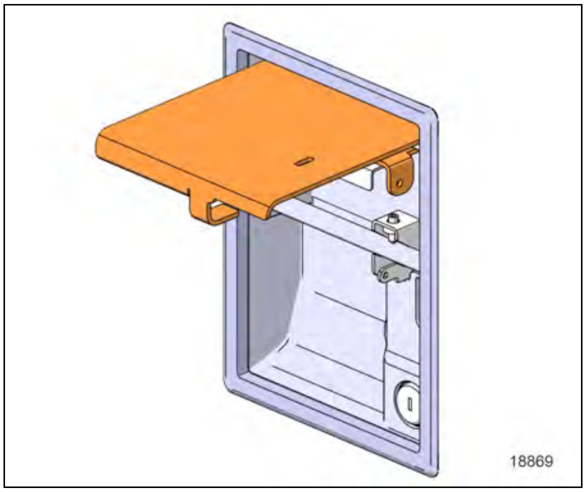


FIGURE 116: HANDLE POSITIONNING

12. Adjust the handle by moving UP and DOWN the locking plate.

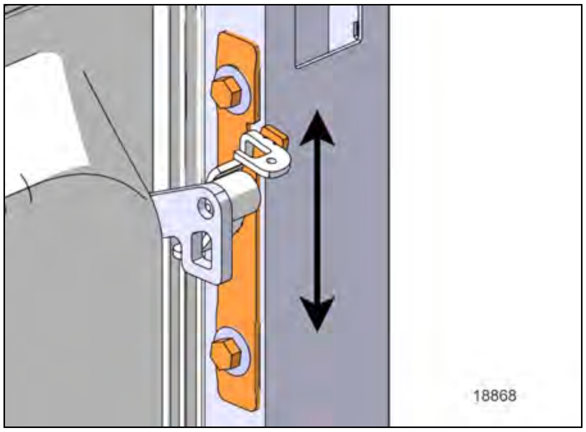


FIGURE 117: HANDLE ADJUSTMENT

13. Open baggage compartment door and adjust using the cylinder mounting block.

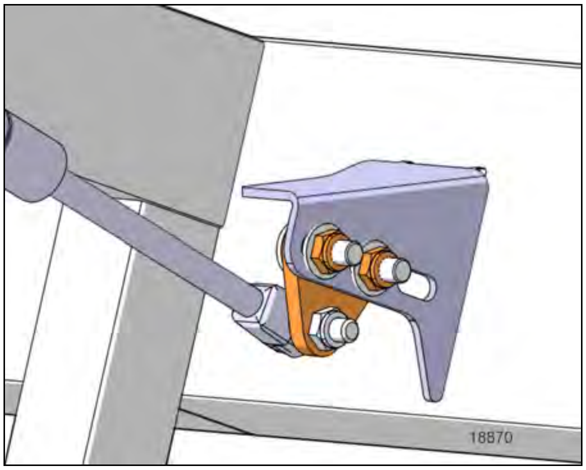


FIGURE 118: CYLINDER MOUNTING BLOCK

14. Door should be adjusted in reference to neighboring doors.
15. Target is to have 5 ½” (140mm) from bus body panel to door panel and +/- 2mm vertically between doors.

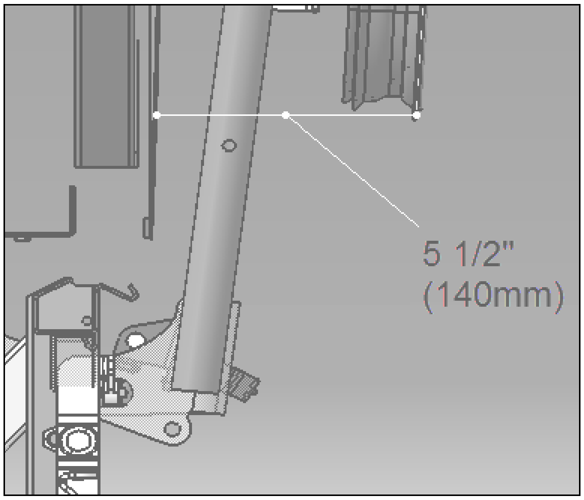


FIGURE 119: OPEN DOOR POSITION TARGET

16. Tighten cylinder block fixing screws.
17. Door bottom edge compression can be adjusted by moving in or out the pantograph arms at this location.

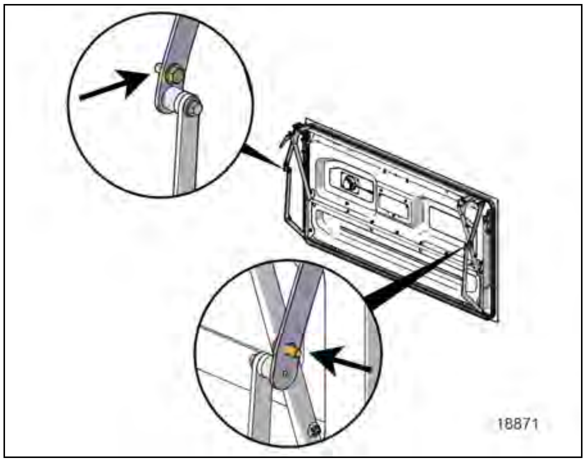


FIGURE 120: CYLINDER BLOCK MOUNTING BOLTS

10.5.2 WCL Cassette Compartment Door

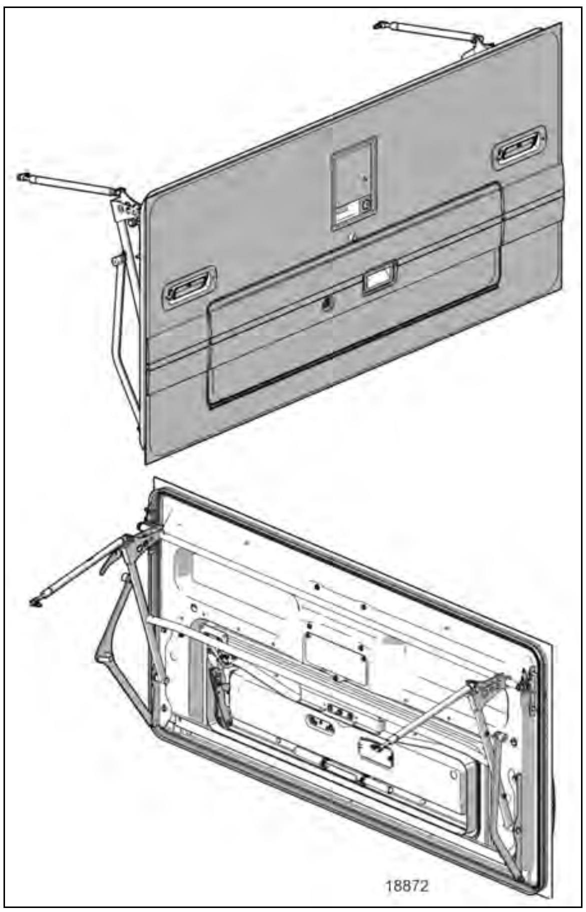


FIGURE 121: WCL CASSETTE COMPARTMENT DOOR

For the removal and installation of the WCL cassette compartment door skin panel, you will need:

A drill with drill bits;

Pneumatic hammer tool (Zip Gun);

Razor sharp window scraper or putty knife.

DOOR SKIN PANEL REPLACEMENT

1. Open damaged compartment door and unfasten rub rail fixing bolts. Remove rub rail.
2. Mark the position of the door bracket with a marker for reinstallation.
3. Unfasten bolts (2 each side) and disconnect cable if necessary in order to remove door from vehicle.

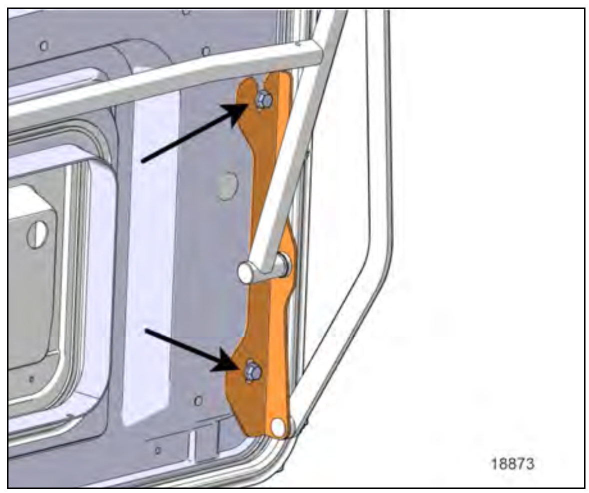


FIGURE 122: DOOR DISMOUNTING

4. Preferably install the door onto a work surface where it can be solidly fixed.
5. Refer to SAV10054-67.

Compartment Door Adjustment

6. Refer to baggage compartment door procedure.

WCL Cassette Door Adjustment

The small door has a piano type hinge on its lower edge.

7. Install only two of the mounting screws, at each end to adjust the door.

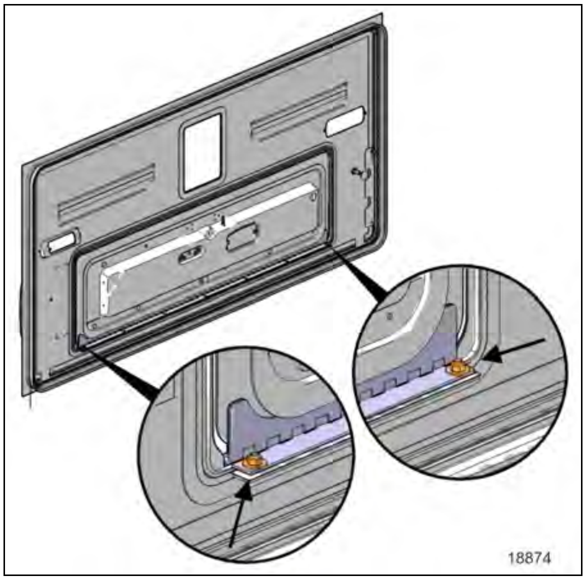


FIGURE 123: HINGE MOUNTING BOLTS

8. Close door and adjust in opening. A 1mm maximum difference between left and right measured gap is accepted.

9. Door should close flush with the larger door panel. Maximum flatness deviation within 1mm.

10. Install the remaining screws and seal with liquid Teflon #680098.

WCL Cassette Door latch adjustment

To allow adjustment of the latch mechanism, lightly tighten the retaining hardware on receptacle and striker support (arrows in Figure 124).

11. Place centering tool G34148_500 in the receptacle cavity.

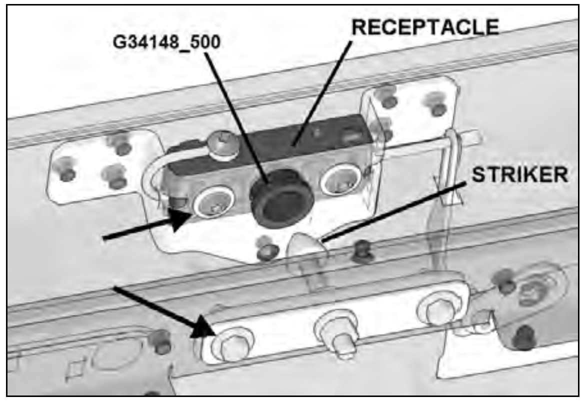


FIGURE 124: WCL CASSETTE DOOR LATCH

12. Close the door to center the latch mechanism.

13. Tighten screws.

14. Check that the door swings freely and closes properly without interference or excessive force.

10.5.3 Baggage Compartment Floors

- **Repair of Mantex Urethane Covering**

Minor Repair

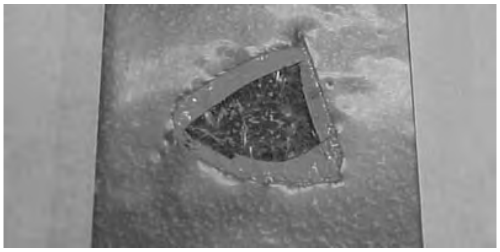
Use “Dupont IMRON” paint. Apply using a paint brush or roller depending on gravity.

Paint Code: #J4099U

Major Repair (Hole)

Chamfer the whole perimeter of the damaged area. If applicable, remove loose covering. Remove dust and particles.

Cover and protect damaged area surroundings.



Using a plastic spatula, apply some Sika 221 gray onto the damaged area.

Remove masking tape and protection around damaged area.

Spray pure water onto Sika. Use a floor sample to create some texture onto the adhesive.

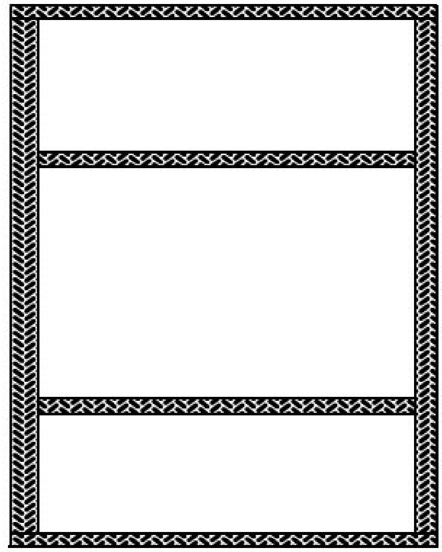
If possible spray some more water onto the adhesive to accelerate curing.

Allow drying for at least **2 hours** then repaint as per paragraph: Minor Repair.

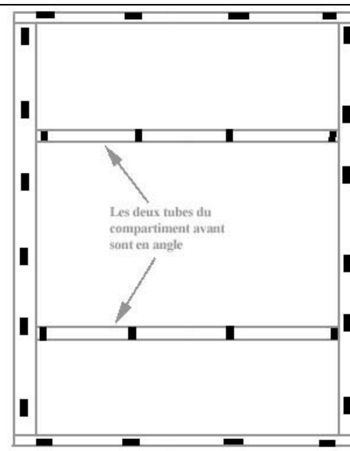
- **Baggage Compartment Floor Installation**

  Preparation and Installation

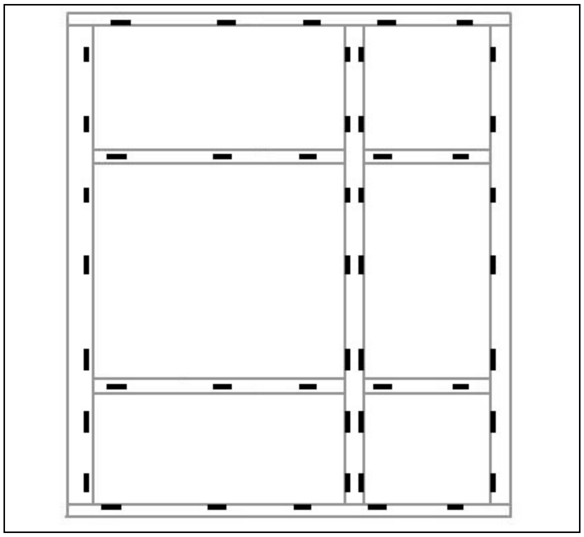
Clean baggage compartment support structure using anti-silicone.



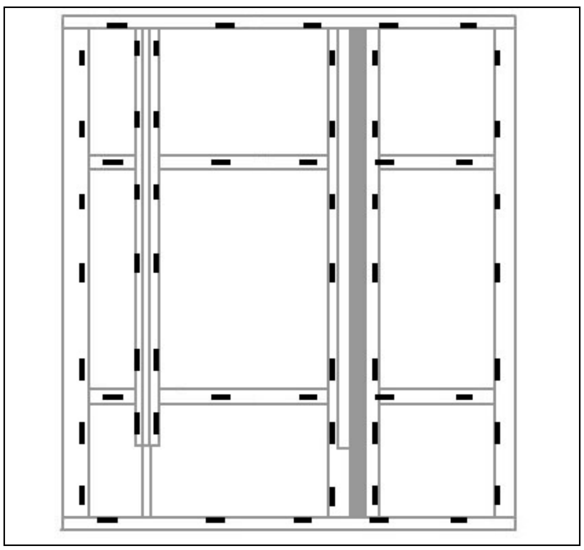
Glue spacers (790392) about 16 inches apart.



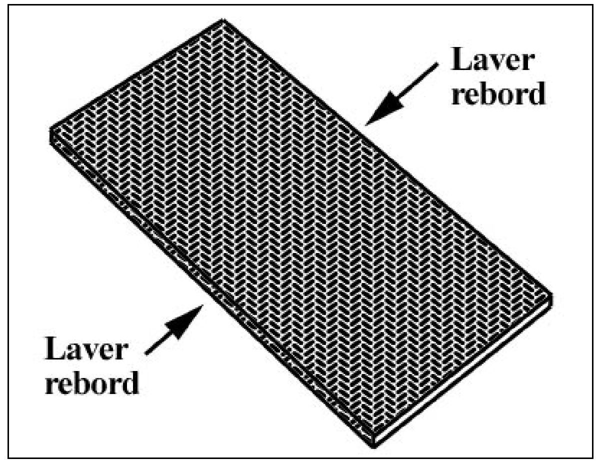
Rear baggage compartment without WCL.



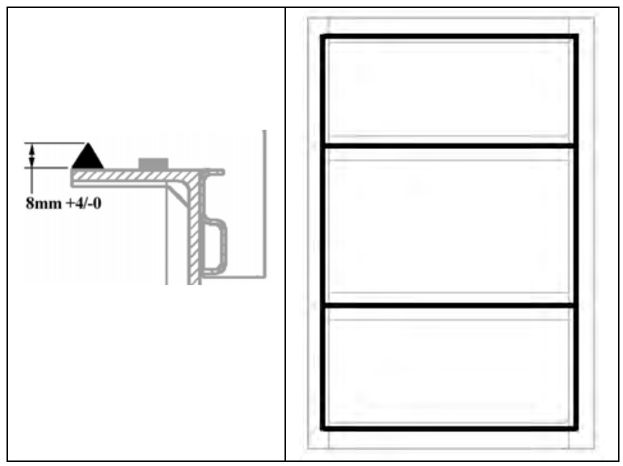
Rear baggage compartment equipped with WCL



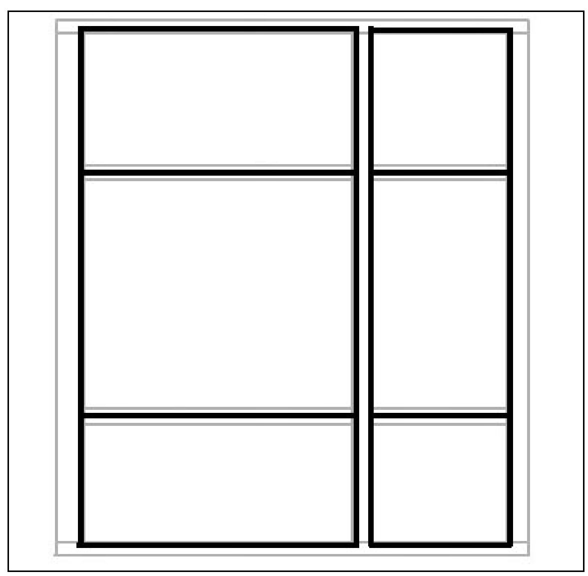
Prepare baggage compartment Mantex floor. Clean panel underside and edges.



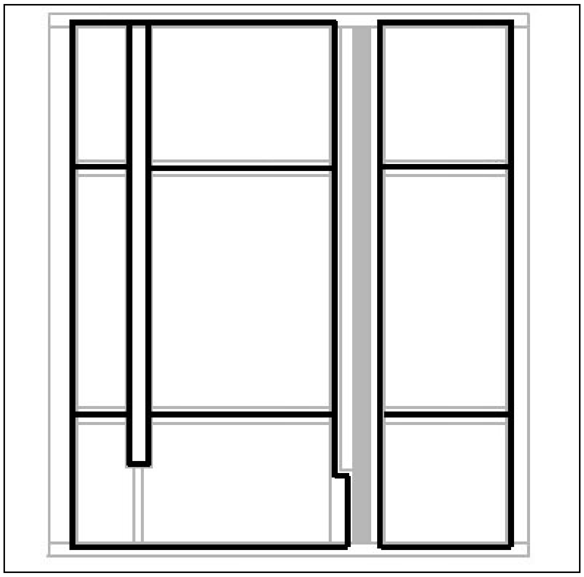
Using a triangular nozzle, apply "Simson" glue (685126) onto support structure.



Rear baggage compartment without WCL.



Rear baggage compartment equipped with WCL

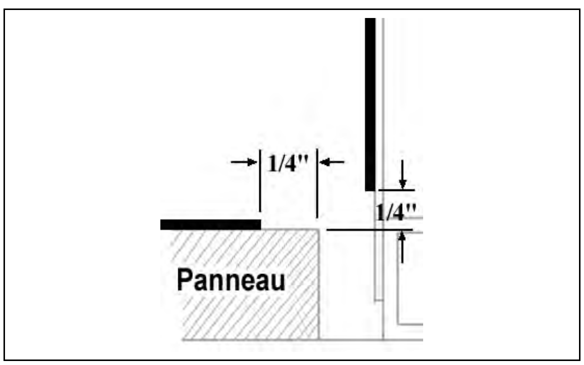


Carefully install panel onto support structure.

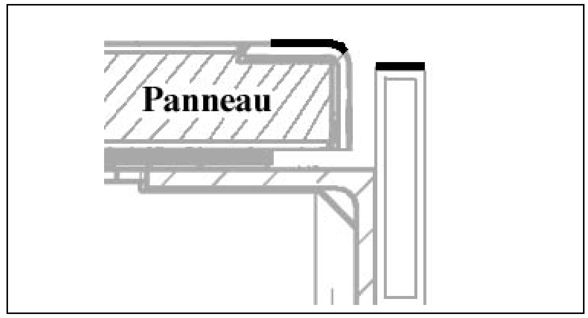
Evenly distribute and install conforming weights (6 to 8) (80 to 100 lbs **total**) onto panel for at least **4 hours**. Make sure panel does not move.

Finishing Joints

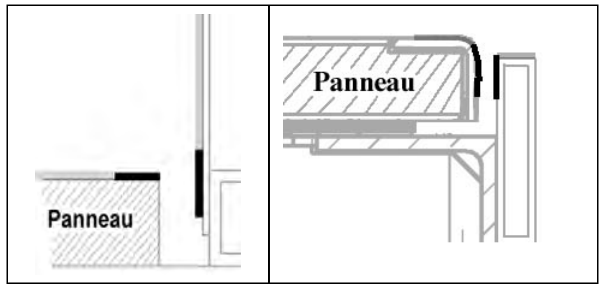
In the case of lateral finishing joint, apply some masking tape ¼“ from panel edge and ¼” above panel.



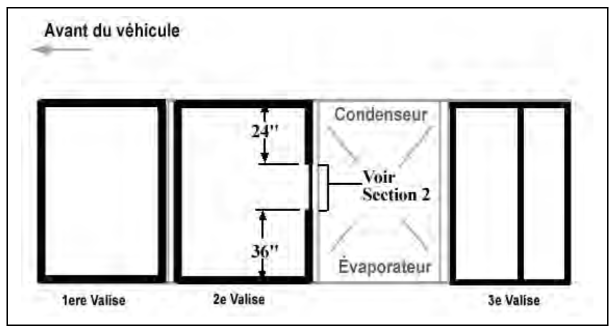
In the case of front finishing joint, apply some masking tape on each side of joint.



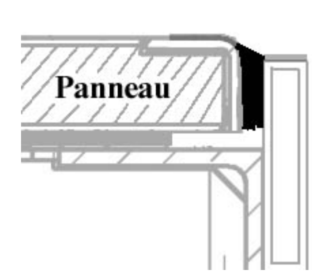
Clean with anti-silicone the area where the Simson glue will be applied.



Apply some Simson glue to fill the gap.

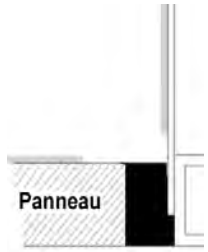


Front finishing joint

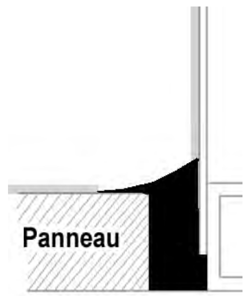


Section 2

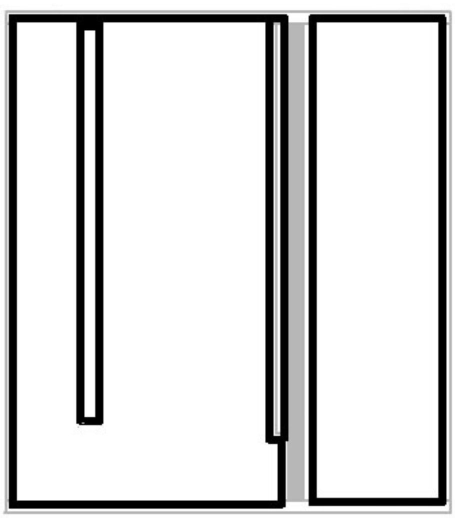
Flat joint in front of fuel tank access panel



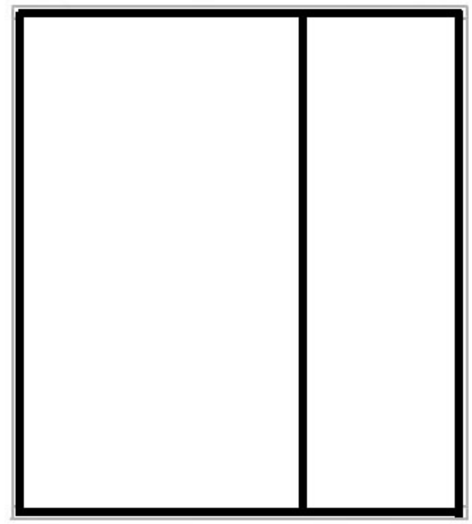
Use plastic spatula #682838 to perform radius



Rear baggage compartment equipped with WCL



Rear baggage compartment without WCL.



Remove masking tape.

Smooth down joints using soapy water.

10.5.4 Evaporator Compartment Door

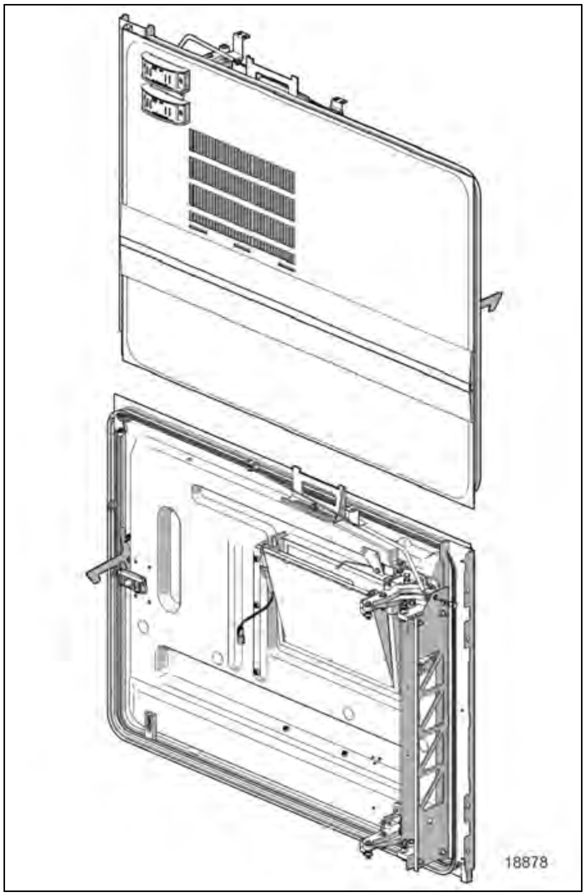


FIGURE 125: EVAPORATOR DOOR

For the adjustment of an evaporator door, you will need:

- Centering tool G34148_500

EVAPORATOR DOOR ADJUSTMENT

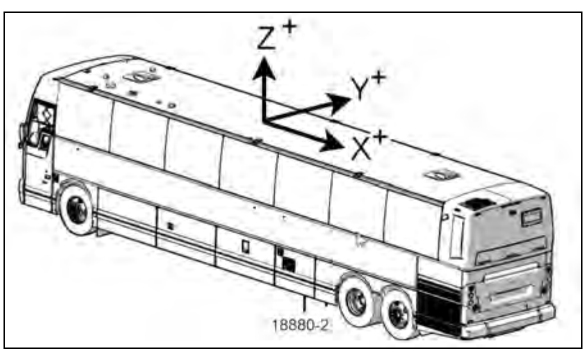


FIGURE 126: VEHICLE XYZ DIRECTIONS

15. Loosen the screws fixing the hinge to the door. Loosening these screws allows evaporator door to be adjusted in the ''X'' and ''Z'' directions on the hinge side.

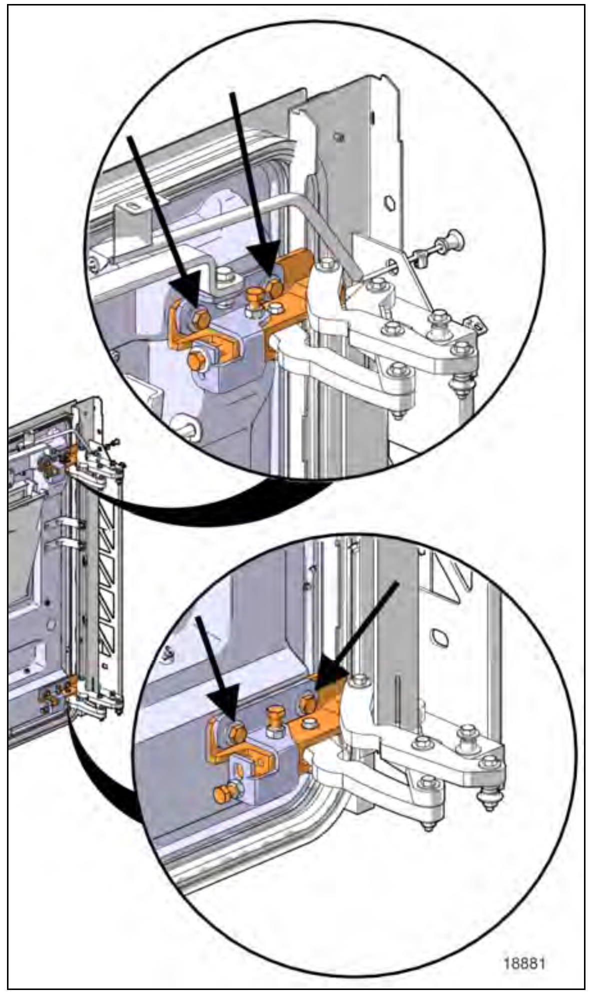


FIGURE 127: HINGE MOUNTING SCREWS

16. Adjust the door in the middle of the opening in the ''X'' direction.

17. For the ''Z'' direction, adjust the top of the door panel between 5.5 and 6 mm from the horizontal trim as shown in Figure 128.

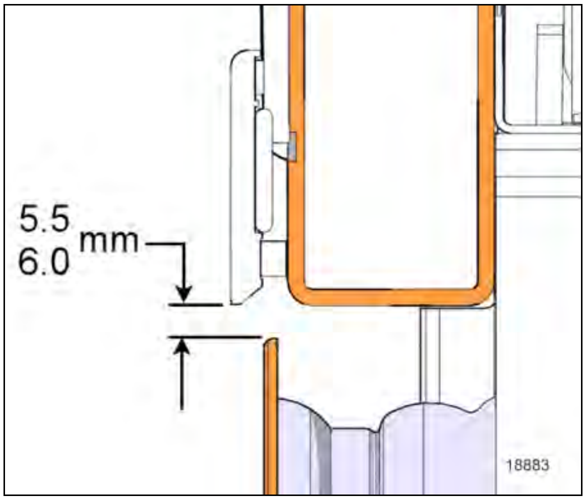


FIGURE 128: "Z" DIRECTION ADJUSTMENT

18. For the ''Y'' direction, on the hinge side, loosen the screws shown in Figure 129 to allows adjustment.

19. Adjust the door exterior panel side flush with the compartment door and the fender.

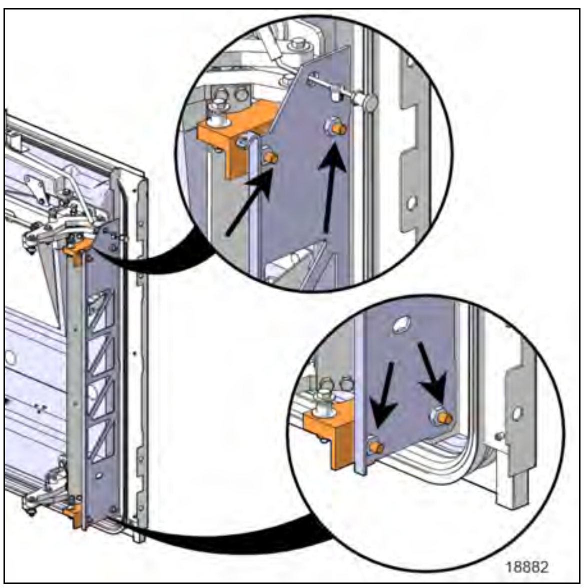


FIGURE 129: "Y" DIRECTION ADJUSTMENT SCREWS

20. Tighten the hinge screws.

21. On the striker side, the locking device is used to adjust the ''Y'' direction.

22. To allow adjustment of the latch mechanism, lightly tighten the retaining hardware on receptacle and receptacle support to frame.

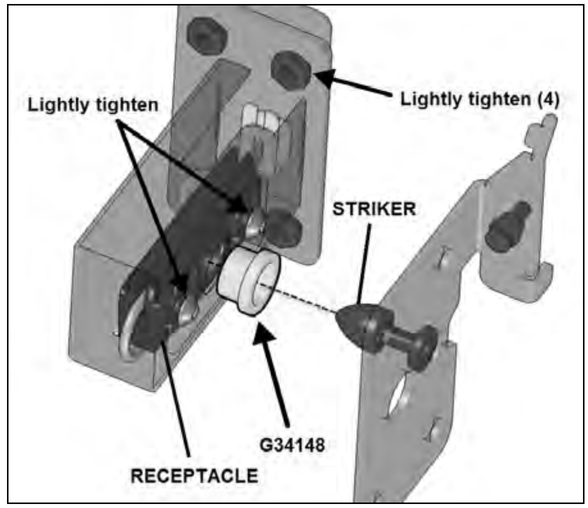


FIGURE 130: STRIKER SIDE ADJUSTMENT

23. Place centering tool G34148_500 in the receptacle cavity.

24. Close door to center the latch assembly.

25. Tighten the Receptacle screws only.

26. Door exterior panel on latch side should be positioned at 8mm ±1mm from frame as shown in Figure 131. Make the adjustments by moving the receptacle support.

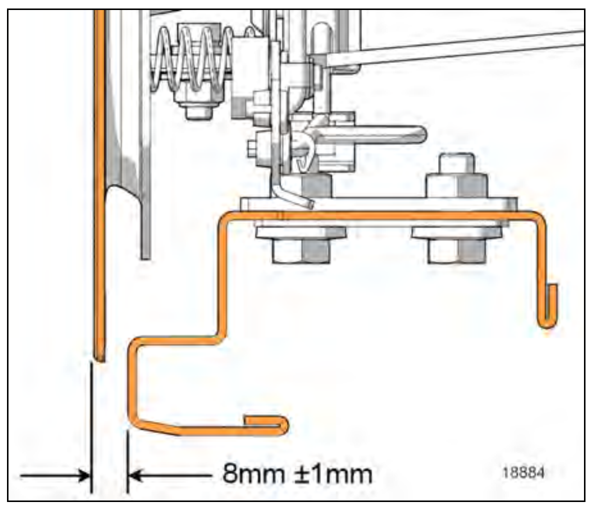


FIGURE 131: STRIKER SIDE TOP VIEW

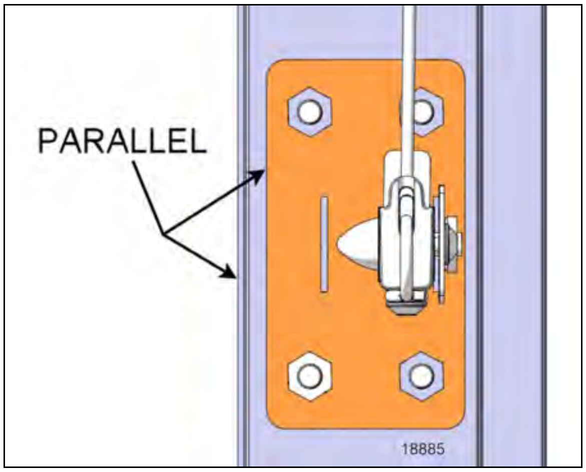


FIGURE 132: BACKING PLATE ALIGNMENT

27. Make sure that backing plate is parallel to structure before tightening hardware
28. Make sure that skid bar only touches slightly bus structure at bottom. The door should not move up when closing.

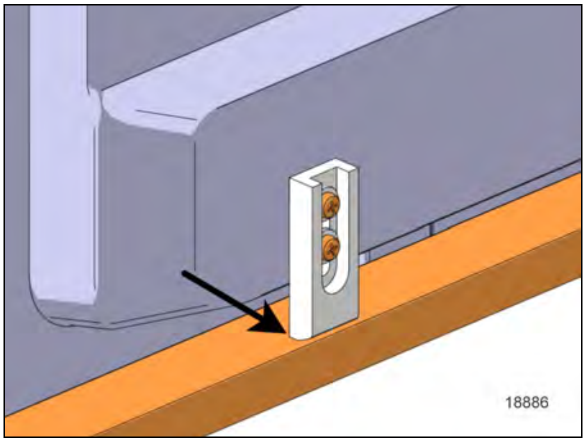


FIGURE 133: SKID BAR ADJUSTMENT

29. Check that the door swings freely and closes properly.

DOOR RELEASE IN THE EVENT OF A LATCH FAILURE

If the door release mechanism is damaged or ceases to function for any reason, the door can be released by removing these screws on the fore wall of the fender side, in the water circulation pump and heater compartment.

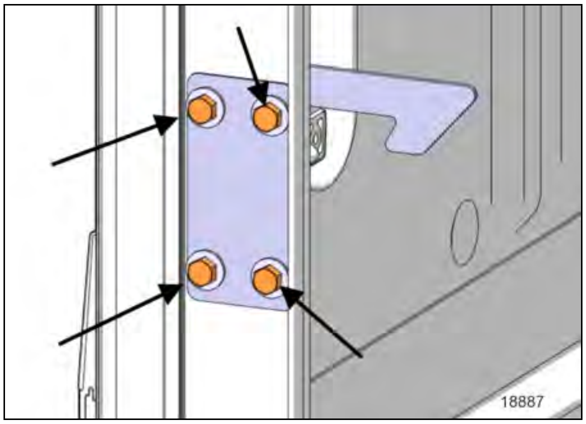


FIGURE 134: DOOR RELEASE MECHANISM

10.5.5 Condenser Compartment Door

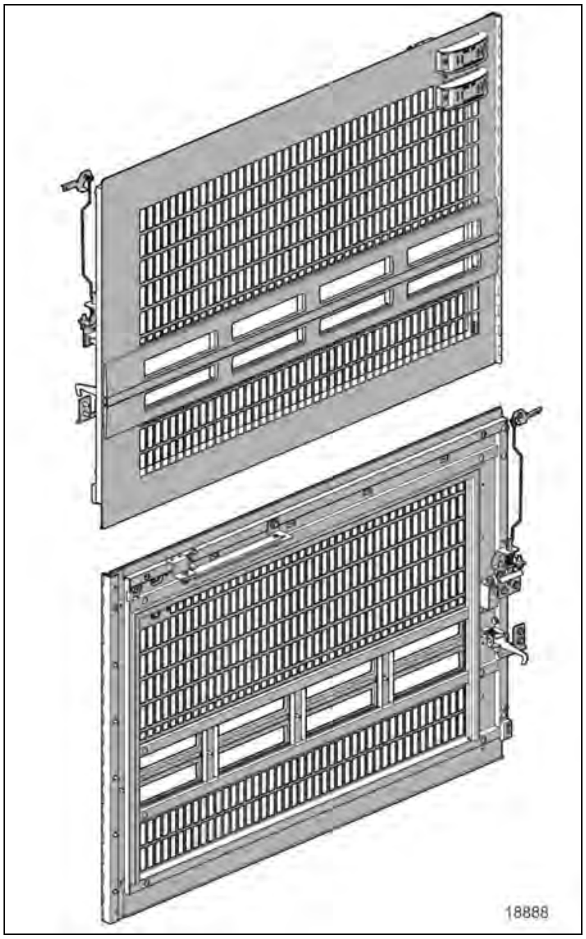


FIGURE 135: CONDENSER DOOR

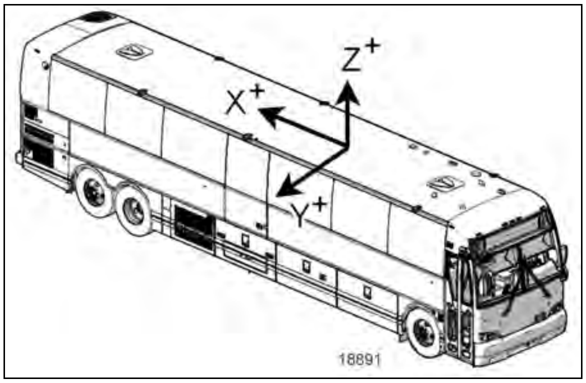


FIGURE 136: VEHICLE XYZ DIRECTIONS

1. Open the condenser door.
2. Loosen the hinge mounting screws. Loosening these screws allows the condenser door assembly to be adjusted in all directions (X, Y or Z).

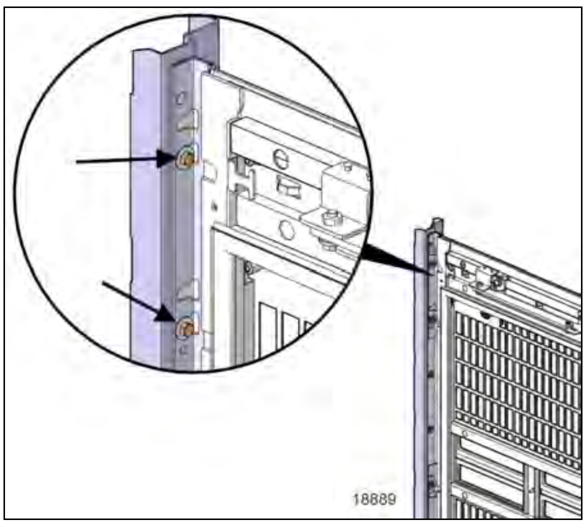


FIGURE 137: HINGE MOUNTING SCREWS

3. Adjust condenser door assembly position at the hinge.
4. Respect the required gap between exterior finishing panels.
5. Tighten the screws.
6. Check that the door swings freely and closes properly. It may be necessary to adjust the door latch to get proper fit and operation.

10.5.6 Fuel Filler Door

1. Open the fuel filler door.
2. Loosen the mounting screws holding the panel to hinge assembly.
3. Adjust the fuel filler door position according to distance required between exterior finishing panels.
4. Tighten the nuts.
5. Check that the door swings freely and closes properly. Use shims if necessary.

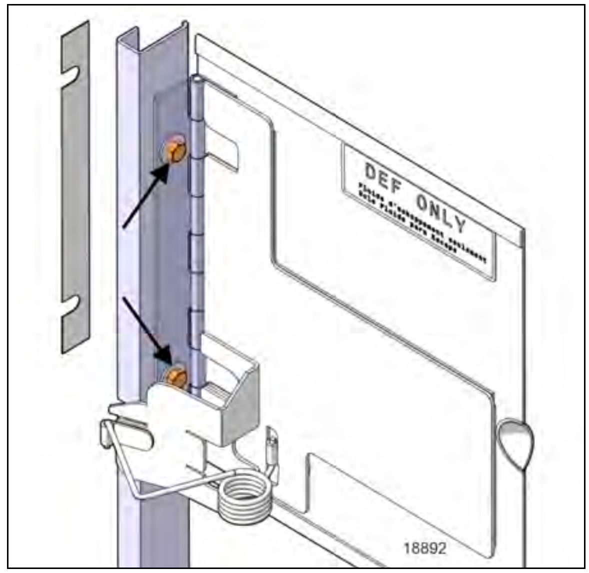


FIGURE 138: FUEL FILLER DOOR MOUNTING SCREWS

10.6 ZONE 6

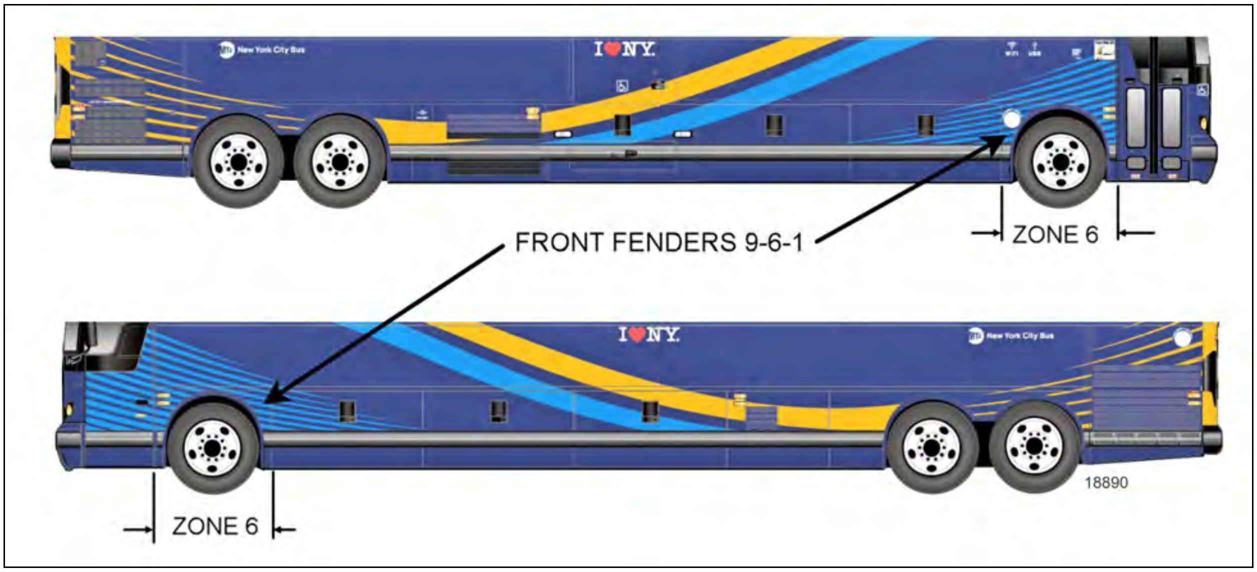


FIGURE 139: ZONE 6

10.6.1 Front Fenders

FRONT FENDER REMOVAL

1. Remove vertical trim mounting rivets and remove the trim. This trim is kept in place with glue and rivets.

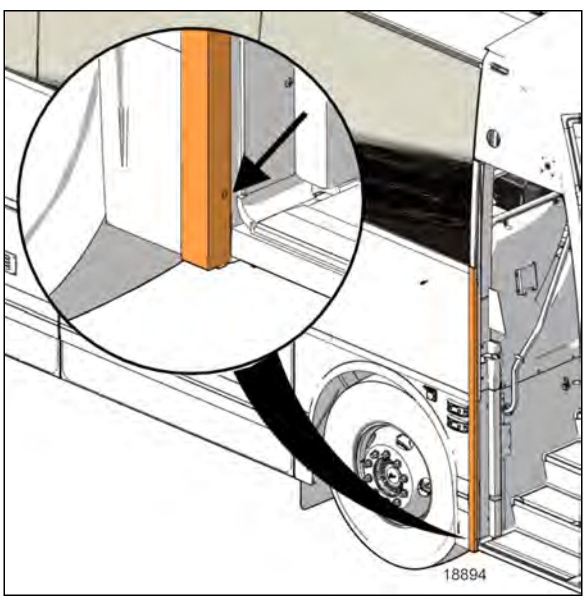


FIGURE 140: VERTICAL TRIM

2. Mark a line on the top of the horizontal trim.
3. Remove the horizontal trim. That trim is glued on the vehicle.

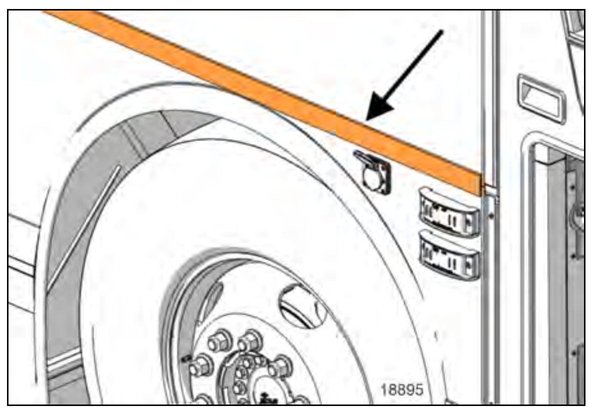


FIGURE 141: HORIZONTAL TRIM

4. Front fenders are kept in place with glue, screws and rivets. Remove fender fasteners (screws and rivets) and move slightly out the fender.

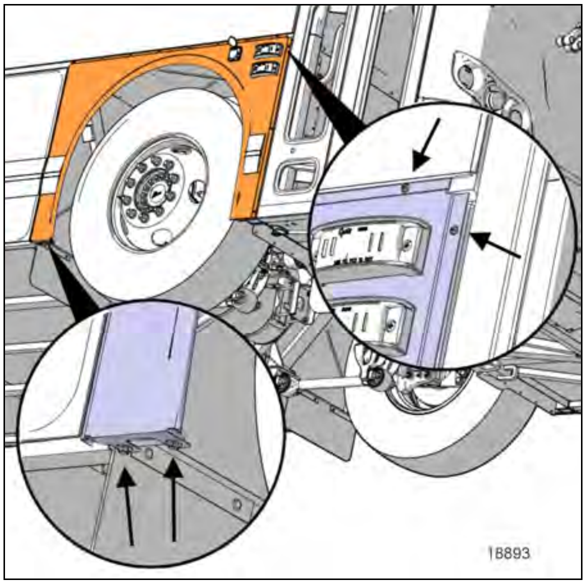


FIGURE 142: FENDER MOUNTING FASTENERS

5. Unplug entrance door switch and lights.
6. Remove rub rails, entrance door switch and lights on the fender.

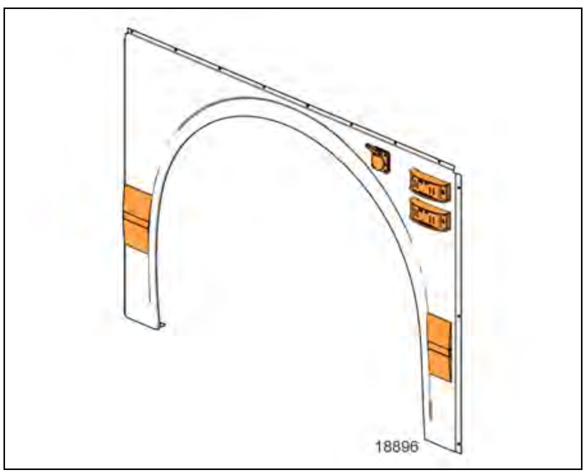


FIGURE 143: COMPONENTS INSTALLED ON FENDER

FRONT FENDER INSTALLATION

7. Remove glue and clean all mounting faces on the vehicle.
8. Install rub rails, entrance door switch and lights on the new fender.
9. Apply glue Simsons 70-03 (685126) on the fender mounting faces as shown in Figure 144.

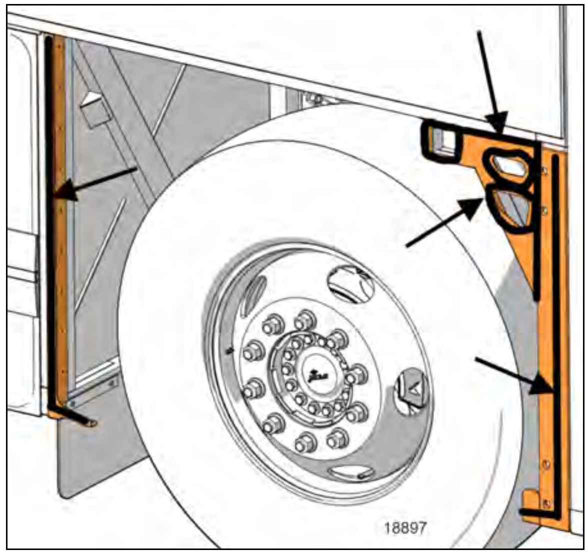


FIGURE 144: GLUE APPLICATION

10. Plug entrance door switch connector and light connectors.
11. Install the fender on the vehicle and position at 6mm from the compartment door.

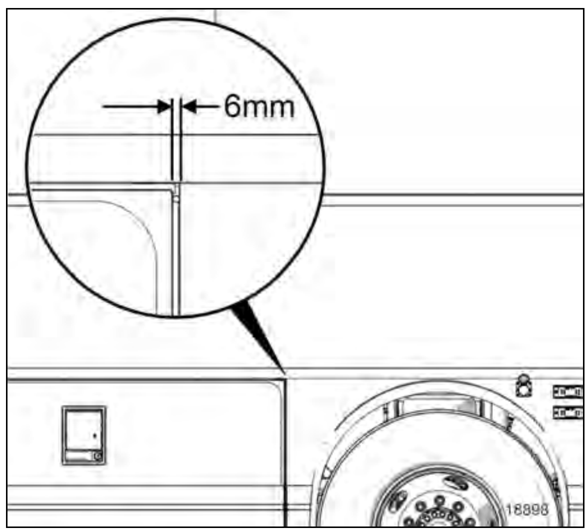


FIGURE 145: FENDER POSITIONNING

12. Install rivets and screws.
13. Fill the cavity with sealant Sika 252 (#683083).

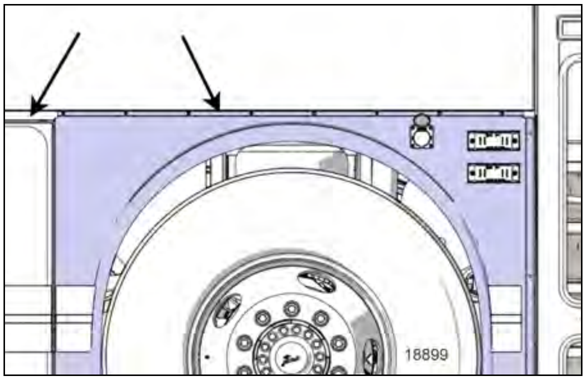


FIGURE 146: SIKA 252 SEALANT APPLICATION

14. Smooth out the joint using a spatula.

IMPORTANTE NOTE
Install the trim in place at a maximum of 15 minutes after sealant application.

15. Apply a bead of Sika 252 on the strip as shown in

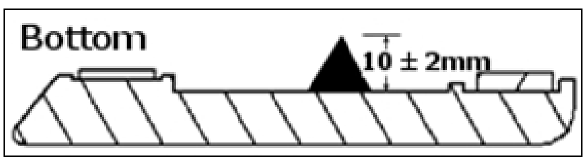


FIGURE 147: BEAD OF SIKA 252

16. Remove the protective film from the double-sided tapes.
17. Stick the trim in place below the marked line, starting from the back of the vehicle, (flush with the end of the welded sheet metal side panel) and moving towards the front.
18. Compress the 1st time the trim flat using a roller.

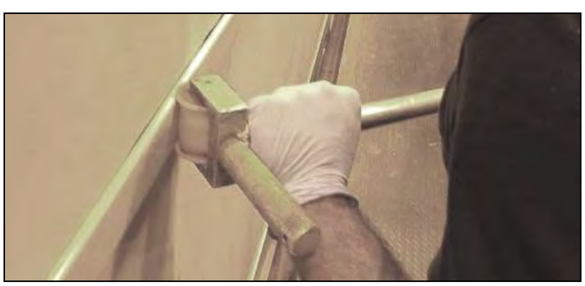


FIGURE 148: TRIM COMPRESSING

19. Compress a 2nd time the trim, while slightly tilting the roller head towards the visible side
20. Reinstall the vertical trim.
21. Apply a bead of TEROSON MS 9399 (687957) as shown in Figure 149.

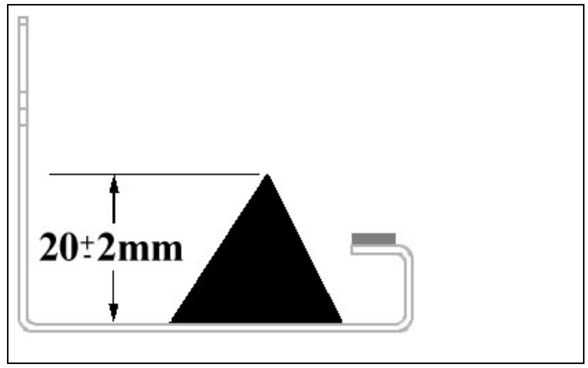


FIGURE 149: GLUE INSIDE THE TRIM

22. Remove the protective film from the double-sided tapes.
23. Install the vertical trim and position the top flush with the top of the upper horizontal trim.

10.7 ZONE 7

FIGURE 150: ZONE 7 18630

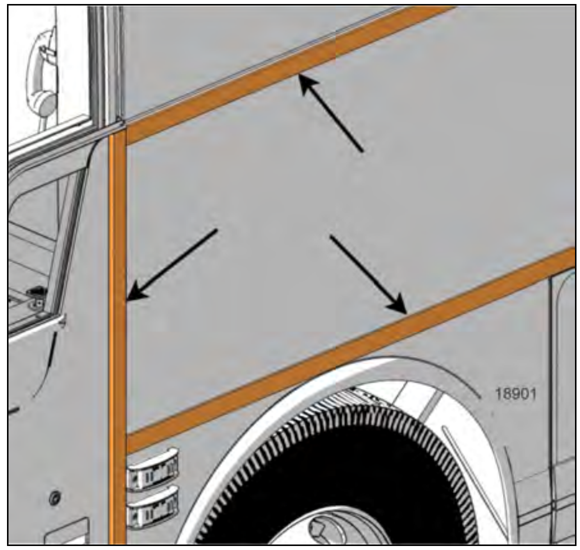
10.7.1 X3 Smooth Side Panel Replacement Procedure

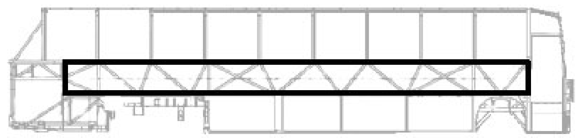
Material:

Anti-silicone (682989)	√	Scotchbrite gray (680226)	√	Sika 221 gray	√
CHIX cloth (682384)	√	Sika 205 1liter (683097)	√	Sika 252 black	√
Blue cloth (682383)	√				

Equipment:

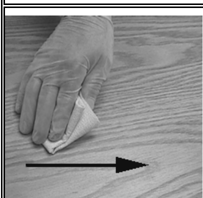
Glue gun	√
Pencil	√

SECTION 1 SMOOTH SIDE PANEL REMOVAL		
A	Remove vertical and horizontal finishing trim. Insert a screwdriver into snap-on trim joint. Bend finishing molding enough to be able to fix a pair of locking pliers. Using the pair of locking pliers, pull the trim and at the same time gradually cut Sika bead with a sharp knife. ***IMPORTANTE NOTE*** Be careful not to damage the adjacent surfaces in all steps.	 **FIGURE 151: TRIMS TO REMOVE**
B	Grind tig weld spots at each end of side panel.	
C	Safely support or temporary fix side panel.	**WARNING** Panel weight is heavy, it may be over 200 pounds.
D	Insert a flat screwdriver between the side panel and the vehicle chassis, in the top left and right corners. Make sure to separate side panel from structure.	
E	Use the c-clamp to separate the side panel from the back structural panel and at the same time gradually cut Sika bead with a sharp knife.	Ideally, the hoist or chain block must be fastened to the floor while pulling from a 45º angle so as not to damage the vehicle structure
F	Remove as much glue as possible from the structure using a putty knife or pneumatic knife without damaging 206 G+P primer.	Never heat SikaFlex adhesive to remove.
G	Check panel horizontal supports for straightness using a straight edge. Take measurements with a ruler.	Tolerance : 1mm towards the outside and 1.5mm towards the inside.

SECTION 2 PREPARATION OF SURFACES		
A	Clean using "anti-silicone" until all clothes come clean. See SAV00001 section A below.	
B	Use the belt sander (grit coarse) Use a new paper on each vehicle side.	
C	Clean using "anti-silicone" until all clothes come clean. See SAV00001 section A below.	
D	Apply – Sika 205 See SAV00001 section B below.	

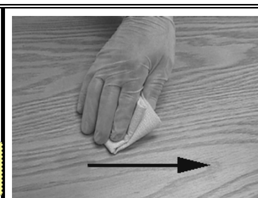
SIDE PANEL PREPARATION		
A	Clean using “anti-silicone” until all clothes come clean. See SAV00001 section A below.	
B	Use the belt sander (grit coarse) Use a new paper on each vehicle side panel.	
C	Clean using “anti-silicone” until all clothes come clean. See SAV00001 section A below.	
D	Apply – Sika 205 See SAV00001 section B below.	

SAV00001 Section A Alcohol or Anti-silicone



***1.* Apply**

CHIX cloth



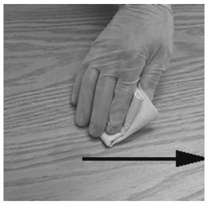
***2.* Dry immediately**

Blue cloth

***3.* Allow to dry**

Mandatory	**Minimum time : Wait for product to evaporate**
	After 2 hours: Start cleaning operation again
Before applying any other product	If surface seems dusty, greasy or with finger marks, start cleaning operation again.

Section B Sika 205

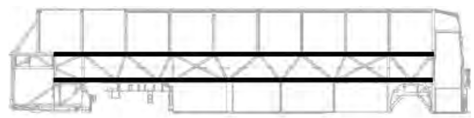
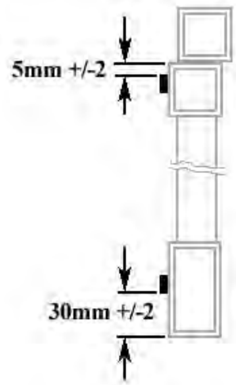
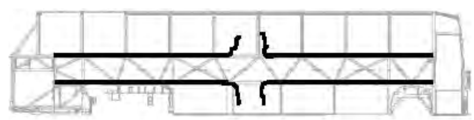
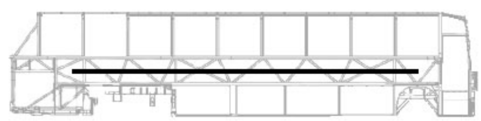
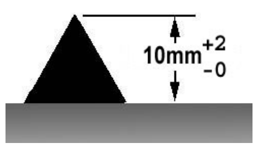
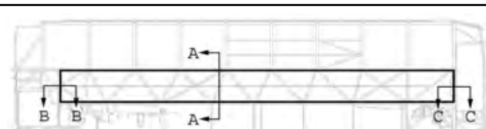
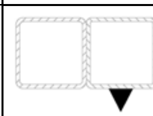
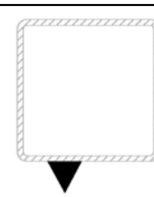


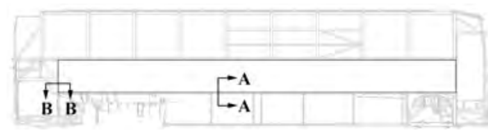
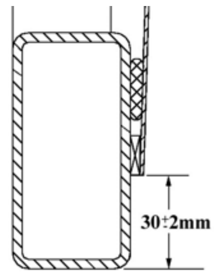
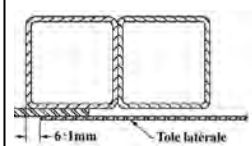
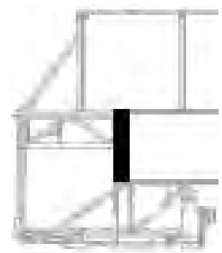
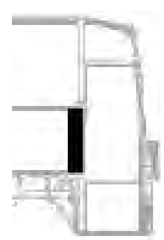
1. Apply

CHIX cloth

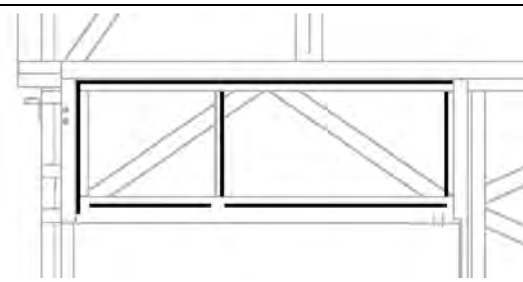
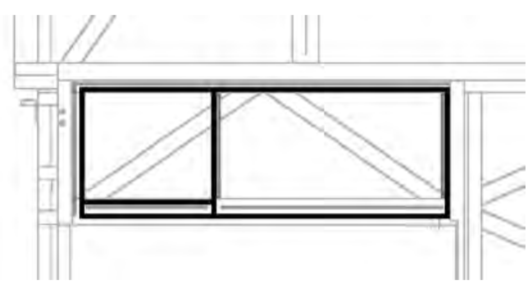
2. Allow drying

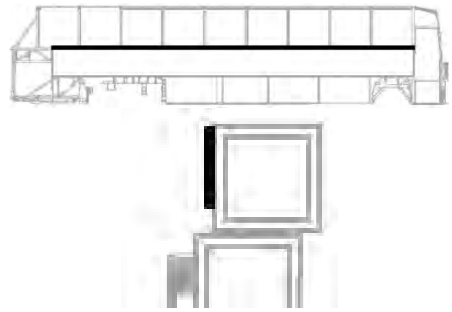
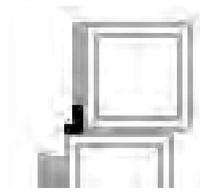
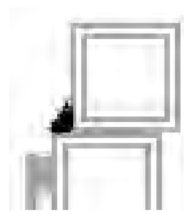
Mandatory	**Minimum time**	**- For a smooth surface (aluminum, stainless, steel, fiber glass (gelcoat side), etc.):**	**2 minutes**
		- Pour a porous surface (fiber glass (non gelcoat side), etc.)	**10 minutes**
	After 2 hours : Reactivate surface with Sika 205		
Before applying any other product	If surface seems dusty, greasy or with finger marks, start operation again.		

SECTION 3 SIDE PANEL INSTALLATION		
A	Using a pencil, mark the double-face self-adhesive tape position onto vehicle side.	 
B	Apply 1/8 X ½”double-face tape as per marking.	
C	Compress tape	
D	Remove protective film from double-face self-adhesive tape center section.	
E	Install 1/8 X ½” foam tape onto middle reinforcement then compress.	
F	Apply Sika 252  – Onto vehicle surface – Cut nozzle as per template – Use the guide for the application Bead must be continuous for the whole perimeter.	 Section A-A:  Section B-B:  Section C-C: 

G	Install side panel onto support jig.	
H	Position side panel in front of vehicle structure	**Section A-A**  **Section B-B** 
I	Perform final adjustment to make sure that side panel is true and square	– 30 mm. ± 2 with reference to bottom tubing – 6 mm ± 1 with reference to vertical tubing
J	Sand rear of side panel 2" wide	
K	Perform tig spot welding (1” apart)	Quantity of "tig spot": 30 minimum.
L	Install pulling equipment at the other end of side panel	
M	Make a final adjustment in height	
N	Sand front of side panel 2" wide	
O	Pull side panel so that panel moves 1/8”	Make sure the equipment pulls along the whole width of side panel
P	Perform tig spot welding	Quantity of "tig spot": 30 minimum.

REMOVE PULLING EQUIPMENT		
Q	Remove protective film from double-face self-adhesive tape.	
R	Compress top and bottom section of side panel	
S	Cut excess of side panel. Make sure that cut is parallel with tubing.	
T	Grind side panel end to line up with door tubing.	
To seal each panel end, apply masking tape on each side of side panel joint. Use a caulking nozzle and gray Sikaflex 221 adhesive to fill the cavity between the panel and vehicle structure. Clean using Sika 205. Allow 5 minutes minimum for drying. Wear surgical gloves and smooth down the joint with your finger.		

<table>
<tr><th colspan="3">SECTION 4
ENGINE AIR INTAKE PANEL INSTALLATION</th></tr>
<tr><td>A</td><td>Make sure that sealing of structure has been performed properly</td><td></td></tr>
<tr><td>B</td><td>Prepare vehicle surface as for side panel.</td><td>Refer to step # 2.00</td></tr>
<tr><td>C</td><td>Prepare air intake panel as for side panel</td><td>Refer to step # 2.05</td></tr>
<tr><td>D</td><td>Install foam tape 1/8" X ¼" onto structure, as shown in picture</td><td></td></tr>
<tr><td>E</td><td>Install foam tape 1/16" X ¼ onto air intake panel pleat</td><td></td></tr>
<tr><td>F</td><td>Apply a bead of 252 onto structure as per picture
Important: Make sure bead is continuous
Triangular bead: 10mm x 8mm</td><td></td></tr>
<tr><td>G</td><td>Install panel onto structure</td><td>Use a jig to make sure that panel is lined up with engine door tubing.</td></tr>
<tr><td>H</td><td>Use a brush to compress Sika bead</td><td></td></tr>
</table>

Finition Joint		
I	Install a protective tape onto the tubing above welding	
J	Apply Sika 205 Use a plastic spatula inside a Chix cloth to ensure that Sika 205 reaches as far as the corner. See SAV00001 section C.	
K	Apply Sika 252 black at the junction of both tubing. Smooth down the joint	
L	Remove protective tape	

11 BODY PANEL AND WINDOW SPACING

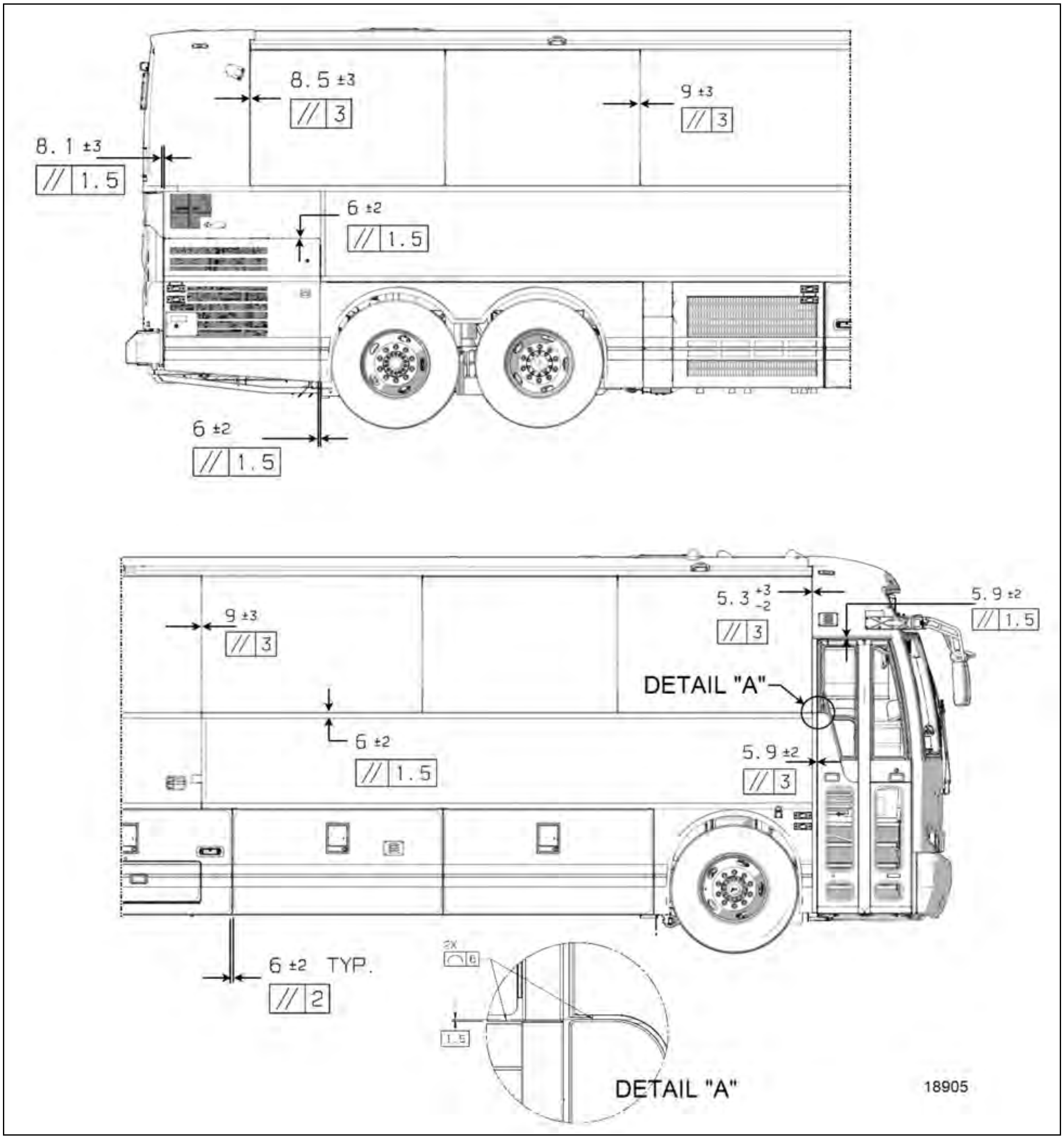


FIGURE 152: BODY PANEL AND WINDOW SPACING (CURB SIDE)

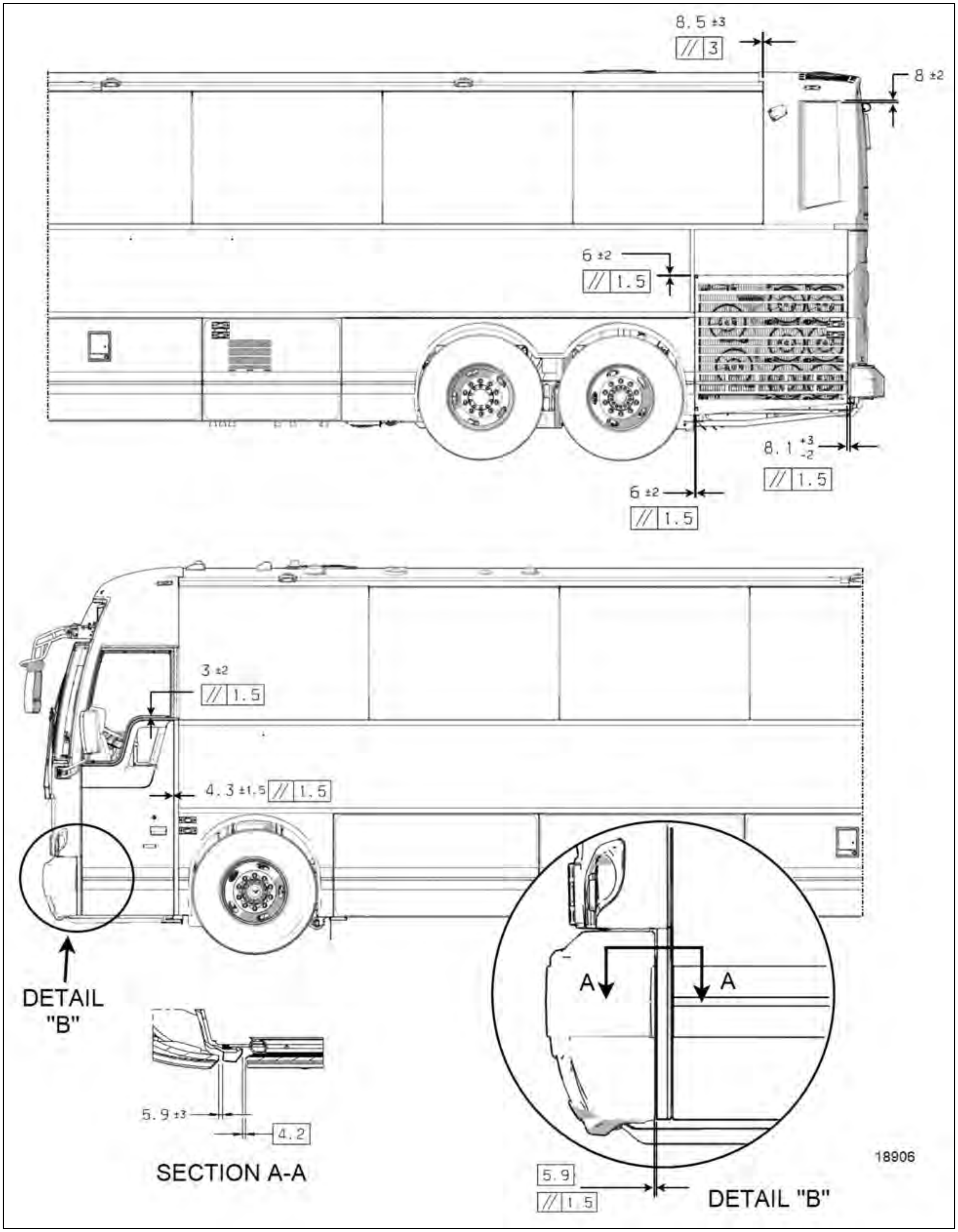


FIGURE 153: BODY PANEL AND WINDOW SPACING (CURB SIDE)

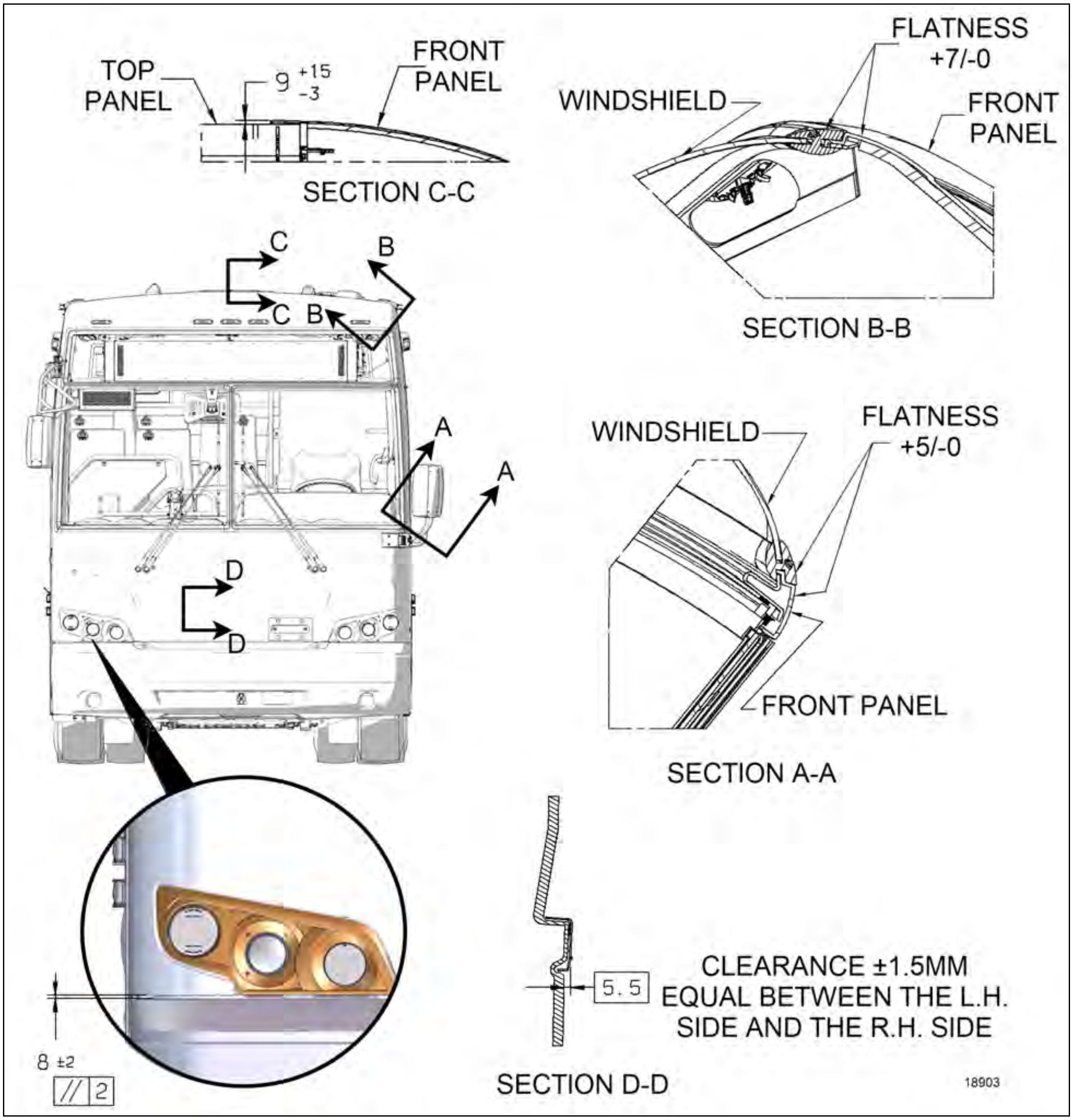


FIGURE 154: BODY PANEL AND WINDOW SPACING (FRONT)

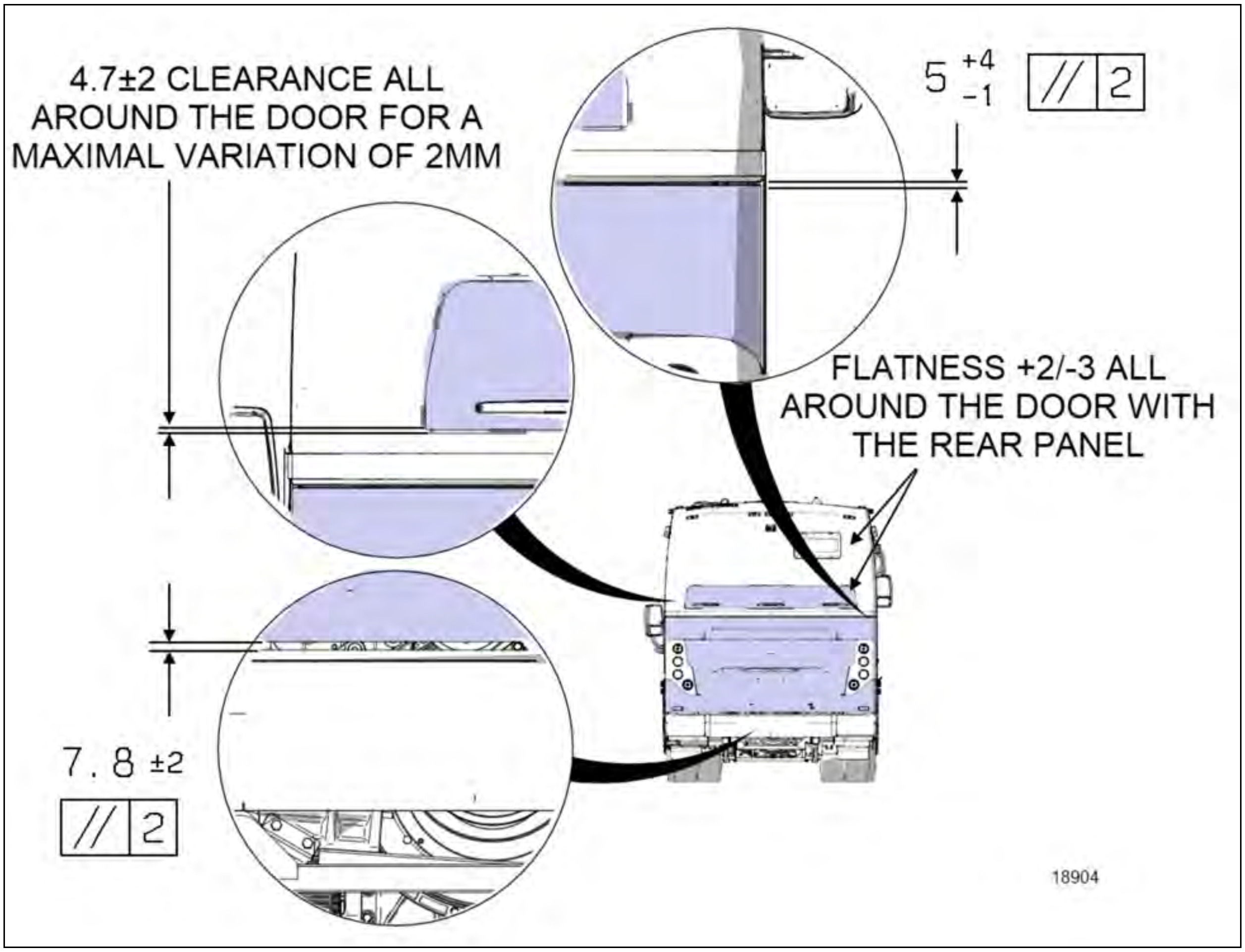


FIGURE 155: BODY PANEL AND WINDOW SPACING (REAR)

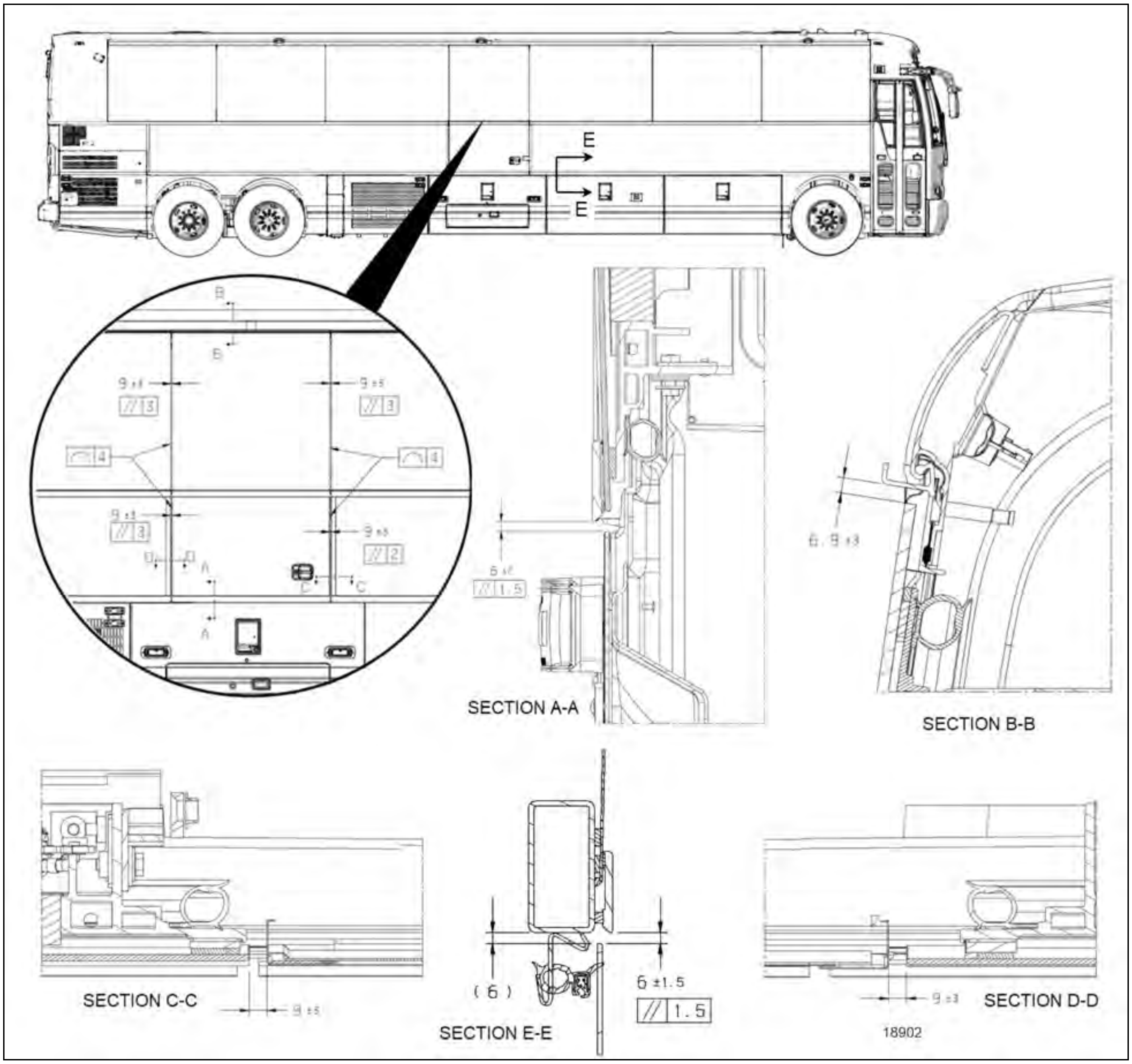


FIGURE 156: BODY PANEL AND WINDOW SPACING (WCL DOOR)

12 PASSENGER SEATS

Each seat has an 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 seats have three armrests. The aisle and center armrests can be folded up and down manually, while the window armrest is fixed.

12.1 UPHOLSTERY MAINTENANCE

Coach seats are lightweight, with foam-padded backs and cushions. For both appearance and durability, best results are obtained if upholstery is cleaned at regular intervals before dirt, dust and grit have been ground into the fabric.

- **Routine Cleaning**

All that is required to remove the dirt is a gentle beating with the hand or the back of a brush. This will bring the dirt to the surface where it is easily removed with a vacuum or brush in the direction of the pile which can easily be recognized by running a hand lightly over the pile. If the fabric becomes excessively dirty, particles of grit will cause gradual wear, reducing the life span of the fabric.

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.

- **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.

12.2 AMERICAN SEATING COMPANY SEATS (AMSECO)

12.2.1 AMSECO 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 screws, nuts, and washers holding seat frame to side wall and retain the 2 holding brackets.

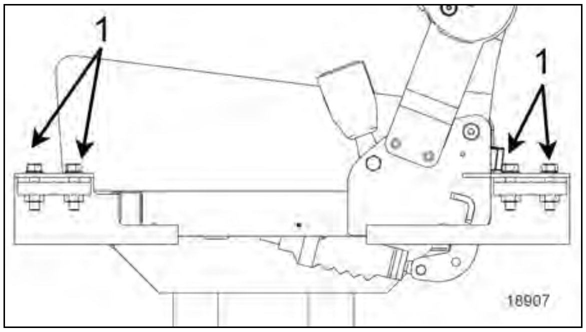


FIGURE 157: SEAT WALL MOUNTING SCREWS

2. On the pedestal, remove caps then remove nuts and washers holding seat to floor.

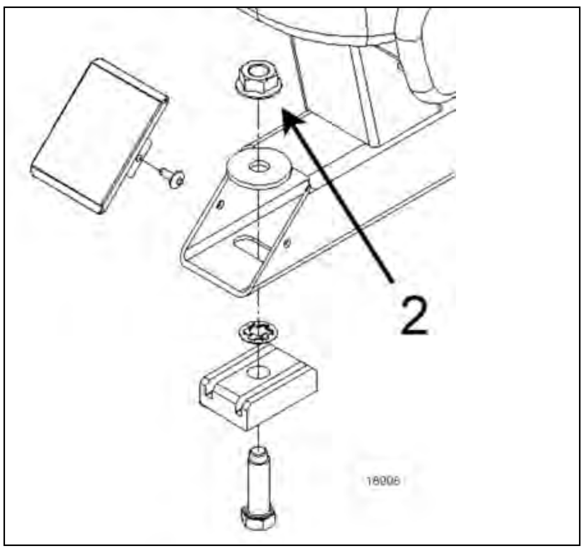


FIGURE 158: PEDESTAL MOUNTING NUTS

3. Remove seat assembly.

4. Reverse the above procedure to install seat assembly. Tighten mounting nuts.

TORQUE: 27 lb-ft (37 Nm)

12.2.2 Amseco Sliding Seats

Pedestal spacing adjustment

1. Attach the track blocks to pedestals placing the short blocks in front and the longer blocks on the rear.

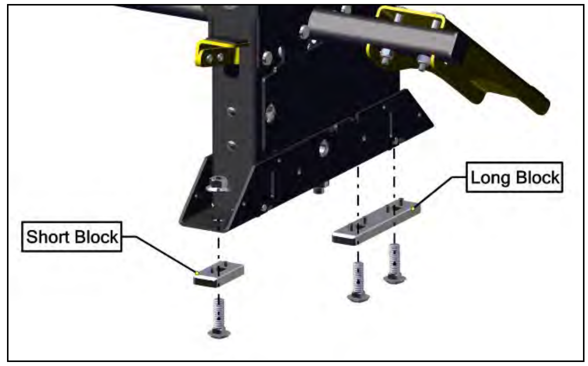


FIGURE 159: TRACK BLOCKS

2. Slightly tighten the nuts with your hand but DO NOT over tighten.

3. Repeat on the opposite side.

4. For adjustment, loosen the two wall side pedestal bolts using a wrench with a T45 Torx bit.

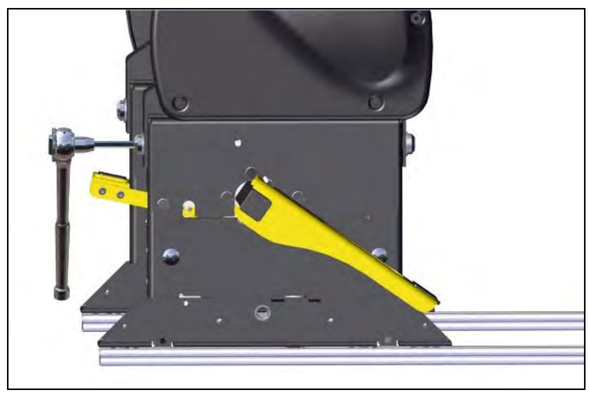


FIGURE 160: PEDESTAL BOLTS

5. Adjust the pedestal to center of track as needed.

6. Complete the seat mounting procedure using provided shims placed along sides of front and rear Track Blocks to center and eliminate binding with side walls of track while tightening to the following torque value:

Torque: 15 to 20 lb-ft (20-27 Nm)

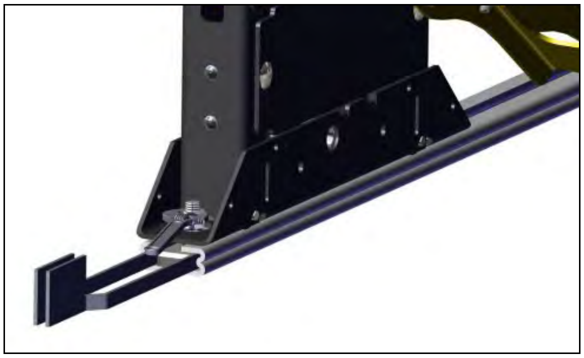


FIGURE 161: CENTERING SHIMS

7. Remove the shims after tightening all the bolts.

Pedestal locking plunger adjustment

8. Slide the pedestal until both plungers locate existing holes in track.

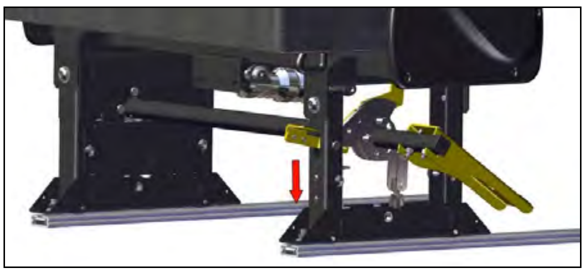


FIGURE 162: LOCATE HOLES IN TRACK

9. Once there, try locking by pressing the lock lever down.

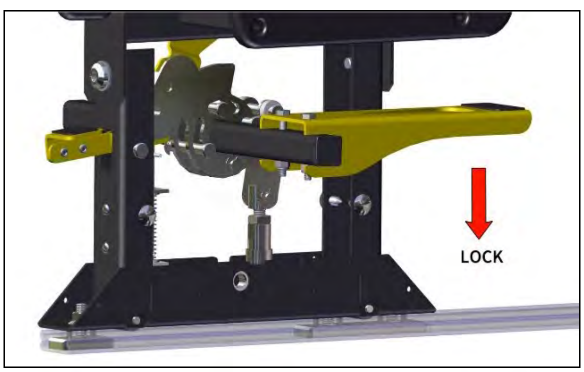


FIGURE 163: SLIDING SEAT LOCK LEVER

10. If too easy or too hard, make plunger adjustments as required.
11. If the pedestal is too loose or too tight, you can adjust as the following steps.
12. Unlock the pedestals to expose the jam nut on the plungers.

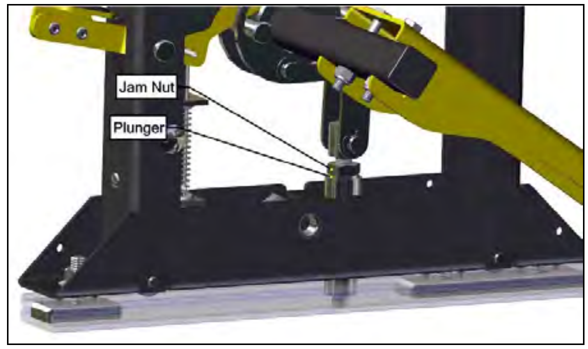


FIGURE 164: SEAT PLUNGER ADJUSTMENT

13. Loosen the jam nut from plunger using a 5/8" end wrench for the plunger and a 11/16" end wrench for the jam nut. This allows space to move the plunger in either direction up or down.
14. If the plunger is too tight, looking from the top, turn the plunger counterclockwise to raise the plunger and to decrease the locking force.

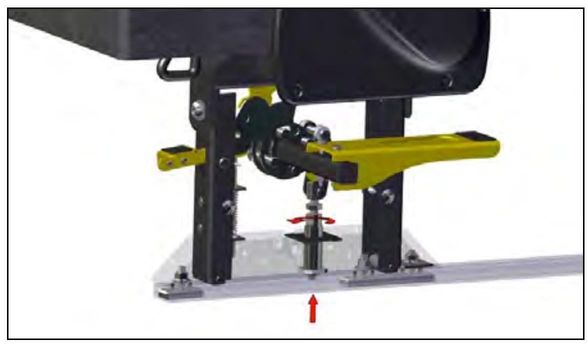


FIGURE 165: PLUNGER HEIGHT ADJUSTMENT

15. If the plunger is too loose and doesn't lock into place, turn the plungers clockwise to extend the plunger down and increase the locking force.
16. Lock the pedestal into place to check the tightness. Once adjusted, unlock the pedestals and retighten jam nuts to plunger without turning the plunger so you don't lose your newly adjusted location.
17. Repeat previous steps for the other pedestal.

12.3 TARABUS FLOOR COVERING REPAIR OR REPLACEMENT

The vehicle is equipped with “Tarabus” covering. It is possible to replace or repair this covering. The purpose of this paragraph is to explain the steps to be followed to ensure the best results and adherence.

MATERIAL

Part No	Description	Qty
680028	Adhesive, Tarabus Floor Covering (White)	A/R
684655	Adhesive, Contact (3M)	3.8L
684654	Adhesive, Contact (3M)	18.9L
680532	Sikaflex 221 Gray	A/R

NOTE

Material can be obtained through regular channels.

1. Remove number of passenger seats required to perform repair.
2. Cut and remove damaged section of floor covering.

NOTE

It would be preferable to cut under two rows of seats so that repair is not as noticeable.

3. Clean plywood using a scraper.

NOTE

Make sure that no staples are sticking out beyond the 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 166).

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 167).

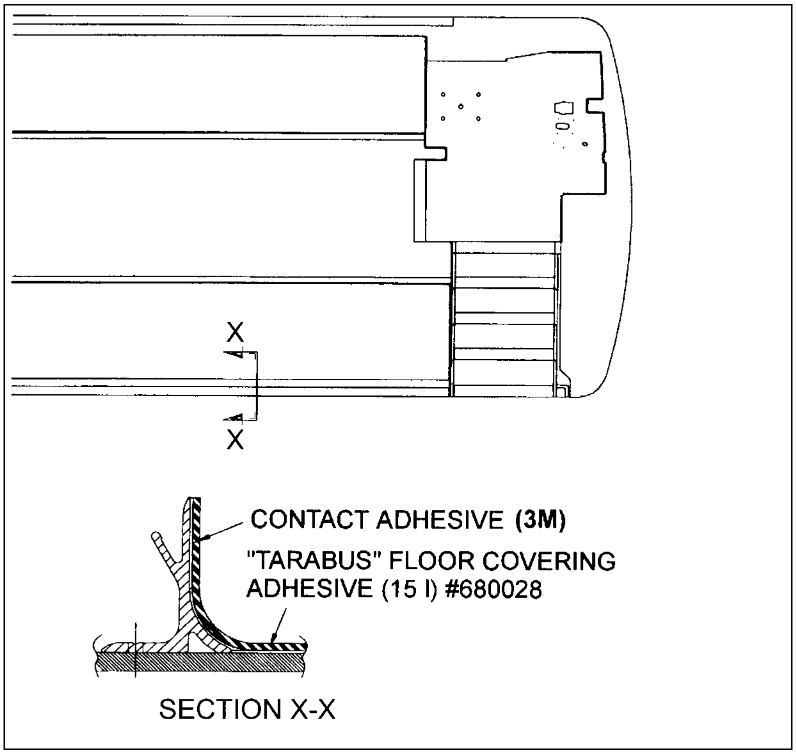


FIGURE 166: TARABUS FLOOR COVERING ADHESIVE APPLICATION 18640

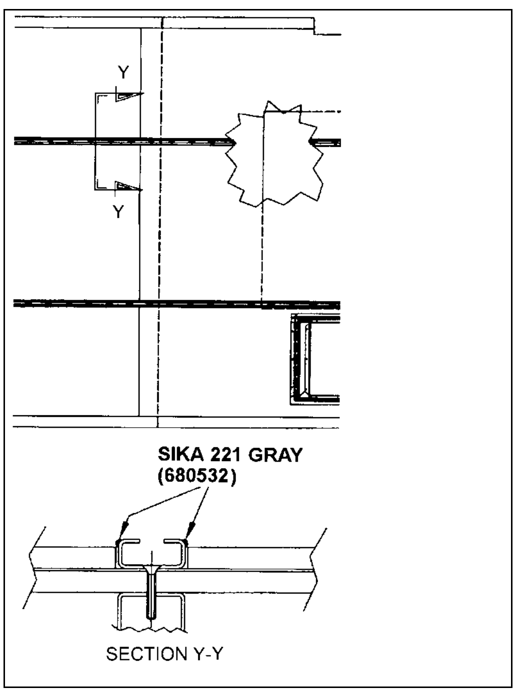


FIGURE 167: APPLICATION OF SIKA 221 GRAY 18641

12.3.1 Front Steps Replacement Procedure

MATERIAL

Part No	Description	Qty
682989	Anti-silicone	A/R
683097	Sika 205 (1 liter)	A/R
685101	Sika Remover 208	A/R
683916	Sika 215 (1 liter)	A/R

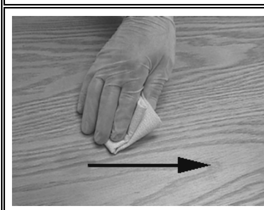
1. Cut and remove damaged step(s).
2. Remove dirt and adhesive residue.

NOTE
In wintertime, condensation and cold temperature may greatly influence bonding parameters. Working area must be at a temperature sufficient to prevent reaching condensation point. Mechanically preheat working area (heat lamp or heat gun) or wait until vehicle reaches room temperature.

PREPARATION OF “TARABUS” FLOOR COVERING

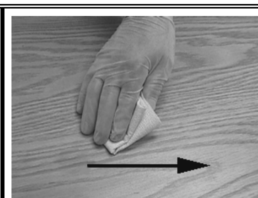
1. Sand under step using “Scotchbrite”.
2. Clean using anti-silicone (refer to Section A).

Section A Alcohol or Anti-silicone



***1.* Apply**

CHIX cloth



***2.* Dry immediately**

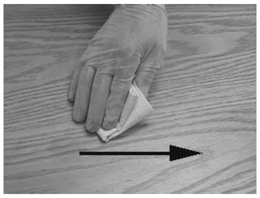
Blue cloth

***3.* Allow drying**

Mandatory	**Minimum time : Wait for product to evaporate**
	After 2 hours: Start cleaning operation again
Before applying any other product	If surface seems dusty, greasy or with finger marks, start cleaning operation again.

3. Apply Sika Primer 215 (refer to Section D).

Section D Sika Primer 215



1. **Shake bottle to mix product**

2. **Apply a thin layer**

CHIX cloth

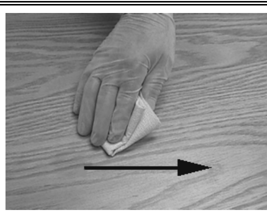
3. **Allow drying**

Mandatory	**215**	**Minimum time : 20 minutes**
		After 2 hours : Remove dust using damp cloth (pure water)
Before applying any other product		If surface seems dusty, dust using damp cloth.
		If surface seems greasy or with finger marks, reactivate with Aktivator.

PREPARATION OF FIBERGLASS

1. Clean using anti-silicone (refer to Section A).
2. Apply Sika 205 (refer to Section B).

Section B Sika 205



1. **Apply**

CHIX cloth

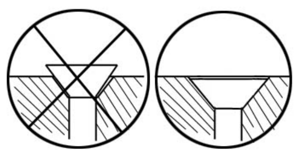
2. **Allow drying**

Mandatory	**Minimum time**	**- For a smooth surface (aluminum, stainless, steel, fiberglass (gelcoat side), etc.):**	**2 minutes**
		- For a porous surface (fiberglass (non gelcoat side), etc.)	**10 minutes**
	After 2 hours : Reactivate surface with Sika 205		
Before applying any other product	If surface seems dusty, greasy or with finger marks, start operation again.		

FRONT STEPS GLUING

1. Use step nosing to measure and cut necessary length of white safety strip.

2. Use a screw to check depth of countersinking in step nosing. Screw top must not stick out beyond the aluminum surface. Countersink if needed.



3. Apply some Sika 252 onto the step; make sure to cover the whole surface of the step. Use a serrated spreader with 1/8-inch serration to spread Sika.

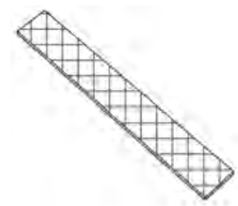
4. Apply a bead of Sika 221 onto the perimeter of the step.

5. Install step and press with hands. If Sika overflows, clean with Sika 208. Repeat previous stages for each step if applicable.

6. Remove protective film from double-coated self-adhesive tape located underneath step nosing, position step nosing then press. Drill and fix using screws.

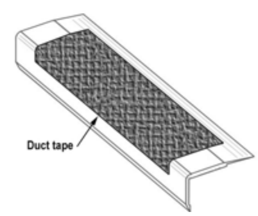
7. Clean top of step nosing using Sika 205 (refer to Section B).

8. Apply some Sika 221 onto white safety strip, spread with a spatula to cover the whole surface.



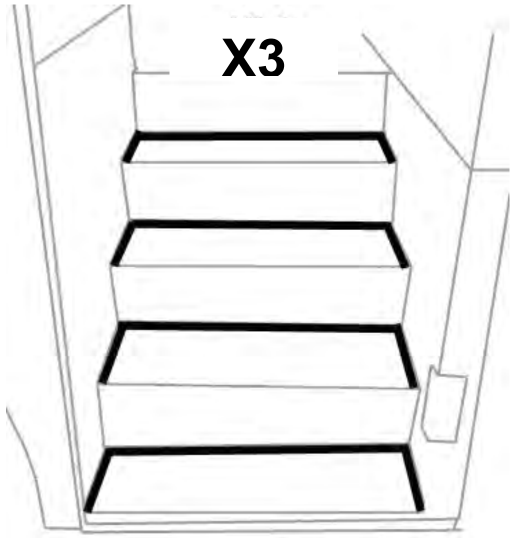
9. Position white safety strip then press using hands. If Sika overflows, clean with Sika 208.

10. Temporarily fix white safety strip with a piece of duct tape, leaving 1 to 2 inches free at each end.



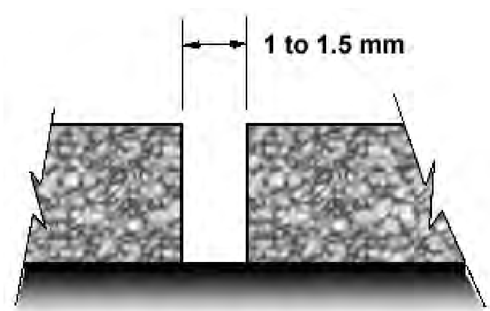
11. Apply some masking tape onto the step perimeter, clean using Sika 205 (refer to Section B) then apply a bead of Sika 252 black. Smooth out the joints then remove masking tape.

12. Install weights onto the steps. Minimum waiting time: 2 hours.



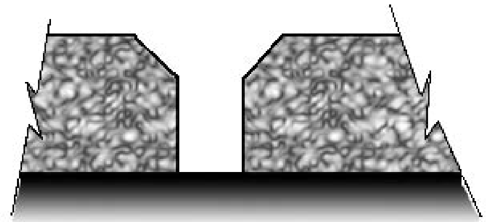
12.3.2 Welding Of Joint Between White Safety Strip And "Tarabus" Floor Covering

1. Pre-heat welding torch;
   - o Set welding torch to position #4.5 (temperature of 500 °C),
   - o Heating time: 5 minutes.
2. Before welding, visually ensure that a 1 to 1.5 mm gap exists between white safety strip and "Tarabus" floor covering. Use a knife if this is not the case.



NOTE
There should be no excess of adhesive on top of surfaces, clean if required using "All-Sol".

3. Chamfer the joint.



NOTE
The chamfer width must always be less than the filler bead diameter (between 2.5 and 3 mm).

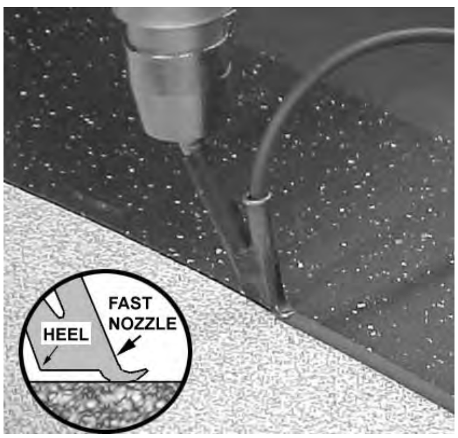
4. Use chamfer knife. **Be careful not to overcut or to cut to the side to prevent damaging "Tarabus" covering.**

5. Add (about 6 inches) some length to the required length of filler bead to make the joint then cut.
6. Take position with welding torch. The proper position is with a slight slope to the rear.

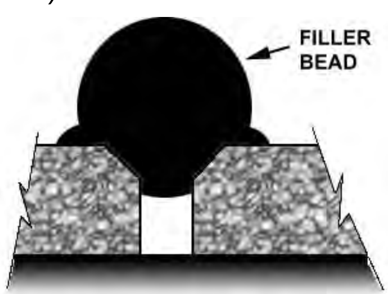
7. Once the welding torch is ready, insert the filler bead into the nozzle and immediately

start welding. Move in a regular manner while pressing slightly with torch.

8. The heel of the fast nozzle must not lean against “Tarabus” covering (always parallel to the surface).

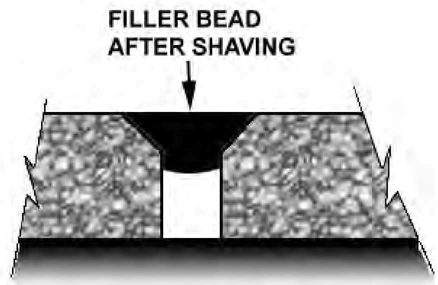


9. Allow cooling down of filler bead (about 5 minutes).



10. Shave filler bead to make it level to the floor. Use supplied knife designed for that purpose.

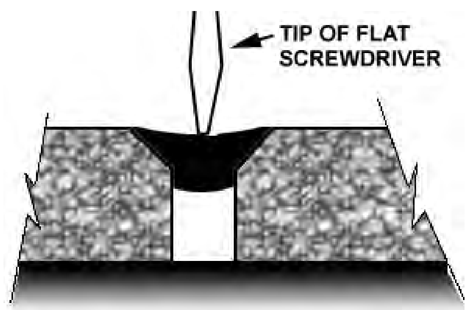
NOTE
To facilitate the cut, you can spray some soapy water onto the joint.



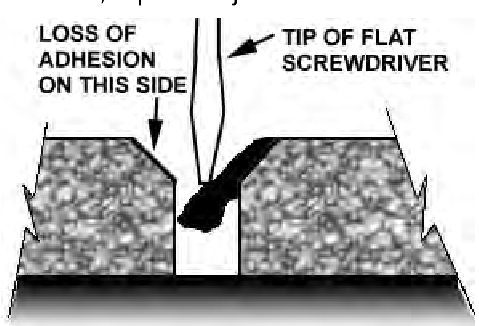
⚠ **CAUTION**
The procedure for turning the torch off must absolutely be followed. If this step is not taken, the element may burn.

11. Set temperature potentiometer to “0” position. Fan will evacuate residual heat. Leave the torch in operation as it is for 3 minutes.

12. Perform adhesion test using the tip of a flat screwdriver; apply a slight pressure on the joint.



13. If welding was not performed properly, there will a loss of adhesion on one side. If this is the case, repair the joint.



12.3.3 Repair Of A Welded Joint

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.

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 and re-weld the joint as shown in section 11.3.2, Section: Welding of Joint between White Safety Strip and "Tarabus" Floor Covering.

WARNING
Nozzle is hot.

3. Always add an extra inch of filler bead at the beginning and at the end of repair.

4. Perform steps 9, 10 and 11 in section 11.3.2.

MAINTENANCE INFORMATION

MI15-41

DATE :	AUGUST 2015 SECTION : 18 - Body
SUBJECT :	CRACKING OF POLYCARBONATE TAILLIGHTS CAUSED BY INAPPROPRIATE CLEANING PRODUCTS

APPLICATION

Model	VIN 
ALL MODELS	

DESCRIPTION

Prevost would like to remind its customers that only **cleaning products designed for external washing of vehicles** should be used for exterior vehicle wash and in particular, for the washing of polycarbonate taillights.

POLYCARBONATE CRACKING

Degreasers designed to clean motors **must not be used** to clean the engine compartment door. These products are not compatible with polycarbonate. They cause cracking of the polycarbonate taillights housing and cracking of the bosses in which the mounting threaded rods are inserted (figures 2 & 3).

CLEANING PRODUCT COMPATIBLE WITH POLYCARBONATE

Cleaning products designed for external washing of vehicles shall be used to clean your vehicle. Prevost suggests a high PH cleaner compatible with polycarbonate. See the description of the product in the following table

Part No	Description	Qty
686037	EXTERIOR CLEANER (BODY)	1 gallon / 4 liters
686036	EXTERIOR CLEANER (BODY)	5.28 gallons / 20 liters
685841	EXTERIOR CLEANER (BODY)	55 gallons / 210 liters

NOTE
Material can be obtained through regular channels.

High PH cleaning product compatible with polycarbonate - product sheet

Traffic film remover

Will not make plastics crack

Perfect for trucks, cars, trains, buses and machinery. Safe for all types of plastics including polycarbonate. Designed for automatic or pressure washing.

ADVANTAGES

- Easily removes traffic film, insects and grease.
- Safe for car and truck paint.
- Safe for use on metal, rubber, chrome, glass and plastic surfaces.
- Does not leave any deposit.
- Concentrated.
- Eco-friendly.
- Easy to rinse.
- Dries evenly.

DIRECTIONS

Pressure washing :
1. Use product accordingly to dilution ratio.
2. Spray evenly on vehicle surface starting by the bottom.
3. Rinse thoroughly with cold or lukewarm water.

MORE DETAILS

Do not wash in direct sunlight. Do not allow product to dry on surface.

DILUTION RATIO

DIRT	RATIO	
Mild	1 oz / 20 oz	50 ml / L
Average	1 oz / 10 oz	100 ml / L
Strong	1 oz / 6.67 oz	150 ml / L

PRECAUTIONS

Avoid all contact with eyes.
Avoid all contact with skin.
Wash hands with soap and water after handling.

FIRST AID

- Skin: Wash contaminated skin with soap and water.
- Eyes: Flush immediately with running water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Seek medical help.
- Ingestion: Do not induce vomiting. If the person is conscious, have them drink several glasses of water or milk. Seek medical help.

PHYSICAL ATTIBUTE

PHYSICAL STATE:	Liquid
APPEARANCE:	Clear
COLOR:	Transparent
SCENT:	Chemical
PH:	13.1
DENSITY (25°C):	1.1

SECURITY

HEALTH	1
FLAMMABILITY	0
REACTIVITY	0
PERSONAL ROTECTION	B

0 =	NEGLIGIBLE
1 =	LOW
2 =	MODERATE
3 =	HIGHT
4 =	EXTREME

FIGURE 1: PRODUCT SHEET

IMAGES SHOWING THE CRACKING ISSUE

FIGURE 2: Cracks at the boss and ribs due to the use of engine degreaser

FIGURE 3: Cracking of the outer surface of the taillight due to the use of engine degreaser

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PREVOST

ENREGISTRÉ - REGISTERED
ISO 9001 & ISO 14001

MAINTENANCE Mi14-01E
INFORMATION

PREVOST

DATE:	**JANUARY 2014**
SUBJECT:	**HOISTING AND TOWING PROCEDURE FOR X3-45 COMMUTER BUSES** *APPLICABLE TO:* *DOB Bus Number Series 2400–2489* *DOB Bus Number Series 2490–2789* *DOB Bus Number Series 1300–1606*

Revision A:
- Addition of comments following front tow demonstration at Zerega CMF, Bus 2491, March 2014
- Addition of comments following rear tow demonstration at Zerega CMF, Bus 2425, December 2013
- MI14-01A merged with MI12-03. MI12-03 is canceled

Revision B:
- Introduction of ZF A-132 drive axle
- Addition of comments following rear tow demonstration, June 2014

Revision C:
- Addition of tow truck connector, April 2020

Revision D:
- Updated 2.1 to show rubber chocks, secure front and rear, updated DOB numbers. July 2020

Revision E:
- Addition of 2.1.2 Mechanical Release of The Emergency/Parking Brake procedure and other updates

Table of contents

1 HOISTING AND TOWING POINTS

1.1 GENERAL DESCRIPTION

This procedure applies to NYCT X3-45 Commuter buses DOB bus number series 2400–2489; 2490–2789 and 1300–1606.

There are several hoisting and towing points. Use only these points when performing hoisting and towing of the bus (Figure 1).

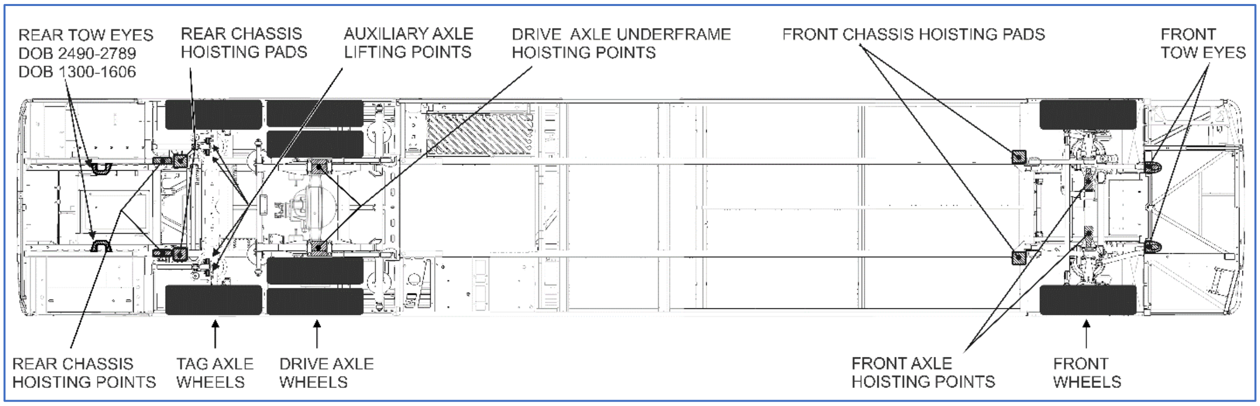


Figure 1: HOISTING AND LIFTING POINTS DIAGRAM

1.2 CHASSIS HOISTING POINTS

The vehicle is provided with six chassis hoisting points. Use chassis hoisting points in replacement of wheels as lifting points when the vehicle cannot be supported from an axle on which repair or maintenance is being done, otherwise use wheels as lifting points.

When using the chassis hoisting points to support the bus, **the tag axle must be unloaded at all time**. To prevent damages to the suspension, **always support the drive and front axles using jack stands** when using chassis hoisting points.

CHASSIS HOISTING POINTS
2 hoisting pads with receptacles located aft of the front axle (FIGURE 4)
2 hoisting pads with receptacles located aft of the tag axle (FIGURE 3)
2 hoisting points located aft of the tag axle (FIGURE 2)

FIGURE 2: CHASSIS HOISTING POINTS - AFT OF TAG AXLE

FIGURE 3: CHASSIS HOISTING RECEPTACLES - AFT OF TAG AXLE

FIGURE 4: CHASSIS HOISTING RECEPTACLES - AFT OF FRONT AXLE

FIGURE 5: JACK STAND AT CHASSIS HOISTING RECEPTACLE - AFT OF FRONT AXLE, ROAD SIDE

FIGURE 6: JACK STAND AT CHASSIS HOISTING RECEPTACLE - AFT OF FRONT AXLE, CURB SIDE

FIGURE 7: JACK STAND AT CHASSIS HOISTING RECEPTACLE – AFT OF TAG AXLE, ROAD SIDE

FIGURE 8: JACK STAND AT CHASSIS HOISTING RECEPTACLE – AFT OF TAG AXLE, CURB SIDE

FIGURE 9: 10-TON CAPACITY JACK STAND

FIGURE 10: 16500 LBF CAPACITY

FIGURE 11: 20-TON CAPACITY JACK STAND

WARNING
Prior hoisting, park the bus on a level surface and apply parking brake.

The bus can be supported at the chassis hoisting pads (refer to HOISTING AND LIFTING POINTS diagram). Use a jack stand of 10 tons capacity at each of the four chassis hoisting pads.

WARNING
Hydraulic jacks are intended for lifting only. Do not get under the bus for any reason unless it is properly supported with safety jack stands.

1.3 AXLES HOISTING POINTS

AXLES HOISTING POINTS
2 front axle hoisting points (Figure 12 to FIGURE 15)
2 drive axle underframe hoisting points (Figure 16 & Figure 17)
2 hoisting points under the tag axle (tag axle must be unloaded) (Figure 18)

To assure stability, always use the two hoisting points under a specific axle simultaneously.

Two hoisting points are located under the tag axle. Using the tag axle as rear hoisting points for the vehicle should be avoided. When possible, use the drive axle as hoisting point.

The vehicle can be lifted from the front axle and the drive axle underframe using lifting equipment of appropriate capacity.

APPROXIMATE WEIGHT PER AXLE
vehicle supported at front axle and drive axle underframe
Front axle: 12,000 lb. (5 443 kg)
Drive axle: 26,500 lb. (12 020 kg)

WARNING
The suspension must be in the normal ride position before hoisting.

WARNING
To prevent damage to suspension components, always unload the tag axle before hoisting the bus.

WARNING
The hoisting points on the tag axle must be used for raising the tag axle only.

FRONT AXLE HOISTING POINTS – DOB Bus Number Series 2400–2489

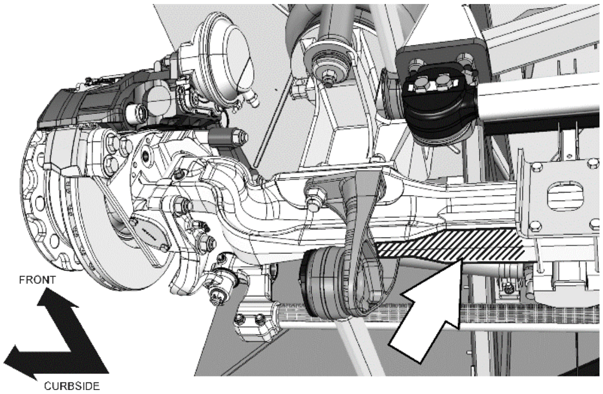


Figure 12: FRONT AXLE HOISTING POINT - CURBSIDE

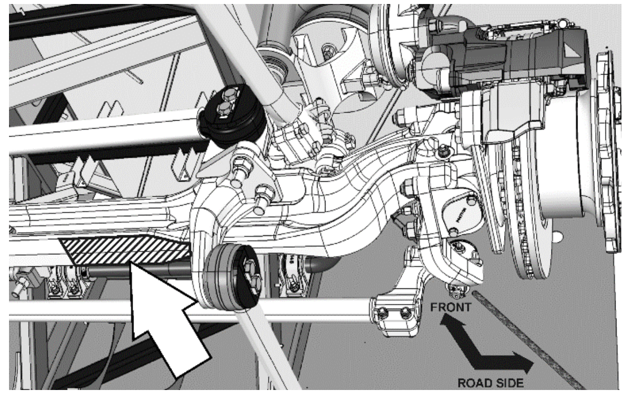


Figure 13: FRONT AXLE HOISTING POINT – ROAD SIDE

FRONT AXLE HOISTING POINTS – DOB Bus Number Series 2490–2789 and 1300–1606.

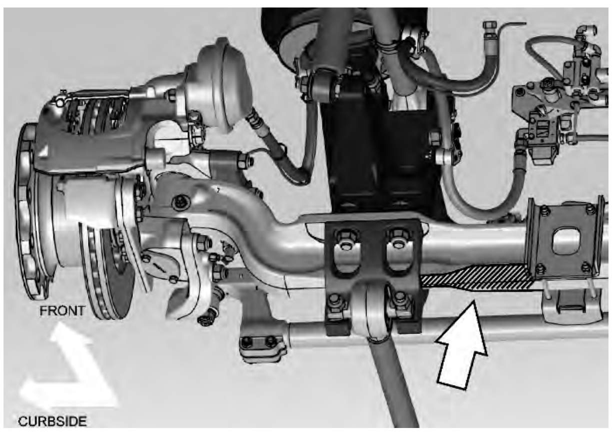


FIGURE 14: FRONT AXLE HOISTING POINT - CURBSIDE

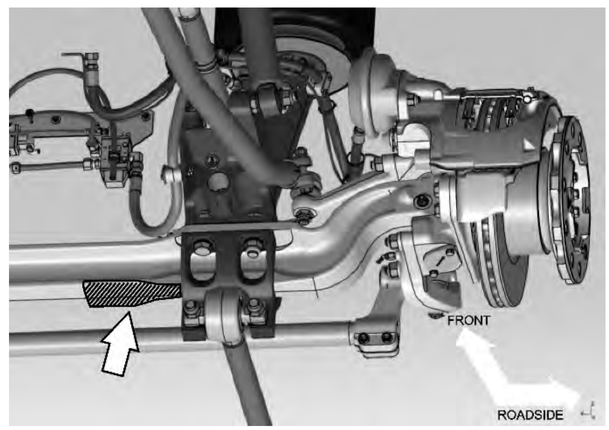


FIGURE 15: FRONT AXLE HOISTING POINT – ROAD SIDE

DRIVE AXLE UNDERFRAME HOISTING POINTS – DOB Bus Number Series 2400–2489

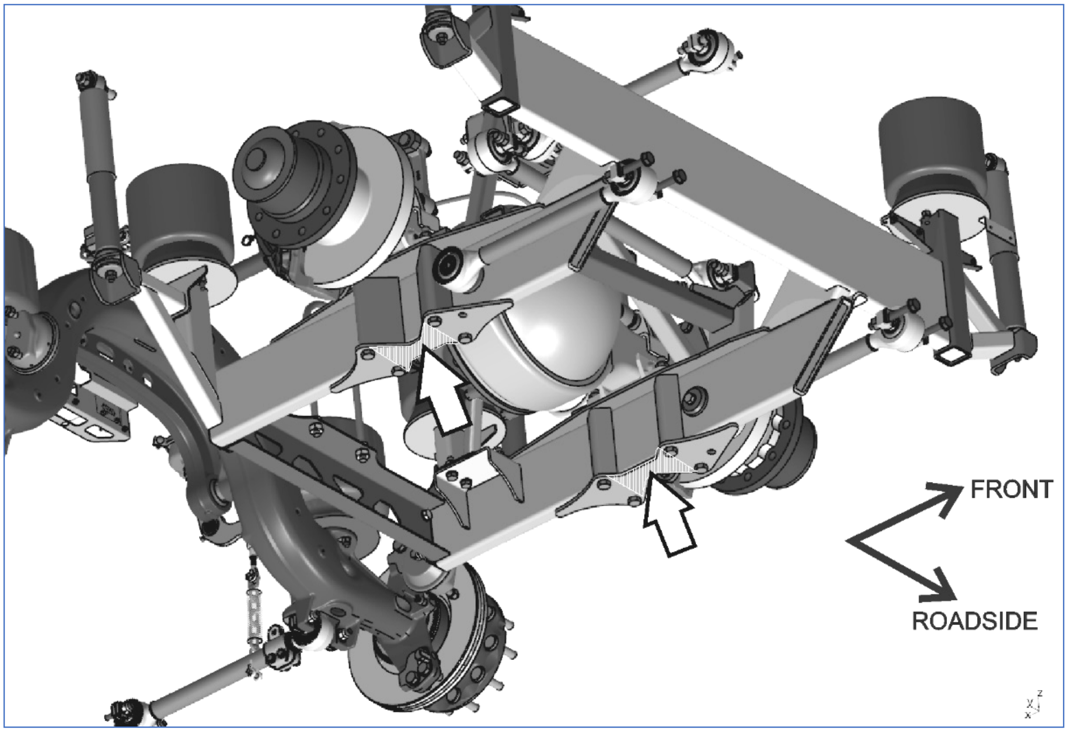


Figure 16: DRIVE AXLE UNDERFRAME HOISTING POINTS – DOB BUS NUMBER SERIES 2400–2489

DRIVE AXLE UNDERFRAME HOISTING POINTS – DOB Bus Number Series 2490–2789 and 1300–1606

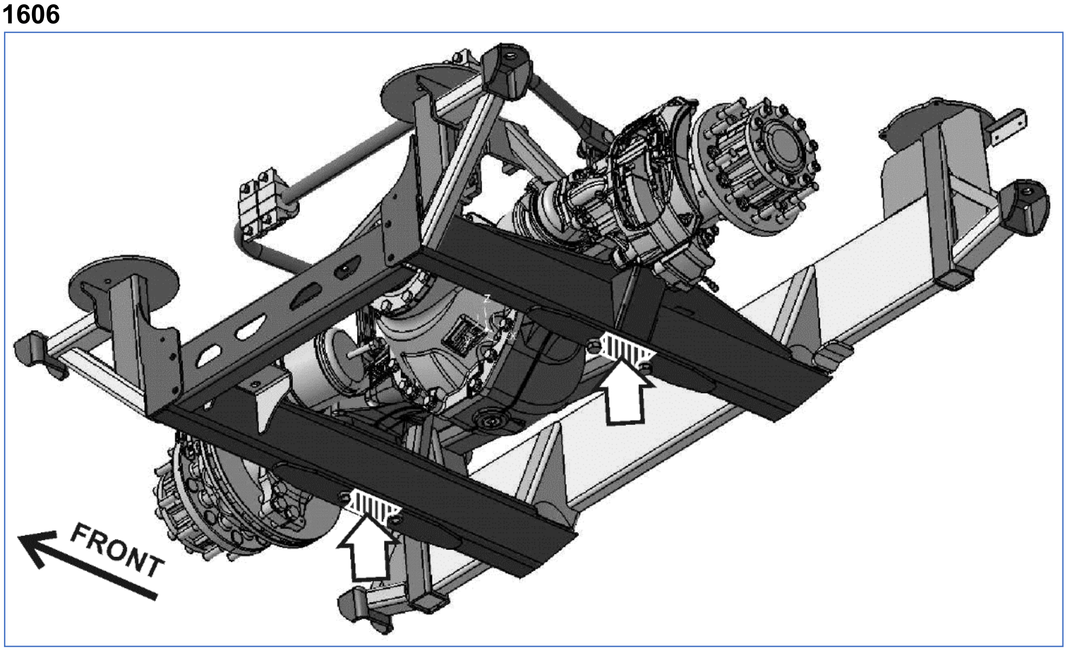


Figure 17: DRIVE AXLE UNDERFRAME HOISTING POINTS – DOB BUS NUMBER SERIES 2490 TO 2789 and 1300 TO 1606

TAG AXLE HOISTING POINTS

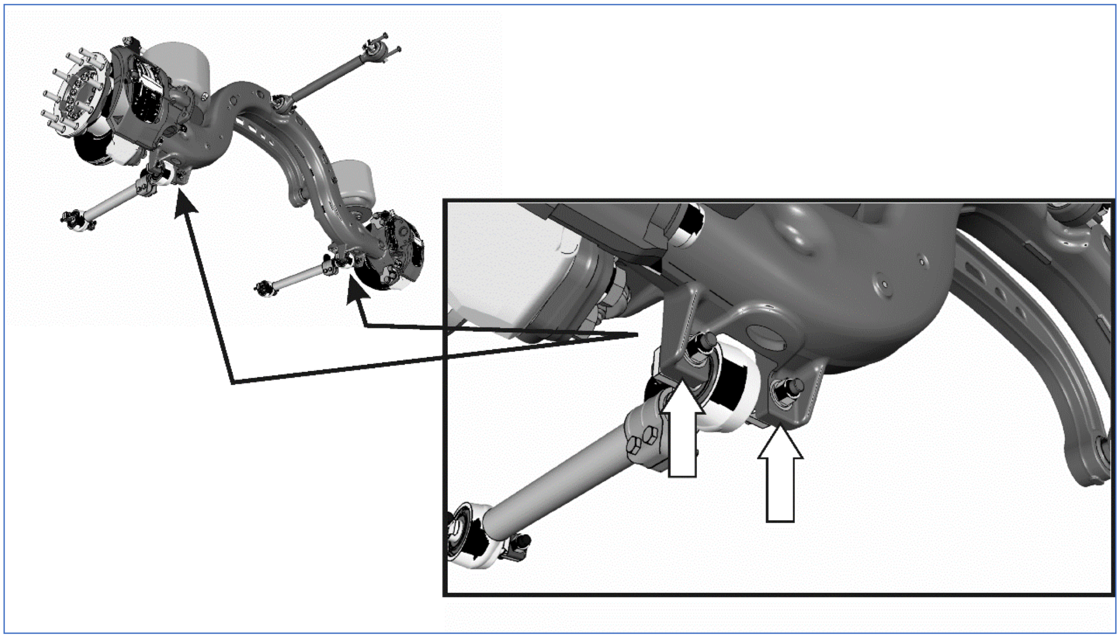


Figure 18: TAG AXLE HOISTING POINTS (use only to support the tag axle)

1.4 WHEELS AS HOISTING POINTS

Use the front and drive axle wheels to lift the bus when using **mobile column lifts**. When doing so, the tag axle must be unloaded at all time.

Using the tag axle wheels as the only lifting point for the rear of the bus should be avoided. However, if the rear of the bus must be lifted using the tag axle wheels only, the tag axle must be unloaded at all time.

2 TOWING

Towing from the front is recommended in order to move an immobilized bus. Prevost does not recommend towing from the rear using hoisting points that are not approved as the bus may sustain structural damage.

The bus should be towed by truck operators authorized and experienced in towing highway buses.

Observe normal precautions including, but not limited to, the ones listed below when towing the bus:

- Make sure the parking brake or the emergency brake is released at time of towing.
- Do not allow passengers to ride onboard the towed bus.
- Tow the bus at a safe speed as dictated by road and weather conditions.
- Accelerate and decelerate slowly and cautiously.
- Avoid sharp turns where possible.

WARNING

Do not carry passengers while the bus is being towed.

CAUTION

Avoid towing the bus from the rear using hoisting points that are not approved as this will cause structural damage. In case of damage to the drive train components, use a low bed semi-trailer.

WARNING

Engage the parking brake to prevent the bus from moving before you begin maintenance or service procedures that require you to be under the bus. Serious personal injury can result.

CAUTION

Lift the bus at the minimal height required for the bus to trail the tow truck.

2.1 BEFORE TOWING PREPARATION

1. Set the transmission to neutral and apply parking brake.
2. Chock the *front and rear* wheels to prevent the bus from moving at time of releasing the parking brake during the towing preparation.
3. On the L.H. dashboard panel, turn on the hazard warning flashers. Preferably, use a towing light bar.

Figure 19: CHOCK THE FRONT AND REAR WHEELS

4. Place the front wheels in a straight-ahead position and keep the steering wheel from turning. To do so, slide the driver's seat close to the steering wheel. Wrap the safety belt around and through the steering wheel and then fasten safety belt.

   This will assure the bus to roll in straight direction and eventually to be stopped by the tow truck in the eventuality of a mechanical failure of the tow truck lifting equipment.

Figure 20

2.1.1 Electrical Power and Air Supply

Operate the engine when towing to maintain brake system air pressure. If the engine cannot be operated, connect external air pressure lines from the tow truck.

⚠ CAUTION
Do not tow the bus without external air pressure applied to the emergency fill valve if the engine does not operate. Without brake system air pressure, the emergency spring 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.

"Brake" quick connect fitting

Flip down the access door located on the front bumper, connect an auxiliary air supply from the tow truck in order to supply air for operation of the bus **service brake** from the tow truck (Figure 21 & Figure 22).

"Air supply" quick connect fitting

While the vehicle is being towed, connect an auxiliary air supply from the tow truck to the quick connect fitting identified AIR SUPPLY to supply air for all systems (brakes, suspension, accessories) through the air dryer (Figure 21 & Figure 22).

Tow truck connector

The tow truck connector provides electrical supply from the tow truck to the rear clearance lights, the rear flasher lights, the tail lights and the stop lights.

Figure 21

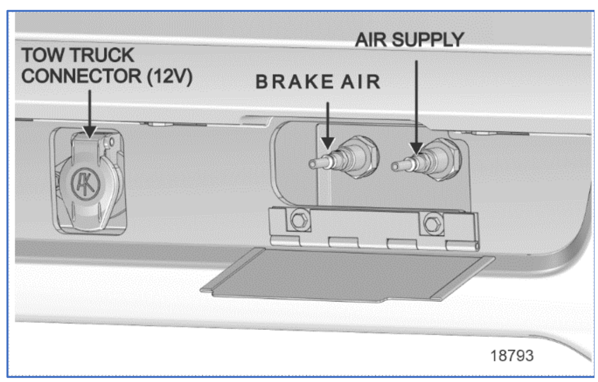


Figure 22: FRONT TOWING AIR SUPPLY ACCESS PANEL QUICK CONNECT FITTINGS

Engine compartment emergency air-fill valve

An additional emergency fill valves is available to supplement the air system when air pressure is low and the engine cannot be operated. This valve is located in the engine compartment (Figure 23) and supplies air for all systems (brakes, suspension and accessories).

Figure 23: ENGINE COMPARTMENT EMERGENCY AIR-FILL VALVE

2.1.2 Mechanical release of the emergency/parking brake

The emergency/parking brake can be released mechanically if for some reasons it cannot be released pneumatically.

1. Turn the release bolt (26) with the help of an open-ended spanner 24 mm A/F in an anti-clockwise direction (torque max. 45 Nm) until the brake is released.

Do not use an impact wrench

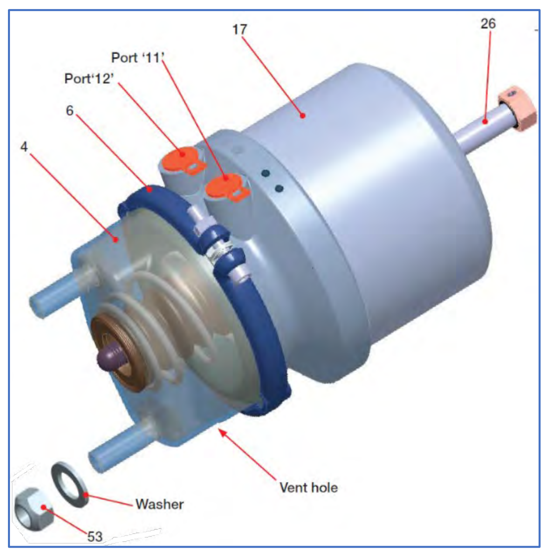


Figure 24: TURN THE RELEASE BOLT (26)

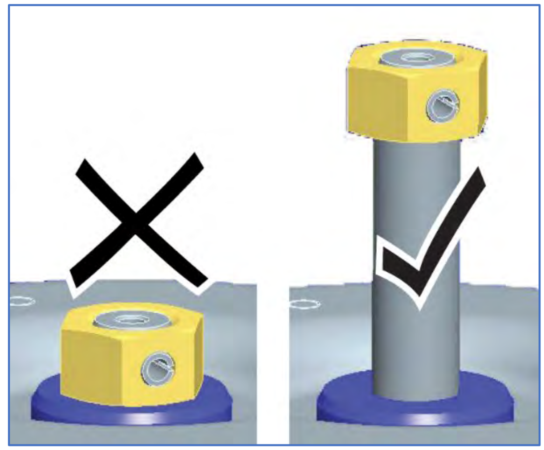


Figure 25: TURN THE RELEASE BOLT (26) IN AN ANTI-CLOCKWISE DIRECTION UNTIL THE BRAKE IS RELEASED

CAUTION!

When the towing has been carried out, screw the release bolt (26) fully into the actuator, ensuring that the seal in the inner face of the release bolt head seals against its adjacent sealing face and tighten to a torque of min. 20 Nm (never exceed 70 Nm).

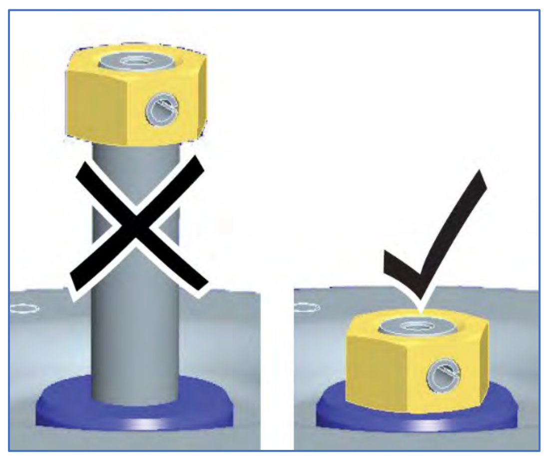


Figure 26: WHEN THE TOWING HAS BEEN CARRIED OUT TURN THE RELEASE BOLT (26) IN A CLOCKWISE DIRECTION UNTIL THE BRAKE IS BACK INTO NORMAL OPERATION

2.1.3 Drive Axle Flange Shafts Removal

1. Apply the bus parking brake.
2. Remove the stud nuts and the washers (with Meritor drive axle) or cap screws (with ZF drive axle) from the flange shaft.

DOB Bus Number Series 2490–2789

cap screw M18x1.5x50mm G10.9 (use 14mm hex socket driver “Allen”)

DOB Bus Number Series 1300–1606

cap screw external Torx M18x1.5x50mm G10.9 (use E24 External Torx driver)

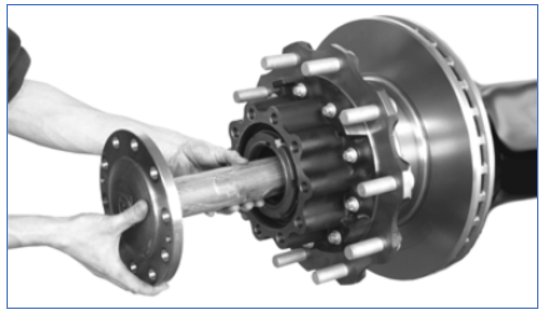


Figure 27: ZF A-132 AXLE

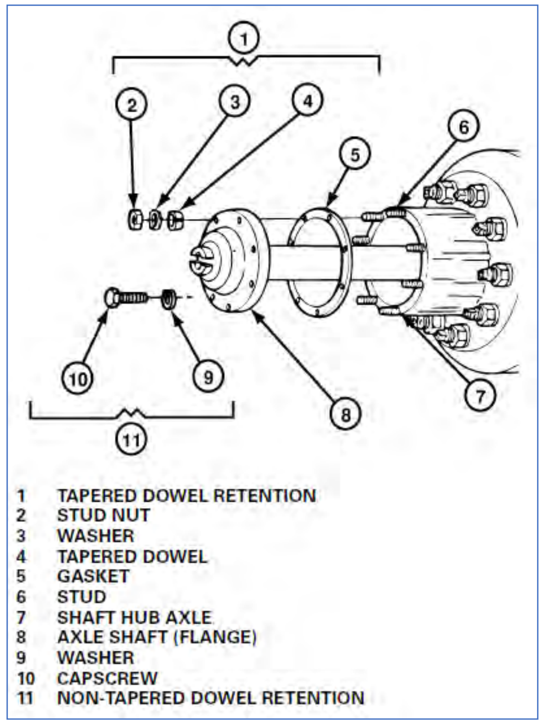


Figure 28: MERITOR RC23-165 AXLE

NOTE: there is oil behind the flange shaft which comes out during disassembly

CAUTION

Do not use a chisel or wedge to loosen the axle flange shaft and tapered dowels. Using a chisel or edge can result in damage to the axle shaft, the gasket and seal, and/or the axle hub.

3. **Meritor axle:** Loosen the tapered dowels in the flange of the axle shaft using the following methods.
   a) Do not strike the round driving lugs on the flange of an axle shaft. Pieces can break off and cause serious personal injury. A 1.5 inch (38.1 mm) diameter brass hammer can be used as a drift.
   b) Hold a 1.5 inch (38.1 mm) diameter brass drift against the center of the axle shaft flange, **inside the round driving lugs.**
   c) Hit the end of the drift with a large hammer (5 to 6 lbs.') to loosen the axle shaft and tapered dowels from the hub.
4. Identify each axle shaft that is removed from the axle assembly so they can be installed in the same location after transporting or repair is completed. (Example: Match mark a mating axle shaft and hub).

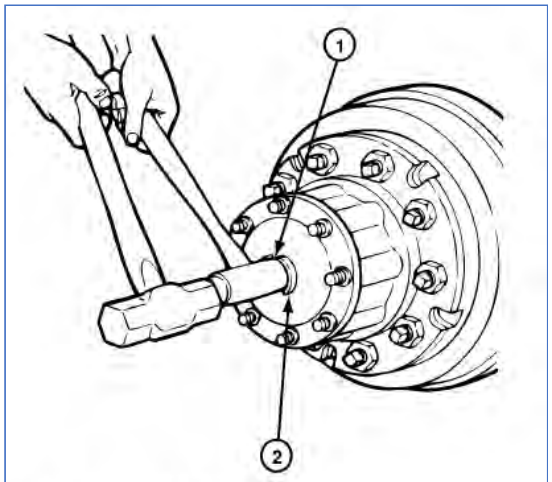


Figure 29: MERITOR RC23-165 AXLE

5. Remove the tapered dowels (if used), gasket or O-ring and the axle shaft from the axle assembly. Use a container to recover the oil.
6. Remove opposite flange shaft similarly.
7. Install a temporary cover over the open end of each hub where an axle shaft was removed. This will prevent dirt from entering the bearing cavity and loss of lubricant.

After Towing

1. Remove the covers from the hubs.
2. Install the gasket or O-ring, and axle shaft into the axle housing and carrier in the same location it was removed from. The gasket and flange of the axle shaft must be flat against the hub. Rotate the axle shaft and/or the driveline as necessary to align the splines and the holes in the flange with the studs or holes in the hub.
3. **Meritor axle only:** Install the dowels over each stud and into the tapered holes of the flange.
4. Install the washers and stud nuts or cap screws.

MERITOR RC23-165 AXLE	**ZF A-132 AXLE**
Determine the size of the fasteners and tighten the nuts to the corresponding torque value shown below. • 9/16-18 plain nut: 110–165 lbf-ft (149–224 Nm) • 5/8-18 plain nut: 150–230 lbf-ft (203–312 Nm)	Tightening torque M18x1.5 G10.9 screw 325 lbf-ft (440 Nm)

5. Mount opposite flange shaft similarly.
6. Inspect the lubricant level in the axles and hubs where the axle shafts were removed. Add the correct type and amount of lubricant if necessary.

CAUTION

Make sure axle shafts or driveshaft are installed correctly after towing. Tighten axle shaft and driveshaft nuts to the correct torque settings. Do not invert shafts.

2.2 TOWING FROM THE FRONT

The towed bus must be lifted from the front with front wheels off the ground. The tow truck must be equipped with the proper lifting equipment i.e. tow bar, axle forks and holders to reach under the ***front axle*** or the ***front tow eye pads*** since no other lifting points are recommended for towing. Lifting and towing from any other point are not authorized as it may cause structural damage. **To prevent overloading the drive axle, do not unload or raise the tag axle when towing the bus**.

To prevent damage to the bus, use the ***front tow eye pads*** fixed to the bus chassis between the front axle and the front bumper. Use only a solid link tow bar and safety chains to tow the bus.

1. Block the wheels to prevent the bus from moving.
2. Perform the BEFORE TOWING PREPARATION. Refer to paragraphs 2.1 and 2.1.1.
3. Disconnect both drive axle shafts to prevent damage to the transmission. Plug axle tube to prevent oil loss. Refer to **2.1.2 DRIVE AXLE SHAFTS REMOVAL**.

CAUTION

Transmission lubrication is inadequate when towing. The axle shafts must be disconnected to avoid serious damage to the transmission.

To prevent damage to the drive train components, disconnect drive axle shafts before towing. Do not attempt to push or pull-start a bus equipped with an automatic transmission.

Failure to disconnect the propeller shaft, remove the drive axle shafts or lift the drive wheels off the ground before towing can cause serious transmission damage and void the warranty.

2.2.1 First Lift

To allow lifting equipment fitted with axle forks to reach under the front axle or tow eyes, it is necessary to perform a first lift of the front of the bus using the tow eye pads as lifting points. This first lift will allow tow cans or blocks to be placed underneath front tires.

1. Retract the tow truck stinger arm.
2. On the first lift, position the tow bar fork holders under the front tow eye pads (Figure 30 to Figure 32) to lift the bus in order to place the front wheels firmly on the tow cans or blocks.

Center to center measurement between
tow eyes= 37 inches (**Figure 30**)

Note: No axle forks are needed for this first lift

Figure 30

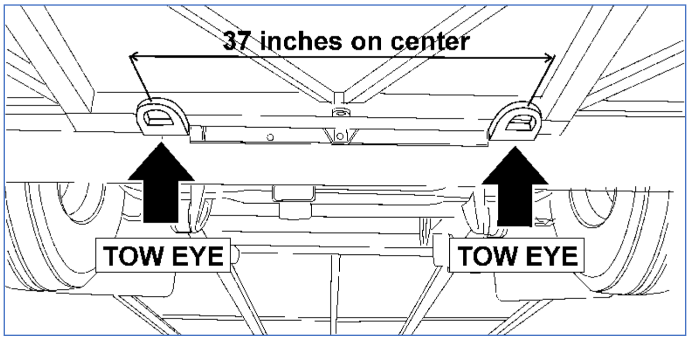


Figure 31

Figure 32: TOW EYE

3. Deploy the tow truck stinger arm, placing the axle fork holders under the tow eye pads (Figure 33).

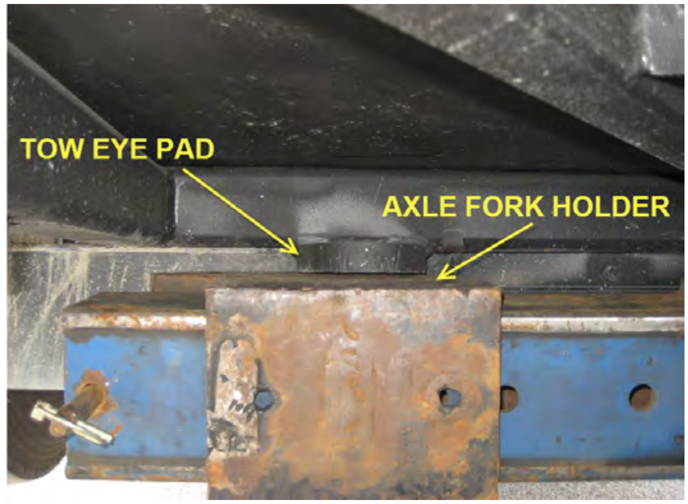


Figure 33

4. Lift the front end of the bus high enough to allow installation of tow cans or blocks. Place the tow cans or blocks perfectly centered underneath each front wheel (Figure 34).
5. With precaution, lower the front of the bus


Figure 34

2.2.2 Second Lift - Front Tow Eye Pads as Lifting Point for Towing

The tow eye pads fixed to the vehicle chassis, fore of the front axle will be used as front end lifting point for towing.

1. Perform the first lift as instructed in paragraph 2.2.1 if not already done.

2. Place the axle forks on the tow bar fork holders (Figure 35). **Use the inner fork receptacles.**

Use 3" to 4 ½" mouth axle forks preferably

REGULAR

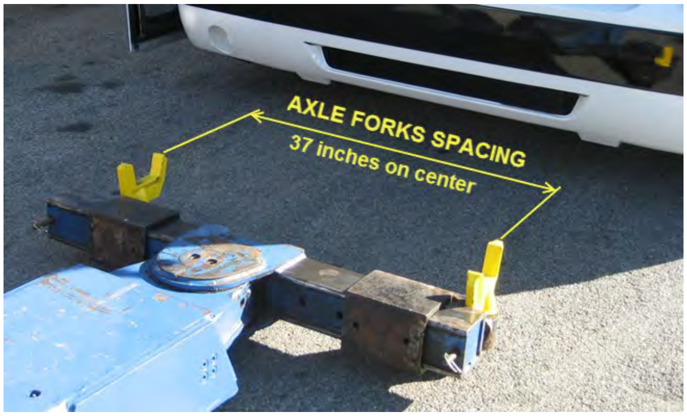


Figure 35

Pre-adjust spacing between axle forks to = 37 inches

3. Lower the tow bar and position under the front tow eye pads.
4. Adjust fork holders position and hand guide the forks into each front tow eye (Figure 35).
5. Lift the tow bar until the axle forks fit snugly into the front tow eyes (Figure 36).

Figure 36

Axle forks properly engaged in tow eyes (Figure 37 ***&*** Figure 38***)***

Figure 37

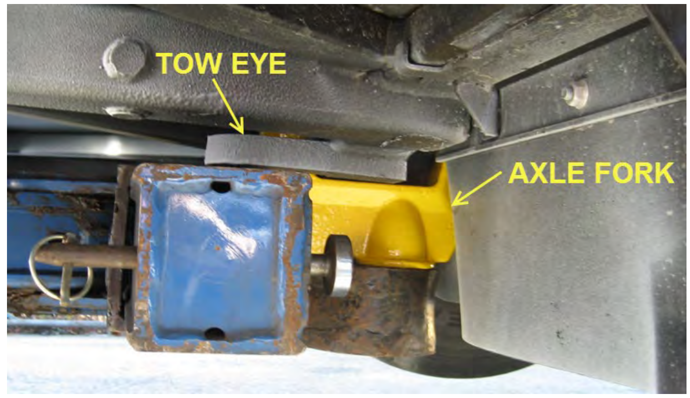


Figure 38

6. Raise the front of the bus.
7. Install a jack stand under the stinger arm for support and safety purposes and then lower the stinger arm so it rests on the jack stand (Figure 39). The tow cans or blocks can be removed from under the front axle wheels.

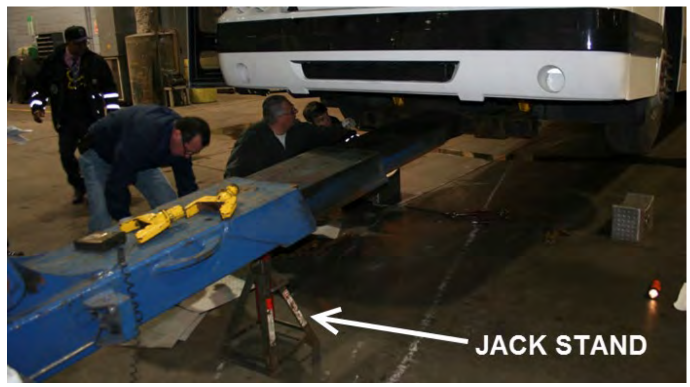


Figure 39

8. Tie the two choke chains together to secure the tow eyes to the tow bar attachment **through the outer fork receptacles** (Figure 40).


Figure 40: DOB BUS NUMBER SERIES 2400–2489 & 2490–2789 CHOKE CHAINS ROUTING

Figure 41: DOB BUS NUMBER SERIES 1300–1606 CHOKE CHAINS ROUTING

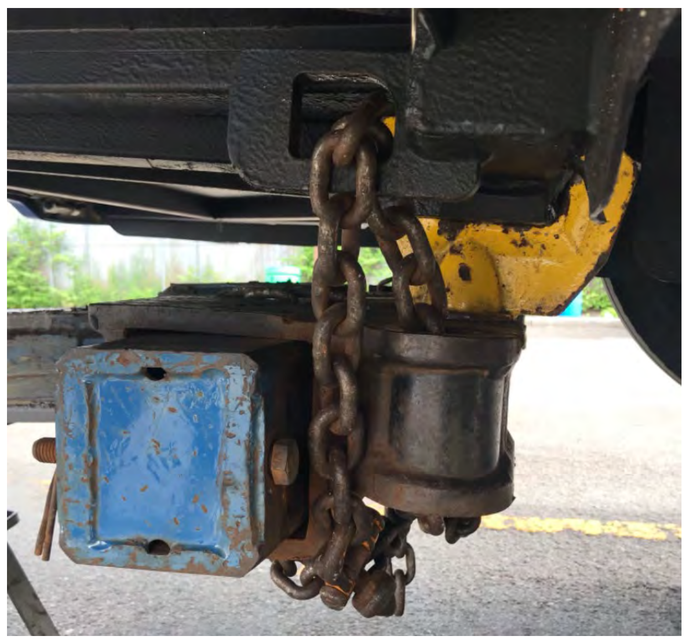


Figure 42: DOB BUS NUMBER SERIES 1300–1606 CHOKE CHAINS ROUTING

Figure 43: : DOB BUS NUMBER SERIES 1300–1606 CHOKE CHAINS ROUTING

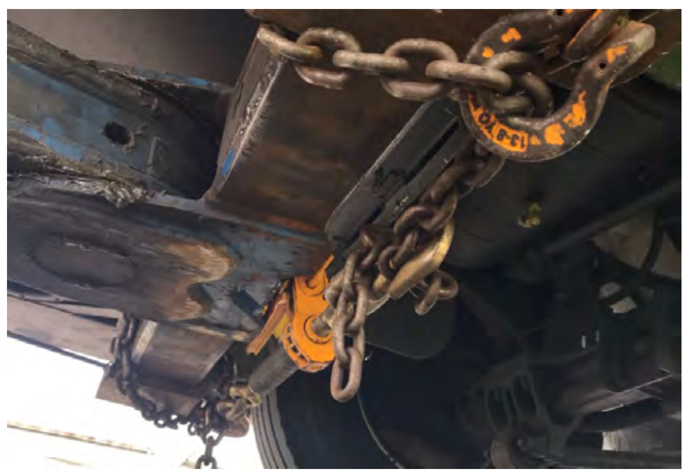


Figure 44

9. Attach the two tow truck safety chains from each of the two front lower radius rods (Figure 45) of the bus to the truck's tow eyes Figure 46).

Figure 45

10. Connect the two truck air lines to the service and brake supply air quick connect fittings adjacent and right above the front bumper (for more details, refer to paragraph *2.1.1 Air Supply* in this document.

Figure 46

11. Raise the stinger arm and remove the support jack stand.
12. Lower the bus. The front tires should be 7″ to 8″ above the ground before the tow can proceed.
13. Use bungee cords to support the safety chains (Figure 47).

Figure 47

14. If required, use the appropriate jig to assure that the highest point on the bus **does not exceed** the maximum allowable height for towing (Figure 48).
15. Make sure the **parking brake** is released before moving the vehicle.
16. Observe safety precautions when towing.

Figure 48

Avoid sharp turns where possible as safety chains may rub and damage the front bumper (**Figure 49)*


Figure 49

2.2.3 Second Lift - Front Axle as Lifting Point for Towing

This method uses the front axle as lifting point for towing (see Figure 12 to FIGURE 15).

1. Perform the first lift as instructed in paragraph 2.2.1 if not already done.

2. Install regular axle forks onto tow bar fork holders.

TALL REGULAR

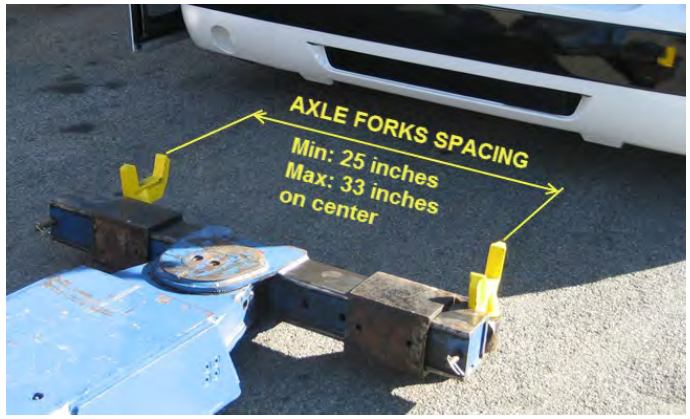


Figure 50

Pre-adjust spacing between axle forks

Minimum spacing: 25 inches

Maximum spacing: 33 inches

3. Lower the stinger arm to position the axle forks under the front axle hoisting points (Figure 12 TO FIGURE 15).

4. Lift the tow bar until the axle forks grab the front axle I-beam at the hoisting points (Figure 51 & Figure 52).

5. Raise the front of the bus.

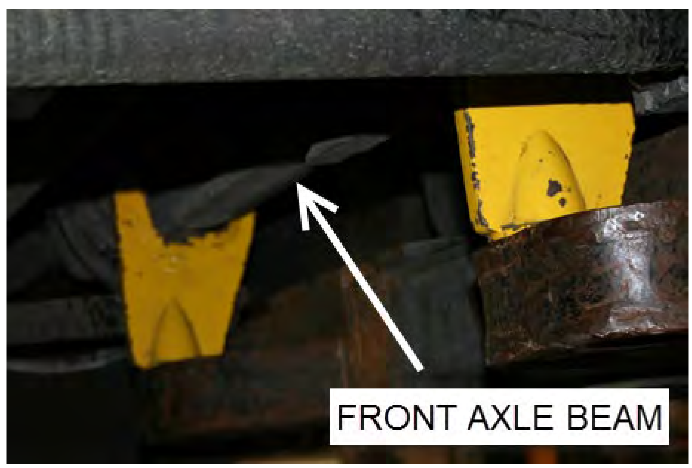


Figure 51

6. Install a jack stand under the stinger arm for support and safety purposes and then lower the stinger arm so it rests on the jack stand (Figure 53). The tow cans or blocks can be removed from under the front axle wheels.
7. Tie the two choke chains together to secure the front axle to the tow bar. Take up any slack that may remain and maintain proper tension on chains.

Figure 52

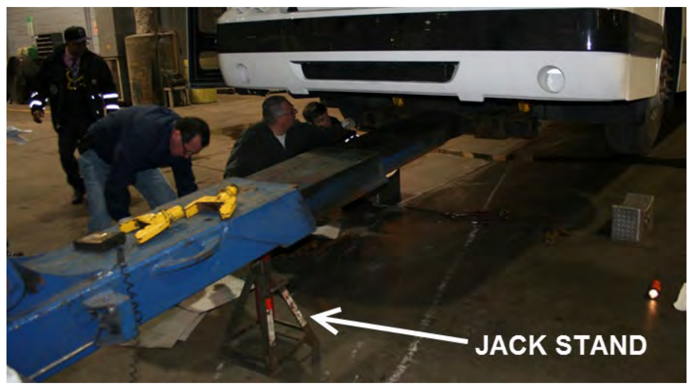


Figure 53

8. Attach the two tow truck safety chains from each of the two front tow eyes of the bus to the truck's tow eyes (Figure 54 & Figure 55).
9. Connect the two truck air lines to the service and brake air supply quick connect fittings adjacent and right above the front bumper (for more details, refer to paragraph *2.1.1 Air Supply* in this document.
10. Raise the tow bar in order to remove the jack stand from under the stinger arm.
11. Lower the bus. The front tire should be about 7″ to 8″ above the ground before the tow can proceed.

Figure 54

Figure 55

12. Use bungee cords to support the safety chains (Figure 56).

Figure 56

13. Make sure that the **parking brake** is released before moving the vehicle.
14. Observe safety precautions when towing.

Figure 57

Avoid sharp turns where possible as safety chains may rub and damage the front bumper (*Figure 58)***

Figure 58

CAUTION

Make sure a safe distance is kept between the front of the bus and the tow truck. This space ensures that bus does not suffer damages when being towed.

CAUTION

Make sure axle shafts or driveshaft are installed correctly after towing. Tighten axle shaft and driveshaft nuts to the correct torque settings. Do not invert shafts.

DANGER

Do not carry passengers while the bus is being towed.

2.3 TOWING WITH ALL WHEELS ON THE GROUND USING REAR TOW EYES – FITTED ON DOB BUS NUMBER SERIES 2490–2789 AND 1300–1606 ONLY

To recover a bus which is no longer on a drivable surface, chains can be looped around or hooked to the rear tow eyes.

This method should be used when the bus has to be moved <u>with its wheels on the ground</u> over a short distance only. After the bus has been brought back on a drivable surface, it should be lifted and towed from the front, with front wheels off the ground.

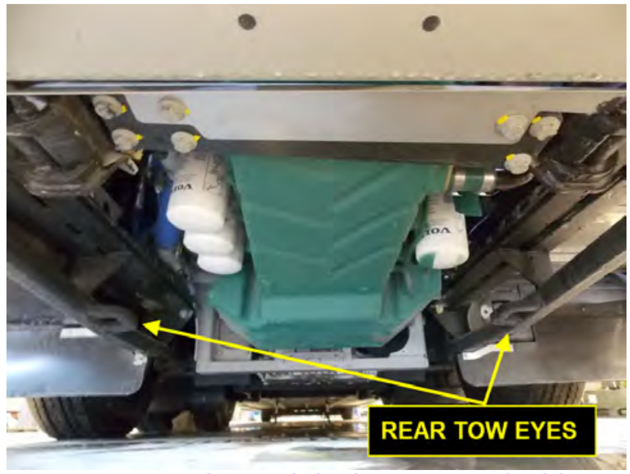


Figure 59: REAR TOW EYES ON SIDE-MEMBERS LOCATED UNDER ENGINE CRADLE SUPPORT RAILS

3 REAR TOW USING NOT APPROVED LIFTING POINTS - FOR EMERGENCY SITUATIONS ONLY

FOR EMERGENCY SITUATION ONLY

CAUTION

The bus should **NOT** be lifted and towed from the rear unless an emergency situation occurs or when the bus has already been damaged and must be moved over a very short distance such as in a parking lot.

Lifting the rear end from the engine cradle or from the side-members located under the engine cradle support rails should be avoided. Doing so may cause structural damage (see image further in this document).

3.1 PRECAUTIONS

In an emergency or if the vehicle has to be moved over a short distance, the side-members may be used as lifting point. Try to lift from the strongest location along the side-members which is near the rear subframe vertical member (Figure 60**).**

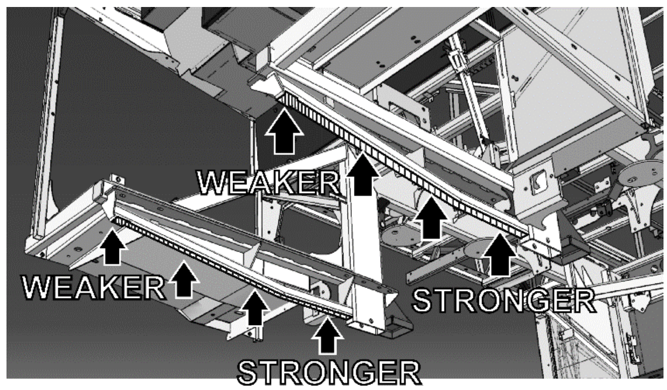


Figure 60: LIFTING POINTS NOT APPROVED FOR REAR-END TOWING – SIDE-MEMBERS LOCATED UNDER THE ENGINE CRADLE SUPPORT RAILS

Lift with precautions as the vehicle may sustain structural damage at the vertical structure shown on the image at right (Figure 61).

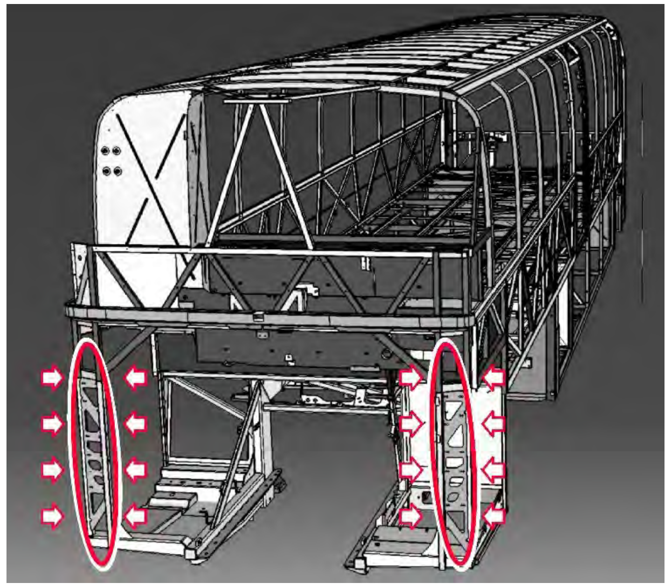


Figure 61: THE VEHICLE MAY SUSTAIN STRUCTURAL DAMAGE WHERE INDICATED WITH ARROWS DURING TOWING FROM THE REAR

DANGER

Do not carry passengers while the bus is being towed.

3.2 FIRST LIFT

A first lift of the bus is necessary. This first lift will allow tow cans or blocks to be placed underneath the drive axle tires.

1. Prepare the bus for towing as instructed in paragraphs 2.1 and 2.1.1
2. If not already done, chock the front wheels.
3. Retract the tow truck stinger arm (Figure 62).
4. Pre-adjust spacing between the axle fork holders. The spacing between the most distant edges of the folk holders should be **30 inches** (Figure 62).

   No axle forks will be used for this first lift

TALL **REGULAR**

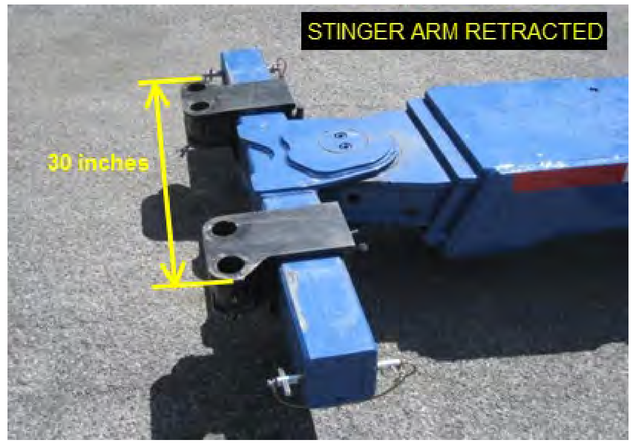


Figure 62

5. Deploy the tow truck stinger arm. Place the fork holders under the engine cradle transverse beam as shown on Figure 63. Lift the tow bar until the fork holders come into contact with the cradle transverse beam.

   Lifting from the engine cradle is the least preferred option and should be done only if lifting from under the side-members shown on figure 53 cannot be achieved

CAUTION

Remember, lifting the rear end from the side-members located under the engine cradle or by the engine cradle itself may cause structural damage.

CAUTION

Use caution when lifting from the engine cradle transverse beam. Maintain the bus in that situation during the shortest period of time.

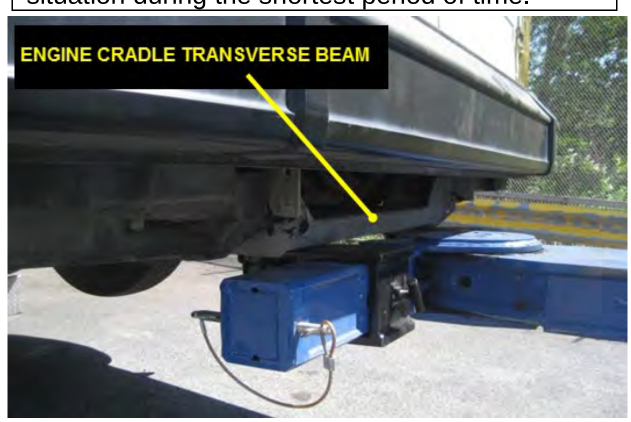


Figure 63

6. Unload or raise the tag axle to prevent it from hanging unsupported. To do so, open the front service compartment located on street side and move the tag axle air valve lever forward as shown on figure 57.

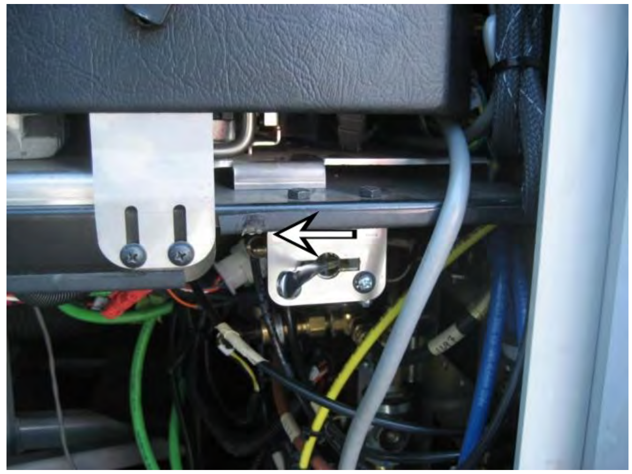


Figure 64

7. Lift the rear end of the bus high enough to allow installation of tow cans or blocks underneath the drive axle wheels (Figure 65).
8. With precaution, lower the rear of bus.

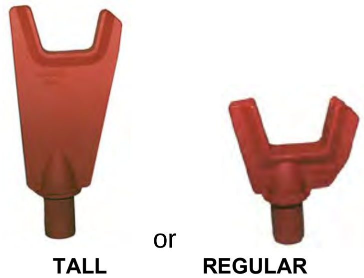
Figure 65

3.2.1 SECOND LIFT

1. Perform the first lift as instructed in paragraph 3.2 if not already done.
2. Retract the tow truck stinger arm.
3. Pre-adjust spacing between the axle fork holders to **43 inches**.

Figure 66

4. Install either long or short axle forks into fork holders.



5. Deploy the tow truck stinger arm. Place the axle forks under the rear tow eyes if equipped or under the side-members (Figure 67 & Figure 68).

   Place the forks in a transversal position i.e. perpendicularly to the side-members (Figure 68).

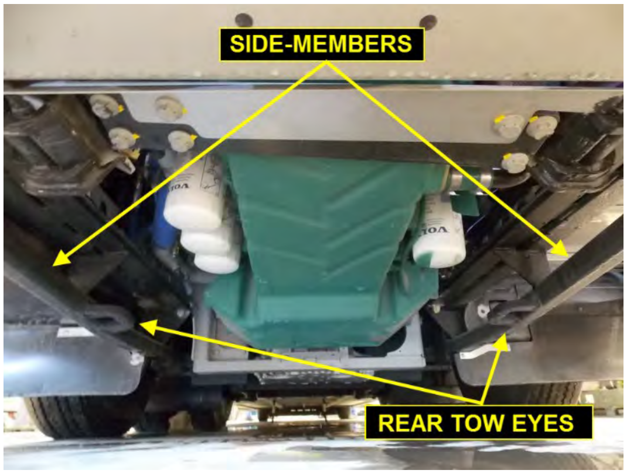


Figure 67: REAR TOW EYES ON SIDE-MEMBERS LOCATED UNDER ENGINE CRADLE SUPPORT RAILS

6. **DOB 2400 – 2489**: Lift the tow bar until the axle forks grab the side-members (Figure 68).

   DOB 2490 – 2789 and 1300 – 1606: Lift the tow bar until the axle forks fit snuggly into the side-members tow eyes.

   Avoid lifting at the side-members further toward the rear of the bus (close to the bumper)

Figure 68: PROPER LOCATION WHEN LIFTING THE SIDE-MEMBERS

7. Place the fork's shorter finger outboard for better clearance (see Figure 69).

Figure 69: PROPER LOCATION WHEN LIFTING THE SIDE-MEMBERS – ON THIS PICTURE, THE BUS IS EQUIPPED WITH REAR TOW EYES

8. Raise the rear of the bus.
9. Install a jack stand under the stinger arm for support and safety purposes and then lower the stinger arm so it rests on the jack stand (Figure 70). The tow cans or blocks can be removed from under the drive axle wheels.

Figure 70

10. Install the choke chains. Tie the two choke chains together to secure the side members to the tow bar (Figure 71 & Figure 72). Take up any slack that may remain and maintain proper tension on chains.

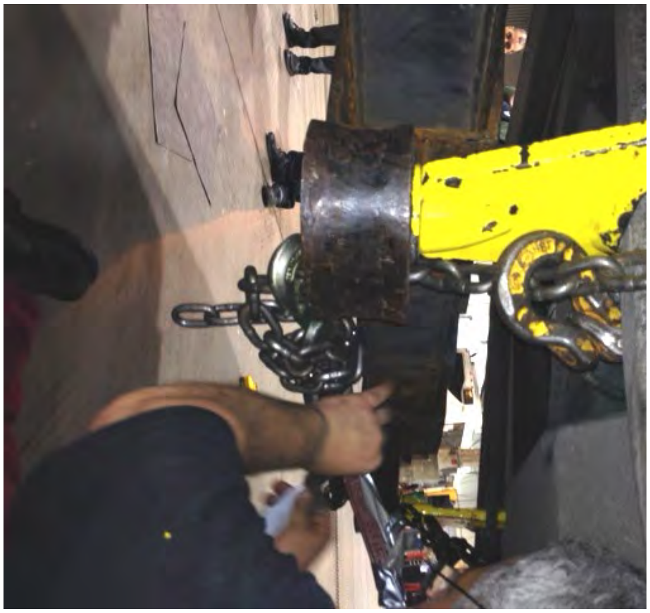


Figure 71

11. Shorten the stinger arm to the minimum safest distance between the bus and the tow truck to allow the towed bus to be as close as possible to the truck yet allowing enough room for the bus to avoid collision with the tow truck during turns.

    Stinger to the rear bumper: Between 59″ and 63″

Figure 72

12. Attach the two tow truck safety chains from the bus engine cradle cross-member to the truck's tow eyes (Figure 73).
13. Raise the stinger arm and remove the support jack stand.
14. Lower the bus. The drive axle tires should be 5″ to 6″ above the ground before the short distance tow can proceed.

Figure 73

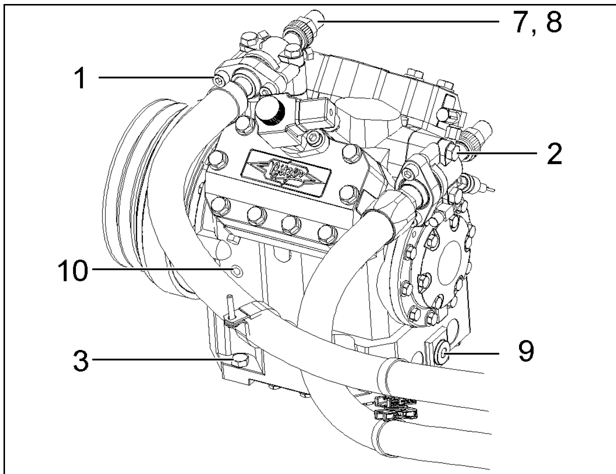
CONTENTS

SECTION CHANGE LOG

	DESCRIPTION	DATE
1		
2		
3		
4		
5		
6		

1. TORQUE TABLES

1.1 HIGH CAPACITY COMPRESSOR (CENTRAL HVAC SYSTEM)



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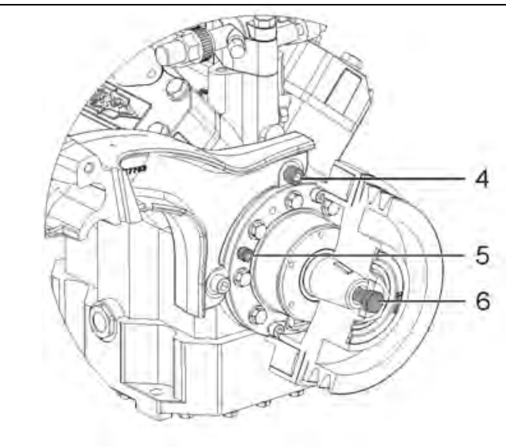

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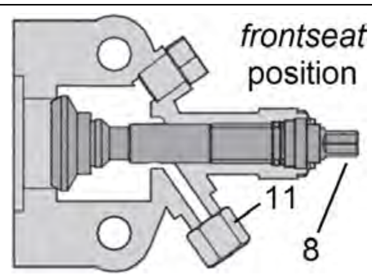

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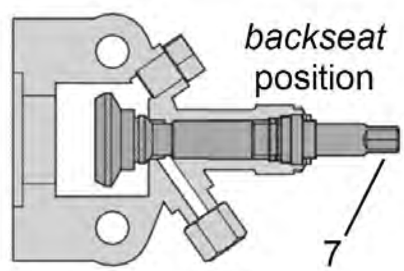
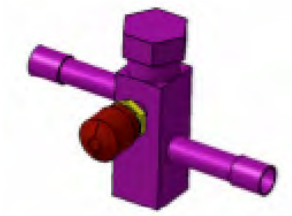
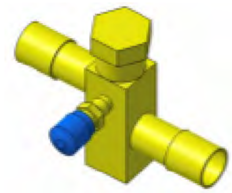
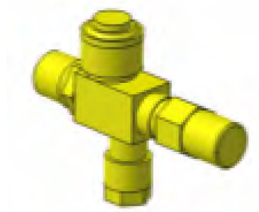


22407

HIGH CAPACITY COMPRESSOR (CENTRAL HVAC SYSTEM)		
No	DESCRIPTION	TORQUE
1	Compressor flange connection screws	31-35 lb-ft (42-47 Nm)
2	Compressor discharge & suction port screws	38-42 lb-ft (52-57 Nm)
3	Compressor mounting bolts	82 lb-ft (111 Nm)
4	Support arm to compressor screws	38-42 lb-ft (52-57 Nm)
5	Clutch to compressor screws	20-24 lb-ft (27-33 Nm)
6	Clutch pulley to compressor shaft screw	58-62 lb-ft (79-84 Nm)
7	Compressor shutoff valve *backseat* position	12 lb-ft (16 Nm) max
8	Compressor shutoff valve *front seat* position	21 lb-ft (28 Nm) max
9	Magnetic drain plug	37-52 lb-ft (50-71 Nm)
10	Oil fill hole plug	15-17 lb-ft (20-23 Nm)
11	Service port 7/16-20 UNF	7.5 lb-ft (10 Nm) Max

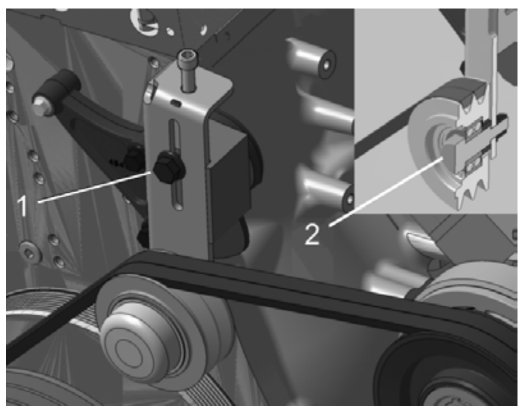
1.2 HIGH/LOW PRESSURE SERVICE AND RECEIVER TANK VALVES

1-HIGH PRESSURE SERVICE VALVE	2-LOW PRESSURE SERVICE VALVE	3-RECEIVER TANK VALVE
		

SERVICE AND RECEIVER TANK VALVE

No	DESCRIPTION	TORQUE
1	High pressure service valve (both positions)	43 lb-ft (58 Nm)
2	Low pressure service valve (both positions)	21 lb-ft (28 Nm)
3	Receiver tank valve (both positions)	21 lb-ft (28 Nm)

1.3 IDLERS & TENSIONERS



12238

IDLERS & TENSIONERS

No	DESCRIPTION	TORQUE
1	Central A/C tensioner lock bolt	43 lb-ft (58 Nm)
2	Central A/C tensioner idler shaft bolt (M12 shoulder bolt)	31.5-38.5 lb-ft (43-52 Nm)
	Central A/C tensioner idler shaft bolt (M12 x 1.75 std bolt)	59 lb-ft (80 Nm)

2. HVAC SYSTEM OVERVIEW

The vehicle interior is pressurized by its Heating Ventilation and Air Conditioning (HVAC) system. On vehicles equipped with a Central HVAC System; airflow and controls divide the vehicle in two areas: driver's area and passengers' area. Each section has its own fresh air, returning air and discharge air ducting. Each section has its own evaporator coil and heater core but both sections share the same condenser.

The exhaust is mainly done through the lavatory ventilator and through normal airtightness losses.

NOTE
Air conditioning   *Air conditioning is the artificial treatment of air to render the living conditions of persons more comfortable and healthful. Complete air conditioning involves adjustment and control of following operations performed on the air supply :*   *Heating or cooling; Dehumidification; Ventilation; Filtering;*

2.1 CENTRAL HVAC SYSTEM EVAPORATOR COMPARTMENT ARRANGEMENT

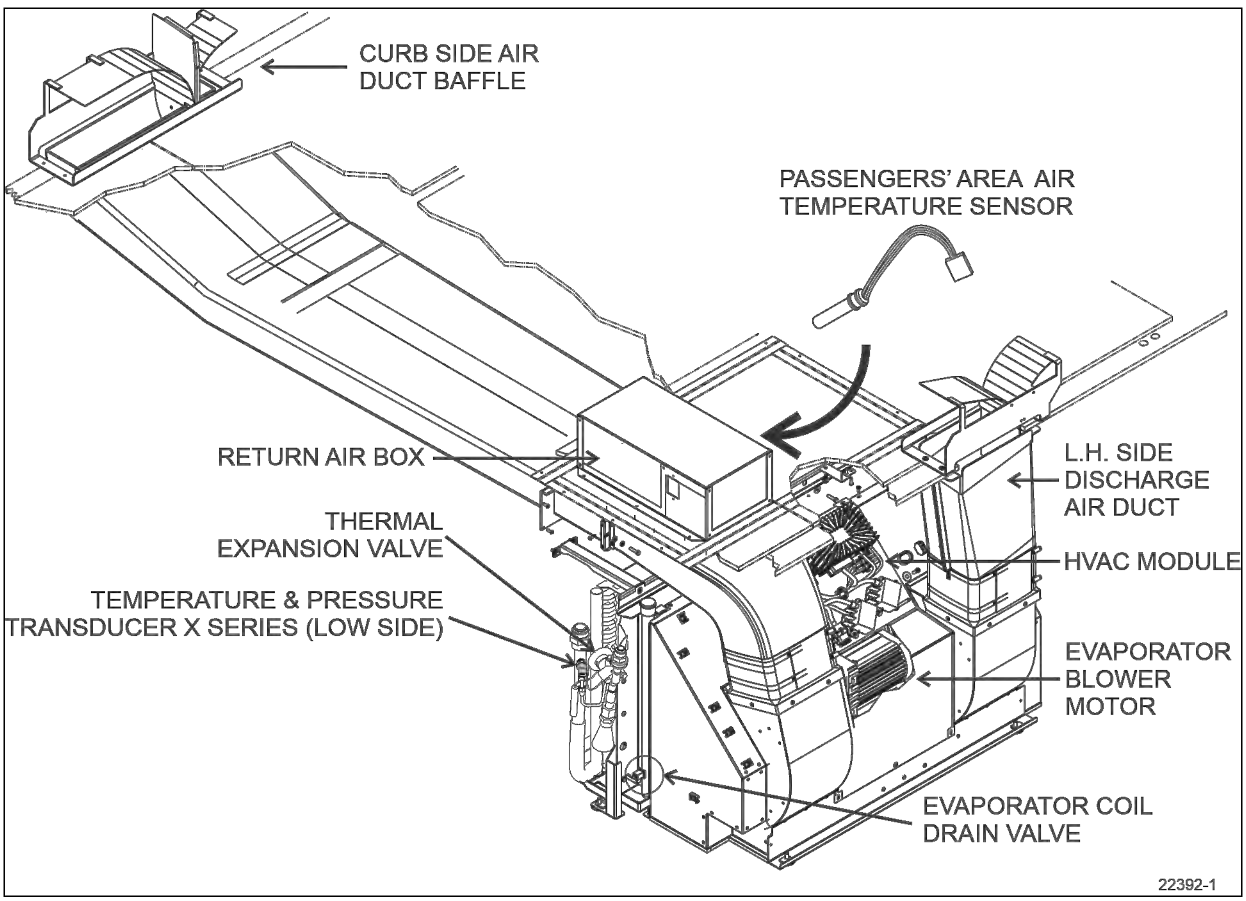


FIGURE 1: EVAPORATOR COMPARTMENT AND DISCHARGE DUCTING ARRANGEMENT

2.2 CENTRAL HVAC SYSTEM

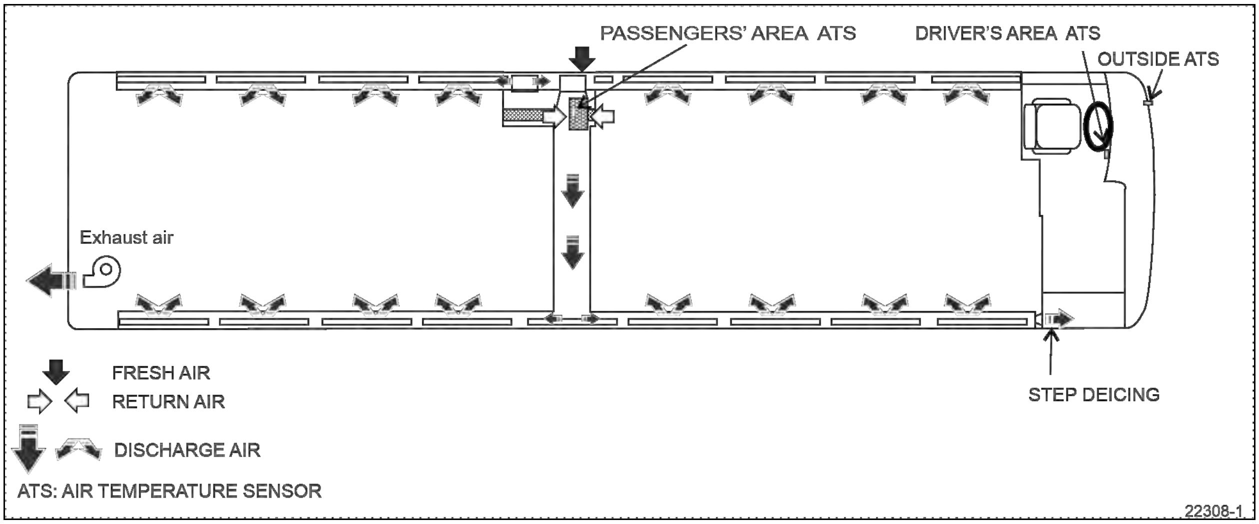


FIGURE 2: X3 COACHES CENTRAL HVAC SYSTEM - PASSENGER'S UNIT AIR CIRCULATION

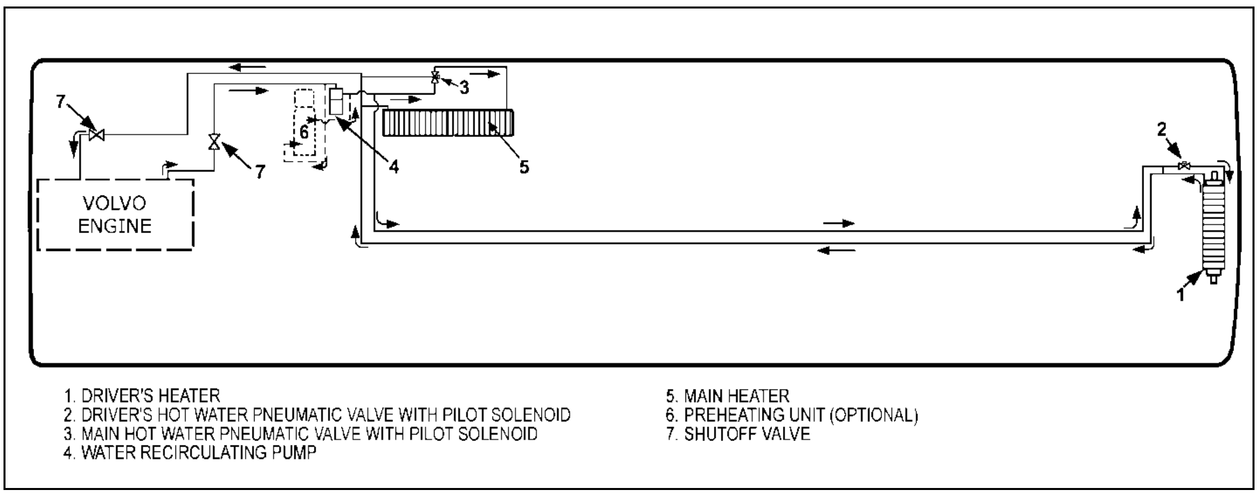


FIGURE 3: X3 SERIES CENTRAL HVAC SYSTEM – HEATING CIRCUIT

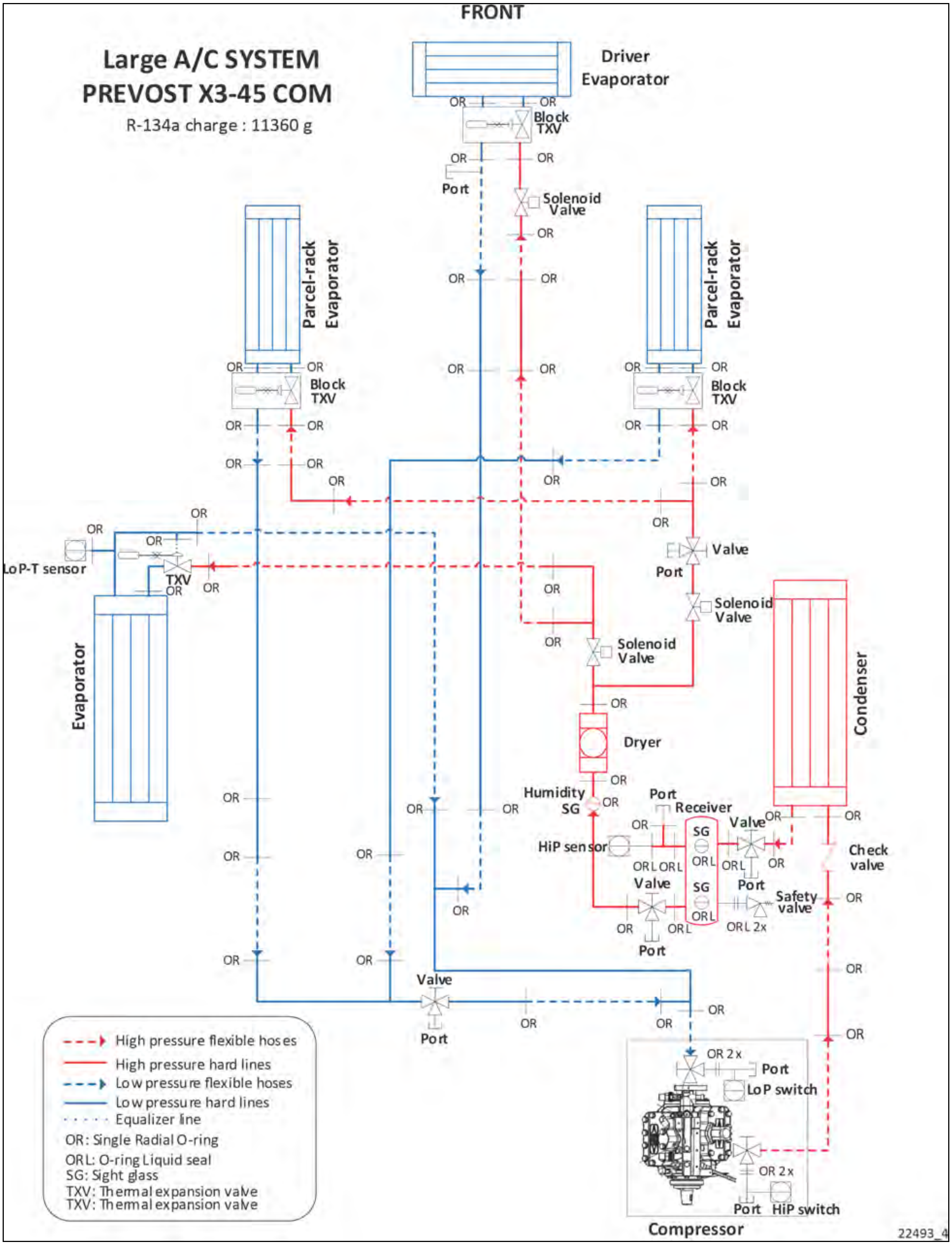


FIGURE 4: X3 SERIES CENTRAL HVAC SYSTEM – REFRIGERANT CIRCUIT W/ OVERHEAD COMPARTMENT EVAPORATORS

3. HVAC SYSTEM BASIC MAINTENANCE

Basic maintenance required on the passenger's and driver's units consists in cleaning their respective coils and cleaning or replacing air filters.

However, periodic inspection for broken drains, hoses and charging of the system should be done.

MAINTENANCE

Squeeze rubber discharge tubes located underneath the appropriate compartment to eliminate the accumulated water and dirt every three months.

3.1 COIL CLEANING

Check the external surface of the coils at regular intervals for dirt or any foreign matter.

3.1.1 Driver's Unit

MAINTENANCE

Once a year, gain access to the driver's unit, remove the coil access panel (Figure 5) and clean the **driver's** unit evaporator and heater coils with low-pressure air jet, taking care not to damage fins. Clean the bottom of the defrost plenum.

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.

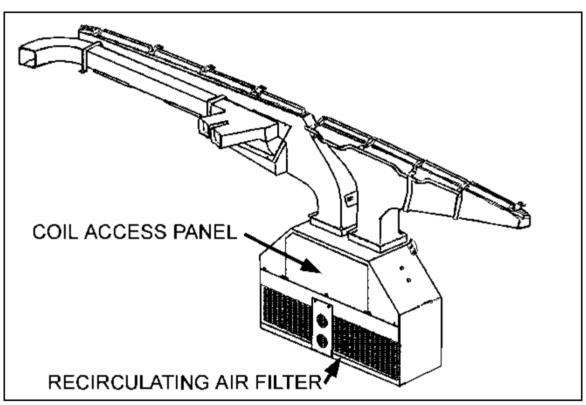


FIGURE 5: DRIVER'S UNIT AIR FILTERS 22171

3.1.2 Passenger's Unit

MAINTENANCE

With the air filters previously removed, clean the **passenger's** unit evaporator and heater coils with low air pressure or a stream low-pressure water **once a year**. Do not use a pressure washer as this will damage the fins. Remove the air filter and brush the evaporator coil from behind.

Once a year, clean the condenser with low-pressure air jet or a stream of low-pressure water, taking care not to damage fins (Figure 7).

CAUTION

Direct the pressure straight through the coil to prevent bending of fins and do not use extremely high pressure. Do not use hot water, steam or caustic soap.

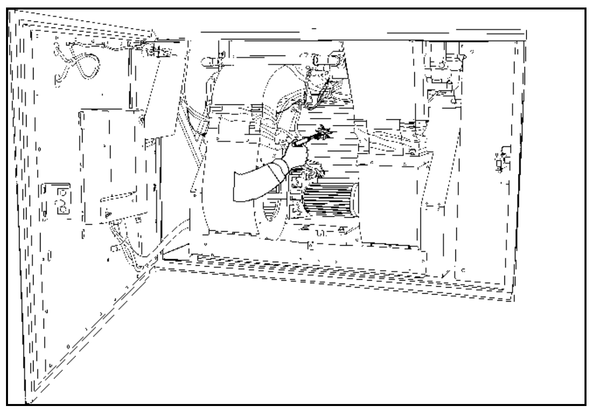


FIGURE 6: EVAPORATOR COIL CLEANING WITH LOW-PRESSURE AIR JET 22373

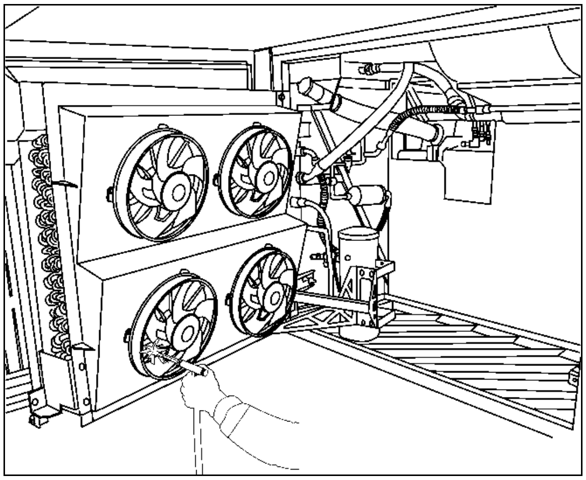


FIGURE 7: CLEANING PASSENGER'S UNIT CONDENSER COIL WITH LOW-PRESSURE AIR JET 22362

3.2 DRIVER'S UNIT AIR FILTER

The driver's unit is located behind the R.H. console panel. To gain access to the air filter, unscrew the R.H. console's grill located in the entrance stepwell. Remove the plastic cover and slide out the recirculating air filter (**FIGURE 9**).

The driver's HVAC unit is located behind the dashboard's R.H. side panel. To gain access to the A/C filters, unscrew the grille located at the top entrance step (Figure 8). Unscrew the plastic cover and slide out the recirculating air filter (**FIGURE 9**). Doing so will give you access to the fresh air filter (see item 18, Figure 53).

MAINTENANCE

Driver's unit return air filter

Clean or replace return air filter at the intervals specified by the Lubrication & Servicing Schedule in Section 24A.

To clean filter, back flush with water or soapy water, then dry with air.

NOTE

If the windshield is continuously fogged, check that :

The driver's unit fresh air filter is not clogged;

The fresh air damper (flapper door) is open, i.e. the recirculation button on the HVAC control unit is not engaged.

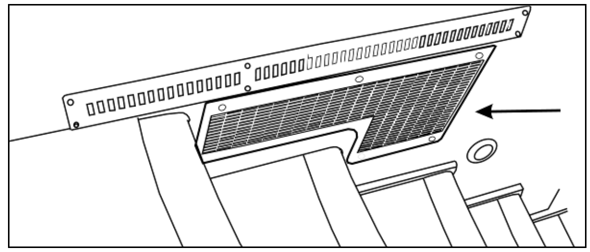


FIGURE 8: R.H CONSOLE AIR FILTER ACCESS GRILL (COACHES) 18505

FIGURE 9: REMOVING DRIVER'S SECTION AIR FILTERS

3.3 PASSENGER'S UNIT AIR FILTER

The cabin or passengers' section air filter is located in the evaporator compartment above the evaporator coil and fans (Figure 10).

MAINTENANCE

Passenger's unit air filters

Replace the two filters at the intervals specified by the Lubrication & Servicing Schedule in Section 24A.

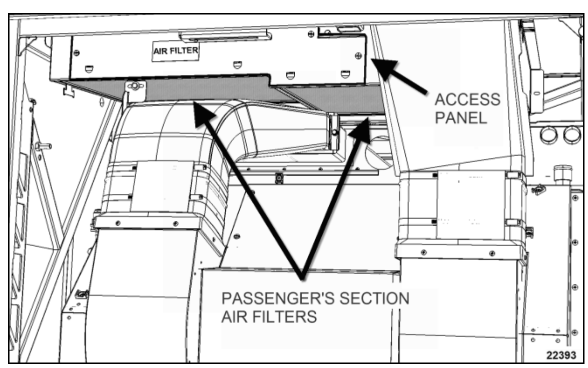


FIGURE 10: PASSENGERS' SECTION AIR FILTERS

⚠ CAUTION

Be sure not to reverse filter upon installation.

3.4 EVAPORATOR DOOR FRESH AIR INTAKE FILTER

The evaporator door is equipped with a replaceable air filter, to remove the filter, disengage the spring tab and slide the filter out.

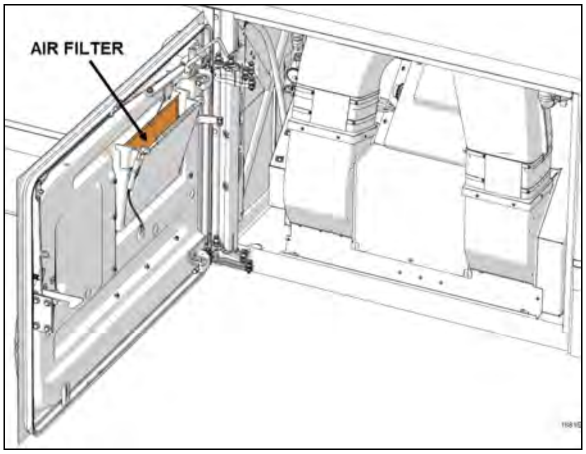


FIGURE 11: EVAPORATOR DOOR FRESH AIR FILTER

MAINTENANCE

Evaporator door fresh air filter

Replace this filter at the interval specified by the Lubrication & Servicing Schedule in Section 24A.

3.5 OVERHEAD COMPARTMENT 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 12).

MAINTENANCE

At the intervals specified in the Lubrication & Servicing Schedule in Section 24A, slide out the filters, then back flush with water, dry with air and reinstall.

For the 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 overhead compartment circuit. When work has to be done on an evaporator coil unit, it will be easier to remove it and repair it on a bench.

FIGURE 12: OVERHEAD COMPARTMENT FAN AIR FILTER 22201

3.6 COMPRESSOR BELTS

3.6.1 Belt Replacement – Central System

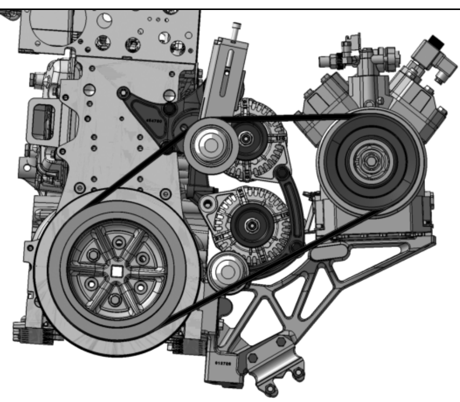
DANGER

Set the main battery disconnect switch to the OFF position. For greater safety, set the engine rear starter selector switch in the engine compartment to the OFF position.

1. Open engine compartment rear door and locate A/C compressor drive belt tensioner. Loosen tensioner screw to release belt tension.
2. Remove the radiator fan drive belt (refer to Section 05 COOLING).
3. Slip the old compressor belts off and the new ones on.

NOTE

Both belts must always be replaced simultaneously to ensure an equal distribution of load on each of them.



Twin BX71 belt proper tension
New: 90-100 lbs
Used: 75-85 lbs
Belt tension Tool:7770002

FIGURE 13: STANDARD BELT LAYOUT WITH CENTRAL HVAC SYSTEM

NOTE

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

MAINTENANCE

A/C compressor drive belt

Clean belt tension, inspect for cracks or frayed material at the intervals specified in the Lubrication & Servicing Schedule in Section 24A.

3.6.2 Belt Tension Adjustment – Central System

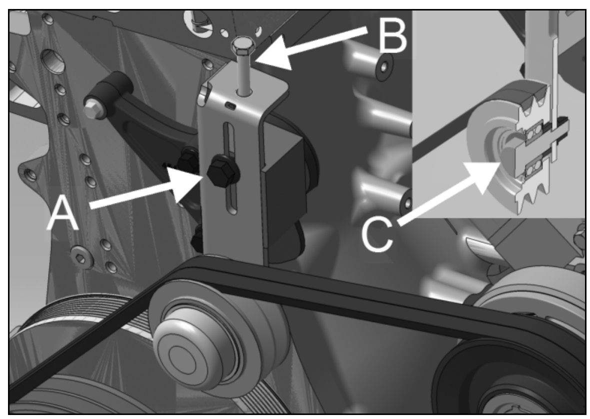
On the mechanical tensioner (Figure 14), slightly slack lock bolt (A). Adjust tension by turning adjustment screw (B). Tighten the lock bolt (A) to preserve adjustment.

TORQUE: 43 lb-ft (58 Nm)

Should the idler bearing need to be serviced, tighten shoulder bolt (C) at reassembly.

TORQUE: 31.5-38.5 lb-ft (43-52 Nm)
(M12 shoulder bolt)

TORQUE: 59 lb-ft (80 Nm)
(M12 x 1.75 std bolt)



22381

FIGURE 14: TENSIONER ON CENTRAL A/C

3.7 TORCH BRAZING

Use electrodes containing 35% silver.

NOTE
A 3.5% silver low temperature brazing electrodes can be used on low side pressure and liquid high side.

CAUTION
When using heat near a valve, wrap with water saturated rags to prevent overheating of vital parts.

DANGER
Before welding any part of refrigeration system, make sure the area is well ventilated.

3.8 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.

4. HVAC SYSTEM COMPONENTS

4.1 COMPRESSOR – CENTRAL A/C SYSTEM

The central system is equipped with a **Bitzer 4-cylinder model 4NFCY** compressor. Refer to paragraph 7 “Specifications” at the end of this section.

For complete information on Bitzer A/C compressor maintenance, installation, torque chart, approved oils, refer to the following Bitzer manuals found on your Technical Publications USB flash drive and on the Prevost Technical Publications web site.

- ***Bitzer kw-540-1 Maintenance Instruction***
- ***Bitzer kb-540-3 Operating Instructions***
- ***Bitzer kw-541-2 Exchanging Shaft Seal***
- ***Bitzer kw-555-3 Tightening Torques***
- ***Bitzer kt-100-3 Capacity Control (unloader)***
- ***Bitzer ke-540-7 Spare Parts List***
- ***Bitzer kt-510-5 Tech Info oils***

4.1.1 Suction and Discharge Hose Connection

1. Before connecting suction and discharge refrigerant hoses to the compressor, apply POE compressor oil on new gaskets, **do not dip in oil**.
2. Tighten hose flange by hand in 2 sequences.
3. Apply a final torque on cap screws.

TORQUE: 31-35 lb-ft (42-47 Nm)

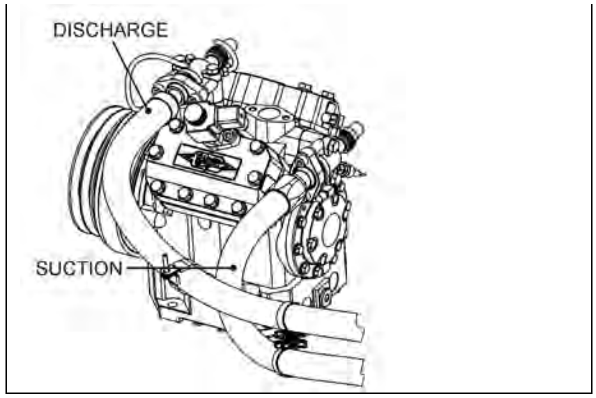


FIGURE 15: SUCTION AND DISCHARGE HOSE

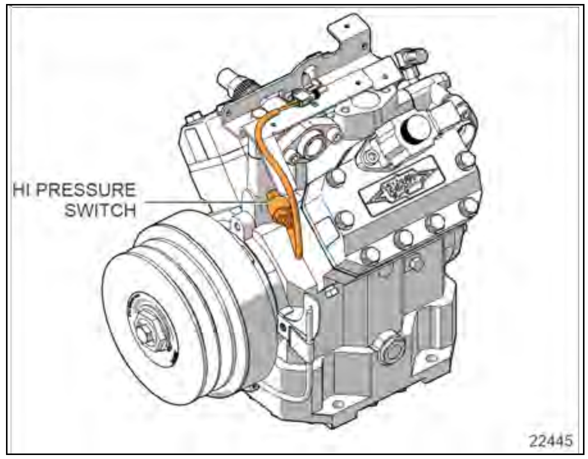


FIGURE 16: BITZER COMPRESSOR

4.1.2 Electro-Magnetic Clutch

For the Lang KK73.1 electromagnetic clutch **removal & installation procedure**, refer to Maintenance Information **MI18-37**.

For Lang KK73.1 electromagnetic clutch service manual or bearing replacement procedure, refer to the following manuals found on your Technical Publications USB flash drive and on the Prevost Technical Publications site.

- ***Lang clutch KK73.1 bearing replacement***
- ***Lang operating instr_KK73 1_2***
- ***Lang Service manual_KK73.1_2***
- ***Bitzer Maintenance Instruction kw-540-1***

4.1.3 Maintenance - Shaft Seal Oil Collecting tube Drain

The shaft seal oil tube collects oil seeping through the felt shaft seal. Remove the tube plug and drain the oil into a container for disposal. Replace the cap on the tube and replace the tube into the clip bracket.

MAINTENANCE

Empty the shaft seal oil collecting tube at the intervals specified by the Lubrication & Servicing Schedule in Section 24A.

During the 250-hour run-in period of the shaft seal, an increased oil seep rate may occur.

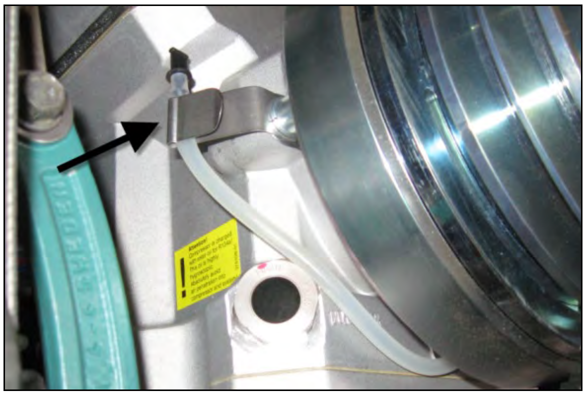


FIGURE 17: SHAFT SEAL OIL COLLECTING TUBE

4.1.4 Maintenance - Oil Color & Level Check

Check the oil color and the oil level, top up as needed. Change the oil if it has darkened (see oil evaluation criteria below).

MAINTENANCE

A/C compressor oil color & level check

Check compressor oil color and level at the intervals specified by the Lubrication & Servicing Schedule in Section 24A.

1. Run the compressor for at least 15 minutes, the time required so that the oil gets clear, unclouded and stabilized (without bubbles).
2. Check the oil level **during operation**. The proper level is:
   - R.H. sight glass: between ½ and ¾ of sight glass height (Figure 18).
   - L.H. sight glass: the full sight glass height (Figure 19).

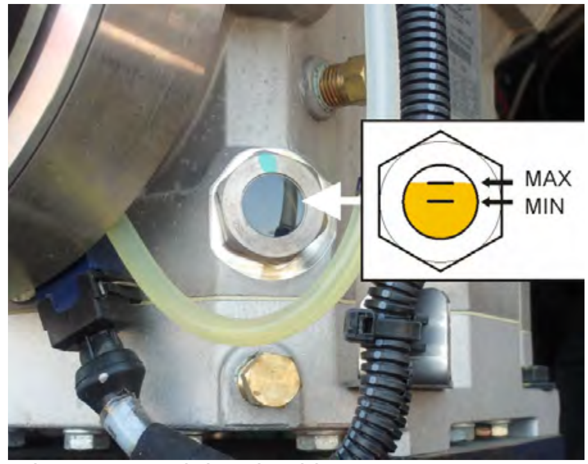


FIGURE 18: R.H. SIGHT GLASS

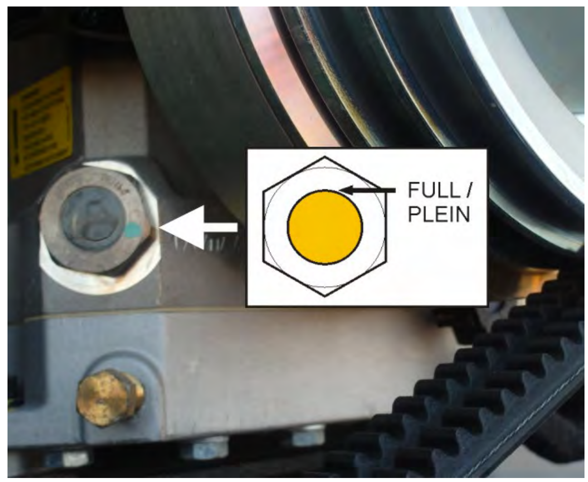
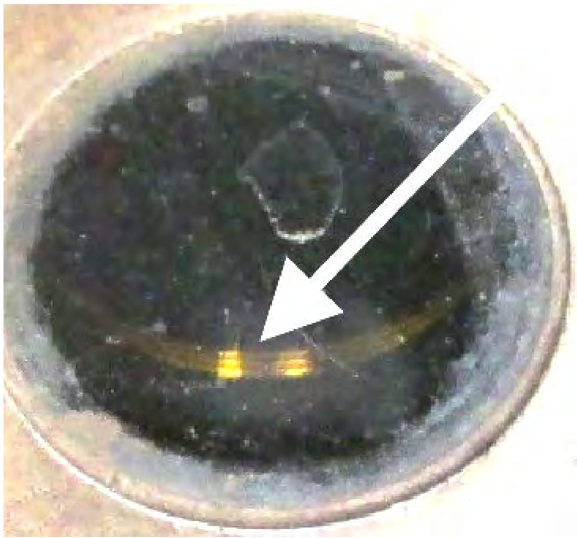


FIGURE 19: L.H. SIGHT GLASS

The oil level is expected to remain the same over time except if there is a loss of refrigerant. Adding oil must be done by taking the same precautions as when changing oil in order not to introduce the moisture content of the ambient air in the air-conditioning system.

3. Check for discoloration of the oil. It should be clear and light in color. Darkened, cloudy and contaminated oil **must be changed**. **Diagnose the problem**. See the following images to help you evaluate the state of the compressor oil.



Tip: use the reflection of light on the threads to help you determine the color of the oil.

OIL EVALUATION CRITERIA			
Normal	Shows deterioration Should be changed soon	Must be changed at once	Heavily deteriorated compressor has suffered damage due to this oil
			

4.1.5 Maintenance - Compressor oil Change

Impurities from the system components or operation outside the application ranges can lead to deposits in the lubrication oil and darken its color. Change the oil in this case. At the same time, clean the oil filter and magnetic plug as well. Determine and eliminate the cause for operation outside the application ranges.

MAINTENANCE

Compressor oil change

Change the oil, clean the compressor oil filter and the magnetic plug at the intervals specified by the Lubrication & Servicing Schedule in Section 24A.

Oil Type: Polyolester ISO68.

- Bitzer BSE55 (POE)
- Castrol Icematic SW 68
- Mobil EAL Arctic 68
- Shell S4 FR-F 68, Clavus R68

- Check the oil level first, according to *"Maintenance - Oil Color* & Level Check*"*.
- Connect the refrigerant recovery station to the service connections of the shut-off valves.
- Isolate the compressor from the system. To do so, front seat the compressor shutoff valves.
- Extract the refrigerant using the recovery station until ambient pressure is reached. Take note of the quantity removed.
- Remove the magnetic drain plug.

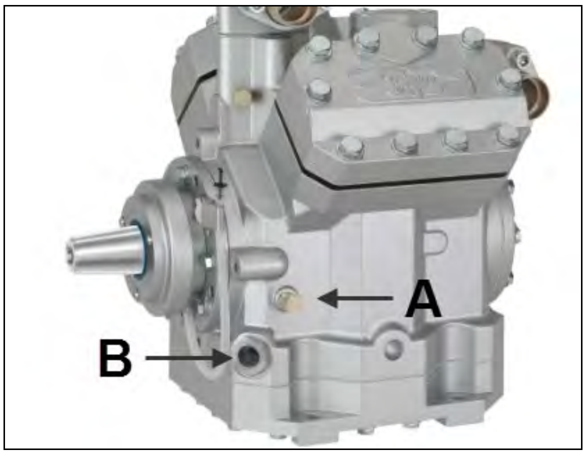


FIGURE 20: OIL FILL PLUG (A) AND SIGHT GLASS (B)

- Drain the oil into a container. Measure the quantity of oil removed.
- Extract and clean the oil filter/strainer. Reinstall once done.

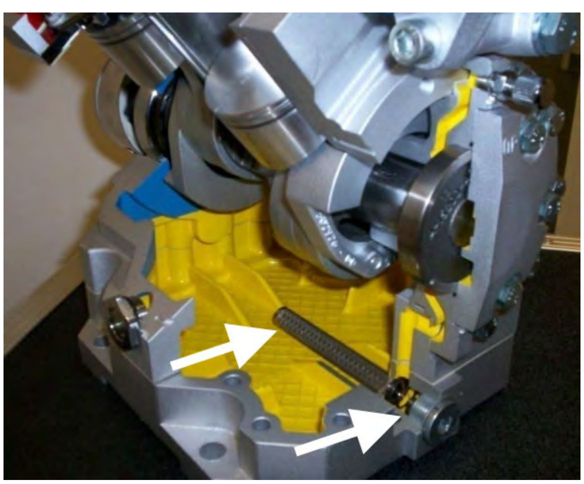


FIGURE 21: CUTAWAY VIEW SHOWING OIL FILTER/STRAINER AND MAGNETIC DRAIN PLUG

- Clean the magnetic drain plug and reinstall.
- Through the oil filling port, add the same amount of fresh oil. More oil should be added if the oil level was too low when checked at the beginning.
- Evacuate the compressor to 500 microns.
- Charge the system with new refrigerant. Charge with the same quantity as recovered previously.

4.1.6 Troubleshooting Guide

A preliminary check may be made by simply feeling the cylinder heads with the unit in operation at ambient temperatures of 35ºF (2ºC) and over. The cylinder heads are internally divided into suction and discharge areas. The upper central section of the cylinder is the suction side and it should be relatively cool to the touch, as opposed to the hot discharge area which is the lowest perimeter area of the cylinder head. 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 flood back.

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 flood back.
- Oil slugging caused by an overcharge of oil or flood starts.
- Discharge valves not seated properly (liquid drain back during shutdown).

Broken Suction Valves

Symptom:

- Loss of unit capacity at all temperatures.
- Compressor unable to pull extremely low vacuum with suction shutoff valve front seated.

Cause:

- Repeated liquid refrigerant flood back.
- Flooded starts.
- Overcharge of oil.
- Discharge valves not seated properly (liquid drain back 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.

4.2 BRUSHLESS EVAPORATOR MOTOR

The brushless evaporator motor is installed in the evaporator compartment (Figure 22). It is a 27.5 volt, 2 HP (1,5 kW) motor which activates a double blower fan unit.

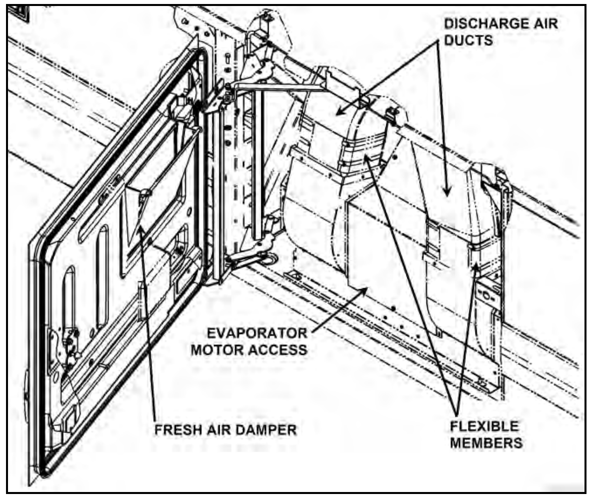


FIGURE 22: X3 SERIES EVAPORATOR COMPARTMENT

4.2.1 Removal

- Set the battery master switch to the OFF position and trip circuit breaker CB3.
- Open the evaporator compartment door.
- On the HVAC module. Disconnect circuit 90H1 from evaporator relay R12.
- Identify the discharge ducts inside compartment and remove the Phillips head screws fixing the air duct to blower fan unit.
- Remove the motor access panel.
- Disconnect electrical motor speed control wire power cable and ground cable from motor terminals.
- From under the vehicle, remove the eight bolts fixing the double blower fan unit base. Remove the complete unit from the evaporator compartment (Figure 23).

CAUTION

Never support evaporator motor assembly by its output shafts while moving it. Always use double blower fan unit base.

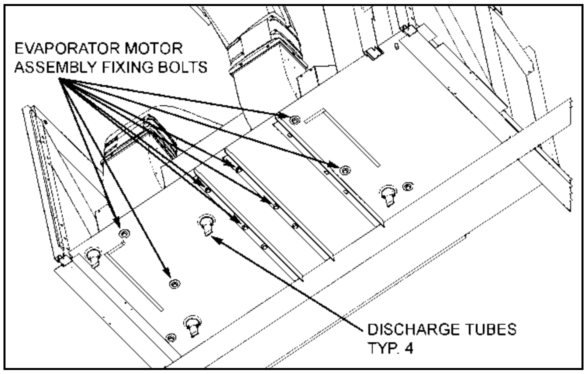


FIGURE 23: EVAPORATOR MOTOR BOLTS 22315

- 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.
- Remove motor from double blower fan unit base.

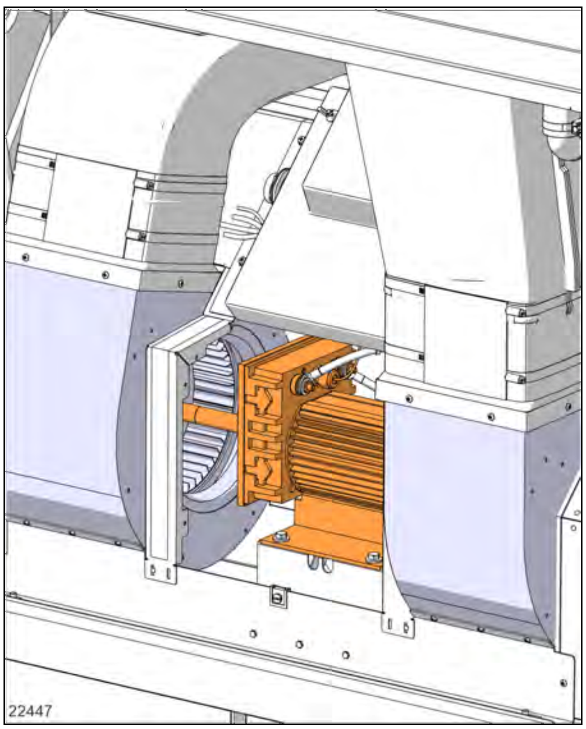


FIGURE 24: EVAPORATOR MOTOR ASSEMBLY

4.2.2 Installation

To reinstall the evaporator motor, reverse "Evaporator Motor Removal" procedure.

4.3 CONDENSER (CENTRAL A/C)

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.

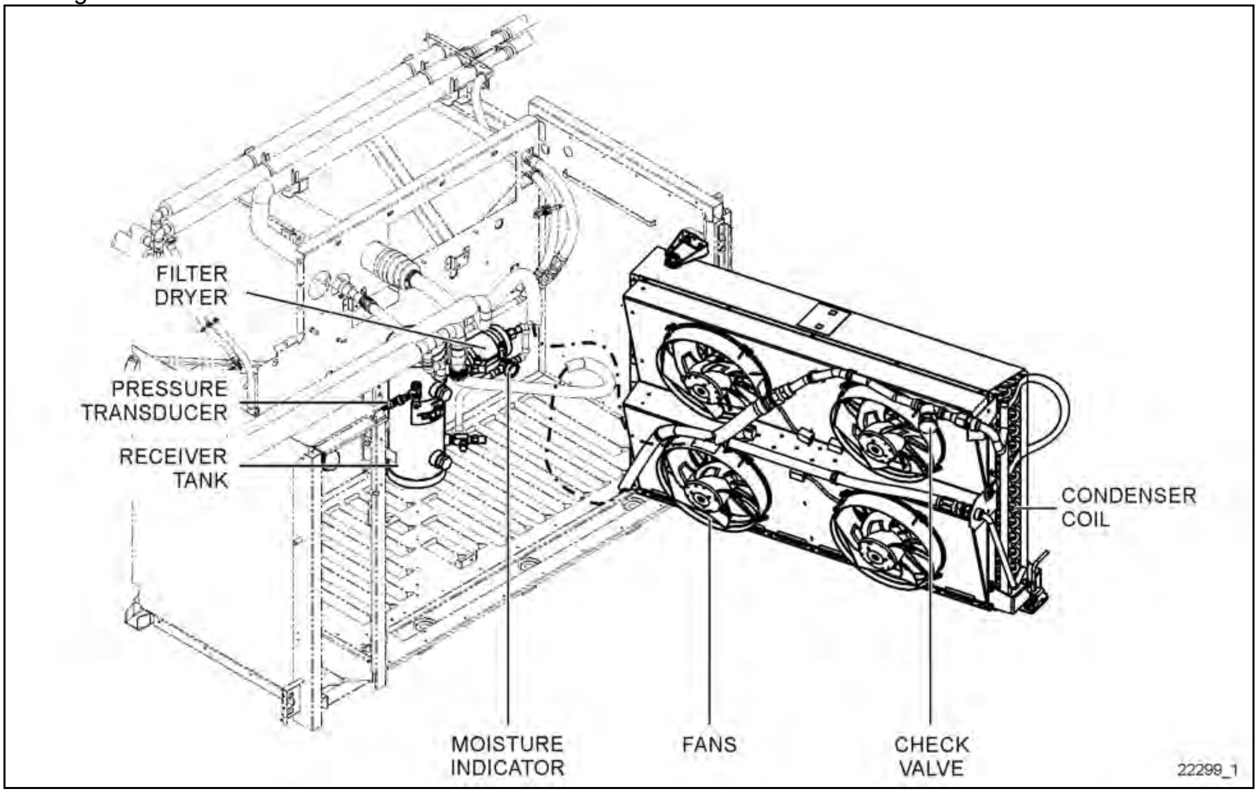


FIGURE 25: CENTRAL A/C CONDENSER

4.3.1 Condenser Fan Control

Four brushless motors fan are installed in the condenser compartment on R.H. side of the 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 the compartment.

Fan speed is controlled by the multiplex program and varies according to high side pressure. A Pulse Width Modulation (PWM) signal is used to control fan speed.

You will notice fan speed ramp up to full speed between 100 psi and 200 psi, and a ramp down from 200 psi to 100 psi. Below 100 psi, the fans are not running. Refer to Figure 26 below.

NOTE
During normal conditions, fan function according to the following specifications: Full speed: 6200 cfm, 37A at 28 VDC Fan motor speed: 2950 rpm at full speed

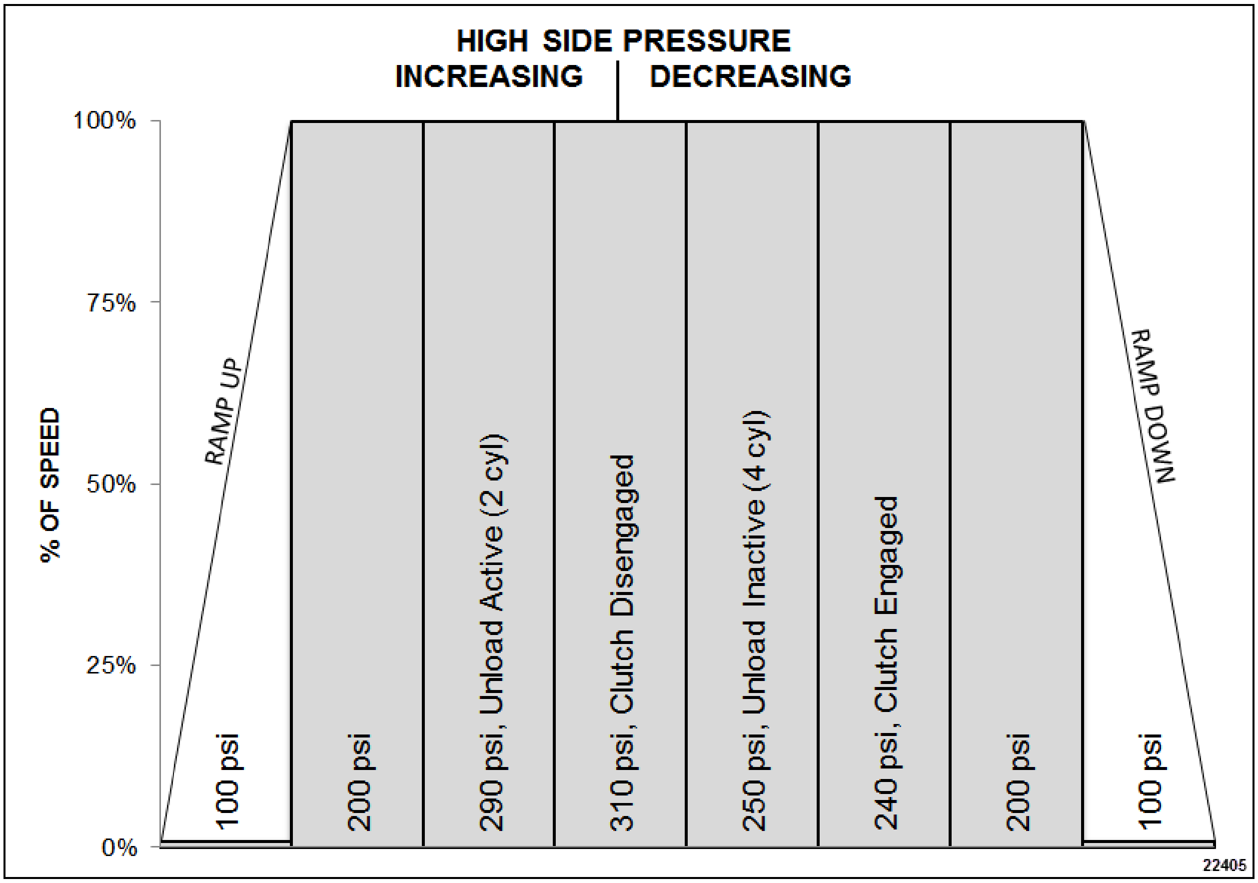


FIGURE 26: CONDENSER FAN SPEED AND COMPRESSOR EVENTS IN RELATION WITH HIGH SIDE PRESSURE

4.3.2 Condenser Fan Removal

1. Set the battery master switch to the OFF position.
2. Unplug the fan harness. (Figure 27).
3. Remove the four hexagonal head cap screws retaining the fan assembly to the shroud.
4. Remove the motor.

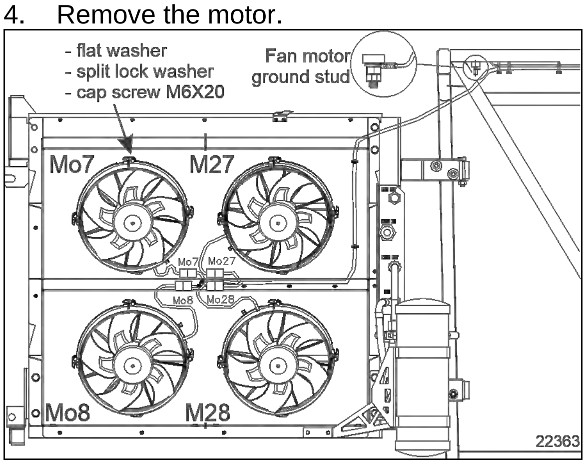


FIGURE 27: CONDENSER FANS

4.4 RECEIVER TANK

The receiver tank is located in the condenser compartment (Figure 28). 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.

MAINTENANCE

Check refrigerant level and add if necessary, at the intervals specified by the Lubrication & Servicing Schedule in Section 24A.

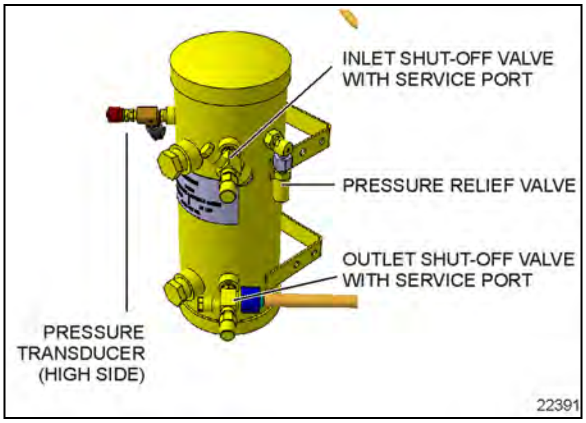


FIGURE 28 RECEIVER TANK X SERIES

In case of extreme pressure there will be a rise in the liquid receiver tank. A pressure relief valve will break at 450 psi 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.

During **normal operation**, inlet and outlet shutoff valves are in back seated position (stem out).

When connecting a gage to the service port, make sure the shut-off valve is in back seated position because the service port is not fitted with a Schrader valve.

4.5 FILTER DRYER

A filter dryer, also located in the condenser compartment, is installed on the liquid refrigerant line after the receiver tank. It is used to absorb moisture and foreign matter from refrigerant before it reaches the expansion valves.

The filter dryer should be replaced after a severe system failure, after a prolonged exposure and most important, when the moisture indicator sight glass turns to pink.

4.5.1 Replacement of the Filter-Dryer After Pumping Down

The filter dryer 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. Perform the pumping down procedure to isolate refrigerant in the receiver tank.
2. Disconnect C24 to isolate the section of the system located between the receiver tank outlet shutoff valve and the passengers unit liquid solenoid valve.
3. Change the filter dryer.

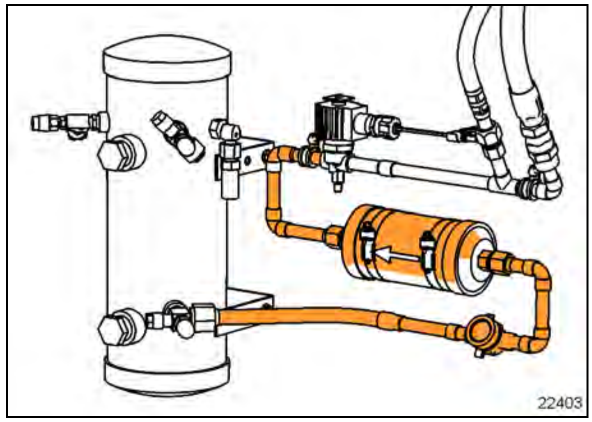


FIGURE 29: ISOLATED SECTION X SERIES

4. Once the filter dryer has been replaced, it is necessary to evacuate the opened section of the refrigerant circuit. Evacuate the isolated section of the system using a vacuum pump connected to the service port of the receiver outlet shutoff valve.
5. Evacuate the section of the refrigerant piping as needed and in accordance with best practices, using a micron gage to monitor the depth of vacuum. Evacuate to a system pressure less than 1000 microns.
6. Turn off the vacuum pump.
7. Backseat the outlet shutoff valve and then disconnect the vacuum pump hose.

CAUTION

Do not use carbon tetrachloride or similar solvents to clean parts. Do not use steam guns. Use mineral spirits or naphtha. All parts should be thoroughly cleaned. Use a stiff brush to wash dirt from grooves, holes, etc.

DANGER

Cleaning products are flammable and may explode under certain conditions. Always handle in a well-ventilated area.

4.6 MOISTURE INDICATOR

The moisture sensitive element consists of a color-changing ring which is reversible from pink to blue and vice versa as the moisture content in the refrigerant changes.

- PINK: high levels of moisture detected.
- PURPLE (caution): low levels of moisture detected.
- BLUE: dry, optimal operating conditions.

Since temperature changes affect the solubility, color change will also vary with the refrigerant temperature. The above table shows the color change for R-134a at various moisture levels and liquid line refrigerant temperatures.

MAINTENANCE

Check refrigerant moisture indicator at the intervals specified by the Lubrication & Servicing Schedule in Section 24A.

Replace filter-dryer unit according to moisture indicator.

COLOR INDICATOR			
TEMPERATURE	BLUE (ppm)	LIGHT VIOLET (ppm)	PINK (ppm)
75°F (24°C)	20	35	130
100°F (38°C)	35	55	160
125°F (52°C)	60	65	190
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 or flash gas indicates an insufficient system charge, low head pressure, insufficient liquid sub cooling or some form of restriction in the liquid line.

Moisture is one of the main causes of chemical instability or contamination in air-conditioning systems. If moisture is present, it can corrode the valves, condenser and evaporator coils, compressor and other components causing a malfunction and eventual failure of the system. Uncontrolled moisture in the system can result in very expensive multiple component replacements if not corrected at an early stage. The moisture indicator permits an early detection of moisture in the system and when corrected by a desiccant charge, system contamination is greatly minimized.

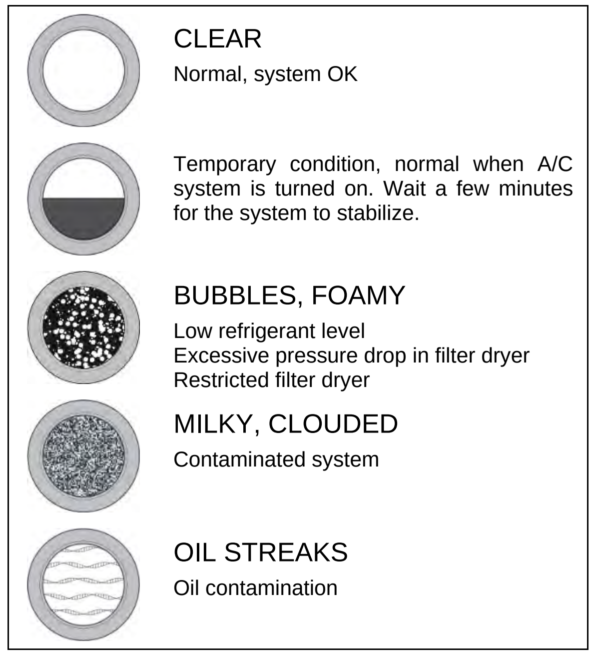


FIGURE 30: CONDITIONS THAT MAY BE OBSERVED IN THE MOISTURE INDICATOR SIGHT GLASS

4.7 SHUTOFF VALVE WITH SERVICE PORT

This shutoff valve (FIGURE 31) is located in the condenser compartment. It is used to isolate one section of the refrigerant circuit. The service port is equipped with a Schrader valve.

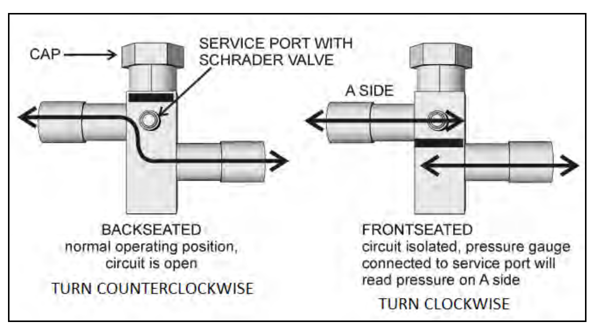


FIGURE 31: REFRIGERANT CIRCUIT SHUTOFF VALVE

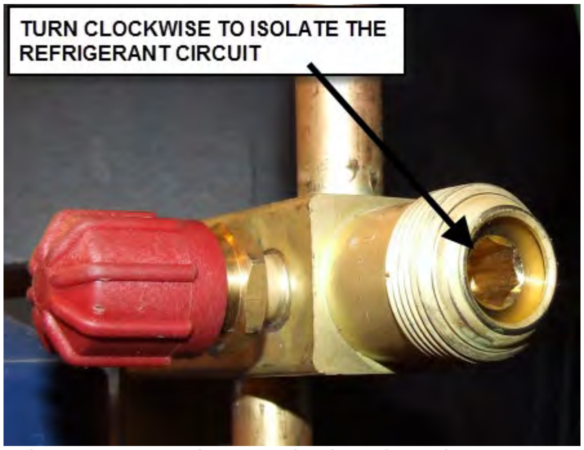


FIGURE 32: REFRIGERANT CIRCUIT SHUTOFF VALVE

4.8 LIQUID REFRIGERANT SOLENOID VALVE

The flow of liquid refrigerant to the driver's unit evaporator, passengers' unit evaporator (main evaporator) and overhead compartment evaporator is controlled by one NC (normally closed) solenoid valve on each circuit, for a total of three solenoid valves.

The driver's unit solenoid valve is located on the ceiling of the spare wheel compartment (FIGURE 33) and is accessible through the reclining bumper.

Two identical NC (normally closed) refrigerant solenoid valves are found in the condenser compartment (FIGURE 34). One is used to control flow of refrigerant to the overhead compartments evaporator while the other is used to control flow to the driver's and passenger's main evaporators.

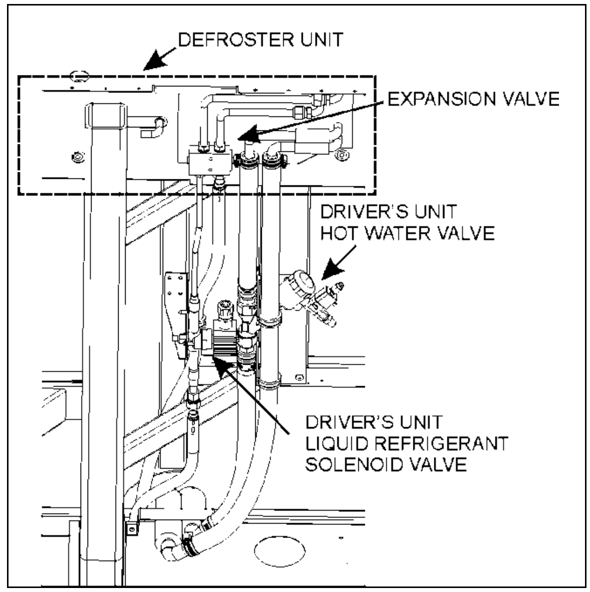


FIGURE 33: DRIVER'S UNIT LIQUID SOLENOID VALVE

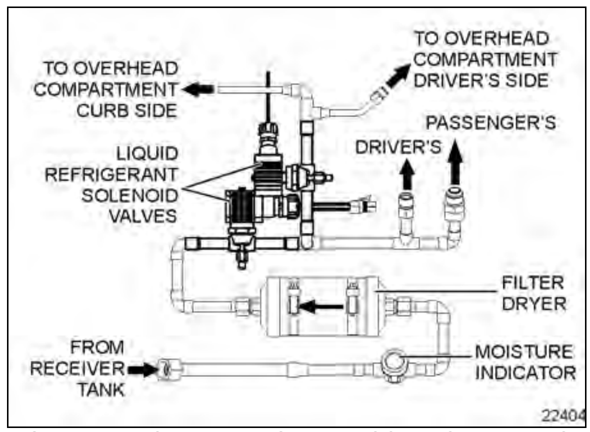


FIGURE 34: LIQUID REFRIGERANT SOLENOID VALVES IN CONDENSER COMPARTMENT (X-SERIES)

4.8.1 Typical malfunctions

Faulty control circuit: Check the electric system by energizing the solenoid with 24 V DC. 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 breakers, open-circuit or grounded coils, broken lead wires.

Burned-out coils: Check for open-circuit coil. Replace coil if necessary.

Low voltage: Check voltage across the coil leads. Voltage must be at least 85% of the nameplate rating.

Excessive leakage: Disassemble valve and clean all parts. Replace worn or damaged parts with a complete repair kit for best results.

There are only three possible main malfunctions:

1. Coil burnout.
2. Failure to open.
3. Failure to close.

Each is discussed in *Sporlan Parker Hannifin Solenoid Valve Installation and Servicing* bulletin included on your Technical Publications USB flash drive.

4.8.2 Electrical Bypass/On Demand Opening of liquid refrigerant solenoid valves

To ease purging, pumping down and refilling of refrigerant, it is possible to open the liquid solenoid valves (normally closed NC). To do so, uncap and connect plug and socket housings of connector **C24 together for the passengers' unit and overhead compartment units liquid solenoid valves** (located on the HVAC module in the evaporator compartment) or **C44 for the driver's unit liquid solenoid valve** (located on the ceiling of the spare wheel compartment). During normal use, both plug and socket housings of connector C24 or C44 are to be kept unplugged and capped.

> **CAUTION**
>
> Connectors C24 & C44 must be disconnected and their caps reinstalled after this procedure. Leaving them connected will keep the driver's, passengers and overhead compartment liquid solenoid valves open, and result in battery draining if the bus remains unused for several days.

4.8.3 Coil Replacement

1. Unplug 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 on the enclosing tube. Lay data identification plate in place.
4. Insert the coil retaining screw, rotate coil housing to proper position and tighten screw securely.
5. Plug coil connector.

4.8.4 Valve Disassembly

1. Because of possible damage to valve components due to the high temperature of soldering and brazing, it is necessary to completely disassemble the **A & B series** valves before any heat is applied to the valve body. For **E series** (extended copper connections), braze into the line without disassembly because the valve contains extended connections. Use caution by placing a wet cloth or chill block on the extensions at the body to prevent excessive overheating.
2. Remove the coil as stated previously.
3. Pump down the system as stated in this section.
4. Remove the enclosing tube and locknut, all internal parts, and manual lift stem assembly.

> *NOTE*
>
> *The previous procedure must be followed before brazing solder-type bodies into the line.*

> **CAUTION**
>
> Be careful not to damage the machined faces while the valve is apart.

4.8.5 Valve Reassembly

1. Place the seat disc into the valve body with the smaller diameter end facing up.
2. Place the enclosing tube gasket onto the valve body above the threads.
3. Hold the plunger with one hand so that the pointed end is resting in the pilot port of the disc. Make sure the small spring is in place on the top of the plunger.
4. With the other hand, place the enclosing tube over the plunger, making sure the enclosing tube gasket is in position.
5. Put back the enclosing tube locknut and tighten. Do not over tighten.

   TORQUE: 20-40 lb-ft (27-54 Nm)

6. Put back manual lift stem. Tighten lift stem assembly and seal cap.

   TORQUE: 11 lb-ft (15 Nm)

7. Place the coil assembly.

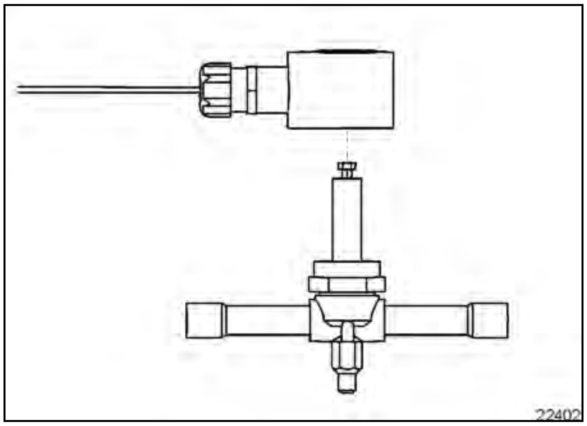


FIGURE 35: TYPICAL REFRIGERANT SOLENOID VALVE

CAUTION

The filter-dryer must be replaced after a severe system failure or if a line in the system has been opened over a prolonged period of time. The line will then have to be properly evacuated.

Best practice would be to replace the filter dryer each time a line is opened.

CAUTION

Be careful not to damage the machined faces while the valve is apart.

4.9 THERMOSTATIC EXPANSION VALVE

4.9.1 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.

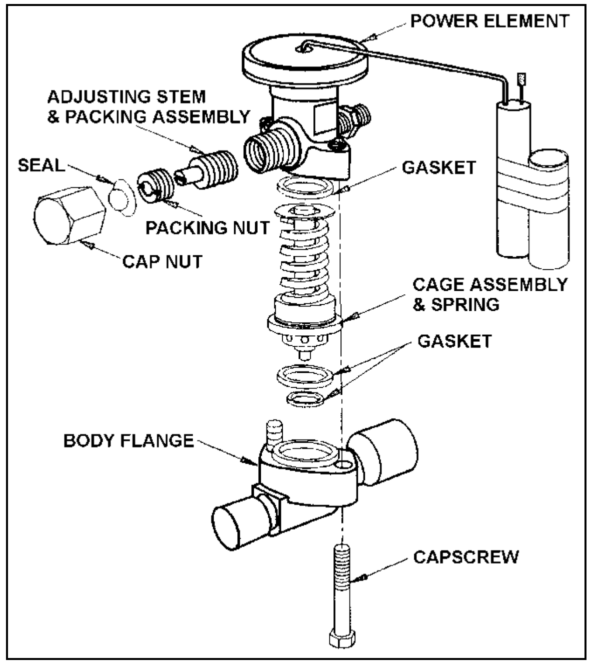


FIGURE 36: EXPANSION VALVE 22215

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 16º F (-11.1 to -8.8 º 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.

4.9.2 Superheat Adjustment

Expansion valves are factory preset for optimum superheat settings. This setting should be modified only if absolutely necessary. The readjustment should be at the lowest expected evaporating temperature.

1. Operate coach for at least one-half hour at fast idle with temperature control set at 82ºF (27,7ºC), then set temperature to minimum to keep the compressor on 4 cylinders.

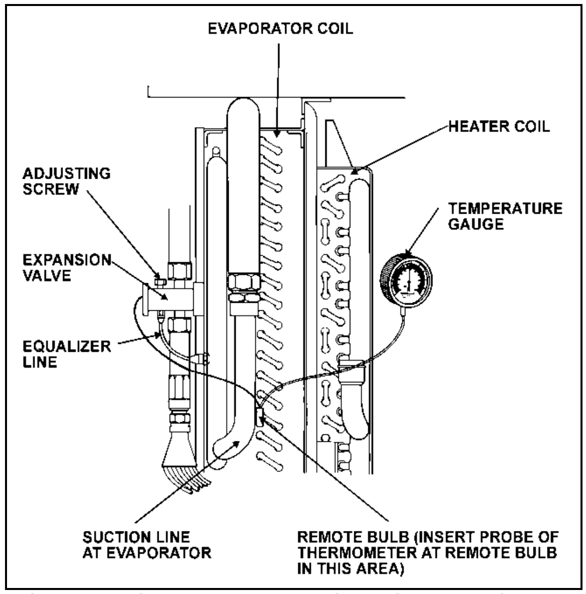


FIGURE 37: SUPERHEAT ADJUST. INSTALLATION 22046

2. In the DID “Gages” Menu note the indicated “LoS” (Low side) pressure.
3. Use a remote reading thermometer or thermocouple / multimeter to measure temperature at the evaporator outlet line near the existing remote bulb (Figure 37).
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. 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 (Figure 38).

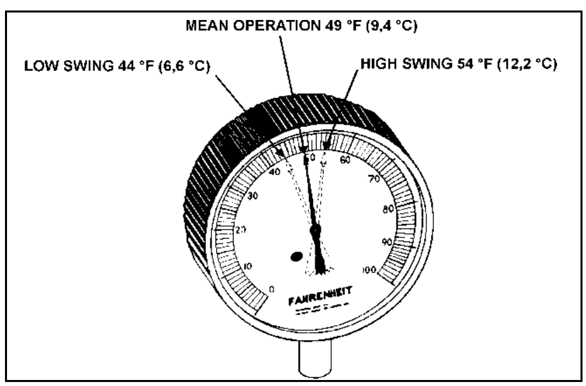


FIGURE 38: HIGH & LOW SWING TEMPERATURE AT REMOTE BULB 22047

Example of readings taken:

A/C pressure gage at compressor suction converted to temperature with chart	40°F	
Temperature on remote bulb	Low swing 44°F	
	High swing 54°F	
Average of low and high swing	49°F	

Formula for superheat

T° at bulb – T° suction = T° superheat

49°F – 40°F = 9°F

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

The thermal expansion valve has a MOP (maximum operating pressure) of 55 psi. At this setting, the valve is completely open.

If the temperature at the bulb is greater than 50°F, do not try to adjust superheat as the valve is almost completely opened.

NOTE

To reduce the superheat, increase refrigerant flow by turning adjusting screw counterclockwise on expansion valve. To increase superheat, flow of refrigerant is reduced by turning adjustment screw of clockwise.

7. Regulate suction pressure to temperature reading according to the temperature chart or to the R-134a temperature scale on the pressure gage.

Example: Suction pressure 30 psi (207 kPa) converted to 32ºF (0ºC) on the chart. If temperature reading is 40ºF (4,4ºC), subtract 32ºF (0ºC) and the result will be 8ºF (4,4ºC) 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.

4.9.3 Maintenance

1. Pump down the system as previously indicated in this section.
2. Disconnect the external equalizer line from the underside 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.

4.9.4 Driver's Unit

The function and operation of the driver's unit expansion valve are similar to the central system, but no superheat adjustment is required (**FIGURE 33**).

4.10 HOT WATER PNEUMATIC VALVE

No maintenance is needed unless a malfunction occurs. Refer to Prevost parts manual for available service kits. Valve is normally closed.

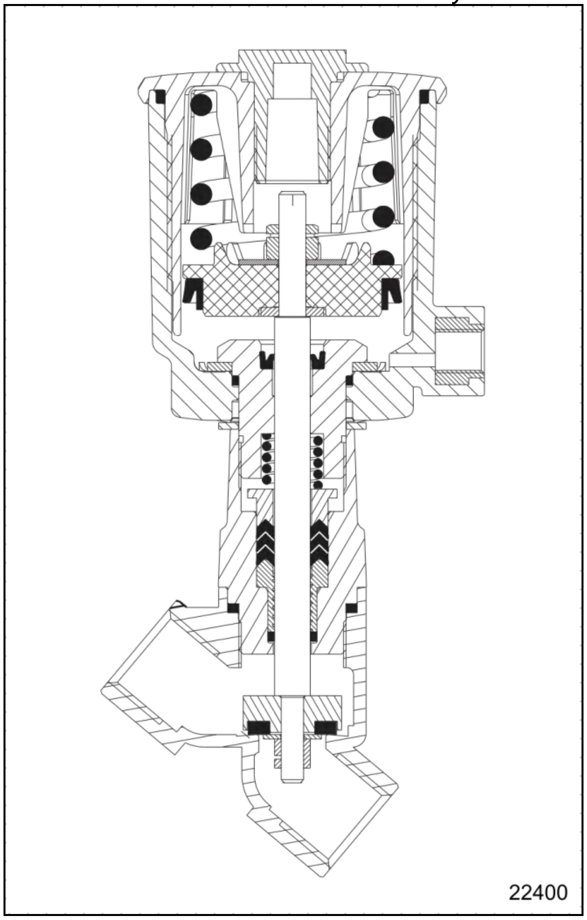


FIGURE 39: PASSENGER'S UNIT PNEUMATIC HOT WATER VALVE – TYPICAL CUT-OUT VIEW

4.10.1 Valve Troubleshooting

PROBLEM	PROCEDURE
Valve fails to close	1. Check electrical supply with a voltmeter. It should agree with nameplate rating. 2. Check pressure at pilot solenoid valve inlet. It must be at least equal to the minimum pressure stamped on the nameplate. It should not go below minimum while valve is operating.
Valve fails to open	1. Check that the closure member assembly, and that main actuator and cylinder springs are free to travel. 2. Check that there is no restriction to the air escaping from the actuator casing. 3. Make sure that pilot solenoid valve operates properly.

4.11 HOT WATER CIRCULATING PUMP

This vehicle is provided with a brushless/sealess water circulation pump which is in the compartment located aft of the evaporator compartment (Figure 40). The assembly consists of a centrifugal pump and an electric motor mounted in a compact assembly.

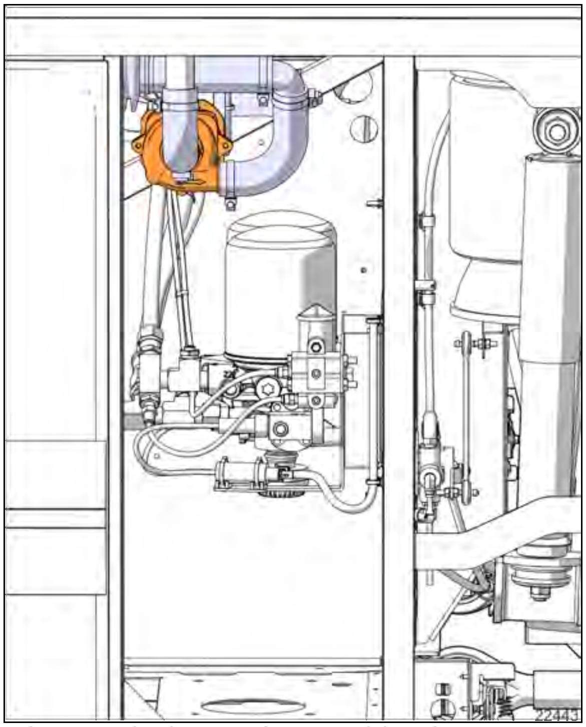


FIGURE 40: CIRCULATING PUMP LOCATION

The brushless DC sealess circulating pump requires no periodic maintenance. The sealess design offers leak-proof protection and the capability to resist harsh environmental conditions. The pump magnetically couples to the brushless DC motor without a wet seal to wear or replace, this coupling method also enables easy motor removal without requiring system draining. The pump electronically commutated brushless DC motor provides virtually maintenance-free operation over time by eliminating brush maintenance and associated brush motor failure.

Inspection of the circulating pump, to determine if the pump is working properly, should be made while the pump is in operation.

If there is evidence that the circulating pump is not operating as per specifications, the unit must be disassembled for repair.

Disassembly of the pump will be necessary only in the case of a rotor failure or motor failure.

- **Removal**

1. Stop engine and allow engine coolant time to cool.
2. Close shutoff valves. Refer to *"05 COOLING"* under heading *"Draining Cooling System"* for location of valves.
3. Disconnect the electrical wiring from the motor.

WARNING

Before proceeding with the following steps, check that coolant has cooled down.

4. Disconnect water lines from the pump at flange connections. Place a container to recover the residual coolant in the line.
5. Remove the two clamps holding the pump motor to its mounting bracket. Remove the pump with the motor as an assembly.

- **Installation**

1. Apply gasket cement to the line flanges, put the two gaskets in place, and connect water lines to the pump at the flange connections. Position the pump and motor assembly on the mounting bracket. Position the mounting clamps over the motor and secure with mounting bolts.
2. Connect electrical wiring to the pump motor.
3. Open shutoff valve. Refer to *"05 COOLING"* under heading *"Draining Cooling System"* for location of valves.
4. Fill the cooling system as previously instructed in this section under *"6.6.4* Filling Heating System*"*, then bleed the system as previously instructed in this section under *"6.6.5* Bleeding Heating System*"*.

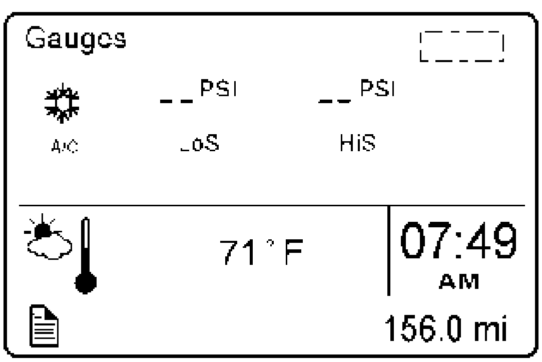
5. HVAC SYSTEM TESTING AND TROUBLESHOOTING

Before undertaking any troubleshooting on the HVAC system, study the appropriate wiring diagrams to get a complete understanding of the HVAC components circuitry, read and understand section 06: ELECTRICAL of this manual under "Troubleshooting And Testing The Multiplex Vehicles" and "Test Mode For Switches And Sensors". The information included in these paragraphs is necessary for troubleshooting the HVAC system on Multiplex vehicles.

5.1 ON DEMAND DISPLAY OF A/C SYSTEM HIGH AND LOW SIDE PRESSURE

Refrigerant pressures can be displayed in the Driver Information Display (DID) by selecting "Gauges" menu and pressing the down arrow to the fifth displayed screen.

A/C Compressor Pressure

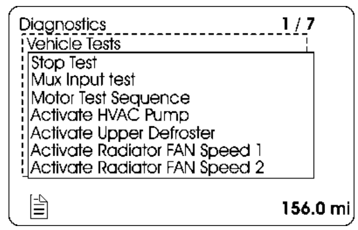


Displays the A/C system's suspension pressure value (LoS=low side) and discharge pressure value (HiS=high side).

NOTE
When starting the A/C compressor, allow enough time before checking pressures in order to give the system a chance to build its pressure. During the first 3 seconds after startup, the compressor is active on 4 cylinders and the A/C valve is open regardless of the pressure readings.

5.2 ON DEMAND ACTIVATION OF HOT WATER CIRCULATING PUMP

In Diagnostics/Vehicle Test mode on the DID, the heating system circulating pump can be turned on manually by selecting ACTIVATE HVAC PUMP command. This feature allows verification of the circulating pump when inside a garage. This is also useful when working on the heating system to remove air pockets trapped in the system.



In normal operation, the heating system circulating pump operates only when the ambient temperature is 50°F or lower.

5.3 TEMPERATURE SENSORS

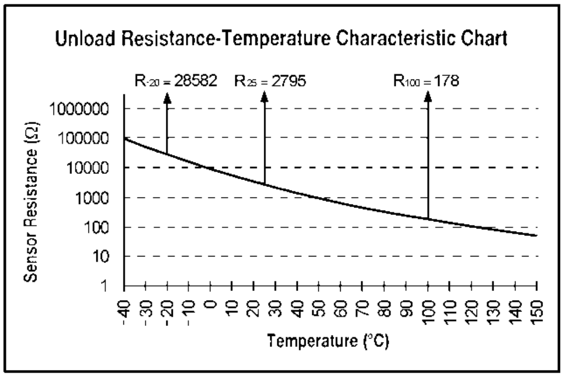
The following table can be used for troubleshooting the following temperature sensors:

1) Driver area temperature sensor (SE21);
2) Passenger area temperature sensor (SE25);
3) Outside air temperature sensor (SE20).

NOTE
The driver's area air temperature sensor is located below the dashboard, just ahead of the driver's right knee.

The table values are for unloaded, disconnected temperature sensors (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 kiloohm 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

5.4 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.

This feature can be used when the vehicle is traveling to check the A/C compressor pressure values.

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

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

5.5 TEST MODE FOR ELECTRIC MOTORS

The test mode allows testing the motors and electric contactors without the need to have the engine running.

Use this test mode for testing of the condenser fans, evaporator fans, overhead compartment fans, A/C compressor clutch activation, A/C compressor unloader activation, driver's unit hot water solenoid valve and refrigerant solenoid valve, passengers' unit hot water solenoid valve and refrigerant solenoid valve, water circulating pump. Refer to Section 06: ELECTRICAL under "TEST MODE FOR ELECTRICAL MOTORS" for complete information.

5.6 MODES OF OPERATION

COOLING DEMAND Conditions for engaging the 2nd speed on the evaporator motor	- The 2nd speed engages if the passengers' area temperature is 1 degree above the set point and it reverts to speed 1 if the temperature gets equal or below the set point.
HEATING DEMAND Conditions for hot water circulating pump activation	- The pump turns ON if the outside temperature is equal or less than 50°F (10°C), when heating is more likely to be needed Note: To test pump operation, it is possible to keep it active even if the outside temperature is above 50°F (10°C). See *5.2 ON DEMAND ACTIVATION OF HOT WATER CIRCULATING PUMP*.
The compressor unloader operation is based on pressure and on the difference between the passengers' area temperature and set point.	**Right compressor cylinders** - Stop if: The passengers' area decreasing temperature becomes less than 0.4°F above the set point (68°F) or if compressor discharge pressure is above 290 psi, or if compressor suction pressure is below 23 psi. - Restart if: The Passengers' area temperature is 1.3°F or more above the set point and compressor discharge pressure is less than 250 psi and compressor suction pressure is above 32 psi.
A/C compressor deactivation pressure	- 310 psi - In case of high pressure, the high pressure transducer connected to the multiplex module deactivates the compressor - There is also a 350 psi pressure switch that acts to stop the compressor in the instance that the multiplex module fails.
Compressor turns on automatically if (2 required conditions)	outside temperature is above 32°F and return air temperature in passengers' area is 61°F or above (ΔT=7° with set point)

5.7 HVAC ELECTRICAL SYSTEM TROUBLESHOOTING

Always check DID for electrical faults before performing repairs. Address any modules not responding and take corrective action. This should be the first step in troubleshooting.

Problem/Symptom	Probable Causes	Actions
Defroster fan not functioning	Module AE47 is not powered or is faulty Module AE24 is not powered or is faulty	1. Check the Diagnostics menu of the Driver Information Display (DID). Select Fault Diagnostics and Electrical System. The message “No Response ModAE47 (or ModAE24), 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 CB16V (VECF) 4. Probe gray connector on module to see if it is powered.
HVAC condenser fans not functioning	Circuit breaker CB7 tripped Seized bearing Bad wiring Module AE54 is not powered or is faulty	1. Check / reset circuit breaker CB7 2. Check CB141, CB142, CB143, CB144 in VECR. 3. Check / replace condenser power relay R10 (probe R10 coil power circuit 67A, should be 24 volts). 4. Check the Diagnostics menu of Driver Information Display (DID). Select Fault Diagnostics and Electrical System. The message “No Response ModAE54, Active” indicates a power problem on the module. (A CAN network problem would show the same message but doesn't produce this symptom). 5. Check CB5, CB67.
HVAC condenser fans not functioning in <u>speed 1</u>	Module AE42 is not powered or is faulty	1. Check the Diagnostics menu of Driver Information Display (DID). Select Fault Diagnostics and Electrical System. The message “No Response ModAE42, 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 CB1, CB5, CB7 3. Check CB67 4. Probe gray connector on module to see if it is powered.

Problem/Symptom	Probable Causes	Actions
HVAC condenser fans not functioning in <u>speed 2</u>	Circuit breaker CB7 tripped Seized bearing Bad wiring	1. Check / reset circuit breaker CB7 2. See *HVAC condenser fans not functioning* & *HVAC condenser fans not functioning in <u>speed 1</u>* above.
Defroster fan is functioning but no heat or cooling available in the driver's area	Module AE46 is not powered or is faulty Bad wiring	1. Check the Diagnostics menu of Driver Information Display (DID). Select Fault Diagnostics and Electrical System. The message "No Response ModAE46, 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 CB12V or CB13V (VECF) 4. Probe gray connector on module to see if it is powered.
The A/C compressor clutch does not engage	Module AE52 is not powered or is faulty	1. Check the Diagnostics menu of Driver Information Display (DID). Select Fault Diagnostics and Electrical System. The message "No Response ModAE52, 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 CB65V (VECR) 4. Probe gray connector on module to see if it is powered.
Evaporator fan not functioning	Circuit breaker CB3 tripped Module AE54 is not powered or is faulty	1. Check / reset circuit breaker CB3 2. Check the Diagnostics menu of Driver Information Display (DID). Select Fault Diagnostics and Electrical System. The message "No Response ModAE54, Active" indicates a power problem on the module. (A CAN network problem would show the same message but doesn't produce this symptom). 3. Check / reset circuit breaker CB5 4. Check CB67 5. Probe gray connector on module to see if it is powered. 6. Check / replace condenser power relay R12 (probe R12 coil power circuit 67, should be 24 volts).

5.7.1 Air Conditioning

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 And High superheat	Loss of contact between the expansion valve bulb and the suction line or sticking of the expansion valve. Improper insulation. Check for corrosion and clean, repair or replace the valve.
Noisy or knocking compressor.	Check for broken internal parts. Overhaul if required.
Compressor vibrates excessively.	Check and tighten compressor mounting bolts and belt tension.
Low refrigerant level	Check for refrigerant leaks and add refrigerant as required.
Suction pressure rises fast after shutdown.	Check compressor valve for breakage or damage.
Insufficient airflow.	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 airflow: 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 starting and stopping 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.) An evaporator just does a proper cooling job without sufficient air. Shortage of air can be caused by the following: o Dirty filters; or

TROUBLE	CAUSE
	o Dirty coils.

Testing condenser pressure.
NOTE: R-134A pressure varies according to temperature.

Example, for an exterior temperature of 100°F.
Exterior temperature (100°F) + 30°F = 130°F.
Take note: 30°F is added to ambient temperature by definition.
Refer to paragraph "5.8 Temperature & Pressure".
Note the corresponding pressure for a temperature of 130°F, 199.8 psi.
Read the condenser pressure, example 171.9 psi.
171.9 psi & 199.8 psi, the pressure in the condenser is inferior to the pressure corresponding to the exterior temperature, in this case the condenser pressure may be too low. Check for refrigerant leaks and add refrigerant if necessary. If the pressure corresponding to the condenser temperature is superior to the pressure corresponding to the exterior temperature, then the air cooled condenser pressure may be too high. Most frequent causes are:

Reduced air quantity. This may be due to:
* Non-condensable in system;
* Dirt on the coil;
* Restricted air inlet or outlet;
* Dirty fan blades;
* Incorrect rotation of fan;
* Fan speed too low;
* Fan motor going out on overload; or
* Prevailing winds.
* Too much refrigerant in system. Remove refrigerant if necessary.

5.7.2 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 filter dryer.
Superheat adjustment too high.	Adjust superheat as outlined under "Superheat Adjustment".
Power assembly failure or partial loss of charge.	Replace expansion valve.
Air filter screen clogged.	Clean or replace air filter screen.
Plugged / kinked / chaffed lines.	Clean, repair or replace lines.
LOW SUCTION PRESSURE-LOW SUPERHEAT	
Uneven or inadequate evaporator loading due to	Balance evaporator load distribution by providing

PROBABLE CAUSE	PROBABLE REMEDY
poor air distribution or liquid flow.	correct air or liquid distribution.
HIGH SUCTION PRESSURE-HIGH SUPERHEAT	
Internally leaking compressor	Locate leak. Repair/ replace.
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.	Recover to proper charge.
Condenser dirty.	Clean condenser.

5.8 TEMPERATURES & PRESSURE CHART

R134a 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

5.9 LEAK TESTING

A leak can be identified by the presence of oil residue on the components.

The preferred method for leak testing is to replace refrigerant with pressurized nitrogen and spaying soap on suspected leaks. Any bubbles appearing would indicate a leak.

Additional possible methods include electronic leak detectors and fluorescent dye and UV light.

6. CENTRAL HVAC SYSTEM

The passenger's unit evaporator fan, located in the evaporator compartment on the L.H. side of the vehicle is protected by circuit breaker CB3 90 amp with manual-reset mounted in the main power compartment/junction panel (Figure 42).

The passenger's unit condenser coil is mounted on the opposite side of the evaporator. It is ventilated by four brushless axial fans. The fan motors are protected by circuit breakers located in the VECR.

Furthermore, the following relays, diodes and multiplex module are located in the evaporator compartment. They are mounted on top of the fan housing.

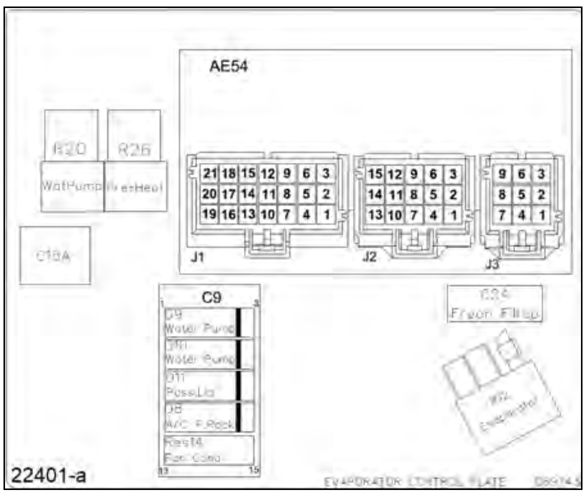


FIGURE 41: HVAC MODULE

A/C Junction Box	
Multiplex Module	
AE54	I/O-B
Relays	
R12	Evaporator fan power
R20	Water circulating pump relay
R26	Water Preheater Relay
Diodes	
D8	Overhead compartment Liq. Sol. Valve
D9	Water circulating pump
D10	Water circulating pump
D11	Pass. Liq. Sol. Valve

Breakers in VECR	
CB141	15A, Condenser fan up-fore
CB142	15A Condenser fan down-fore
CB144	15A Condenser fan up-aft
CB143	15A Condenser fan down-aft

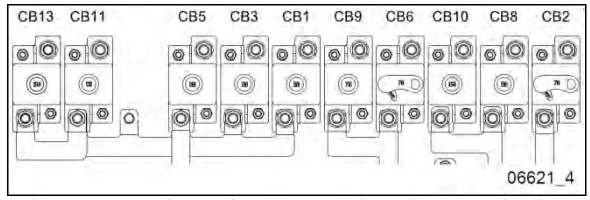


FIGURE 42: X3 SERIES REAR ELECTRICAL JUNCTION PANEL WITH CIRCUIT BREAKERS

6.1 AIR CIRCULATION IN DRIVER'S AREA

Fresh air is taken from a plenum underneath the front service compartment and enters the mixing box through a ON/OFF damper. Return air is taken through the right console into the mixing box (Figure 51). Mixed air goes through cooling and heating coils, fans and discharge ducts.

Both right and left discharge ducts defrost one half of the windshield. The driver can also divert some air flow to the console, from which he can direct air to his knees and/or upper body with adjustable HVAC air registers and to his feet with the appropriate button (see FIGURE 43 and Owner's or Operator's manual).

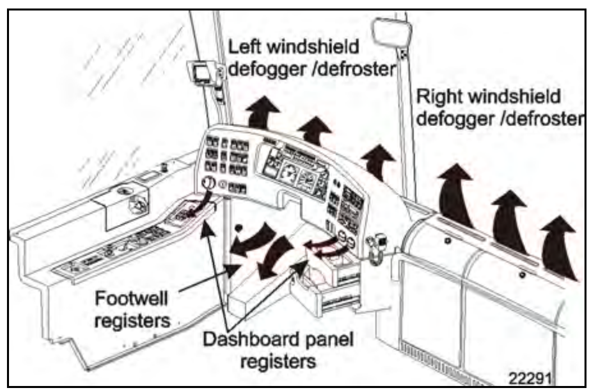


FIGURE 43: DRIVER'S UNIT AIR CIRCULATION

An additional air is located in the stepwell for step de-icing (Figure 2). This airflow is supplied by the passengers' air ducting system.

6.2 AIR CIRCULATION IN PASSENGER'S AREA

Fresh air enters from the left side of the vehicle through a damper located on the evaporator compartment door (Figure 44).

The 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 (refer to the Owner's or Operator's Manual for more details).

MAINTENANCE

Passenger's area fresh air intake filter (X3 Series only)

Clean or replace filter at the intervals specified by the Lubrication & Servicing Schedule in Section 24A.

To clean filter, back flush with water or soapy water, then dry with air.

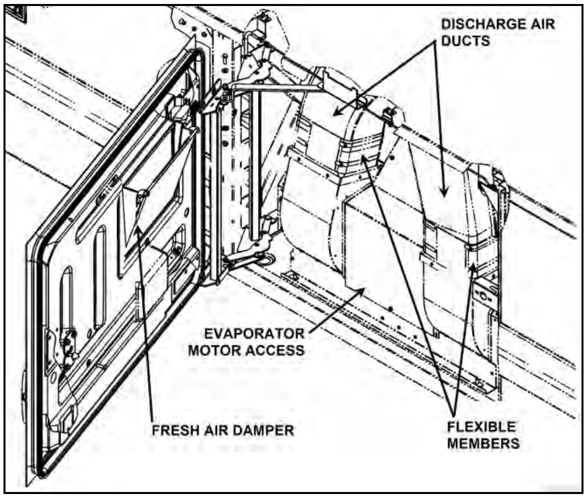


FIGURE 44: X3 SERIES PASSENGERS' AREA FRESH AIR DAMPER

NOTE

Opening the entrance door also partially closes the fresh air damper.

Return air is drawn from inside the vehicle through the register duct located on L.H. side of vehicle (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.

The coaches are equipped with an overhead compartment ventilation system equipped with adjustable registers in the passenger's overhead console to control air flow. Return air is drawn just below the middle side windows through an air filter into the overhead compartment fan; discharge air is fed to the rotating registers through the ventilation duct (Figure 45).

The lavatory ventilator found on the coach acts as the main exhaust for the whole vehicle, eliminates odors, and finally heats or cools the lavatory with the vehicle's ambient air.

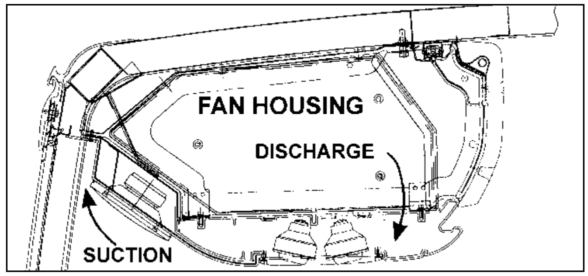


FIGURE 45: OVERHEAD COMPARTMENT VENTILATION SYSTEM 22211

6.3 HVAC SYSTEM OPERATION

To operate the HVAC system when the vehicle is stationary, engine should run at fast idle. During operation of the HVAC system, windows should be kept closed and door not left open longer than necessary. In order to prevent battery discharge, the HVAC system will not operate if the battery voltage drops below 24 volts.

The vehicle is divided into two areas:

- Driver's area (driver's HVAC unit).
- Passengers' area (passengers' HVAC unit).

The A/C compressor starts automatically when the two following conditions are satisfied:

1. The outside temperature is above 32°F (0°C).
2. The passengers' area temperature is within 7° (4°C) of the set point or higher. (if set point is 68°F for example, return air temperature must be above 61°F, at this moment, enough heat is available from the engine to warm up the area while the air conditioning will remove moisture in air and prevent fogging up of the windows).

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 fogging up of 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.

6.4 HVAC CONTROL UNIT

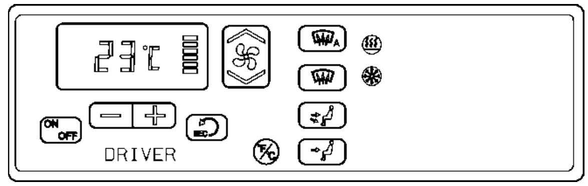
The vehicle is divided into two areas:

1 - Driver's area (driver's HVAC unit)

2 - Passengers' area (passengers' HVAC unit)

Fresh air is fed in each area and has a separate return air and discharge air duct.

Both driver and passengers HVAC units turn on automatically at starting of the engine but the driver can turn both off if desired and can then turn them back on using the ON/OFF button on the HVAC control unit.



22333

The HVAC control unit is used to control heating, ventilation, air conditioning and defroster in the driver's area only. The passengers' area HVAC unit (passengers' unit) temperature and fan speed is fully automatic. It has a preset temperature of 68°F (20°C). The temperature and fan speed cannot be changed by the driver.

NOTE
It is recommended to run engine at fast idle to operate the air conditioning system when the vehicle is stationary. *This will improve A/C compressor performance and provide adequate electrical power to the multiple A/C system fans.* *When the system is running, keep roof ventilation hatch and door closed to prevent cooling loss.*

To prevent battery run-down, the central HVAC unit will not operate if the battery voltage drops below 24 volts.

When the HVAC system is in operation, park at least 4 feet from other vehicles or buildings to allow sufficient air flow through the condenser coil.

The HVAC control unit performs a self-test every time it is turned on. Codes are shown on displays or flashed on control buttons.

The A/C compressor starts automatically when the two following conditions are satisfied:

1. The outside temperature is above 32°F (0°C).
2. The passengers' area temperature is within 7° of the set point or higher (set point is 68°F, so return air temperature must be above 61°F, at this moment, enough heat is available from the engine to warm up the area while the air

conditioning will remove moisture in air and prevent fogging up of the windows).

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 down to a temperature of 15°F (-9°C) to prevent fogging up of the windows.

The driver’s HVAC unit piping is paralleled with the passengers’ HVAC unit piping. Both sections use the same refrigerant and hot water, and are linked to the same condenser and compressor, even if they are individually controlled. In order for the driver to have air conditioning, the passenger air conditioning system must be operating (A/C compressor must be operating).

NOTE
The driver's and passengers’ HVAC unit turn on automatically at starting of the engine (multiplex receives the “engine running” signal) when the multiplex system receives an “engine running” signal.

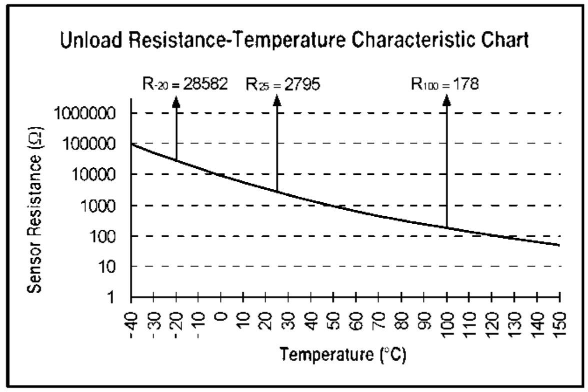
NOTE
To perform a test of the driver's section windshield defroster, it is possible to run the system without running the engine.

The following table can be used for troubleshooting the following temperature sensors:

NOTE
The driver’s area air temperature sensor is located below the dashboard, just ahead of the driver's right knee.

1) Driver’s area temperature sensor (SE21);
2) Passengers’ area temperature sensor (SE25);
3) Outside air temperature sensor (SE20).

The table values are for unloaded, <u>disconnected</u> temperature sensor (thermistor) probed at the temperature sensor connector pins.



TEMPERATURE SENSOR		
Temp °C	**Temp °F**	**Resistance Ohms**
-40	-40	100865
-35	-31	72437
-30	-22	52594
-25	-13	38583
-20	-4	28582
-15	5	21371
-10	14	16120
-5	23	12261
0	32	9399
5	41	7263
10	50	5658
15	59	4441
20	68	3511
25	77	2795
30	86	2240
35	95	1806
40	104	1465
45	113	1195
50	122	980
55	131	808
60	140	670

6.5 PASSENGERS’ SECTION OPERATION

The passengers’ section has a preset temperature of 68°F (20°C).

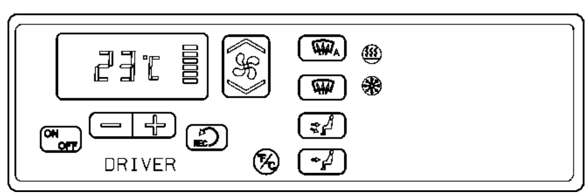


FIGURE 46: HVAC SYSTEM CONTROL UNIT

Temperature control is provided in conjunction with a thermistor sensor inside the return air box, located on the mid L.H. side of the vehicle under the seats (Figure 47).

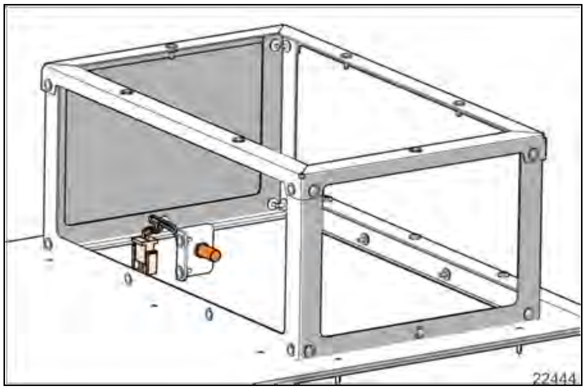


FIGURE 47: TEMPERATURE SENSOR IN PASSENGER AREA

The flow of water to the vehicle's main heater core is controlled by a pneumatic water valve which varies the cycling rate depending on selected temperature. A red LED, located on HVAC control unit, illuminates when heating mode is selected. A green LED illuminates when compressor clutch is in operation.

NOTE
The red Heat LED and the green AC LED may be illuminated at the same time. This indicates that the temperature control is requesting heat and the HVAC control is calling for compressor operation for dehumidification.

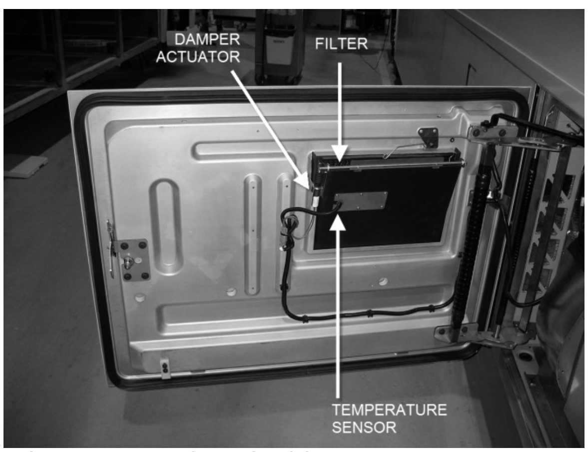


FIGURE 48: EVAPORATOR COMPARTMENT 22301

6.5.1 Overhead Compartment Unit

A/C 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.

6.6 HEATING

The Figure 3 schematic shows the central HVAC system heating arrangement.

On coaches, 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.

6.6.1 Driver's Unit Hot Water Pneumatic Valve

The flow of hot water to the driver's unit heater core is controlled by a normally open (NO) pneumatic valve like. The valve located at the ceiling of the spare wheel compartment (Figure 49), 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 without electrical supply 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.

Air pressure at port + 24 V signal at coil = valve closed

The driver's unit hot water valve requires a minimum amount of maintenance. The valve should be free of dirt sediment that might interfere with its operation. No other maintenance is needed unless a malfunction occurs.

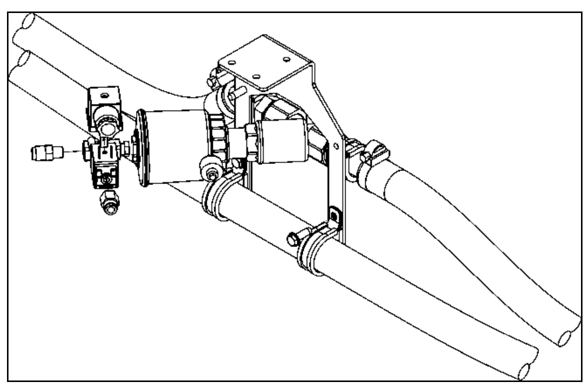


FIGURE 49: DRIVER'S UNIT HOT WATER PNEUMATIC VALVE ASSEMBLY

6.6.2 Passenger's Unit Hot Water Pneumatic Valve

The flow of hot water to the vehicle's central heater core is controlled by a normally open NO 3-way pneumatic water valve assembly (Figure 50). 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 without electrical power 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.

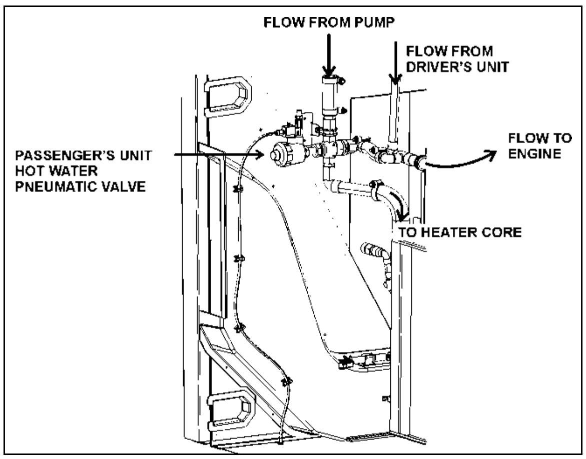


FIGURE 50: PASSENGER'S UNIT PNEUMATIC HOT WATER VALVE ASSEMBLY 22240

6.6.3 Draining Heating System

To drain the entire system, refer to SECTION 05 COOLING SYSTEM. If only the driver's unit heater core or passenger's unit heater core must be drained, refer to the following instructions.

<u>Draining Driver's Unit Heater Core</u>

1. Stop engine and allow the engine coolant to cool.
2. Locate the normally open hot water pneumatic valve on the ceiling of the spare wheel compartment (Figure 49), disconnect its wiring connector, and then connect a 24-volt external power source, using jumper cables, to close the valve.
3. Close the hot water lines shutoff valves located next the engine on the street side (see Figure 54).

> **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 the vehicle remove the two finishing panels in front of the unit. Remove the three screws fixing the unit front panel. Open the purge valve located inside the driver's unit (Figure 51) to ensure an efficient draining.

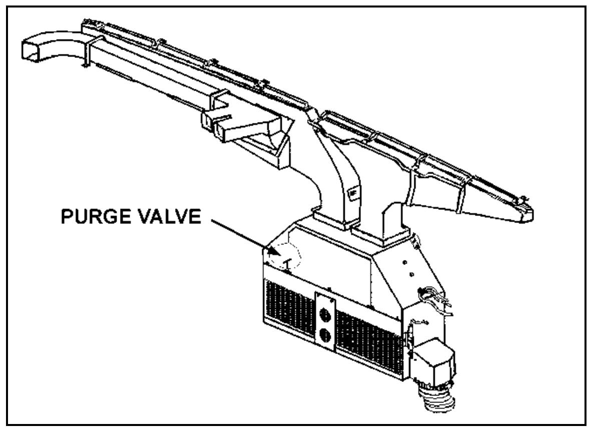


FIGURE 51: DRIVER'S UNIT AIR MIXING BOX 22171PV

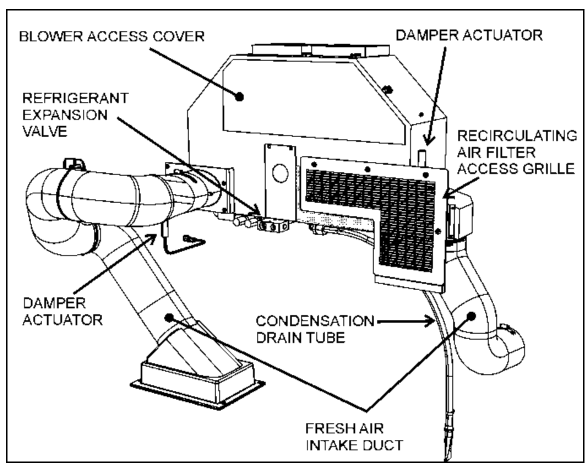


FIGURE 52: DRIVER'S HVAC UNIT

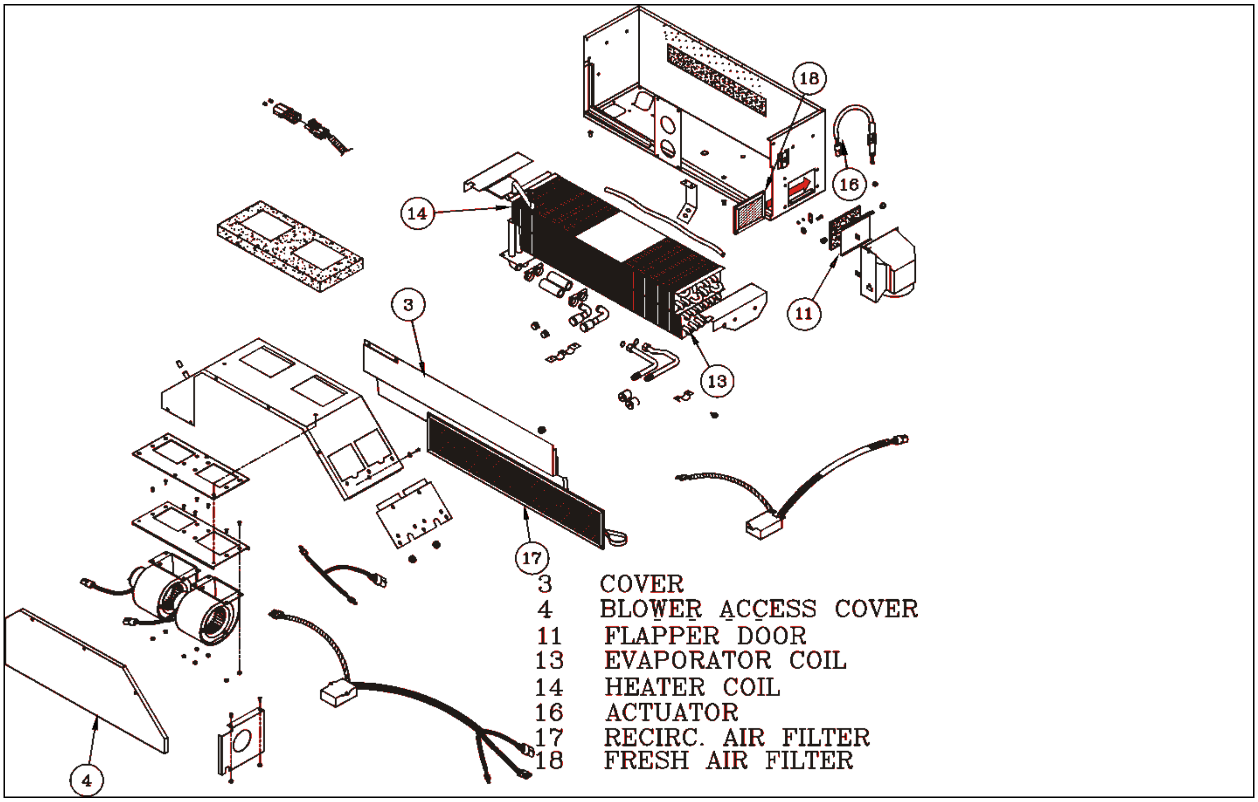


FIGURE 53: DRIVER'S HVAC UNIT

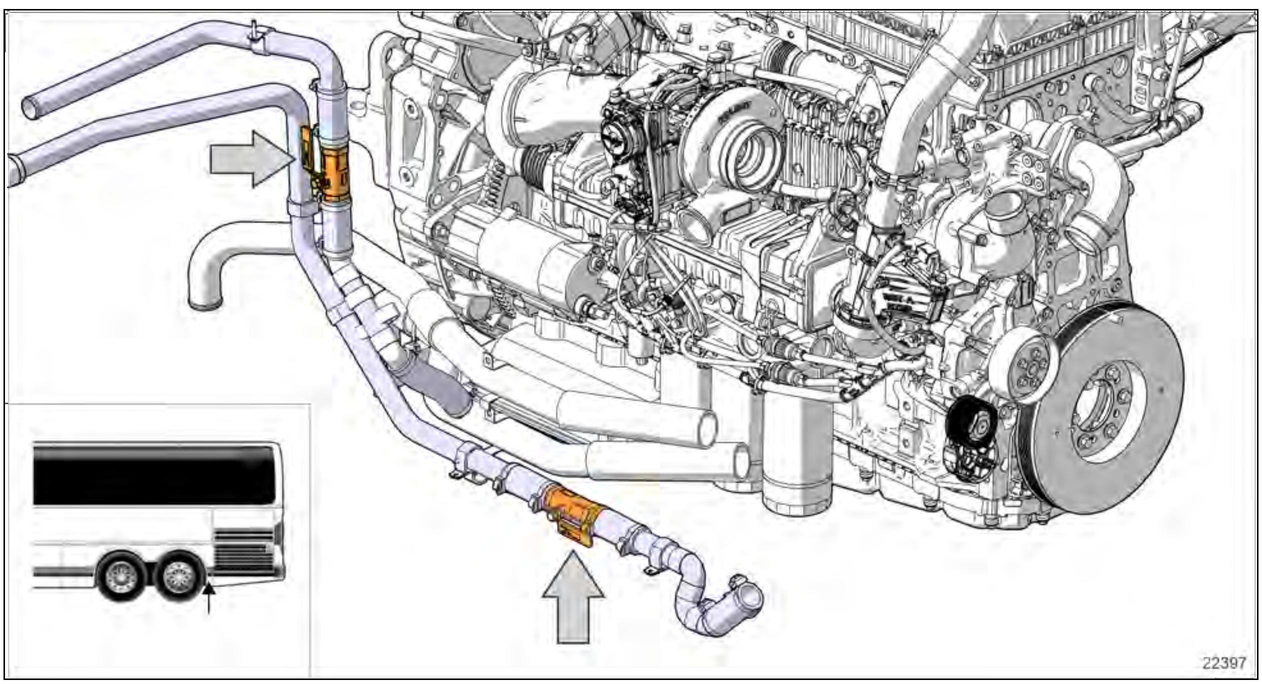


FIGURE 54 X SERIES HEATER LINE SHUTOFF VALVES- (ALLISON TRANS. PIPING ARRANGEMENT SHOWN)

Draining Passenger's Unit Heater Core

1. Stop engine and allow the engine coolant to cool.
2. Close both heater line shutoff valves (Figure 54). One is located in the engine compartment, lower road side, near the radiator while the other one is located behind the L.H. hinged rear fender near the preheater.
3. 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 (Figure 55) you can unfasten a hose connection on top of heater core in order to allow air to enter while draining. The main heater core drain cock is located in the evaporator compartment. To access the valve, open baggage compartment door located in front of the evaporator compartment (L.H. side). Open the evaporator compartment access panel.

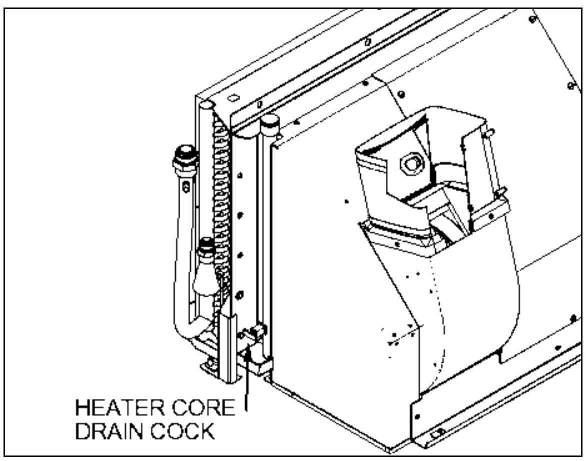


FIGURE 55: HEATER CORE DRAIN COCK LOCATION

6.6.4 Filling Heating System

1. Ensure that the driver's unit heater core purge valve and the passenger's unit heater core drain cock are closed.
2. Open the surge tank filler cap and slowly fill the tank to top of sight glass.
3. After initial filling, the hot water shutoff valves should be open and the water circulating 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 sight glass, slowly fill the tank to top of the sight glass.
5. If vehicle is equipped with a windshield upper section defroster, open front baggage compartment R.H. side door. Locate circulating pump on top of front wheelhousing, momentarily pinch the hose located between the circulating pump suction and the defroster outlet connector to ensure windshield upper section defroster complete filling.
6. Once the level has been stabilized, replace cap

6.6.5 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 the heating system. Locate the purge valve illustrated in Figure 51 & Figure 55, and open them momentarily until no air escapes from the lines. If present, open the manual vent located inside the HVAC unit, on the driver's side.

NOTE

In test mode (see paragraph 5.4 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.*

6.7 COOLING

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.

The schematic on FIGURE 4 shows the central HVAC system's cooling function arrangement.

6.7.1 Refrigeration 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. The air conditioning system used 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 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 in^2 (5162 mm^2) could easily neutralize the total capacity of the system.
6. Other causes of inadequate cooling are dirty coils or filter. Dirt acts as insulation and is also serves as a restriction to the airflow.
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.

The compressor will load depending on operating conditions.

6.7.2 Refrigerant

The A/C system of this vehicle has been designed to use R134a refrigerant as a medium. Regardless of the brand, only R134a must be used in this system. The chemical name for this refrigerant is 1,1,1,2-Tetrafluoroethane.

WARNING

Refrigerant in itself is nonflammable, but if it comes in contact with an open flame, it will decompose.

Procurement

Refrigerant is shipped and stored in metal cylinders. It is serviced in 30 and 100 pound cylinders.

Approximately 24 lbs are needed in the Central HVAC system plus an additional 2 lbs will be needed for the overhead compartment A/C system if equipped.

Refrigerant charge (Approximate)

Central A/C system:	*24 lbs*
Overhead comp. A/C system:	*2 lbs*

It will be impossible to draw the entire refrigerant out of the cylinder. However, the use of warm water or heating blanket when charging the system will assure the extraction of a maximum amount of refrigerant from the cylinder.

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 to more than 80% liquid full to allow for refrigerant expansion.
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 fulness 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 -40ºF (-40ºC). If refrigerant comes in contact with the eyes, serious injury could result. Always wear goggles to protect the eyes when opening refrigerant connections.

<u>Treatment in Case of Injury</u>

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.

<u>Precautions in Handling Refrigerant Lines</u>

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 2-½" (6,3 cm) from the exhaust manifold.
3. Use only sealed lines from parts stock.
4. When disconnecting any fitting in the refrigeration system, the system must first be discharged of all refrigerant. However, proceed very cautiously, regardless of gage readings. If there happens to be liquid refrigerant in the line, disconnect fittings very slowly, keeping face and hands away so that no injury can occur. If pressure is noticed when fitting is loosened, allow it to bleed off very slowly.

WARNING

Always wear safety goggles and gloves when opening refrigerant lines.

5. In the event that any line is open 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 and gaskets should be coated with refrigeration oil** and installed on the line before the line is inserted into the fitting to prevent damaging the O-ring. If leaks are encountered at the couplings or connectors, no attempt should be made to correct the leaks by tightening the connections beyond

the recommended torque. The O-rings are designed to seal at the specified torque and overtightening the connection does not result in a satisfactory and permanently sealed connection. The connection must be disassembled and the cause of the leak (damaged O-ring, defective lines, etc.) corrected. Use new O-ring.

6.7.3 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 clean-out procedures mentioned.

<u>Determining Severity of Failure</u>

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.

<u>Clean-out after Minor Compressor Failure</u>

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.

<u>Clean-out After Major Compressor Failure</u>

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 using prescribed method.
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.

6.7.4 Pumping Down

This procedure is intended to reduce refrigerant loss, on the central system only, by isolating it in the compressor and the receiver tank, as well as in their connecting line, in order to carry out repairs on other sections of the air-conditioning system (lines and components).

> NOTE
>
> *Once this pull down procedure has been properly done, any component from the outlet hose on the receiver tank, the filter dryer, the liquid solenoid valves, the evaporators, the expansion valves, and all lines associated with them can be serviced, **then properly evacuated**.*
>
> *It must be noted that there is STILL refrigerant under pressure in the compressor, the discharge lines, condenser, and receiver tank and that these items cannot be serviced. To service these items, it is required to recover the refrigerant using a recovery unit.*

> **CAUTION**
>
> The filter dryer should be changed each time a line in the system is opened.

> NOTE
>
> *Before attempting any repair between compressor and receiver tank, use a recovery unit to remove refrigerant from the system.*

> **WARNING**
>
> To prevent any injury, when the air conditioning system must be opened, refer to previous paragraph "Precautions In Handling Refrigerant" to prevent any injury.

> NOTE
>
> *For this procedure to be done properly, it is assumed the proper amount of refrigerant is in the refrigeration system. If there is any doubt, use a recovery unit to recover and weight the amount of refrigerant in the system.*

> NOTE
>
> *On vehicles equipped with small HVAC systems, refer to "Sanden SD Compressor Service Manual ".*

Procedure

1. Energize driver's unit and passengers' unit (main HVAC system) section liquid solenoid valve. To do so, connect male and female connector housings of C24 together for the passengers' area (found on the HVAC module in the evaporator compartment) and 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 and C44 are kept unplugged.

> **CAUTION**
>
> Connectors C24 & C44 must be disconnected and their caps reinstalled after this procedure. Leaving them connected will keep the driver's, passengers and overhead compartment liquid solenoid valves open, and result in battery draining if the vehicle remains unused for several days.

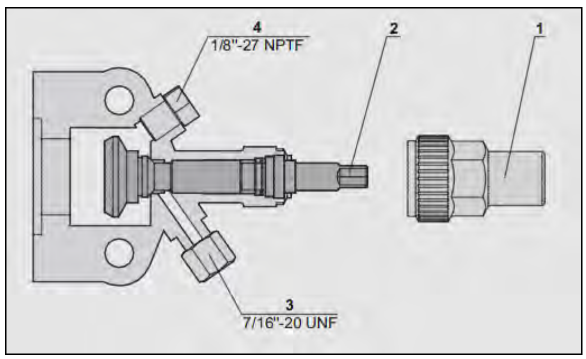


FIGURE 56: COMPRESSOR SHUTOFF VALVE BACKSEATED POSITION (NORMAL OPERATING POSITION)

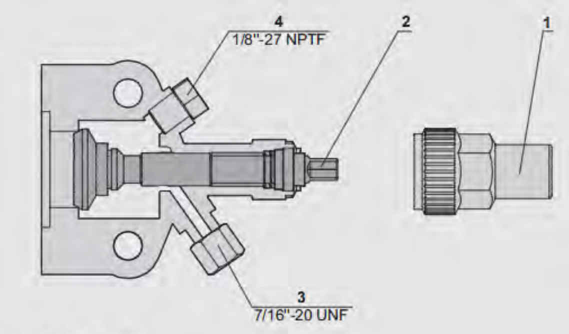


FIGURE 57: COMPRESSOR SHUTOFF VALVE IN FRONT SEATED POSITION

2. Run the system for 10 minutes and then shut it off.

3. Close (front seat) the receiver tank outlet shutoff valve by turning the stem clockwise (Figure 57).

   MAX TORQUE: 21 lb-ft (28 Nm)

4. Backseat the compressor suction shutoff valve (FIGURE 56).

   MAX TORQUE: 12 lb-ft (16 Nm)

5. Install an appropriate pressure gage set on the service port and then turn the shutoff valve forward ¼ turn more or less until a visual check of the suction pressure is possible.

6. Disconnect the low pressure transducer. The multiplex system will establish a default value of 34 psig and this will allow pulling down the A/C compressor to 0 psig. **Note: the low-pressure transducer must be reconnected after the pumping down operation is complete.**

7. Run the A/C compressor until suction pressure is pulled down to 0 psig.

8. Disconnect the compressor clutch to stop the compressor from pulling the system into a vacuum. Vacuum is not required. The pressure will probably slowly increase on the suction side. When it reaches 10 psig, reconnect the clutch and repeat the pull down to pull down this residual pressure. This process might need to be repeated a couple of times until the suction pressure drops and remains to 0 psig.

9. Stop the compressor.

10. Close (front seat) the suction shutoff valve on the compressor (Figure 57).

    MAX TORQUE: 21 lb-ft (28 Nm)

11. At this point, C24 can be disconnected to isolate the section of the system located between the receiver tank outlet shutoff valve and the passengers' unit liquid solenoid valve. Doing so would be useful to perform replacement of the filter dryer, for example.

NOTE
During this operation, care must be taken not to fill the receiver tank over the upper sight glass. If so, stop process immediately. Always allow refrigerant piping and units to warm up to the ambient air temperature before opening system or sweating will take place inside the lines.

6.7.5 Adding Vapor State Refrigerant

Addition of vapor state refrigerant is carried out to compensate for hose permeation and shaft seal losses over a long period and is done from the suction side while compressor is in operation.

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.

<u>Verification</u>

Perform the following verification:

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 (FIGURE 58) should be clear, not milky, without bubbles in the stream of refrigerant. Bubbles in the moisture indicator sight glass are sign of refrigerant low charge. 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.

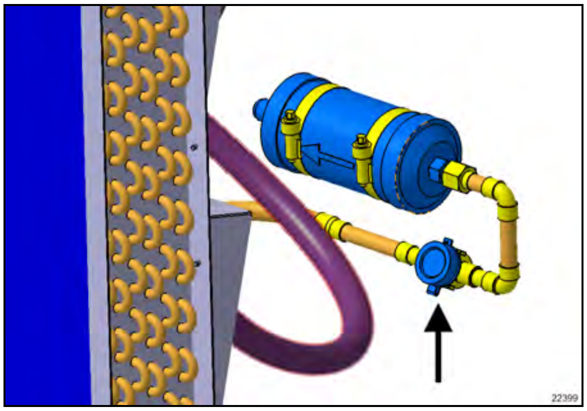


FIGURE 58: MOISTURE INDICATOR SIGHT GLASS

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 (*see 5.8 TEMPERATURES & PRESSURE CHART),* find this temperature and the corresponding saturation pressure and add 10 psi for the pressure drop between compressor and condenser.

Calculation example:

At 70°F outside, add 30°F. In the chart (paragraph 5.8 **), find the pressure value for a temperature of 100°F. For R-134a refrigerant gas, you will find a value of 124 psi. Add 10 psi 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.**

Refrigerant addition

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.

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.

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 shutoff valve service port of the compressor. Connect the red valve of the gage set to the discharge shutoff valve service port. Hoses should be purged of air at installation (evacuated).

WARNING

Secure manifold gage hoses so they will not be damaged by engine belts and pulleys.

3. Midseat the compressor suction and discharge shutoff valves.
4. In order to speed up the charging, unplug the unloader 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.

WARNING

If discharge pressure is above 100 psig, the condenser fans will be running. Keep hands clear of fans

6. Start engine.
7. Switch to fast idle for faster fill and battery protection.
8. 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.
9. Check the moisture indicator sight glass and the discharge pressure to meet the criteria described above.
10. 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.
11. When finished, close gage valves and bottle valve.
12. Before stopping the engine, check the compressor oil level and note it in the repair book as well as the amount of refrigerant added.
13. Shut down engine and backseat suction and discharge shutoff valves (FIGURE 56).

    MAX TORQUE: 12 lb-ft (16 Nm)

14. Remove gages and replace caps.
15. Perform a road test for final verification.

6.7.6 Charging System

When a system has been opened or if there are any questions about the air or moisture in the system, evacuate the system. **Charging of an evacuated system** may be accomplished by forcing liquid R-134a directly into the receiver tank. This may be accomplished by placing the refrigerant cylinder upside down on a scale with the valves at the bottom. This ensures that only liquid will enter the **receiver tank**.

When charging an empty system, weigh the amount of refrigerant put into the system. This will eliminate any possibility of overfilling.

A Central HVAC System nominal charge requires 24 pounds. If the vehicle is equipped with the overhead compartment A/C system, a full charge requires an additional 2 lbs.

After charging the system, it may be necessary to add refrigerant. Vapor state refrigerant addition will be done from the suction side of the compressor while the compressor is in operation.

1. Using connector C24 and C44, energize and open the liquid solenoid valves (driver's unit, passengers' unit and overhead compartment units). To do so, uncap and connect male and female connector housings of C24 together for the passengers' area (located on the HVAC module in the evaporator compartment) or C44 for the driver's area (located on the ceiling of the spare wheel compartment).
2. Backseat (stem out) the two compressor shutoff valves (FIGURE 56).

   MAX TORQUE: 12 lb-ft (16 Nm)
3. Install A/C pressure gages at the compressor shutoff valves service ports (item 4, FIGURE 56).
4. Midseat the two compressor shutoff valves.
5. Ensure that the two receiver service valves are in back seated position (stem out).
6. Remove the cover cap from the service port on the receiver inlet service valve.
7. Attach an evacuated charging hose (purged from air and moisture) to the R-134a tank.
8. Connect the evacuated charging hose to the service port on the receiver tank inlet shutoff valve.
9. Open the R-134a tank valve. The refrigerant supply tank should be kept warm to allow more refrigerant to be transferred into the system. Use a heating blanket for this matter.
10. Midseat the receiver inlet shutoff valve. The R-134a will now enter the system.
11. The proper charge of R-134a is 24 lbs, to this, add 2 lbs for overhead compartments A/C system. When the scale indicates this amount of charge, backseat the receiver valve and close the R-134a tank valve.
12. Disconnect the charging hose. Replace the cover caps.
13. Disconnect C24 & C44.
14. The system is now ready for operation.

CAUTION

The evacuation of the system must be made by authorized and qualified personnel only. Refer to local laws for R-134a recuperation.

6.8 LIQUID REFRIGERANT RECOVERY

Liquid recovery is performed the same way as standard vapor recovery except that liquid recovery will be done by connecting to the high side of the system. Recovering liquid is ideal for recovering large amounts of refrigerant.

1. Energize driver's unit and passengers' unit (main HVAC system) section liquid solenoid valve. To do so, connect male and female connector housings of C24 together for the passengers' area (located on the HVAC module in the evaporator compartment) and 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 or C44 are kept unplugged.
2. Backseat (normal operating position) the compressor suction and discharge shutoff valves.

   MAX TORQUE: 12 lb-ft (16 Nm)
3. Connect manifold gages on the service port and then turn the compressor shutoff valves forward just enough to enable a visual check of the suction and discharge pressure.
4. Make sure the receiver outlet shutoff valve is in back seated position (normal operating position). Connect the recovery unit hose to

the receiver outlet shutoff valve service port (FIGURE 59).

FIGURE 59: RECOVERY UNIT CONNECTED TO RECEIVER SERVICE PORT

5. Perform the recovery of the refrigerant as prescribed by the recovery unit manufacturer.

6.9 EVACUATING SYSTEM

When A/C system has been opened or if there are any questions about the air or moisture in the system, evacuate the system.

Backseat (stem out) both compressor shutoff valves. Evacuate the entire system including compressor using a **vacuum pump** connected to the high and low pressure sides.

A steady vacuum (i.e. pressure does not rise within two hours) less than 0.02 psi (1.5 mbar) must be maintained once the vacuum pump is turned off.

CAUTION

The evacuation of the system must be made by authorized and qualified personnel only. Refer to local laws for R-134a recuperation.

1. Make sure both receiver tank shutoff valves are is the normal back seated position (stem turned out).
2. Clean the area around the compressor shutoff valves.
3. Remove the blue and red caps from the service ports on suction and discharge shutoff valves. Connect two hoses to the vacuum pump.
4. Mid seat the compressor suction and discharge shutoff valves.
5. Using connector C24 and C44, energize and open the liquid solenoid valves (driver's unit, passengers' unit and overhead compartment units). To do so, uncap and connect male and female connector housings of C24 together for the passengers' area (located on the HVAC module in the evaporator compartment) or C44 for the driver's area (located on the ceiling of the spare wheel compartment).
6. Start the vacuum pump.
7. The pressure will drop to approximately 29 in-HG gage vacuum.
8. Evacuate to a system pressure of 500 micron.
9. Shut down the vacuum pump. Validate that the vacuum holds. If the pressure rises, it indicates a leak.
10. Backseat the compressor shutoff valves by turning "out" all the way.
11. Remove the hoses.
12. Reinstall the red and blue caps at the suction and discharge shutoff valves service ports.
13. Disconnect C24 & C44.

7. SPECIFICATIONS

Passenger's unit evaporator motor

Make.. AMETEK ROTRON
Type .... BRUSHLESS DC MICROPROCESSOR CONTROLLED
Voltage .... 27.6 V DC
draw.. 68 amps
Horsepower.. 2
Revolution .... 1400 & 1700 rpm
Insulation.. Class F

Passenger's unit condenser fan motors

Make.. EBMPAST
Type .... 12" AXIAL BRUSHLESS
Voltage .... 24 V DC
Qty.. 4

Driver's unit evaporator motors

Make.. MCC
Voltage .... 24 V DC
Quantity.. 1

Driver's unit evaporator air filter

Make.. MCC
TYPE.. Washable recirculating air 6-¼" x 28"
Make.. MCC
TYPE.. Washable fresh air 3-5/8" X 5-1/4"

Refrigerant

Type R-134a
Quantity (central HVAC system with optional overhead compartment A/C system) .... 26 lbs

Compressor (Central HVAC system)

Make.. Bitzer
Displacement .... 41 CFM
Model, R-134a.. 4NFCY
No. of cylinders 4
Cylinder volume .... 39 in^3 (647 cm^3)
Operating speed.. 500 to 3500 rpm
Oil capacity.. 2.8 quarts (2,6 liters)
Weight .... 74 lbs (33 kg)
Oil type .... Polyolester ISO68

Magnetic clutch

Make........ Lang
Type........ KK73.1
Voltage........ 24 V DC

Receiver tank (with sight glasses)

Make........ Westermeyer
Maximum pressure........ 450 psig

Filter-dryer assembly

Make........ Emerson-Alco

Moisture indicator

Make........ Emerson-Alco

Liquid refrigerant solenoid valve

Make........ Sporlan Parker Hannifin
Type........ Normally closed with manual bypass
Voltage........ 24 V DC

Passengers' unit hot water pneumatic valve

Make........ BURKERT
Type........ Normally open
Voltage........ 24 V DC
Pressure range........ 0 to 230 psi
Max. temperature........ 356ºF

Driver's unit hot water pneumatic valve

Make........ Asco
Type........ Normally open
Voltage........ 24 V DC

Hot water circulating pump

Make........ AMETEK
Flow........ 15 gpm
Inlet/outlet OD........ 3/8"

Main expansion valve

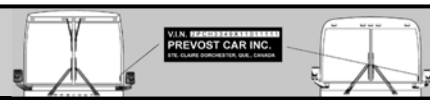
Make........ Emerson-Alco

MAINTENANCE INFORMATION

MI18-37

DATE :	Month Year	SECTION : 00 GENERAL
SUBJECT :	**LANG KK73.1 ELECTROMAGNETIC CLUTCH REMOVAL & INSTALLATION - BITZER A/C COMPRESSOR**	

APPLICATION

Model	
Prevost coaches, from year model 2014, with the Bitzer air conditioning compressor	

DESCRIPTION

In this Maintenance Information, you will find instructions and important details necessary to perform the removal or installation of the Lang KK73.1 electromagnetic clutch, which equips the Bitzer (model 4NFCY) air conditioning compressor.

Note: If not equipped with a Lang KK73.1 electromagnetic clutch, your Bitzer a/c compressor is equipped with a Linnig LA16 clutch. If this is the case, you will find the installation instructions on the document Linnig LA16 Electromagnetic Clutch_142.254 available on the Prevost Technical Publications site, under SUPPLIER PUBLICATIONS.

CONTENT

PROCEDURE

DANGER

Park vehicle safely, apply parking brake, stop the engine. Prior to working on the vehicle, set the ignition switch to the OFF position and trip the main circuit breakers equipped with a trip button. On Commuter type vehicles, set the battery master switch (master cut-out) to the OFF position.

LANG KK73 CLUTCH IDENTIFICATION

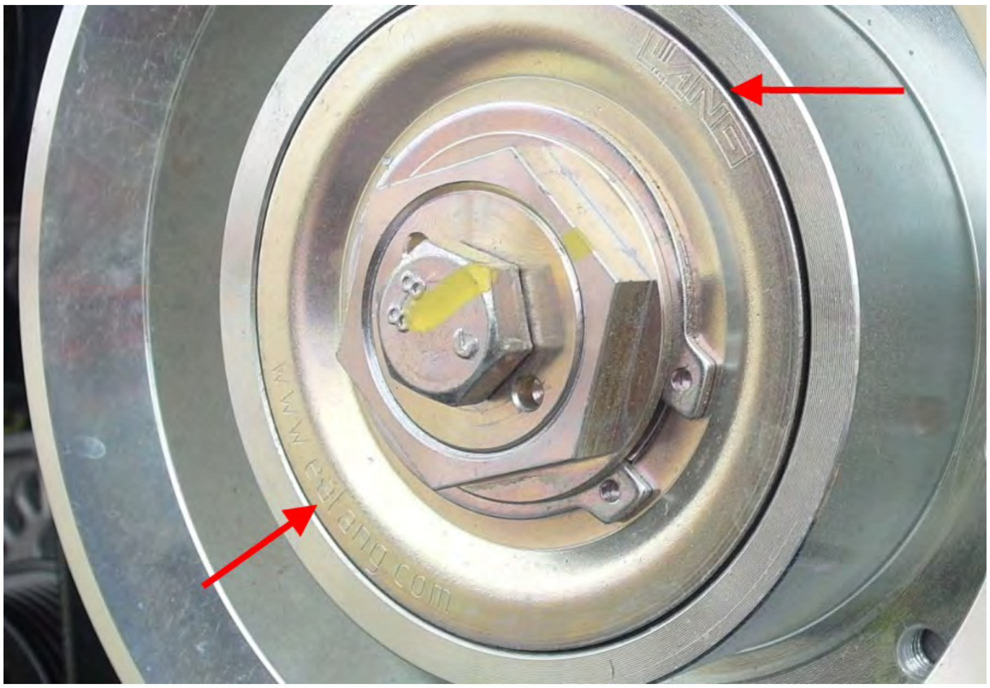


Figure 1: "LANG" & "WWW.EALANG.COM" ENGRAVED ON THE HUB

CLUTCH SECTION VIEW

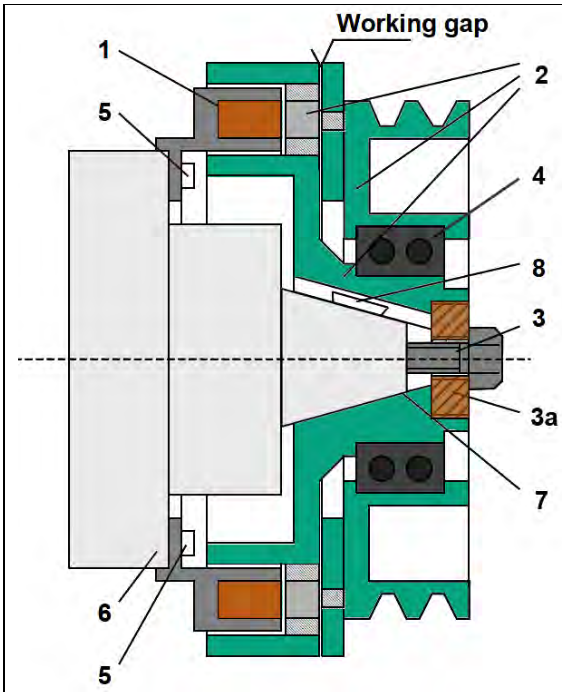


Figure 2: CLUTCH SECTION VIEW

1 -	coil
2 -	rotor
3 -	M12 mounting screw
3a -	straining washer
4 -	bearing
5 -	M8 screw (4x)
6 -	flange
7 -	shaft end
8 -	woodruff key

COLOR CODE

rotor assembly

compressor body

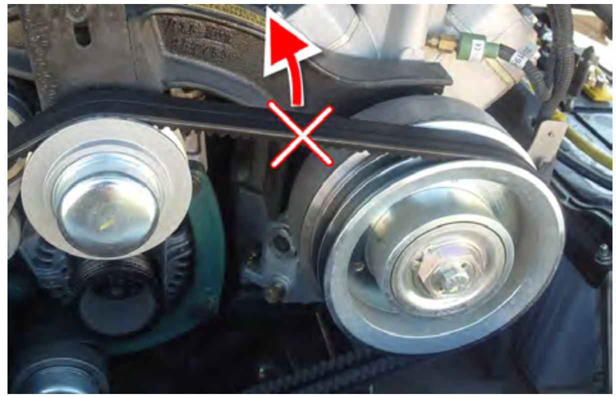
Working gap must be: 0.024 in to 0.035 in
0.60 mm to 0.90 mm

REMOVING THE ROTOR

REMOVING THE BELTS

1) Remove the two drive belts.

to



M12 MOUNTING SCREW REMOVAL

2) While holding the hexagonal part of the rotor with a wrench, loosen and remove the M12 mounting screw (3, Figure 2).

EXTRACTOR TOOL

3) Screw extractor tool #680888 in the straining washer (3a, Figure 2).

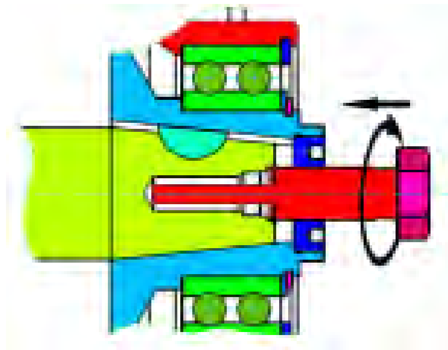
Do not use a standard M16 screws unless the tip of it has been rounded off, failing to do so may damage the shaft end bore or threads where the M12 screw is fastened

EXTRACTOR TOOL # 680888

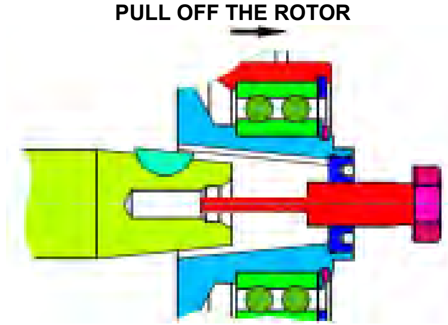
PULLING OFF THE ROTOR

4) Pull off the rotor with the extractor tool. Due to the back pressure, the rotor detaches from the shaft end (7, Figure 2) of the compressor.

DO NOT USE AN IMPACT WRENCH



PULL OFF THE ROTOR



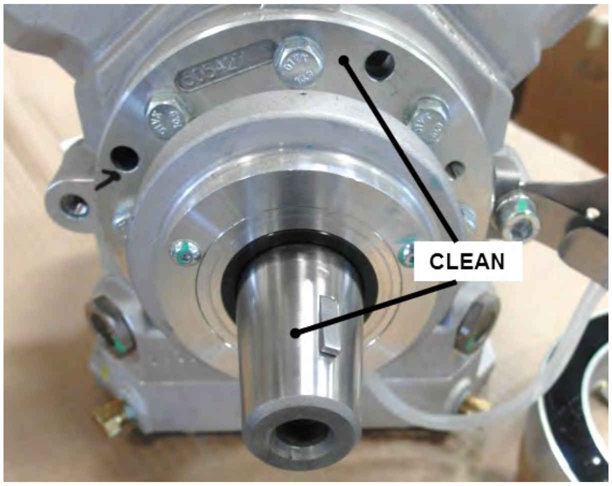
TAKE OFF THE ROTOR

REMOVING THE COIL

5) Loosen the coil M8 fastening screws (5, Figure 2) and pull the coil off the.

MOUNTING THE CLUTCH ON THE COMPRESSOR

PREPARATION

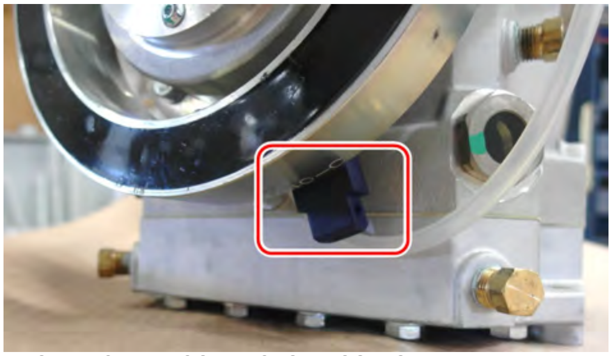


1) The flange and the shaft end must be free from dirt.

2) Apply high temperature approved assembly grease on the shaft end for easy dismounting of the clutch.

Use of Molykote G-rapid-plus or Molykote P 40 is recommended

INSTALLING THE COIL


PROPER CABLE CONNECTOR POSITION

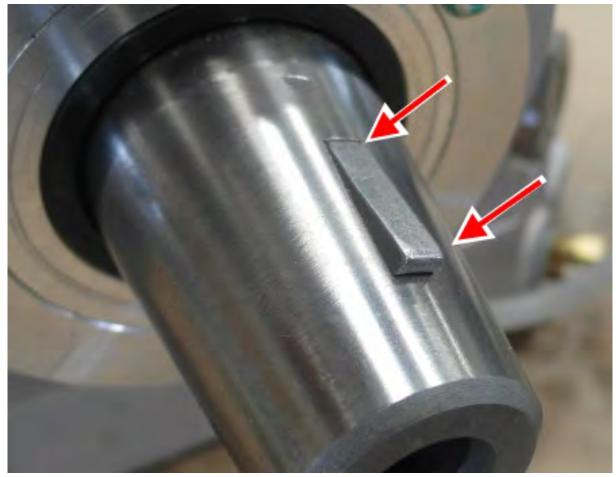
3) Reinstall the coil. Slip the coil on the compressor flange. The cable connector must be positioned on the right side as shown on the image.

4) Fasten the four M8 screws by hand to the compressor and then apply final torque.

Coil mounting screws: 22 lbf-ft (30 N-m). Use blue Loctite 243.

Caution: *Pay attention to the precise seat of the coil. A non-observance may cause the destruction of the clutch components during operation.*

PROPER WOODRUFF KEY POSITION



5) To avoid damaging the rotor bore, make sure that the woodruff key is positioned as shown on the image at right, otherwise, it could move when the rotor is inserted on the shaft end.

SLIPPING THE ROTOR

6) Carefully mount the rotor on the shaft end by hand.

Never use a hammer for pressing the rotor on.

To avoid damaging the bore of the rotor, feel the engagement of the key in the keyway and slip the rotor on the shaft end of the compressor till reaching the stop.

FASTENING THE ROTOR

7) Fasten the rotor to the shaft end by using the M12 screw and holding-up with a wrench on the hexagonal part of the rotor.

Rotor mounting screw: 60 lbf-ft (81 Nm)

Use blue Loctite 243.

Turn rotor by hand and pay attention to the free run and the generation of noises. In case of rubbing, grinding or similar noises, dismount the rotor and check installation.

8) Once properly tighten, apply a torque seal mark.

During cleaning or other work on the compressor, the clutch must be covered to prevent the penetration of greasy liquids, grease or dirt particles in the working gap (see figure 2) of the clutch. No high pressure cleaning.

Working gap must be: 0.024 in - 0.035 in
0.60 mm - 0.90 mm

REINSTALLING THE BELTS

1. Reinstall the drive belts.

   A belt strand tension gage is needed

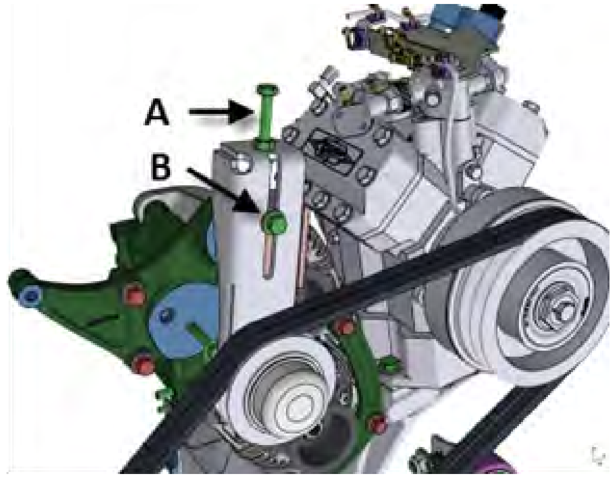
   On vehicles not equipped with an auxiliary alternator (i.e. 2 identical belts), belt tension should be within this range:

   90-100 lbs new belts (mean of 2 belt values)
   75-85 lbs used belts (mean of 2 belt values)

   On vehicles equipped with an auxiliary alternator (i.e. 2 different belts), belt tension should be within this range:

   A belt strand tension gage is needed
   150-160 lbs new belts (mean of 2 belt values)
   120-130 lbs used belts (mean of 2 belt values)

   Apply loctite on bolt (**B**) and hand tighten. Adjust belt tension using bolt (**A**). Use the jam nut to prevent rotation of bolt (**A**). When proper tension is achieved, tighten bolt (**B**) to **43 lbf-ft**. (58 N-m).



TROUBLESHOOTING, POSSIBLE DEFECTS, ELIMINATION

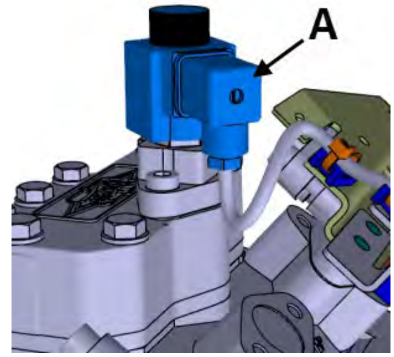
PROBLEM	CAUSE	SOLUTION
Clutch does not close any more, no current stream	Intermittent contact in the plug	Check plug
	Contact corroded	Clean contact
	Connection cable defect	Repair cable, replace coil
Clutch does not close in spite of current stream	Insufficient voltage supply	Check supply voltage
	Impurities in the working gap (foreign matters)	Disassemble clutch, remove foreign matters and assemble it again
Clutch slips when switched on (causes the destruction of the clutch by premature wear),	Insufficient voltage supply	Check power supply
	Friction surface polluted by small quantities of greasy/oily substances	Disassemble clutch, clean friction surfaces with alcohol and assemble it again.
	Heat penetration in the clutch by slipping V-belts thus grease penetration in the bearing or overheating of the clutch	Disassemble clutch. Clean friction surfaces or replace already damaged components. After reassembly of the clutch, tension V-belts correctly
	Incorrect distance between coil and rotor (coil not in line with the rotor), thus the switchable torque is reduced	Disassemble clutch, check cone for cleanness. Check the seat of the feather key, check the seat of the coil.
	Clutch worn, working gap too big (app. 1,2 mm), friction partner blue	Replace clutch or component
Clutch does not open immediately when switched off, this will cause a premature wear of the clutch), shrieking noise	Voltage supply not completely interrupted	Check circuit element for switching the coil ON/OFF and replace it if necessary
Clutch does not open any more, voltage supply is in order	Clutch worn and friction partners welded to each other on the friction surface	Replace clutch
Permanent grinding noise	Coil not correctly centered or not firmly screwed down	Check coil, screw it down, or replace it if damaged. Check clutch for consequential damages, eventually disassemble clutch, check bearing and friction surfaces, replace eventually damaged components.
	Compressor bearings defect, causes friction between coil and rotor.	Replace bearings. Check coil function. Replace it if damaged. If clutch slips, replace whole clutch due to friction damage.

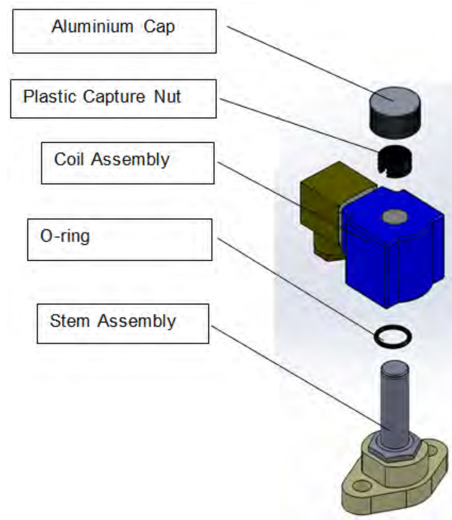
	Friction surface polluted by greasy or oily substances	Disassemble the clutch, replace bearing, if necessary, clean friction surfaces with alcohol and assemble them again.
	Blockade of the compressor. Clutch slips, both components blue due to friction heating.	Clutch destroyed, replace it.
Untrue run of the pulley, loud running noise.	Bearing damaged due to wear or incorrect seat of the feather key.	Check whether feather key and groove are flushing. If not, change clutch as the components will be permanently damaged, or disassemble the clutch and replace bearing.

SUPPLEMENT

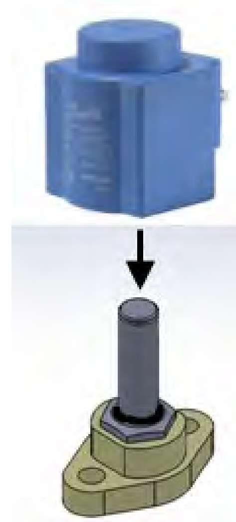
HOW TO INSTALL A NEW “CLIP-ON” UNLOADER COIL

1. Loosen the screw securing the connector to the coil and then unplug the connector (**A**). Keep the screw and the connector rubber gasket for later use.
2. Unscrew the aluminum cap and discard.
3. Remove the plastic capture nut and discard.
4. Remove the coil and discard
5. **Keep the O-ring** on the stem.





6. Install the new clip-on coil on the stem.
7. Slide the coil over the stem assembly with the O-ring at the base of the stem.



PARTS / WASTE DISPOSAL

Discard according to applicable environmental regulations (Municipal/State[Prov.]/ Federal)

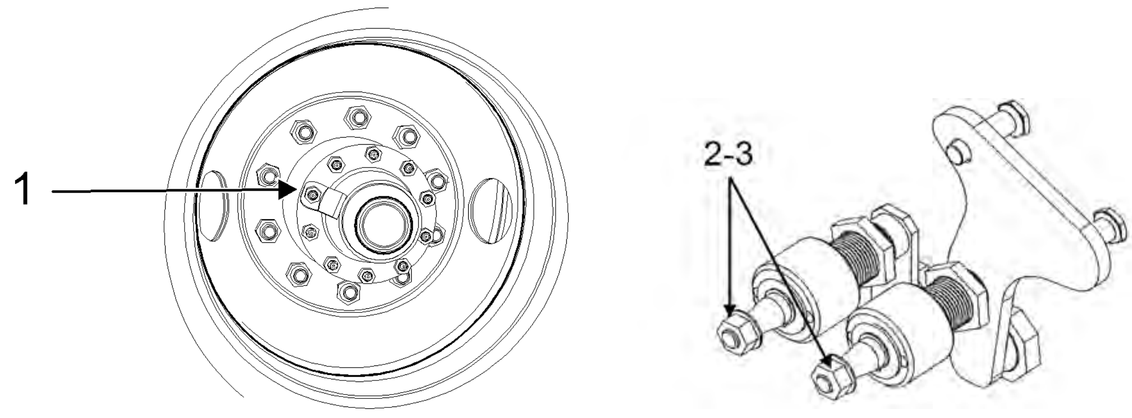
Access all our Service Bulletins on http://techpub.prevostcar.com/en/
Or scan the QR-Code with your smart phone
.
Are you a vehicle owner?
*E-mail us at **technicalpublications_prev@volvo.com** and type "ADD" in the subject to receive warranty bulletins applicable to your vehicle(s) by e-mail.*

CONTENTS

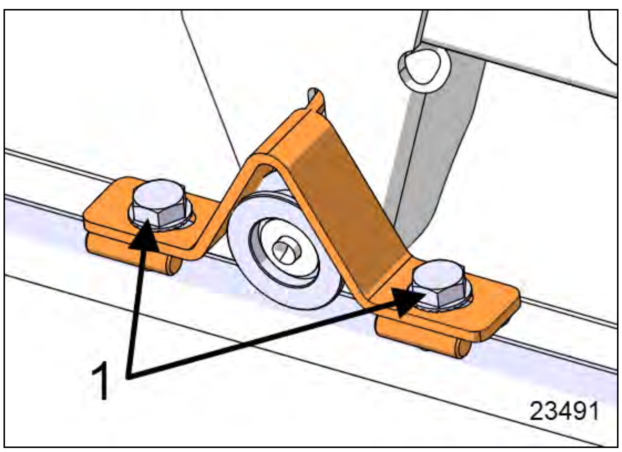
SECTION CHANGE LOG

	DESCRIPTION	DATE
1	REMOVED: Every 2 years replace L-bracket and related components (both shims & hardware)	Nov 2021
2	CHANGED: FIGURE 36 SNOW CHAIN SYSTEM MAIN PNEUMATIC COMPONENTS	Jul 2023
3		
4		
5		
6		

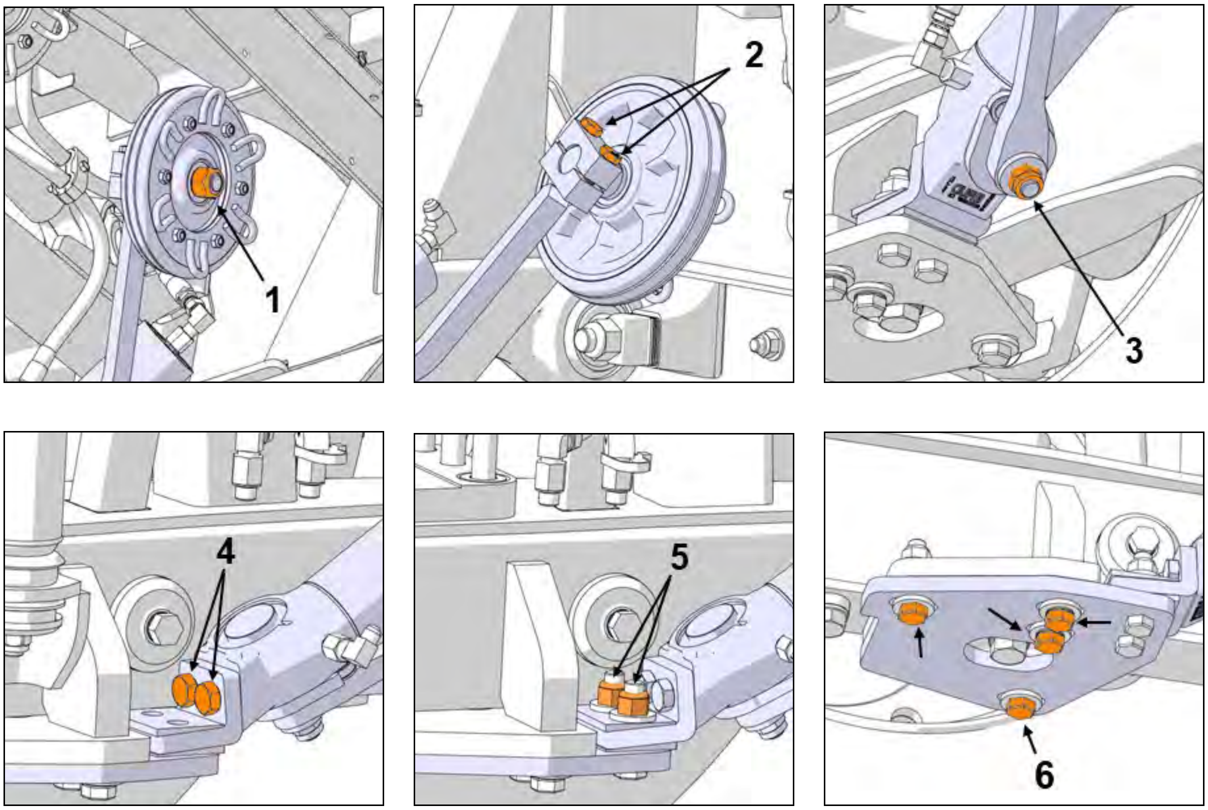
1. TORQUE TABLES



MISCELLANEOUS		
No	DESCRIPTION	TORQUE
1	Hub odometer mounting bolts	110-165 lb-ft (149-224 Nm)
2	Wiper arm mounting bolts (first tightening)	9 lb-ft (12 Nm)
3	Wiper arm mounting bolts (second tightening)	22 lb-ft (30 Nm)



WHEELCHAIR LIFT CASSETTE INSTALLATION		
No	DESCRIPTION	TORQUE
1	WCL Cassette anchor bolts	55-65 lb-ft (75-88 Nm)



WHEEL CHAIN SYSTEM		
No	DESCRIPTION	TORQUE
1	Wheel to ball stud nut	100 lb-ft (136 Nm)
2	Ball stud to arm (clamp) bolts	55 lb-ft (75 Nm)
3	Arm to pneumatic actuator nut	118 lb-ft (160 Nm)
4	Pneumatic actuator to L-bracket	135 lb-ft (183 Nm)
5	L-bracket to support plate	198 lb-ft (268 Nm)
6	Support plate to frame bracket (all)	198 lb-ft (268 Nm)

2. HUB ODOMETER

A wheel hub odometer (Figure 1) have been installed on the R.H. side of the drive axle. It indicates the total distance in miles covered by the coach since it has left the factory, including road testing.

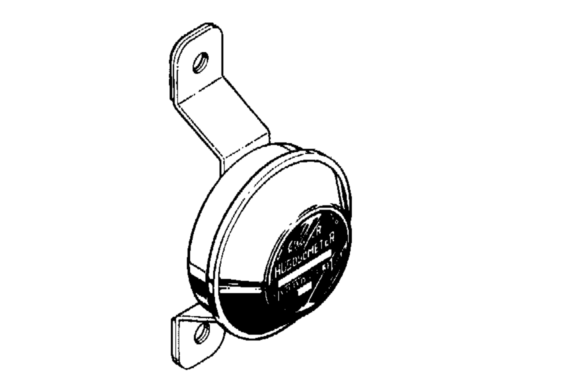


FIGURE 1: HUB ODOMETER 23024

2.1 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.

2.2 REMOVAL

To remove the unit, remove the two lock nuts and washers securing it to the wheel hub, and pull the unit off the studs.

2.3 INSTALLATION

Place the hub odometer unit over the wheel hub studs. Replace the lock washers and nuts. Torque stud nuts.

TORQUE: 110-165 lb-ft (149-224 Nm)

3. HORN INSTALLATION

The electric and air horns are located in a plastic box under the front step well and are accessible from the front body substructure. Refer to Operator's or Owner's Manual for operation.

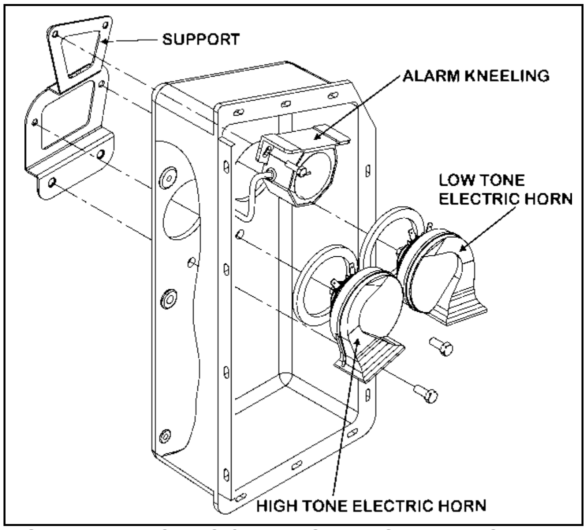


FIGURE 2: ELECTRIC & AIR HORN INSTALLATION 23420

3.1 ELECTRIC HORN MAINTENANCE

When needed, the electric or air horn can be serviced or replaced using the following procedure:

1. Raise vehicle by the jacking points;
2. Unplug the cable connector;
3. Disconnect the air tube if applicable;
4. Loosen the retaining bolts;
5. Service or replace the defective horn;
6. Reinstall by reversing procedure.

4. WINDSHIELD WIPERS AND WASHERS

4.1 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.

Push the control button (Figure 3) to activate the windshield washer. Turn the button to activate the wipers. The first position activates the wipers intermittently. The second position is the slow speed and the third position is for high speed wiping.

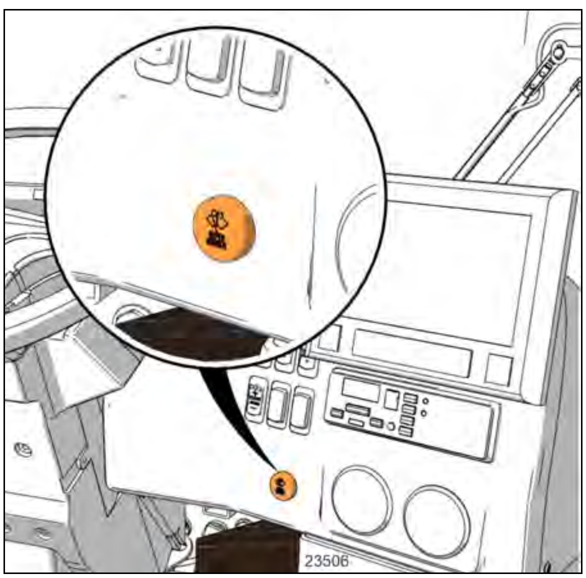


FIGURE 3: WIPERS-WASHER MULTIFUNCTION BUTTON

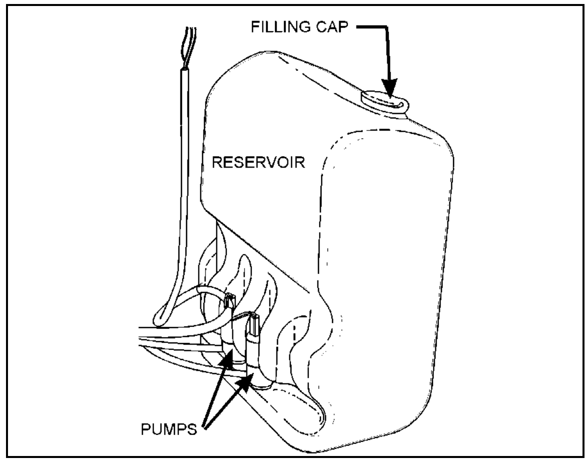


FIGURE 4: WINDSHIELD WASHER RESERVOIR 23220

The windshield washer pumps are electrically operated and are controlled by a washer multifunction control button (Figure 3). This unit pumps the washer liquid to the spray nozzles where it is dispersed across the windshield.

4.2 WIPER MECHANISM

The windshield wipers are controlled by one electric wiper motor that is accessible for maintenance after removing the appropriate access panel beside the footwell.

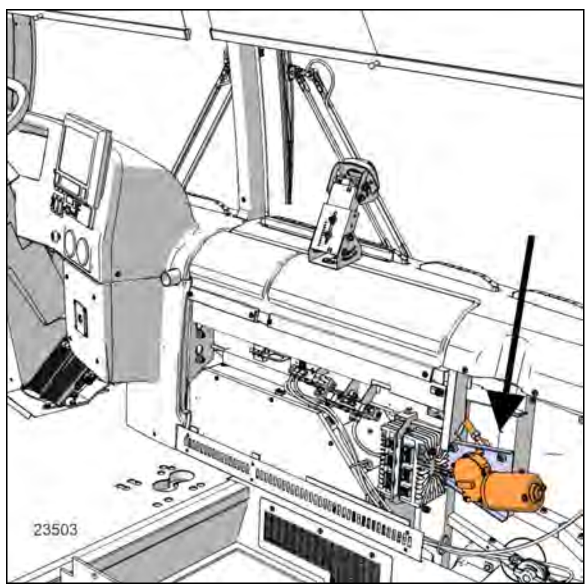


FIGURE 5: WIPER ELECTRICAL MOTOR LOCATION

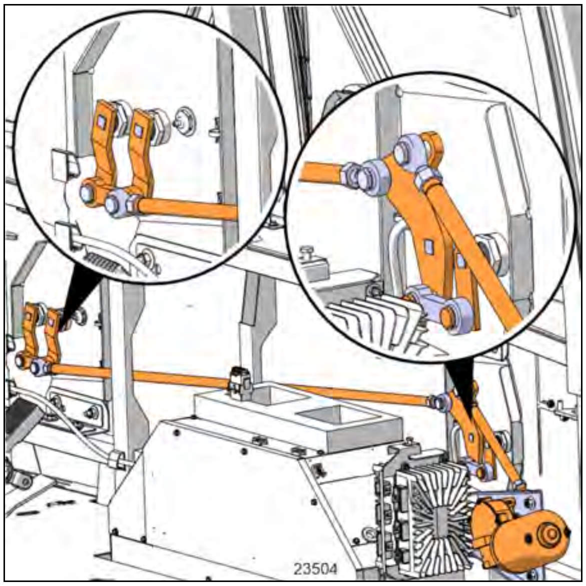


FIGURE 6: WIPER MECHANISM

4.3 WINDSHIELD WIPER MOTOR

4.3.1 Windshield Wiper Motor Replacement

The windshield wiper motor is located at lower front of the vehicle, behind the defroster panel. Refer to Figure 5 for motor location.

> **WARNING**
>
> Park vehicle safely, apply parking brake, stop the engine and set battery master switch to the ''OFF'' position prior to working on the vehicle.

1. Remove the Phillips-head screws retaining the defroster panels, and remove panels.

2. Disconnect wiring connector from the windshield wiper motor.

3. Loosen clamping screw retaining the lever at the end of the motor driving shaft.

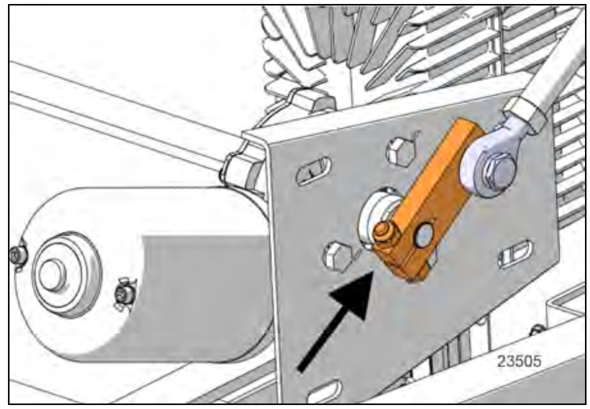


FIGURE 7: RETAINING SCREW

4. Remove the three bolts holding the motor to the steel plate.

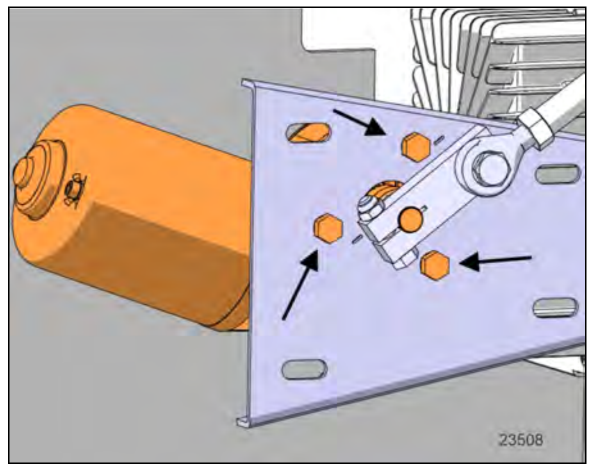


FIGURE 8: MOTOR RETAINING BOLTS

5. Remove the windshield wiper motor, reverse removal procedure to reinstall.

4.4 WIPER BLADES

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.

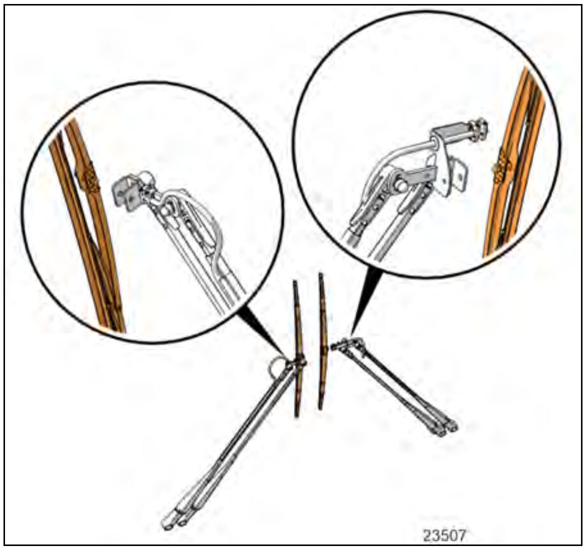


FIGURE 9: WINDSHIELD WIPER BLADES

4.5 WIPER ARMS INSTALLATION

1. Install the wiper arms and position as shown in Figure 10.

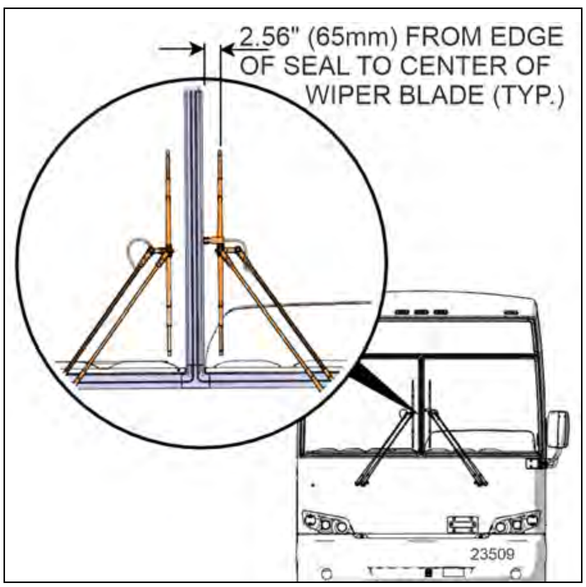


FIGURE 10: WIPER ARM POSITIONING

2. Before positioning the wipers at their final position, tighten temporary the arm mounting nuts with a torque value of:

TORQUE 9 lb-ft (12 Nm)

3. Lift the blades then release the wiper arm so it falls back on the windshield. If necessary, loosen the arm mounting nuts and adjust the position as shown in Figure 10.

4. When the final position is found, tighten wiper arm mounting nuts to a torque value of:

TORQUE 22 lb-ft (30 Nm)

5. Wait 30 minutes and tighten again to the previous step torque value.
6. Install finishing caps over all arm mounting nuts.
7. Connect the windshield washer tubing at the base of the wiper arm.
8. Check the adjustment on a wet windshield.

23253

4.6 TROUBLESHOOTING

SYMPTOM	PROBABLE CAUSE	REMEDY
FAIL TO SPRAY WASHER FLUID	A. Reservoir empty. B. If below 32°F (0°C), improper washer fluid frozen. C. Contamination in tubing or nozzles. D. Tubing damage. E. Tubing bent (kinked) or off one or more connections.	A. Add proper fluid. B. Store coach or parts in heated area, then purge system with low-temperature solution. C. Remove with compressed air, if severely clogged, replace items. D. Replace section. E. Realign tubing and/or refit. Trim end to ensure proper fit or replace.
INADEQUATE SPRAYING	A. Tubing failure.	A. Replace tubing.
SLOW OPERATION	A. Improper solution. B. Jet stream improperly directed. C. Check if the valve is stuck in the open position.	A. Replace with proper type solution. B. Reposition nozzles. C. Remove, clean or replace.

5. AUTOMATIC FIRE SUPPRESSION SYSTEM (AFSS)

The vehicle is equipped with an Automatic Fire Detection and Suppression System (AFSS) intended to automatically detects and suppress an engine compartment fire. The system also includes real-time driver status warnings and alarms as well as an automatic engine shutdown function.

The system operation is fully automatic but can be manually activated by the operator at any time.

Refer to Prevost Operator’s Manual for system operation and operational sequence (fire).

If more information is needed regarding the system, please refer to Kidde 182246A document – “OM Manual-Prevost 45ft Diesel Buses at NYCT" found on your Technical Publications USB flash drive.

5.1 STARTING THE VEHICLE AFTER A FIRE ALARM

The vehicle may be started after a fire alarm without resetting the system. This will not reset the system, rather it will instruct the vehicle’s multiplex system to ignore vehicle interface outputs. This feature is intended to be used only in emergencies 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.

> ***NOTE***
>
> For information, refer to Kidde 182246A document – “OM Manual-Prevost 45ft Diesel Buses at NYCT"

To start the vehicle, perform this ignition switch sequence.

- Reset the AFSS from the AFSS panel.
- Reset manual switch in rear junction box (curb side of engine compartment)

- Perform this switch sequence: ON - OFF - ON (within 2 seconds) then START the vehicle.

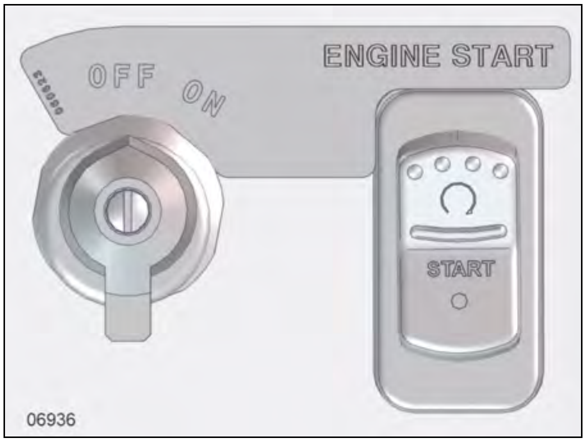


FIGURE 11: IGNITION SWITCH

5.2 CHECKOUT PROCEDURE

Pre-Trip

- Verify the Display panel indicates system “OK”.
  - Display is illuminated constant white.
  - Fire Extinguisher with OK icon and MENU button is displayed.
- Verify the time and date are correct.

General

- Verify that no obvious physical damage or condition exists that might prevent system operation.

Display Panel

- Verify the indicator screen displays the ‘System OK’ screen.

Manual Activation Switch

- Verify that the tamper seal is intact and access to the switch is unobstructed.

Fire Detectors

- 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 contamination (dirt, oil, grease, etc.) – if necessary, clean using a water soaked non-abrasive towel.
  - Verify there is no physical damage or corrosion to the detector’s housing, wire leads, or any of the 3 windows on the face of the detector.
- TLSE detector (Module and element)
  - Verify the status lamp on the face of the TLSE Module is illuminated solid green.
  - Verify the electrical connections of the TLSE module and element have no visible damage and all connections are secure.
  - Verify the element has no visible damage or wearing and is properly held in place via the mounting clamps. If wear is found, adjust the positioning of the element so that it will not touch adjacent components and eliminates the point of wear. Replace the element if it is cut or if internal material can be seen.
  - Visually examine the element to make sure that it is not twisted. If the element is twisted, the sheath will not be smooth. If found, replace the element.
  - Visually examine the element’s booted ends and pigtail wiring for damage.
  - Verify the element’s ground wire connection at each terminal lug end is not loose, damaged, or missing.

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 gage 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.
- Visually inspect the extinguisher for damage such as pits, gouges, dents, or corrosion. Have the extinguisher evaluated by a

qualified fire protection equipment company familiar with Kidde equipment if:

- o If a pit, gouge, or cut exceeds a depth of 0.08 inches.
- o If the depth of a dent exceeds 0.25 inches or one tenth of the average diameter of the dent.
- o If corrosion exceeds a depth of 0.05 inches or a coverage area larger than 15% of the extinguisher's outer surface.

5.3 SYSTEM TESTING

MAINTENANCE

Perform a fire system test and service the extinguisher according to the Lubrication & Servicing schedule.

- To perform a complete fire system test, refer to Kidde R10723 document – "Kidde Generic AFSS Datalogger System Checkout Procedure"

  (Use Kidde Dual Spectrum System Test Set - P/N 420871-2).

5.4 SIX YEARS & TWELVE YEARS MAINTENANCE

MAINTENANCE

EVERY SIX YEARS

If the date of manufacture of the extinguisher is past the 6 year mark, Replace the system's fire extinguisher with a new or refurbished extinguisher. The system's fire extinguisher can be refurbished by a qualified fire protection equipment company familiar with Kidde CGV equipment.

EVERY TWELVE YEARS

If the date of manufacture of the extinguisher is past the 12 year mark, replace the system's fire extinguisher with a new or refurbished extinguisher. A fire extinguisher with a date of manufacture past the 12 year mark will need to be hydrostatically tested by a qualified fire protection equipment company familiar with Kidde equipment.

NOTE

The date of manufacture of the extinguisher can be found stamped either (MM/YY) or (YYYY/MM) on the top neck of the cylinder. This is the date that should be used to determine the 6 or 12 year service interval date.

CAUTION

The AFSS extinguisher will not function as intended if oriented incorrectly. Refer to labels on the extinguisher bottle or the "Operation & Maintenance Manual''.

6. WHEELCHAIR LIFT CASSETTE INSTALLATION

WARNING

For better stability, keep the platform at minimum height when moving.

WARNING

Never deploy the platform from enclosure while standing on the telescopic legs.

WARNING

Telescopic legs were designed to support and move the platform only, do not use as a work table.

WARNING

Before moving platform, make sure that floor is level and free of obstacles.

Install four lifting jacks on the wheelchair lift cassette.

NOTE

There are two telescopic legs for each platform side. The proper side is indicated onto the telescopic leg.

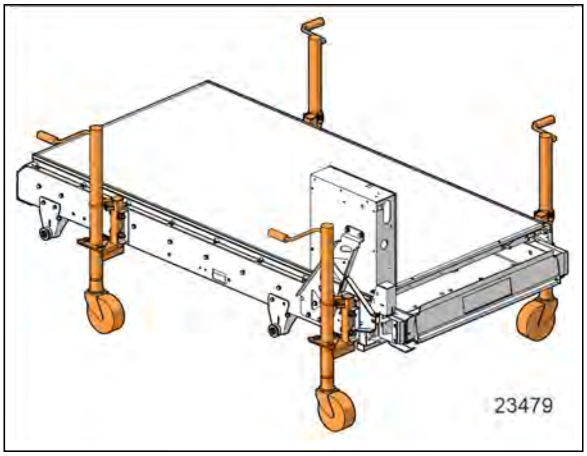


FIGURE 12: JACK INSTALLATION

Dismount partially the control box (4 screws) and tilt it slightly to allow the cassette to slide inside the compartment.

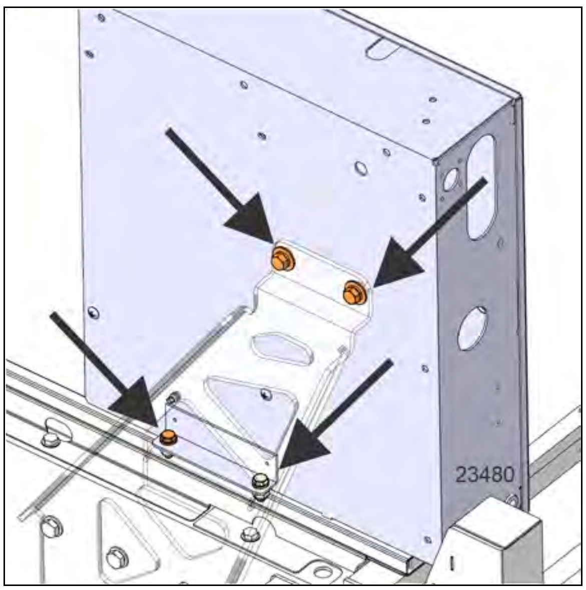


FIGURE 13: CONTROL BOX DISMOUNTING

Slide the cassette into the compartment to get the rear rollers backward the rail front stopper.

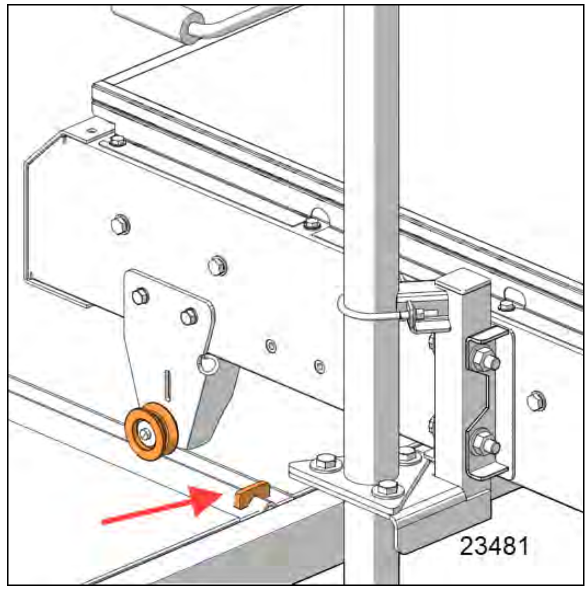


FIGURE 14: SLIDE CASSETTE OVER STOPPERS

Drop down the rear side of the cassette until it gets contact with the rail and make sure the back rollers are aligned with the V-rail.

Remove jacks (2) on the rear side.

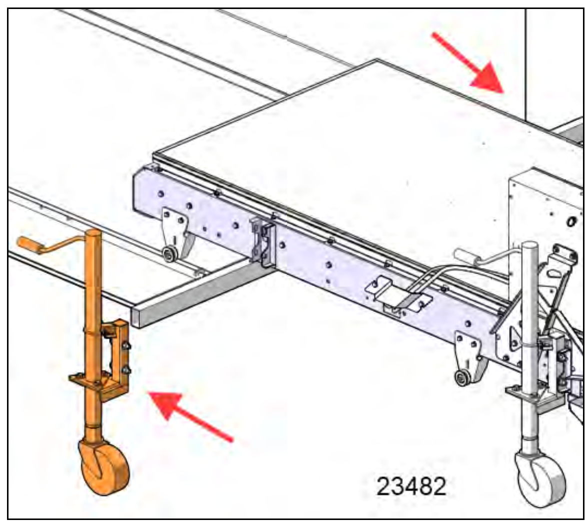


FIGURE 15: JACKS REMOVAL ON REAR SIDE

Install the fasteners on the dismounted jacks.

Slide the cassette inside the compartment to get the front rollers backward of the stoppers.

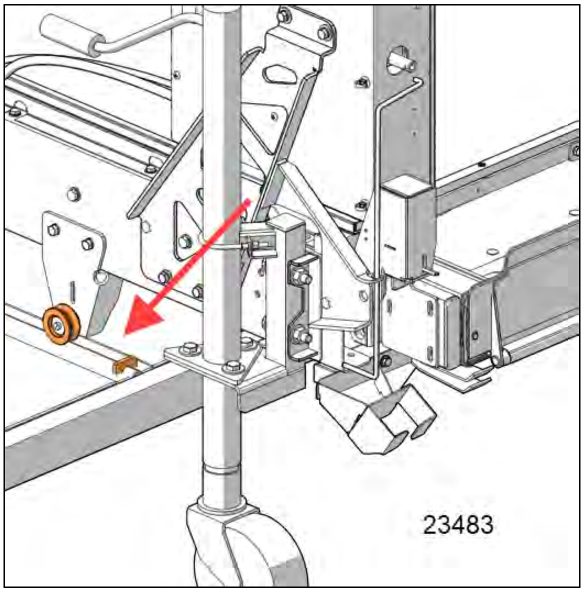


FIGURE 16: SLIDE THE CASSETTE INSIDE THE COMPARTMENT

Drop down the front side of the cassette until it gets contact with the rail and make sure the rollers are aligned with the V-rail.

Remove the jacks (2) on the front side of the cassette.

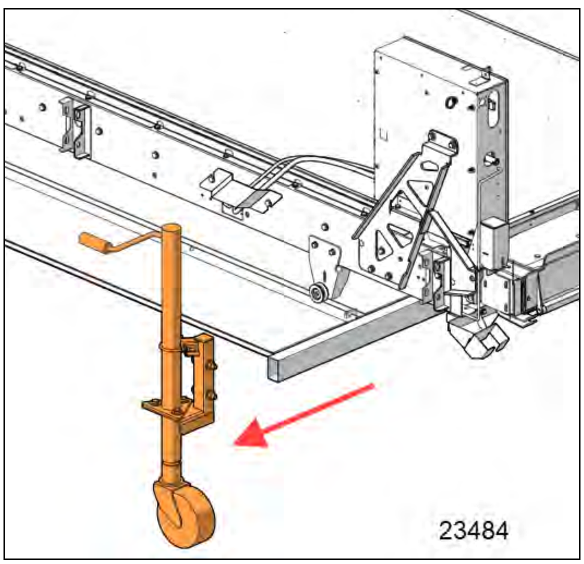


FIGURE 17: JACKS REMOVAL

Install the fasteners on the dismounted jacks.

Install locks in four locations and tighten screws:

TORQUE:.55-65 lb-ft (75-88 Nm)

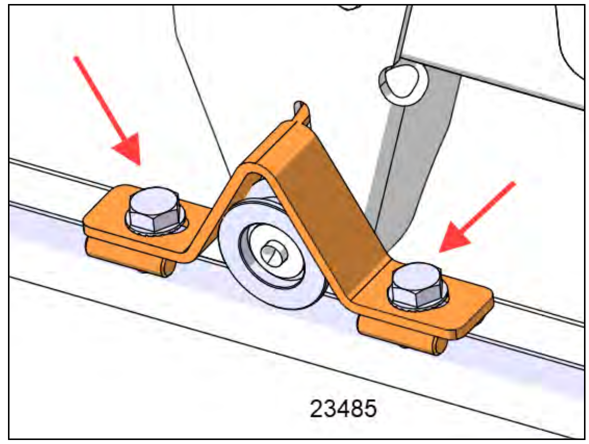


FIGURE 18: ANCHOR BOLTS INSTALLATION

Reinstall the control box with 4 screws.

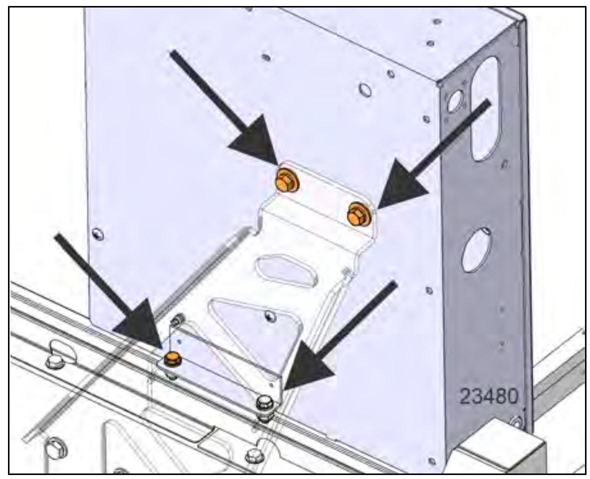


FIGURE 19: CONTROL BOX DISMOUNTING

Plug the electrical connectors and lock it with the connector cover.

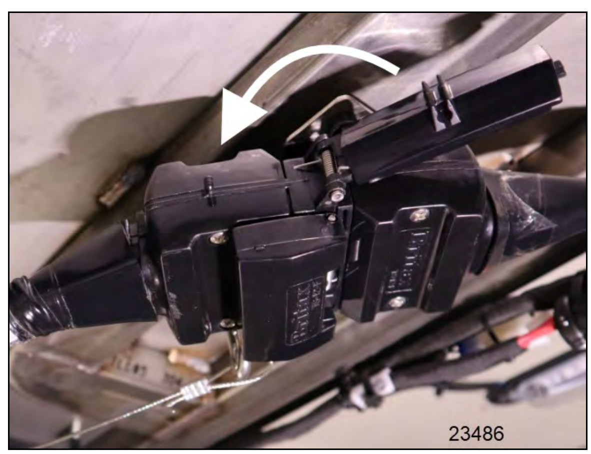


FIGURE 20: ELECTRICAL CONNECTION

Attach the protective wire.

FIGURE 21: PROTECTIVE WIRE INSTALLATION

7. WHEELCHAIR LIFT CASSETTE DISMOUNTING

Detach the protective wire. Unlock the connectors. Unplug the electrical connectors.

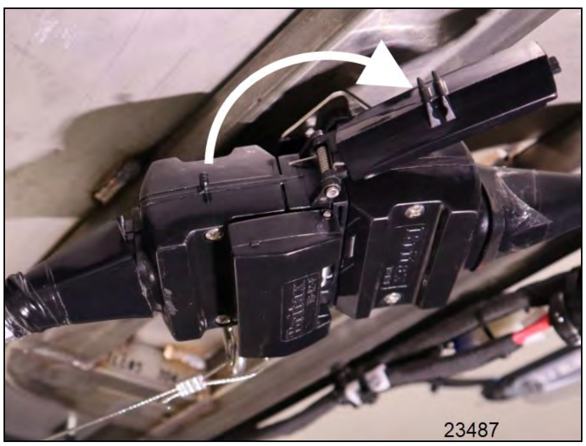


FIGURE 22: ELECTRICAL DISCONNECTION

Detach the protective wire.

FIGURE 23: PROTECTIVE WIRE INSTALLATION

Dismount partially the control box (4 screws) and tilt it slightly to allow the cassette to slide outside the compartment.

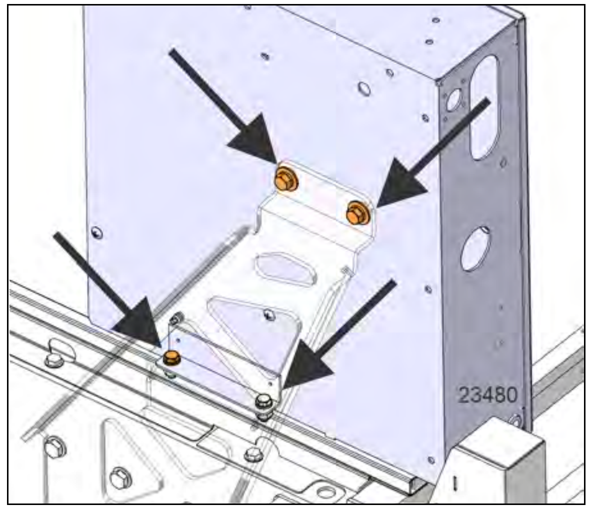


FIGURE 24: CONTROL BOX DISMOUNTING

Remove locks in four locations and keep it with the removed cassette.

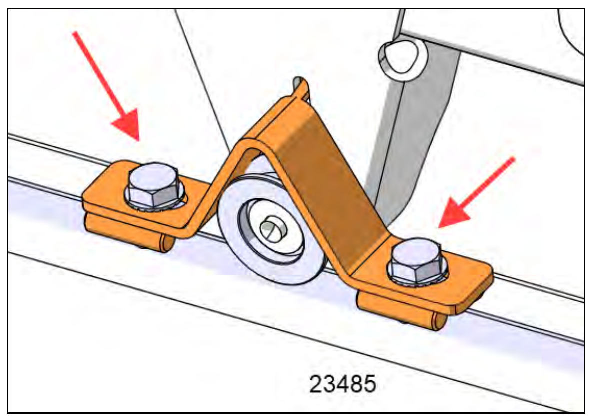


FIGURE 25: LOCK REMOVAL

Slide out the cassette until the front rollers get the stoppers. Install jacks on the front side of the cassette. Lift up the front side of the cassette until the front rollers clear the front stoppers.

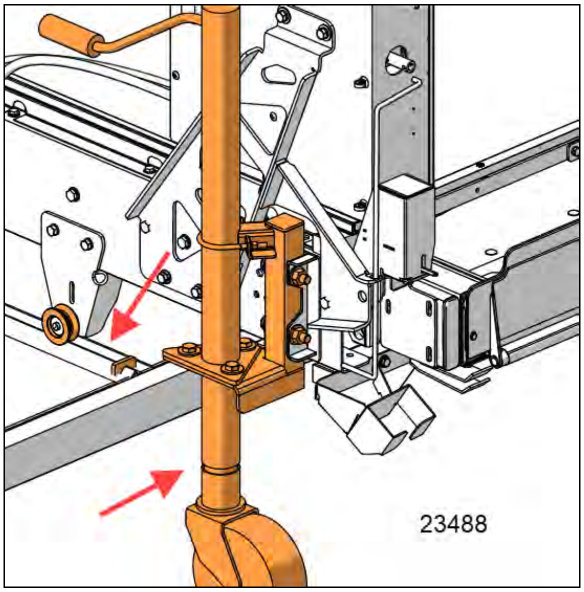


FIGURE 26: LIFT UP THE FRONT SIDE OF THE CASSETTE

Keep sliding out the cassette until the rear rollers get to stoppers. Install jacks on the rear side of the cassette. Lift up the rear side until the rear rollers clear the stoppers.

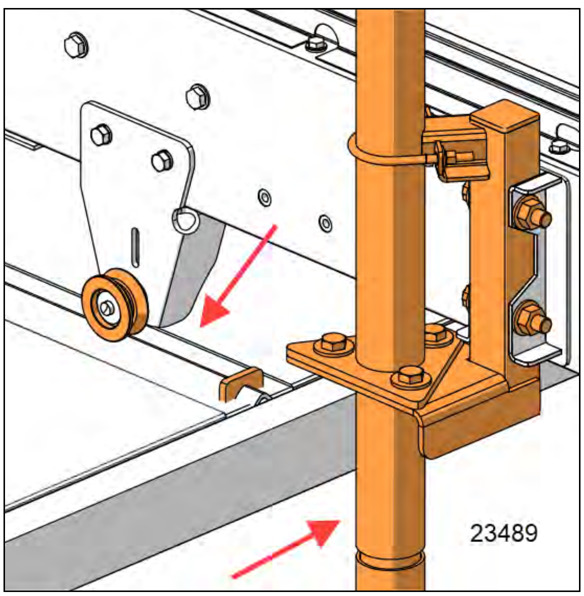


FIGURE 27: DROP THE REAR SIDE ON RAILS

Reinstall the control box with the screws (4).

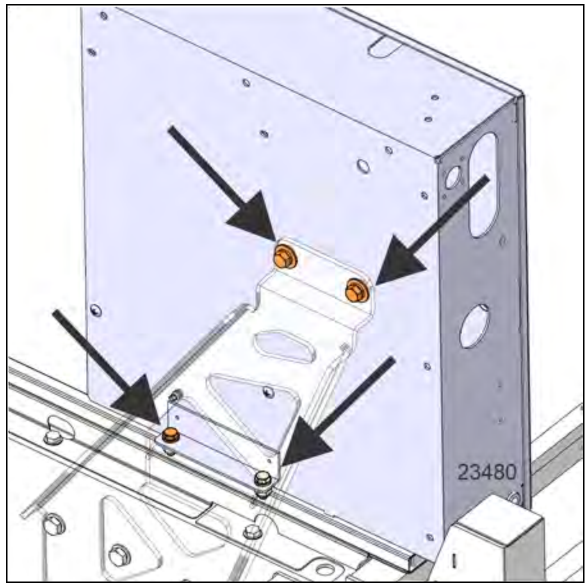


FIGURE 28: CONTROL BOX DISMOUNTING

Slide out completely the wheelchair lift cassette.

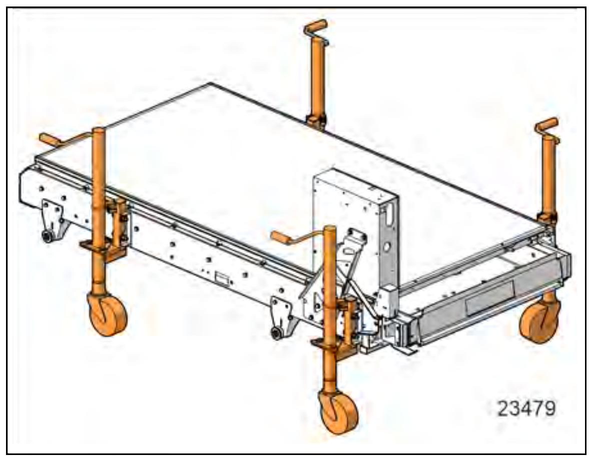


FIGURE 29: MOVE OUT THE CASSETTE

8. SNOW CHAIN SYSTEM

The vehicle is equipped with a driver activated snow chain system that will deploy under the drive wheels to provide added traction on ice and snow.

To ensure optimal performance, a regular inspection of the system components must be performed and wearable parts replaced as required.

8.1 PREVENTIVE INSPECTION AND MAINTENANCE

MAINTENANCE

Snow Chain System

Inspect and replace components at intervals specified by the Lubrication And Servicing Schedule in Section 24: LUBRICATION & SERVICING.

Do not exceed recommended service intervals.

1. Inspect all parts for damage or excessive rust.
2. Check all fasteners for correct torque (refer to the torque table at the beginning of this section).
3. Check air lines, valves and solenoids for leak when the system is engaged.
4. Inspect contact ring rubber and chain strands for wear.
    - Replace wheel assembly when rubber ring indicators are fading out or if the wheel bearing is not spinning freely (FIGURE 30).
    - Replace wheel assembly when any of the chain strands reach 0.130in (3.25mm) in diameter (equivalent to 50% wear FIGURE 31)
5. Inspect inside sidewall of the tires. Tire wear indicates misalignment or damage to the system.

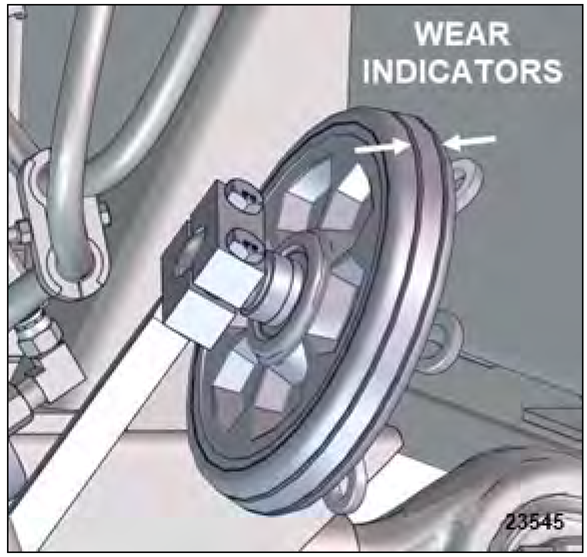


FIGURE 30: WEAR INDICATORS ON RUBBER CONTACT RING

FIGURE 31: CHAIN STRAND MIN DIAMETER 0.130”

6. Check for proper chain wheel angle and position in relation to the vertical centerline of the tire (see 8.2 POSITIONING REQUIREMENTS).
7. To keep the system in good working order, carry out the swiveling action once a week. This can be done with the vehicle in a stationary position by one of these ways:
    - Pressing on the button located on top of the system valve in the front pneumatic compartment (this will bypass the electrical activation system as shown in FIGURE 32).

- From the driver seat's, pressing and holding simultaneously both the stop request reset (1) and the sweep mode (2) momentary switches while pressing the chain activation switch (3) 4 times in less than 2 seconds (FIGURE 33).

NOTE
Do not stay within the arm moving radius when the snow chain system is connected to the vehicle accessories air system.

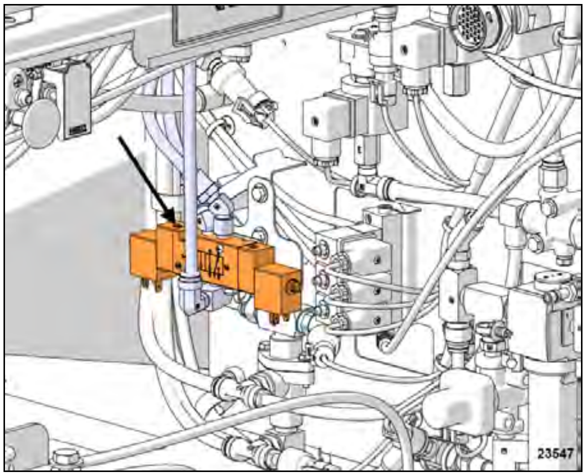


FIGURE 32: ELECTRO-PNEUMATIC VALVE & 70 PSI VALVE PROTECTION IN FRONT COMPARTMENT

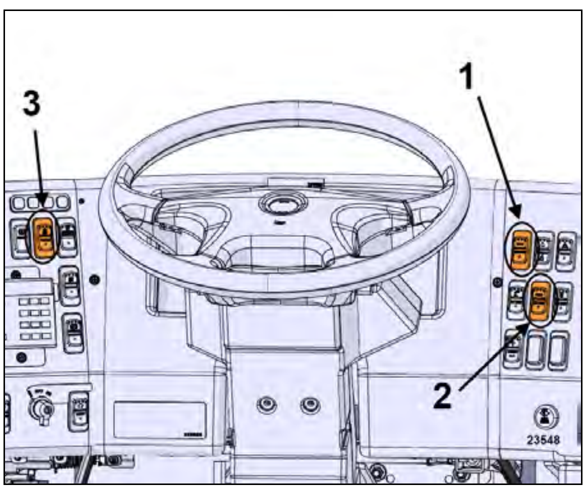


FIGURE 33: ACTIVATING THE CHAIN SYSTEM USING DASHBOARD SWITCHES

8. Clean the mechanical cam stop of the arms and lubricate with a lite oil (FIGURE 34).

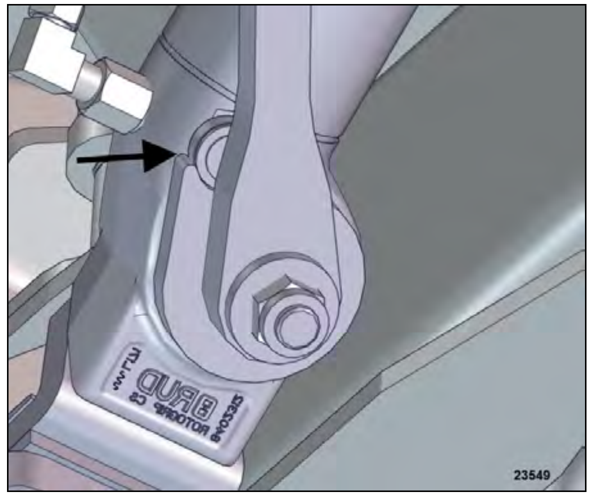


FIGURE 34: CAM STOP – CLEAN AND LIGHTLY LUBE

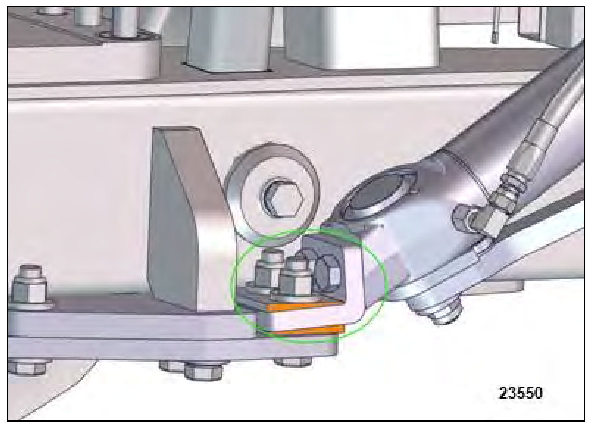


FIGURE 35: L-BRACKET AND RELATED COMPONENTS

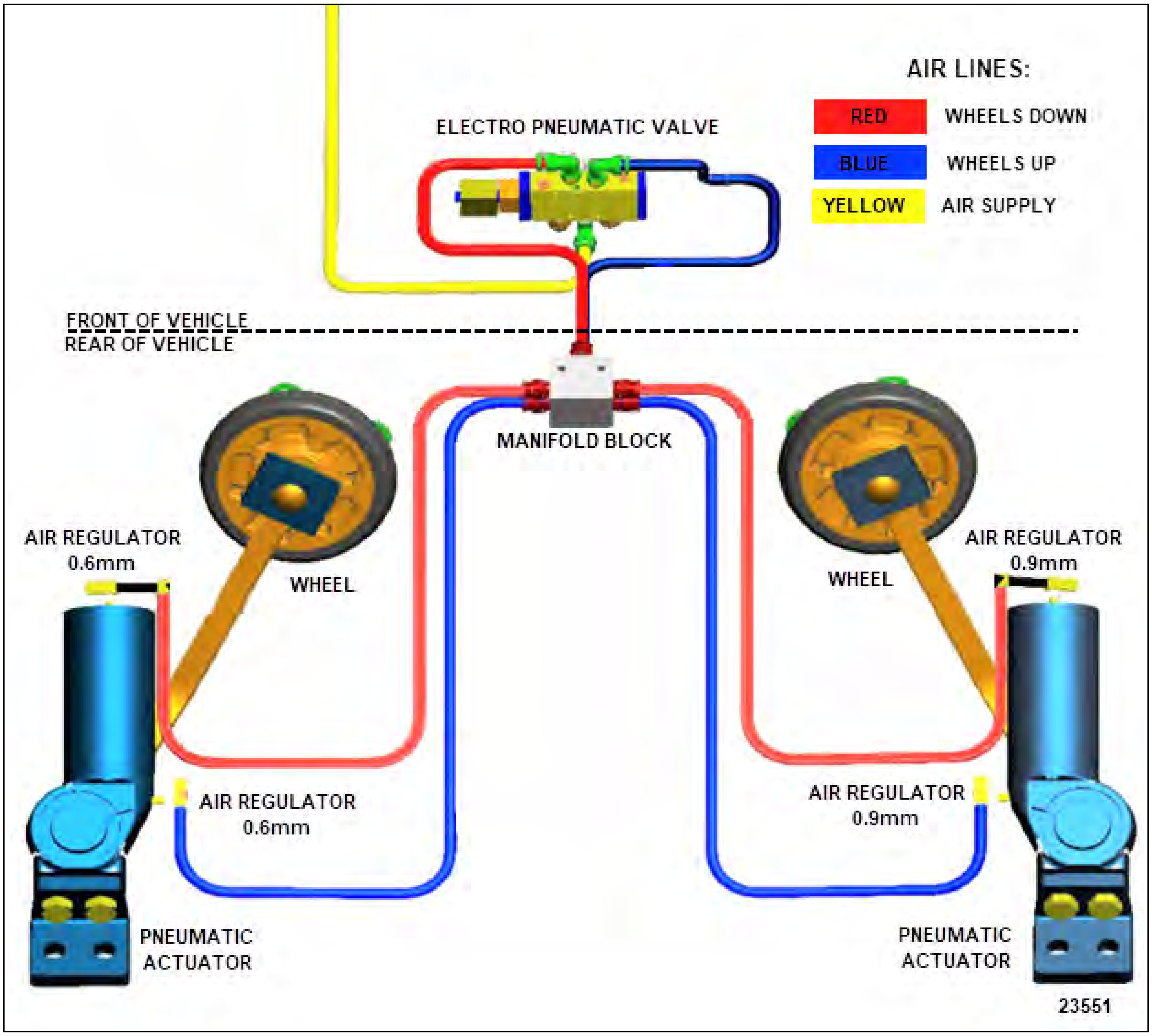
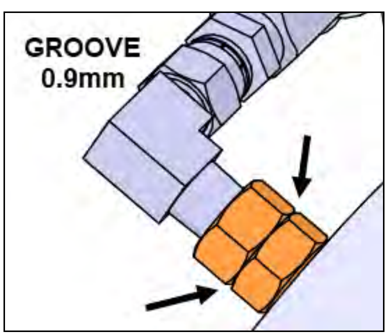


FIGURE 36: SNOW CHAIN SYSTEM MAIN PNEUMATIC COMPONENTS

NOTE



DO NOT MIX OR INVERT LEFT & RIGHT AIR REGULATORS.

Pneumatic actuators are equipped with air regulators at their air supply connection (both upper and lower hoses).

Left (street side) air regulators have a different inner diameter than the right (curb side) regulators.

- *Left side regulators have an inner diameter of 0.6mm and a plain hex body.*
- *Right side regulators have an inner diameter of 0.9mm and can be easily identified by their groove around the hex body (as shown in left picture).*
- *Clean the inside of the regulator if erratic movements of the arm(s) are noticed.*

8.2 POSITIONING REQUIREMENTS

To adjust the snow chain wheel as shown in FIGURE 39, follow these steps :

1. Use a paint marker to mark vertically the centerline of the drive axle curb side tire at the 6 O'clock position.
2. Draw a horizontal line that intersect the centerline mark 3 inches from the bottom of the tire.
3. Draw another horizontal line 5 inches from the bottom of the tire.
4. Manually extend the chain unit (arm & wheel) so that the chain wheel contacts the sidewall of the vehicle tire.
5. Create a rub mark on the tire by twisting the chain wheel back and forth.
   - The middle of the rub mark must match the vertical centerline or be up to 3/8th of an inch behind (rearward) the centerline. *Rub mark must never be forward the centerline (toward front of vehicle)*. To adjust centerline position, loosen the four (4) support plate to frame bracket screws and slide the entire mechanism fore or aft as shown in FIGURE 37.
   - The chain wheel should be level from the front to the back of the vehicle but can be pinched downward up to 2 degrees maximum toward the rear (use angle gage).
   - Chain wheel operating angle should be between 5 to 10 degrees (use angle gage) and the chain wheel must contact the tire between the two horizontal lines marked in steps 2 and 3 above. To adjust the wheel angle, slightly loosen the two (2) ball stud clamp screws and move the wheel to the desired position (FIGURE 38).

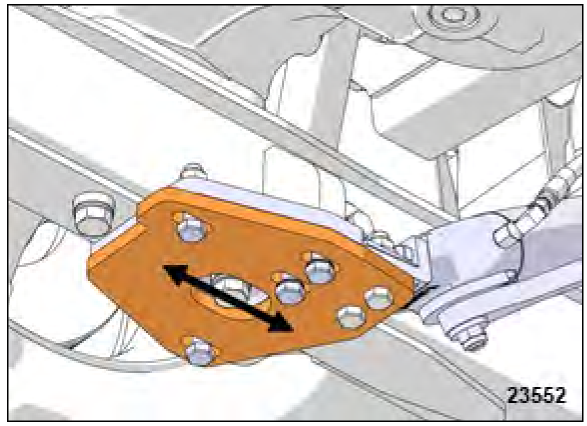


FIGURE 37: FORE AND AFT ADJUSTMENT VS TIRE CENTERLINE

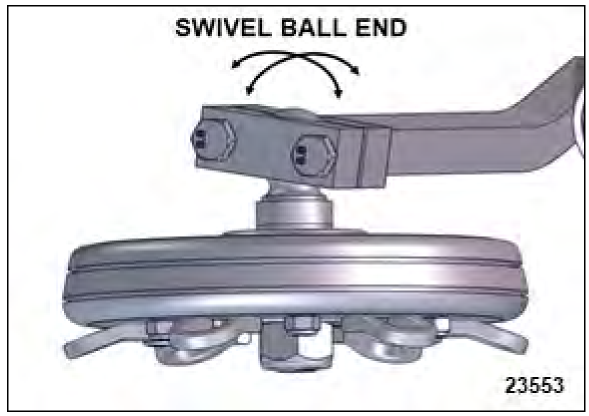


FIGURE 38: WHEEL ANGLE ADJUSTMENT

   - Once the above requirements are met, torque the fasteners.

     Ball stud to arm (clamp) bolts.

     TORQUE: 55 lb-ft (75 Nm)

     Support plate to frame bracket (all)

     TORQUE: 198 lb-ft (268 Nm)

6. Repeat the procedure for the street side chain wheel.

NOTE
Use chain unit marked "SNOWCHAIN/RIGHT" for the curb side unit and the "SNOWCHAIN/LEFT" for the street side one.

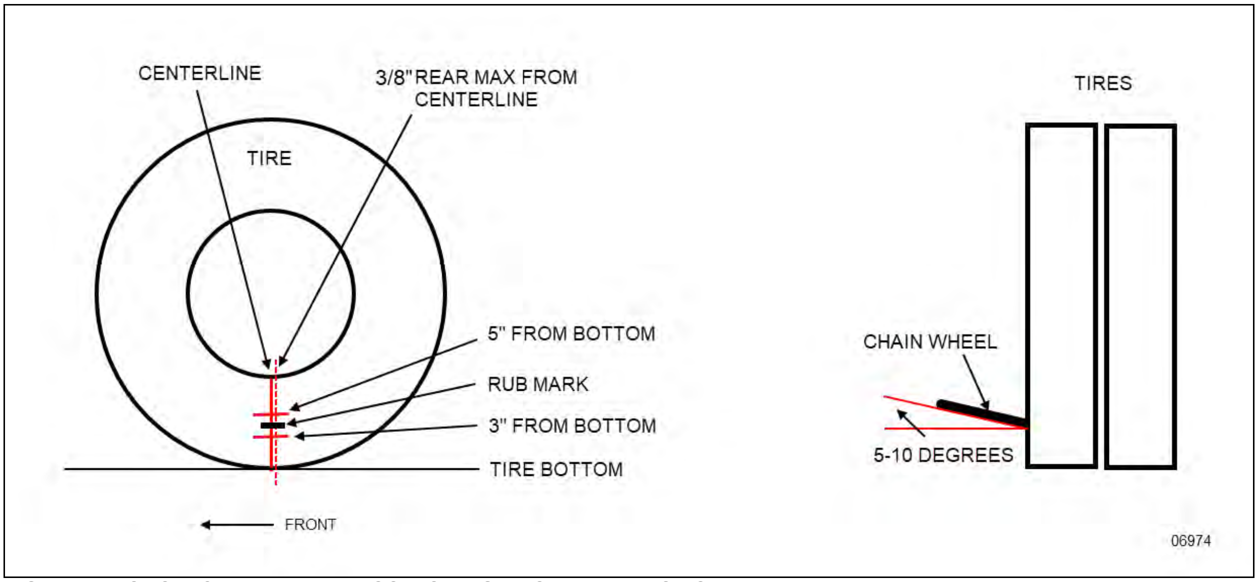


FIGURE 39: SNOW CHAIN WHEEL POSITIONING REQUIREMENTS VS TIRE

9. NYCT AUXILIARY SYSTEMS

In the first two left hand (road side) overhead parcel rack compartments you will find the following vehicle monitoring, surveillance and communications equipment:

- Clever Devices' IVN5;
- Mobile View's NVR 700 & Network Switch
- Vianova infotainment system
- Ethernet switch;
- Motorola communication radio and antenna;
- Wi-Fi Modem and antenna
- Sierra Modem ;

A provision for Bus Customer Information System (BCIS) equipment is also provided.

Refer to the equipment manufacturer's documentation for these particular items.

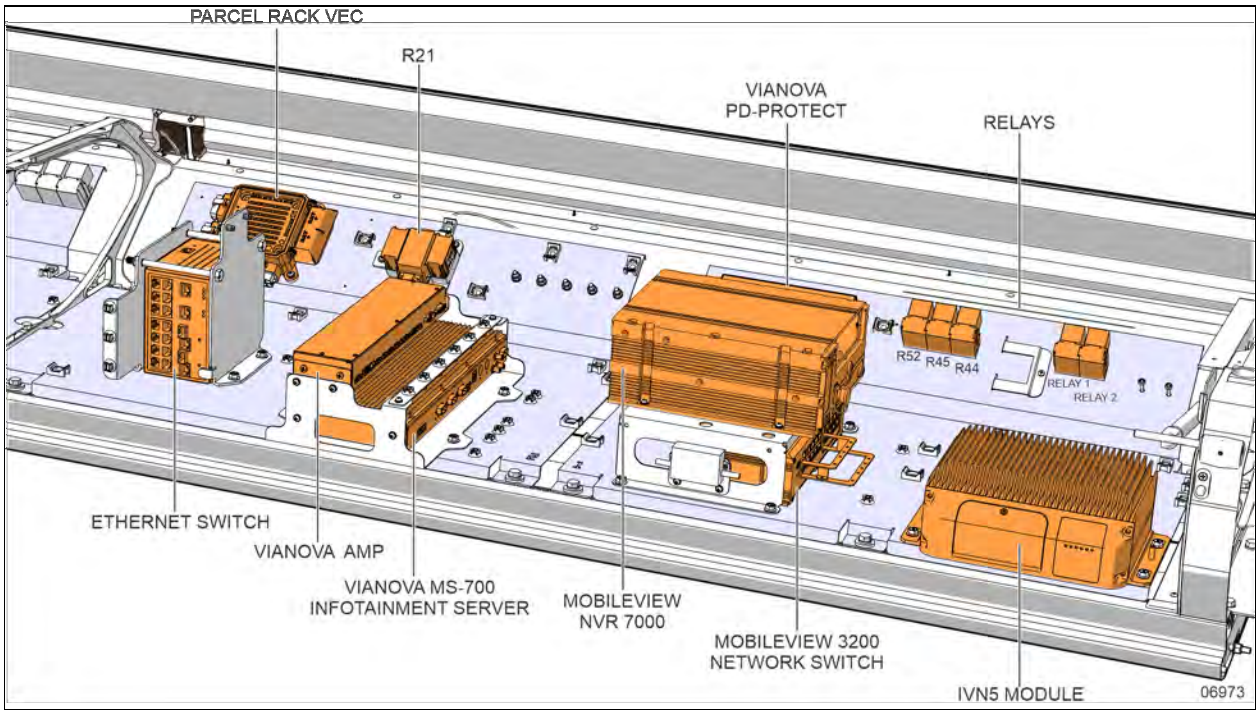


FIGURE 40: NYCT AUXILIARY SYSTEMS, PLATES 1 & 2

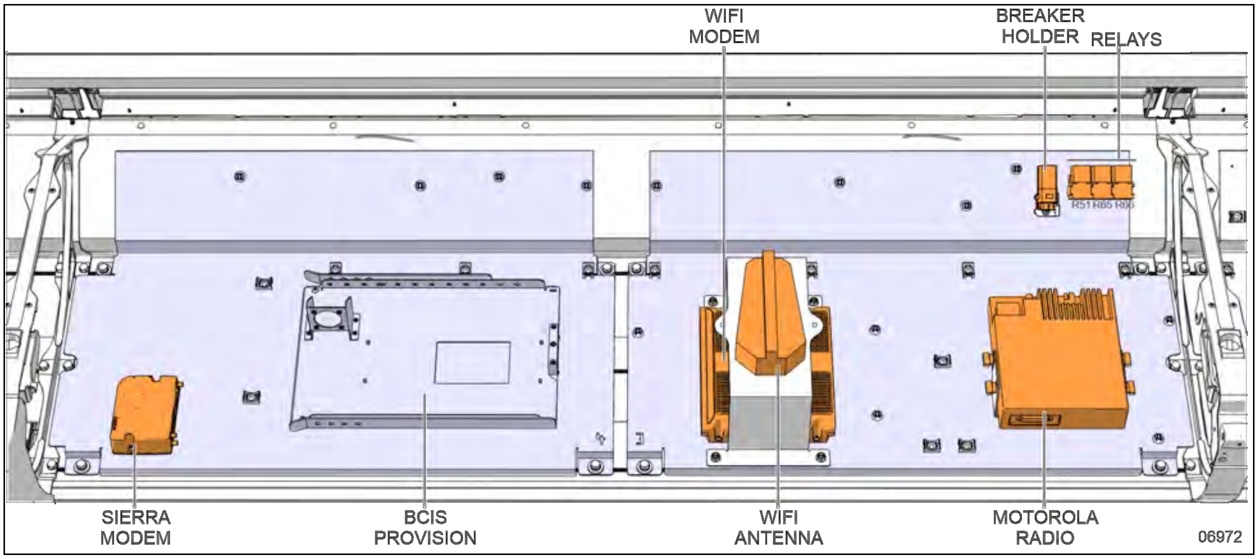


FIGURE 41: NYCT AUXILIARY SYSTEMS, PLATES 3 & 4

9.1 CLEVER DEVICE IVN5

Installed in the vehicle's first left (road side) overhead compartment, you will find an IVN5 module configured for the following features:

Automatic Vehicle monitoring®

Geo-Fenced Auto Regeneration Control

Public Service Announcement.

Pedestrian Turn Warning

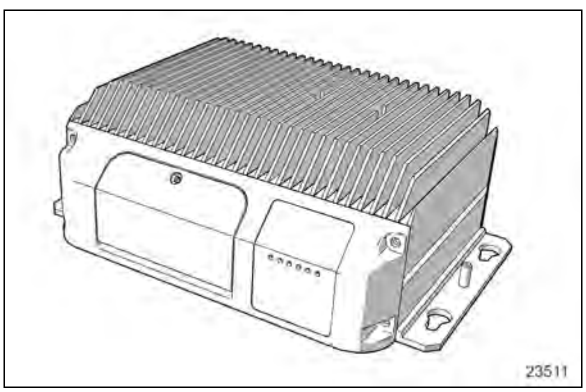


FIGURE 42: IVN5 MODULE

The control head module is installed on the left windshield post.

One interior speaker is located along the driver's right knee.

9.1.1 Pedestrian Turn Warning Speakers Location

The system is using speakers located on both sides of the vehicle and turns on automatically when the vehicle speed is less than 10 mph (16 km/h) and the steering wheel is rotated at least 45 deg (a quarter turn) left or right.

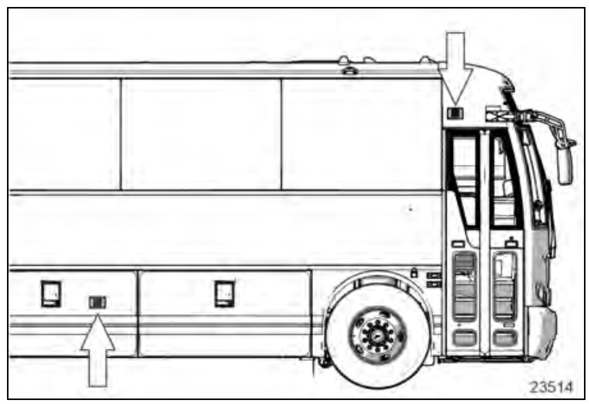


FIGURE 43: PTW SPEAKERS, CURB SIDE SHOWN

9.2 MOTOROLA COMMUNICATION RADIO POWER

The communication radio power can be supplied either directly from the battery or from ignition.

To change the power mode to "battery power", disconnect the two connectors shown in Figure below.

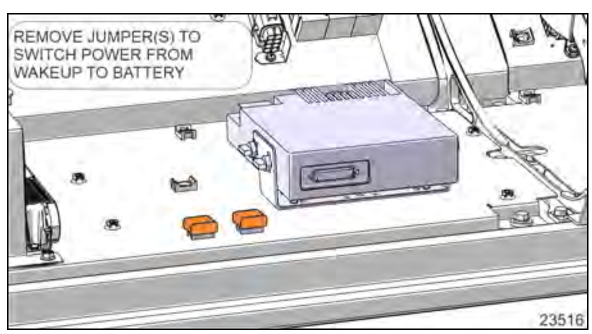


FIGURE 44: RADIO POWER MODE CHANGE

9.3 AUTOMATIC PASSENGER COUNTER

An automatic passenger counter is installed above the entrance door.

It is connected to the ethernet switch. Refer to wiring diagram for details.

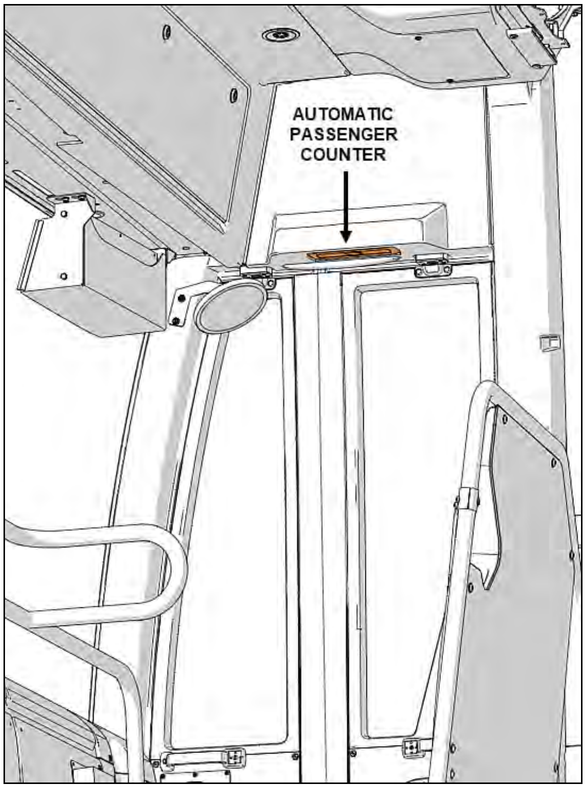


FIGURE 45: APC LOCATION

9.4 MOBILEVIEW BUS CAMERA SECURITY SYSTEM (BCSS)

In addition to the components installed in the overhead parcel rack, the BCSS on this vehicle includes seven (8) interior cameras and three (3) exterior cameras. One of the cameras is hidden in the front sign access panel. A motion sensor is also installed in this location.

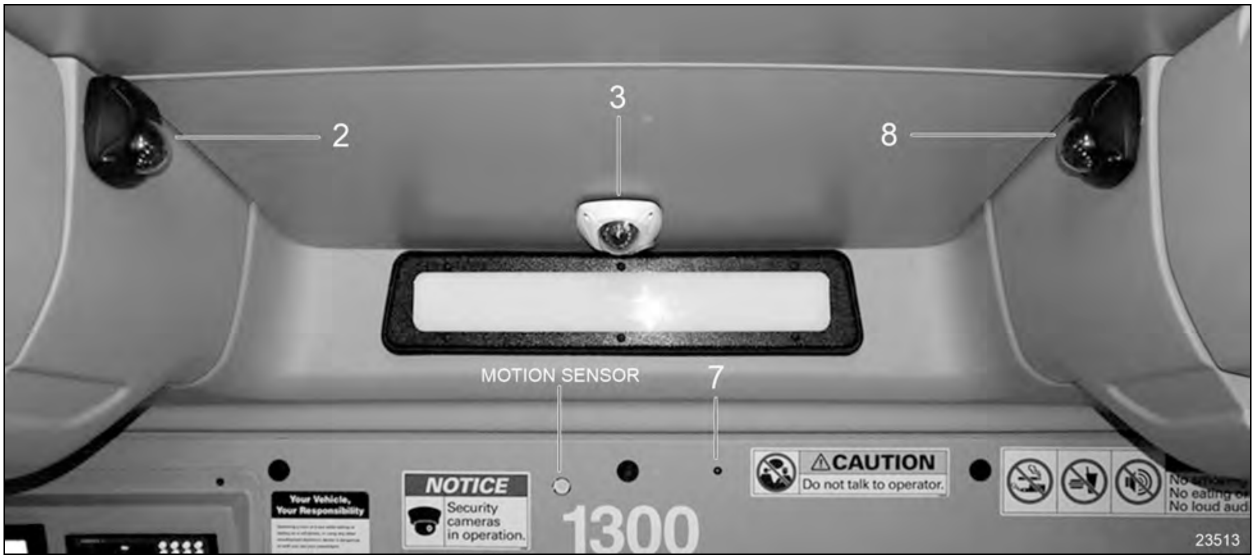


FIGURE 46: CAMERAS AND MOTION SENSOR (UPPER FRONT OF VEHICLE)

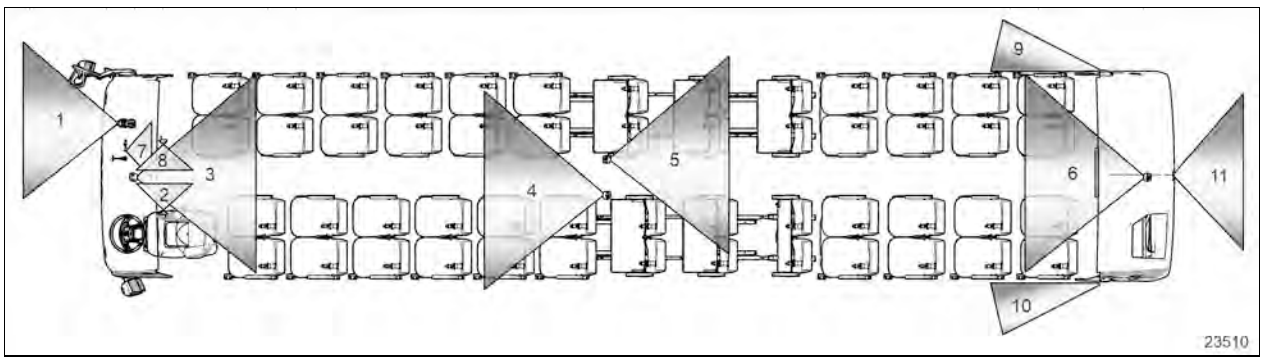


FIGURE 47: CAMERA LOCATIONS (TOP VIEW)

CAMERA	LOCATION	VIEW DESCRIPTION
1	Interior	Forward view (dash mounted)
2	Interior	Front door and fare box
3	Interior	Front looking backward
4	Interior	Center looking forward
5	Interior	Center looking backward
6	Interior	Rear looking forward
7	Interior	Front looking backward
8	Interior	Bus operator's area
9	Exterior	Curbside rear looking forward
10	Exterior	Driver side rear looking forward
11	Exterior	Backup view

Note that an encoder for the hidden camera (7) is located above the driver's area, fixed to the front cap.

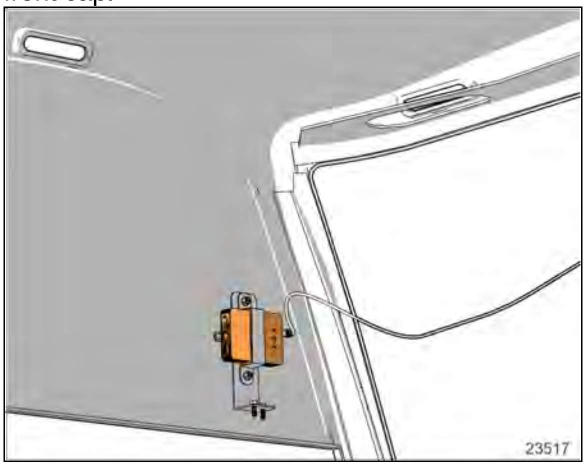


FIGURE 48: ENCODER

CONTENTS

SECTION CHANGE LOG

	DESCRIPTION	DATE
1		
2		
3		
4		
5		
6		

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.

2.1.2 Leaks

Investigate leaks immediately to determine if fittings have loosened or cracked, and also if hoses have ruptured or worn through. Take corrective action immediately. Leaks are not only potentially detrimental to machine operation, but can also result in added expenses caused by the need to replace lost fluids.

WARNING

Personal injury and/or property damage may result from fire due to the leakage of flammable fluids, such as fuel or lube oil.

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.

2.2 LUBRICATION AND SERVICING SCHEDULE REFERENCE NUMBERS

FIGURE 1: COMPONENTS IDENTIFICATION (COMPONENTS REPRESENTATION MAY DIFFER SLIGHTLY FROM AN ACTUAL VEHICLE)

1	Accessories air filter	23	Engine oil filter
2	Accessories air tank fill valve	24	Allison transmission oil dipstick
3	Steering drag link	25	Engine coolant surge tank
4	Height control valve (front)	26	Coolant filter & conditioner
5	Steering tie rod	27	Engine air filter restriction indicator
6	Accessories air tank	28	Engine air filter
7	Steering column U-joints	29	DEF tank
8	Steering knuckle pins	30	DEF pump
9	Steering damper cylinder	31	Engine oil dipstick and filler tube
10	Secondary air tank	32	Diesel particulate filter (DPF)
11	Kneeling air tank	33	SCR catalytic converter
12	Air dryer	34	Diffuser assembly
13	Height control valve (rear)	35	Diesel fuel tank
14	Wet air tank	36	Power steering pump & fuel pump
15	Primary air tank	37	Air compressor
16	Differential	38	R.H. side alternators
17	Propeller shaft	39	L.H. side alternator
18	Transmission	40	Emergency / parking brakes overrule control valve
19	Starter	41	Twin Haldex condenser/separator
20	Primary fuel filter/Davco Fuel Pro 382	42	Radiator core & charge air cooler (CAC)
21	Secondary fuel filter	43	Brake caliper
22	Power steering fluid tank	44	Steering gear

IMPORTANT NOTE

Refer to the manufacturers documentation included in this maintenance manual for specific manufacturer's maintenance requirements.

A Lubrication and Servicing Schedule is included in this section to emphasize key service and lubrication points on the vehicle. Other maintenance requirements and specific instructions on how to check and service different components are covered in their respective sections in this maintenance manual.

LUBRICATION AND SERVICING SCHEDULE

X3–45 Commuter DOB 1300-1606

#	SECTION	Figure item	6 000	12 000	18 000	24 000	30 000	50 000	100 000	150 000	200 000	250 000	300 000	Lubricant / Spec.tool★[1]
			Proceed to maintenance operation every (miles)											
	GENERAL													
1	Flexible hoses – thoroughly inspect all hoses							●						
	01 ENGINE													
1	Engine oil & filter – heavy operation condition, change	23		●										A
2	Drive belts and idlers – visually inspect for signs of deterioration, cracks or frayed material			●										★
3	Drive belts – change							●						
4	Air cleaner – replace filter element when indicated by air filter restriction indicator or according to this interval whichever comes first	27 28							●					
5	Valves & injectors – initial adjust at 48 000 miles													★
6	Valves & injectors – check & adjust every 72 000 miles (5 000 hrs)													★
7	Automatic belt tensioners & idler pulleys inspection – remove belts, check for noisy bearings, play, bushing play. Perform AUTOMATIC BELT TENSIONER AND IDLER PULLEYS INSPECTION procedure							●						
	03 FUEL													
1	Davco Fuel Pro 382 primary fuel filter – Perform visual check of fuel level in the clear cover. Change the filter when the fuel reaches the top of the “CHANGE FILTER” lettering on the clear cover	20		●										
2	Secondary fuel filters – change at every engine oil change	21		●										★
3	Fuel tank and cradle visual inspection – perform yearly inspection. Refer to Fuel Tank Yearly Inspection	35					●							
	04 EXHAUST AND AFTERTREATMENT SYSTEM													
1	DEF tank – clean filler neck strainer	29						●						
2	DEF tank – drain & clean with water	29							●					
3	DEF pump filter element – replace	30							●					
4	DPF filter – either clean or replace every **36 000 miles**	32												★
5	Diffuser assembly, rain cap & drain tube – check proper functioning & clean every **36 000 miles**	34												
6	Aftertreatment Hydrocarbon Injector (AHI) – High flow nozzle type 1 & alternate, change every **36 000 miles** – high flow nozzle type 2, no maintenance required. For nozzle type identification, refer to Maintenance Information MI23-44													
	05 COOLING													
1	Coolant filter housing shutoff valve – rotate the handle periodically to keep spindle rotation smooth			●										
2	Coolant surge tank – test coolant solution	25		●										★
3	Coolant filter – change (Long-Life filter without additives to be used with Extended Life Coolant)	26					●							
4	Radiator – inspect exterior core & clean with low pressure water jet if necessary	42						●						
5	Coolant filter housing shutoff valve spindle – apply fresh grease at cooling system drain													
6	Cooling system – drain, flush & refill (using Extended Life Coolant) every **750 000 miles**	42												C / ★

[1] ★= Specialty tool required. You will find the SPECIALTY TOOLS REQUIRED FOR REGULAR MAINTENANCE table and the LUBRICANTS SPECIFICATIONS table following this Lubrication and Servicing Schedule.

	06 ELECTRICAL													
1	Bosch HD10 alternators drive belt – replace	38 39						●						
2	Alternators – perform ALTERNATOR PERIODIC INSPECTION procedure – remove belts, check for noisy bearings, bearing play	38 39		●										
3	Battery terminals – clean & coat terminals							●						
	07 TRANSMISSION [2]													
1	Severe vocation, filled with TranSynd or TES295 synthetic fluid only, no mixture[3] & using High–Capacity filters[4]**.** Transmission fluid – change every **84 000 miles**	18												H
2	Severe vocation, filled with TranSynd or TES295 synthetic fluid only, no mixture & using High–Capacity filters. Transmission Main & Lube filters – change every **42 000 miles**	18												
	09 PROPELLER SHAFT													
1	Perform Spicer's Driveshaft "Inspection Procedures"	17		●										
2	Grease one fitting on each universal joint	17				●								K
	10 FRONT AXLE													
1	Steering knuckle (king) pins – grease two fittings per knuckle	8			●									K
2	Steering knuckle (king) pins – inspect	8					●							
	11 REAR AXLES													
1	ZF Drive axle – check differential oil level, add if necessary	16						●						F
2	ZF Drive axle – change differential oil & breather	16							●					F
3	ZF Drive axle – check compact bearing axial play	16							●					★
4	ZF Drive axle – change grease in compact bearing (hub unit)	16											●	E / ★
	12 BRAKE & AIR SYSTEM													
1	Brakes – (visual & functional check) check correct functioning of the adjuster, check that caliper operates smoothly over its full range of movement, check the adjuster cap for correct fitting and condition, check the sealing elements for correct fitting and condition (caliper guide pin seals + tappet & boot assemblies), check the caliper bearing in the area of the rubber bush/guide sleeve, check caliper running clearance, check fitting and condition of the cover **at brake pad replacements or once a year whichever comes first**	43												
2	Brakes – check pad & disc wear	43		●										
3	Air tanks – drain water from all tanks equipped with manual drain valve, including the air dryer purge tanks (2x)			●										
4	Haldex Consep Condenser/Separator – inspect	41		●										
5	Accessories air filter – drain bowl	2		●										
6	ABS & Electronic Stability Control systems – check proper functioning							●						★
7	Accessories air filter – change filter element	2							●					
8	Air dryer – change two cartridges	12							●					
	13 WHEELS, HUBS & TIRES													
1	Hub bearing, front and tag axle – inspect						●							★

[2] Allison Transmission recommends that customers use fluid analysis as the primary method for determining fluid change intervals. In the absence of a fluid analysis program, the fluid change interval listed in the chart above should be used. Change filters according to chart above even if a fluid analysis shows that the fluid doesn't need to be changed.

[3] 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 & filter change according to the TES389 intervals. Refer to the Maintenance Manual for TES389 intervals.

[4] Extended TranSynd or TES 295 fluid & filter change intervals are only allowed with Allison High-Capacity filters.

	14 STEERING													
1	Drag link end ball joints – inspect for corrosion	3					●							
2	Power steering fluid – check fluid condition (color) through visual inspection and change if required. Check level, add if necessary	22					●							B
3	Power steering tank filter cartridge – replace	22						●						
4	Tie rod – perform TIE ROD INSPECTION PROCEDURE (tube, ball joint, fine adjustment sleeve, corrosion)	5					●							
5	Steering system – perform STEERING SYSTEM PLAY INSPECTION	7							●					
6	Power steering fluid – replace	22								●				B
	16 SUSPENSION													
1	Air springs– inspect			●										
	18 BODY													
1	Front bumper, exterior compartment door latches, grease fittings							●						K
	22 HEATING & AIR CONDITIONING													
1	Passengers HVAC unit disposable return air filters (2) – replace				●									
2	Evaporator compartment door fresh air intake filter – replace				●									
3	Parcel rack fans air filter – clean or replace				●									
4	Driver HVAC unit return & fresh air filters – clean or replace				●									
5	A/C compressor – check oil level, add if necessary. Change the oil if it has darkened. Refer to **Oil Color And Level Check** in Maintenance Information MI18-21				●									D
6	A/C receiver tank – check refrigerant level, add if necessary				●									
7	A/C compressor – empty shaft seal oil collection tube				●									
8	Refrigerant moisture indicator – check, replace filter dryer unit according to moisture indicator							●						
9	Driver's HVAC units – clean heater & evaporator cores with low-pressure air jet								●					
10	Passengers' HVAC unit – clean evaporator & heater cores with a stream of low-pressure water or low-pressure air jet								●					
11	Passengers' HVAC unit – clean condenser core with a stream of low-pressure water or low pressure air jet								●					
12	A/C compressor – change oil, clean oil filter and magnetic plug every 4 years (10 000 operating hours approximately)													★
	23 ACCESSORIES													
1	AFSS extinguisher tank – proceed to the verification of the AFSS main components, to do so, refer to **Checkout Procedure** paragraph in Prevost Maintenance Manual			●										
2	AFSS extinguisher tank –perform a fire system test and service the extinguisher, refer to **System Testing** paragraph in Prevost Maintenance Manual					●								
3	AFSS extinguisher tank – have the fire extinguisher rebuilt by a qualified fire protection equipment company familiar with the extinguisher used – every 6 years													
4	AFSS extinguisher tank – have the fire extinguisher cylinder hydrostatically tested by a qualified fire protection equipment company – every 12 years													
5	Rotogrip snow chains – Inspect all parts for damage. Check all fasteners for correct torque			●										
6	Rotogrip snow chains – Check air lines, valve and solenoids for leak when the system is engaged			●										
7	Rotogrip snow chains – Inspect contact ring rubber and chain strands for wear and replace when wear exceeds 50%			●										
8	Rotogrip snow chains – Inspect inside sidewall of the tires. Tire wear indicates misalignment or damage to the system.			●										
9	Rotogrip snow chains – Check for proper chain wheel angle and position in relation to the vertical centerline of the tire			●										

LUBRICANT AND COOLANT SPECIFICATIONS

REF	DESCRIPTION	SPECIFICATIONS
A	Engine Oil	SAE Viscosity Grade: 15W-40 oil meeting Volvo specification VDS-4.5 & API CK-4 *(New vehicle delivered with: Grade 5W-30 oil, Volvo specification VDS-5 & API FA-4)*
B	Power Steering Oil	Mobil DEXRON-VI ATF SYNTHETIC BLEND (Automatic Transmission Fluid)
C	Engine Coolant	Final Charge Global Extended Life 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
E	ZF Drive axle compact bearing (hub unit)	Fuchs Europe Schmierstoffe GMBS/Renolit LXPEP-2 Lithium saponified, multipurpose grease, NLGI No. 2,
F	Differential Oil	Mobil Delvac Synthetic Gear Oil 80W-140 *(New vehicle delivered with: Chevron Multigear Oil 80W90 (ZF Lub Class 12M)*
G	---	---
H	Allison Automatic Transmission Oil	Castrol TranSynd™ Synthetic Transmission Fluid for Allison or TES 295 approved equivalent
I	Allison Automatic Transmission Oil	Approved equivalent 1 Schedule 1 TES-389 fluids
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

SPECIALTY TOOLS REQUIRED FOR REGULAR MAINTENANCE OF THE VEHICLES

Use this list of specialty tools in conjunction with the LUBRICATION AND SERVICING SCHEDULE

#	MAINTENANCE DESCRIPTION	TOOL #	SPECIALITY TOOL DESCRIPTION	PART #
01 ENGINE				
2	drive belts and idlers	1	belt tensioner wrench	010032
5, 6	valves & injectors	2	engine cranking adapter	88840317
		3	feeler gauge 2.45-2.55	88880052
		4	feeler gauge set	85111377
		5	setting tool 3.20, 3.85	88800232
03 FUEL				
1	Davco Fuel Pro 382/386 system	6	collar spanner wrench	530224
04 EXHAUST AND AFTERTREATMENT SYSTEM				
4	DPF filter – either clean or replace	7	DPF removal tool	680790
05 COOLING				
1	test coolant solution	8	refractometer coolant/DEF	88890105
6	cooling system drain, flush & refill	9	coolant extractor (optional)	85112740
		10	tube with connector (optional)	9996049
06 ELECTRICAL				
		11	none	
07 TRANSMISSION				
		12	none	
09 PROPELLER SHAFT				
		13	none	
10 FRONT AXLE				
		14	none	
11 REAR AXLE				
4	check compact bearing axial play	15	14 mm hex socket driver (Allen)	*
		16	E20 Torx socket	*
		17	dial indicator with magnetic base	*
5	change grease in compact bearing	15	14 mm hex socket driver (Allen)	*
		16	E20 Torx socket	*
		18	slotted nut wrench 5870 401 146	N67817-21
		19	lifting bracket 5870 281 043	19400451
		20	driver 5870 050 007	19400449

#	MAINTENANCE DESCRIPTION	TOOL #	SPECIALITY TOOL DESCRIPTION	PART #
		21	handle 5870 260 004	N67817-19
		22	driver 5870 051 053	N67817-16
		23	seal installer 5870 651 085	19400265
		24	pry bar 5870 345 071	N78017-20
12 BRAKE & AIR SYSTEM				
6	ABS & Electronic Stability Control systems – check proper functioning	25	ACOM diagnostic software available free of charge	Bendix website
13 WHEEL, HUBS & TIRES				
1	Hub bearing, front & tag axle – inspect	26	dial indicator with magnetic base	*
14 STEERING				
		27	none	
16 SUSPENSION				
		29	none	
18 BODY				
		29	none	
22 HEATING & AIR CONDITIONING				
12	A/C compressor – change oil, clean oil filter	30	Refrigerant recovery unit	

*: Common tool. Contact your local tool supplier

	CHANGE LOG - LUBRICATION AND SERVICING SCHEDULE	DATE m/d/y
1	SEC 05 COOLING – Engine coolant filter changed for Long-Life filter without additives to be used with Extended Life Coolant. Interval was 12 000 miles, changed to 30 000 miles	05/07/2020
2	SEC 05 COOLING – Engine coolant, was Fleet Charge 50/50 Fully Formulated Coolant, changed for Final Charge Global Extended Life. Interval was 100 000 miles, changed for 750 000 miles	05/07/2020
3	SEC 03 FUEL – ADDED: Davco Fuel Pro 382 primary fuel filter visual inspection at 12 000 miles	06/12/2020
4	SEC 04 EXHAUST AND AFTERTREATMENT SYSTEM – ADDED: Aftertreatment Hydrocarbon Injector (a.k.a. AHI doser) – change every **66 000 miles**	06/12/2020
5	SEC 23 ACCESSORIES – ADDED: Six (6) Rotogrip snow chains maintenance items	06/12/2020
6	SEC 23 ACCESSORIES – AFSS extinguisher tank – ADDED: four (4) maintenance items	06/12/2020
7	SEC 14 STEERING – REMOVED: Steering damper cylinder – grease one fitting at rod end	08/11/2020
8	SEC 06 ELECTRICAL – Alternators – perform ALTERNATOR PERIODIC INSPECTION. Interval was 6 000 miles, changed to 12 000 miles	08/11/2020
9	SEC 09 PROPELLER SHAFT – Perform Spicer's Driveshaft "Inspection Procedures" . Interval was 6 000 miles, changed to 12 000 miles	08/11/2020
10	SEC 12 BRAKE & AIR SYSTEM – ADDED: Accessories air filter – drain bowl	08/11/2020
11	SEC 14 STEERING – Drag link end ball joints – inspect for corrosion. Interval was 6 000 miles, changed to 12 000 miles	08/11/2020
12	SEC 14 STEERING – ADDED: Tie rod – perform TIE ROD INSPECTION PROCEDURE	08/11/2020
13	SEC 16 SUSPENSION – Air springs– inspect. Interval was 6 000 miles, changed to 12 000 miles	08/11/2020
14	SEC 05 COOLING – ADDED: Coolant filter housing shutoff valve – rotate the handle periodically to keep spindle rotation smooth.	08/17/2020
15	SEC 01 ENGINE – REMOVED: Coolant pump bearing inspection	10/21/2020
16	SEC 03 FUEL – Fuel tank and cradle visual inspection, was 50 000 miles, changed to 30 000 miles	10/21/2020
17	SEC 04 EXHAUST & AFTERTREATMENT SYSTEM – ADDED: Aftertreatment Hydrocarbon Injector – change every 66 000 miles	10/21/2020
18	SEC 12 BRAKE & AIR SYSTEM – Brakes (visual & functional check) - interval changed to: at brake pad replacements or once a year whichever comes first	10/21/2020
19	SEC 12 BRAKE & AIR SYSTEM – Brakes – check pad & disc wear, was 6 000 miles changed to 12 000 miles	10/21/2020
20	SEC 01 ENGINE – Valves & injectors – initial adjust, was 100 000 miles changed to 36 000 miles (2500 hrs)	11/09/2020
21	SEC 01 ENGINE – Valves & injectors – check & adjust, was every 250 000 miles changed to 72 000 miles (5 000 hrs)	11/09/2020
22	SEC 05 COOLING – ADDED: Coolant filter housing shutoff valve spindle – apply fresh grease at cooling system drain	11/09/2020
23	SEC 22 HEATING & AIR CONDITIONING – All fresh air & return air filters. Interval was 6 000 miles, changed to 18 000 miles	11/09/2020
24	SEC 22 HEATING & AIR CONDITIONING – A/C compressor – check oil level, add if necessary. Change the oil if it has darkened. Interval was 6 000 miles, changed to 18 000 miles	11/09/2020
25	SEC 22 HEATING & AIR CONDITIONING – A/C receiver tank – check refrigerant level, add if necessary. Interval was 6 000 miles, changed to 18 000 miles	11/09/2020
26	SEC 22 HEATING & AIR CONDITIONING – A/C compressor – empty shaft seal oil collection tube. Interval was 6 000 miles, changed to 18 000 miles	11/09/2020
27	SEC 09 PROPELLER SHAFT – Perform Spicer's Driveshaft "Inspection Procedures", was 6 000 miles changed to 12 000 miles	11/09/2020
28	SEC 10 FRONT AXLE – Steering knuckle (king) pins – grease two fittings per knuckle, was 6 000 miles changed to 18 000 miles	06/23/2021
29	SEC 23 ACCESSORIES – REMOVED: Rotogrip snow chains – replace L-bracket and related components – every 2 years	11/02/2021
30	SEC 04 EXHAUST & AFTERTREATMENT SYSTEM – Aftertreatment Hydrocarbon Injector. Interval was 66 000 miles, changed to 36 000 miles	12/05/2021
31	SEC 04 EXHAUST & AFTERTREATMENT SYSTEM – DPF filter – either clean or replace. Interval was 66 000 miles, changed to 36 000 miles	12/05/2021
32	SEC 04 EXHAUST & AFTERTREATMENT SYSTEM – Diffuser assembly, rain cap & drain tube – check proper functioning & clean. Interval was 24 000 miles, changed to 36 000 miles	12/05/2021
33	SEC 03 FUEL –Davco Fuel Pro 382 primary fuel filter changed for Davco Fuel Pro 382/386	08/29/2022
34	SEC 06 ELECTRICAL – Alternators – remove belts, check for noisy bearings, bearing play added	09/28/2022
35	SEC 01 ENGINE – Valves & injectors – initial adjust, was 36 000 miles (2500 hrs) changed to 48 000 miles	10/17/2022
36	SEC 04 EXHAUST & AFTERTREATMENT SYSTEM – Aftertreatment Hydrocarbon Injector. Modified to differentiate the types of nozzle which have distinct maintenance requirements.	12/07/2023

	CHANGE LOG - LUBRICANT AND COOLANT SPECIFICATIONS TABLE	DATE m/d/y
1	REMOVED: Ref G. Was radiator fan gearbox oil	01/04/2020
2	Engine coolant, was Fleet Charge 50/50 Fully Formulated Coolant, changed for Final Charge Global Extended Life	05/07/2020
3	ADDED: Ref A Engine oil – “New vehicle delivered with…”	05/29/2020
4	ADDED: Ref F Differential oil – “New vehicle delivered with…”	05/29/2020
5	REMOVED: Ref I. Was transmission fluid TES-389	06/12/2020
6		
7		
8		
9		
10		